The AIR Hurricane Model for the U.S. V16.0.0 as Implemented in Touchstone® V4.1.0

Submitted in Compliance with the 2015 Standards of the Florida Commission on Hurricane Loss Projection Methodology

January 2017

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Trademarks

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Touchstone is a registered trademark of AIR Worldwide.

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Model Submission Checklist

Please indicate by checking below that the following has been included in your submission documentation to the Florida Commission on Hurricane Loss Projection Methodology.

Yes	***No***	***Item***
✓		a) *Letter to the Commission*
✓		a. *Refers to the certification forms and states that professionals having credentials and/or experience in the areas of meteorology, statistics, structural/wind engineering, actuarial science, and computer/information science have reviewed the model for compliance with the standards*
✓		b. *States model is ready to be reviewed by the Professional Team*
✓		c. *Any caveats to the above statements noted with a complete explanation*
✓		b) *Summary statement of compliance with each individual standard and the data and analyses required in the disclosures and forms*
✓		c) *General description of any trade secret information the modeling organization intends to present to the Professional Team and the Commission*
✓		d) *Model Identification*
✓		e) *Seven Bound Copies (duplexed)*
✓		f) *Link emailed to SBA staff containing all required documentation that can be downloaded from a single ZIP file*
✓		*a. Submission text in PDF format*
✓		*b. PDF file supports highlighting and hyperlinking, and is bookmarked by standard, form, and section*
✓		*c. Data file names include abbreviated name of modeling organization, standards year, and form name (when applicable)*
	✓	*d. Form S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis, if required, in ASCII and PDF format*
✓		*e. Forms M-1, Annual Occurrence Rates, M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds, V-2, Mitigation Measures, Range of Changes in Damage, A-1, Zero Deductible Personal Residential Loss Costs by ZIP Code, A-2, Base Hurricane Storm Set Statewide Losses, A-3, 2004 Hurricane Season Losses, A-4, Output Ranges, A-5, Percentage Change in Output Ranges, A-7, Percentage Change in Logical Relationship to Risk, and A-8, Probable Maximum Loss for Florida, in Excel format*
✓		g) *All hyperlinks to the locations of forms are functional*
✓		h) *Table of Contents*
✓		i) *Materials consecutively numbered from beginning to end starting with the first page (including cover) using a single numbering system, including date and time in footnote*
✓		j) *All tables, graphs, and other non-text items consecutively numbered using whole numbers, listed in Table of Contents, and clearly labeled with*

Yes	*No*	*Item*
		abbreviations defined
✓		k) *All column headings shown and repeated at the top of every subsequent page for forms and tables*
✓		l) *Standards, disclosures, and forms in italics, modeling organization responses in non-italics*
✓		m) *All graphs and maps conform to guidelines in* ***II. Notification Requirements A.5.e.***
✓		n) *All units of measurement clearly identified with appropriate units used*
✓		o) *All forms included in submission appendix except Forms V-3, Mitigation Measures, Mean Damage Ratios and Loss Costs (Trade Secret item) and A-6, Logical Relationship to Risk (Trade Secret item)*
✓		p) *Hard copy documentation identical to electronic version*
✓		q) *Signed Expert Certification Forms G-1 to G-7*
✓		r) *All acronyms listed and defined in submission appendix*

Explanation of "No" responses indicated above. (Attach additional pages if needed.)

Form S-6 was submitted as a requirement under the 2009 Standards. The results are unchanged.

AIR Hurricane Model for the U.S. V16.0.0 as Implemented in Touchstone® V4.1.0

November 1, 2016

Model Name and Identification

Modeler Signature

Date

Florida Commission on Hurricane Loss Projection Methodology

Model Identification

Name of Model:	AIR Hurricane Model for the U.S.
Model Version Identification:	V16.0.0
Interim Model Update Version Identification:	Touchstone® V4.1.0
Model Platform Name and Identifications:	Touchstone V4.1.0
Interim Data Update Designation:	
Name of Modeling Organization:	AIR Worldwide Corporation
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Trade Secret Information to be Presented to the Professional Team in Connection with the Acceptability Process

The list of trade secret items that will be provided to the Professional Team during the on-site review includes:

- Form V-3 (Mitigation Measures–Mean Damage Ratios and Loss Costs)
- Form A-6 (Logical Relationship to Risk)
- Trade secret details related to G-1, Disclosure 5, as warranted

Any other materials will be dependent upon requests or suggestions from the Professional Team.

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2015 General Standards

G-1 Scope of the Model and Its Implementation*

*(*Significant Revision)*

A. The model shall project loss costs and probable maximum loss levels for damage to insured residential property from hurricane events.

The AIR Hurricane Model for the U.S. projects loss costs and probable maximum loss levels for residential property insured damage from hurricane events.

B. The modeling organization shall maintain a documented process to assure continual agreement and correct correspondence of databases, data files, and computer source code to slides, technical papers, and modeling organization documents.

AIR has maintained a documented process to assure continual agreement and correct correspondence of various modeling organization documents used in or generated through model update efforts, submission preparation and preparation for all related meetings with the Commission. Coordination across research, software development, quality assurance and consulting, combined with adherence to documentation standards, ensure that changes are supported throughout the workflow. Preparation for Commission meetings, including slides to be shown to the Commission and work papers to be shown to the Professional Team, will draw upon the central repositories of data and documentation.

C. All software and data (1) located within the model, (2) used to validate the model, (3) used to project modeled loss costs and probable maximum loss levels, and (4) used to create forms required by the Commission in the Report of Activities shall fall within the scope of the Computer/Information Standards and shall be located in centralized, model-level file areas.

All software and data located within the model, used to validate the model, used to project modeled loss costs and probable maximum loss levels and used to create forms required by the Commission fall within the scope of the Computer/Information Standards and are located in central, model-level file areas.

Relevant Form: G-1, General Standards Expert Certification

Disclosures

1. *Specify the model version identification. If the model submitted for review is implemented on more than one platform, specify each model platform. Specify which platform is the primary platform and verify how many other platforms produce the same model output results or are otherwise functionally equivalent as provided for in the "Process for Determining the Acceptability of a Computer Simulation Model" in VI. Review by the Commission, I. Review and Acceptance Criteria for Functionally Equivalent Model Platforms.*

The current AIR hurricane model being submitted to the Commission for approval is the AIR Hurricane Model for the U.S. V 16.0.0; Program: Touchstone® V4.1.0.

2. *Provide a comprehensive summary of the model. This summary should include a technical description of the model, including each major component of the model used to project loss costs and probable maximum loss levels for damage to insured residential property from hurricane events causing damage in Florida. Describe the theoretical basis of the model and include a description of the methodology, particularly the wind components, the vulnerability components, and the insured loss components used in the model. The description should be complete and must not reference unpublished work.*

Introduction

Figure 1 illustrates the component parts of the AIR Hurricane Model for the U.S. Each component represents both the ongoing efforts of the research scientists and engineers responsible for its design and the computer processes that occur as the simulations are run.

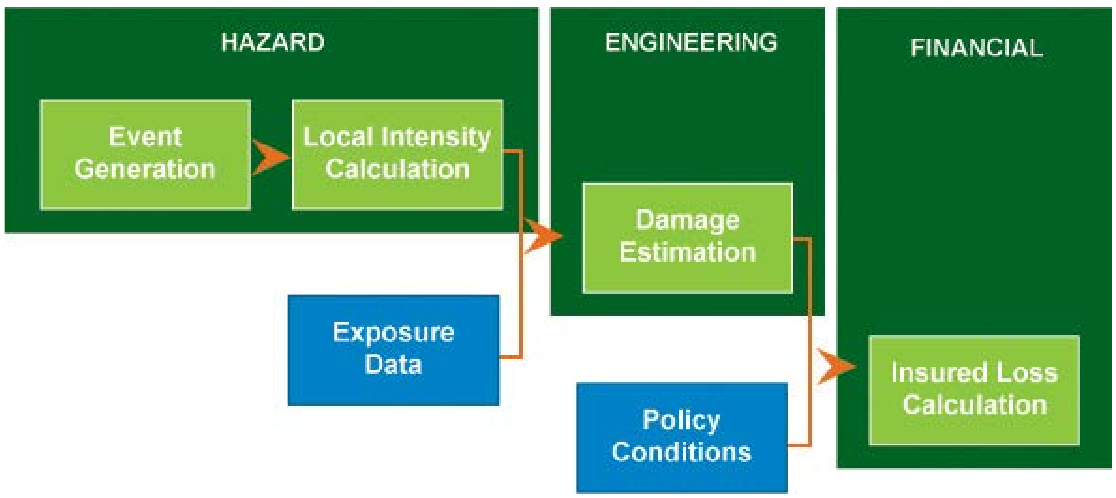

Figure 1. Components of the AIR Hurricane Model for the U.S.

Methodology

The AIR research team collects the available scientific data pertaining to the meteorological variables critical to the characterization of hurricanes and therefore to the simulation process. These primary model variables include landfall location, central pressure, radius of maximum winds, forward speed and storm heading. Data sources used in the development of the AIR Hurricane Model for the U.S. include the most complete databases available from various agencies of the National Weather Service, including the National Hurricane Center. All data is cross-verified. If data from different sources conflict, a detailed analysis and the use of expert judgment are applied to prepare the data for modeling purposes.

After the rigorous data analysis, AIR researchers develop probability distributions for each of the variables, testing them for accuracy-of-fit and robustness. The selection and subsequent refinement of these distributions are based on the expert application of statistical techniques, on well-established scientific principles and on an understanding of how hurricanes behave.

By sampling from the various probability distributions, the model generates a large catalog of simulated "years" of event activity. A simulated year in this context represents a hypothetical year of hurricane experience that could occur in the current year. The AIR Hurricane Model for the U.S. allows for the possibility of multiple events occurring within a single year. That is, each simulated year may have no, one, or multiple hurricanes, just as might be observed in an actual year.

Many thousands of these scenario years are generated to produce the complete and stable range of potential annual experience of tropical cyclone activity. The pattern and distribution of the simulated years approximate the pattern of historical and future years because their derivation is based on a scientific extrapolation of actual historical data.

Each simulated storm is propagated along its track once values for each of the important meteorological characteristics have been stochastically assigned. A complete time profile is estimated for each geographical location affected by the storm. Based on the wind profile, damages are estimated at each location for different types of structures. Finally, policy conditions are applied to estimate the insured losses resulting from each event.

As opposed to purely deterministic simulation models, probabilistic simulation models enable the estimation of the complete probability distribution of losses from hurricanes. Once this probability distribution is estimated, hurricane loss costs by county, five digit ZIP Code or location can be derived.

Event Generation Component

This first module of the AIR tropical cyclone model is used to create the stochastic storm catalog. More than one hundred years of historical data on the frequency of hurricanes and their meteorological characteristics were used to fit statistical distributions for each parameter. By stochastically drawing from these distributions, the fundamental characteristics of each simulated storm are generated. The result is a large, representative catalog of potential events.

Landfall Location: There are 62 potential landfall segments in the AIR Hurricane Model for the U.S., each representing approximately 50 nautical miles of smoothed coastline from Texas to Maine. There is an additional segment for the Florida Keys. To estimate the probability of a hurricane occurring on each of these segments, a cumulative distribution of landfall locations is developed as described below. Once a segment is chosen, the landfall location is picked uniformly along the segment.

The coastline is first smoothed for irregularities such as inlets and bays. The actual number of hurricane occurrences is then tabulated for smoothed 50-nautical-mile segments. The actual number of occurrences for each segment is then smoothed by setting it equal to the weighted average of a set of successive data points centered on that segment.

This smoothing technique was selected because it has been used in other climatological studies and because it maintains areas of high and low frequency and also accounts for the lack of historical landfalls in certain portions of the coastline.

Bypassing Storms: The AIR Hurricane Model for the U.S. generates bypassing as well as landfalling storms through a track generation procedure that follows each simulated hurricane from the time of its inception until it dissipates. A bypassing hurricane is one that does not make landfall in Florida as a hurricane but does cause damaging winds over land.

Meteorological Standards: The simulated frequency of hurricanes is consistent with the frequency observed historically over the period 1900–2014.

Meteorological Characteristics: Probability distributions are estimated for central pressure and forward speed for 31 one-hundred-nautical-mile segments of coastline. Separate distributions are estimated for each of these segments because the likely range and probabilities of values within each range for these variables depend upon geographic location and, in particular, latitude. For example, intense hurricanes are more likely to occur in southern latitudes where the water is warmer. Storms affecting the coast in northern latitudes tend to be larger and faster moving on average. Radius of maximum winds is represented using a regression model that relates the mean radius to central pressure and latitude.

Storm Heading at Landfall: Landfall angle is measured clockwise (+) or counterclockwise (-) with 0 representing due North. Separate distributions for storm heading at landfall are estimated for each 50-nautical-mile segment of coastline. Storm heading is modeled as combined Normal distributions, and bounded based on the historical record, geographical constraints, and meteorological expertise. Diagnostic tests performed show a reasonable agreement between historical and modeled values.

Storm Track: The methodology used to generate storm tracks is based on the information available in the National Hurricane Center HURDAT database for the period 1900–2007. This database provides track information for more than 1,000 North Atlantic storms at six-hour time intervals. Time series techniques have been used to determine the dependence structure present in key model variables from one time period to the next. Time series models that describe the dependence in the historical data are used in the generation of simulated tracks. For example, a first-order Markov model with transition probabilities estimated from the historical data is used to generate changes in track direction of simulated storms. An illustration of the procedure is given in Figure 2. The storm tracks generated using this approach are realistic and resemble storm tracks that have been observed for historical storms.

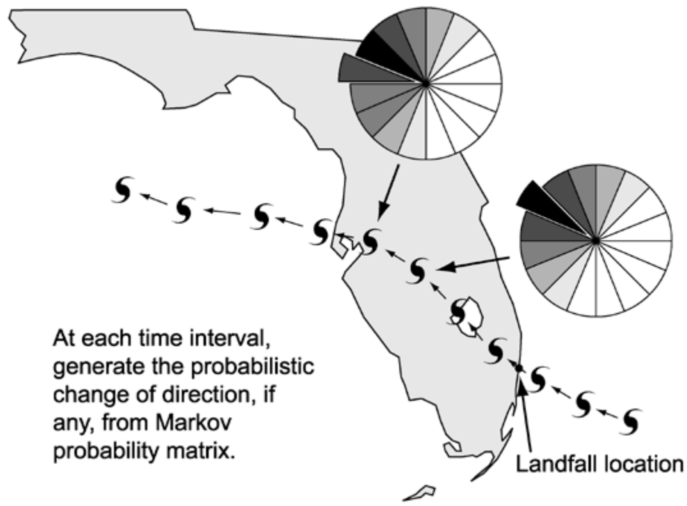

Figure 2. Storm Track Generation

AIR uses the event generation component of the model to simulate 50,000 years of potential hurricane activity.

Wind Field Generation Component

Once the model probabilistically generates the hurricane's meteorological characteristics, it simulates the storm's movement along its track. A complete time profile of wind speeds is developed for each location affected by the storm, thus capturing the effect of duration of wind on structures as well as peak wind speed. Calculations of local intensity take into account the effects of the asymmetric nature of the hurricane windfield, storm filling over land and radial variation of wind speeds from the radius of maximum winds. The model also uses surface roughness information to account for boundary layer modification of the winds by the local land surface.

Gradient Wind Reduction Factor (GWRF): The model uses a stochastic GWRF, which varies from storm to storm. The mean value, the distribution about the mean and the radial profile of the GWRF have been developed based on analyses of dropsonde (GPS dropsonde data are provided courtesy of the NOAA/AOML/Hurricane Research Division in Miami, Florida), as well as results from published literature (Franklin et al., 2003, Powell et al., 2009). The GWRF is adjusted based on the Peak Weighting Factor (see below) and the distance from the eye. Both parameters (GWRF and PWF) are generated jointly using a bounded Bivariate Normal Distribution (based on Casella and Berger, 1990).

Peak Weighting Factor (PWF): The PWF is a stochastic parameter used to reflect the vertical slant in the hurricane eye (Powell et al., 2009). As mentioned above, the PWF and GWRF are generated jointly using a bounded Bivariate Normal Distribution.

Damage Calculation Component

AIR scientists and engineers have developed damage functions that describe the interaction between buildings, both their structural/nonstructural components and their contents, and the local intensity to which they are exposed. These functions relate the mean damage level as well as the variability of damage to the measure of intensity at each location.

The damage functions vary according to construction class and occupancy because different structural types will experience different degrees of damage. For example, a home of masonry construction generally performs better in a hurricane than does a home of wood frame construction, all things being equal. The AIR Hurricane Model for the U.S. estimates a complete distribution around the mean level of damage for each local intensity and each structural type. Losses are calculated by applying the appropriate damage function to the replacement value of the insured property.

The AIR damageability relationships incorporate the results of well-documented engineering studies, damage surveys and analyses of available loss data. AIR engineers have surveyed all significant loss causing events since Hugo in 1989 as part of the ongoing process of refinement and validation of these functions. In addition, actual claims data from recent hurricanes, supplied to AIR by client companies, have been extensively analyzed.

Insured Loss Calculation Component

In this last component of the AIR Hurricane Model for the U.S., insured losses are calculated by applying the policy conditions to the total damage estimates. Policy conditions may include deductibles by coverage, site-specific or blanket deductibles, coverage limits and sublimits, loss triggers, coinsurance, attachment points and limits for single or multiple location policies, and risk-specific reinsurance terms.

3. *Provide a flowchart that illustrates interactions among major model components.*

The interactions among major model components are illustrated in Figure 3.

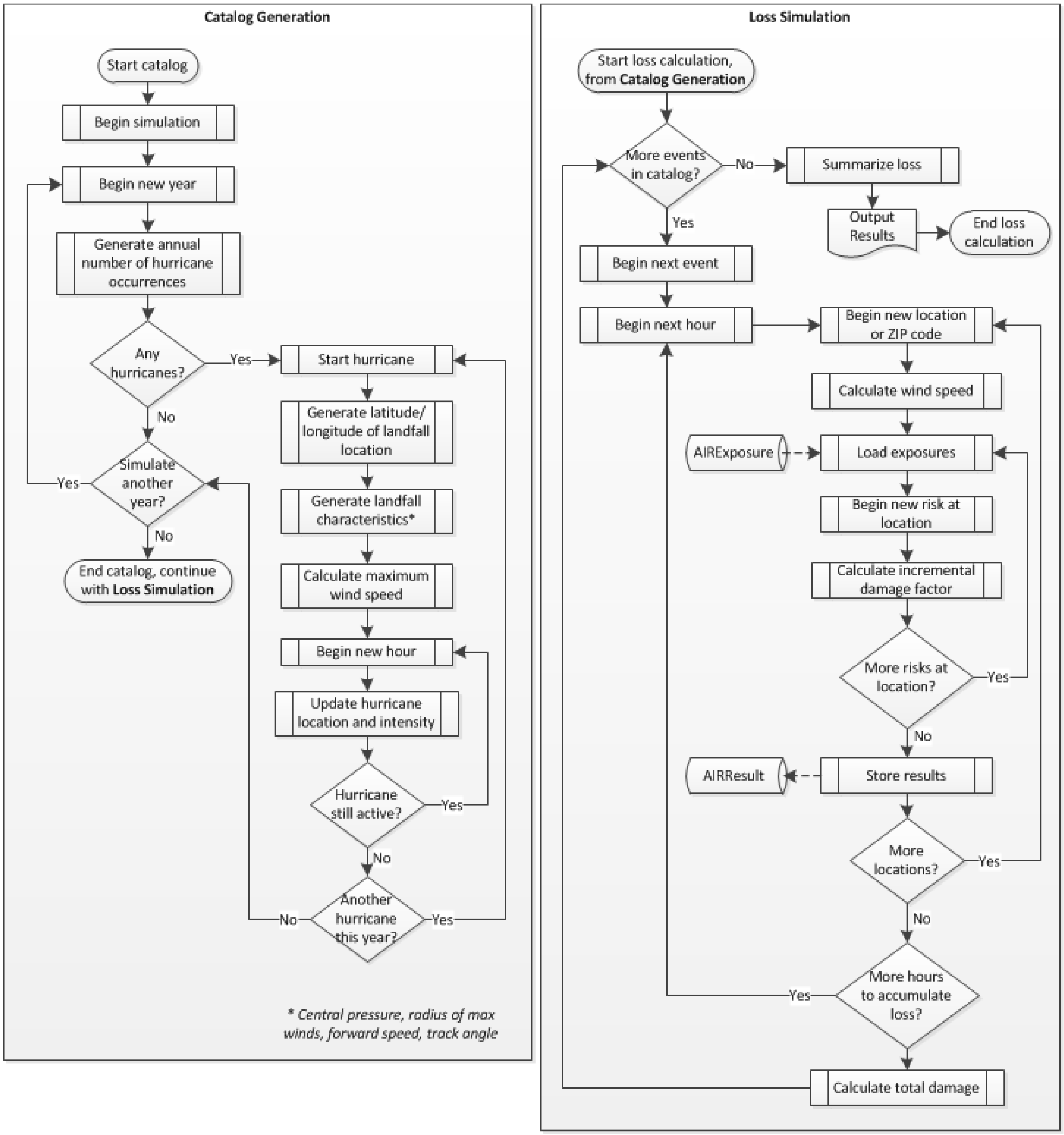

Figure 3. Flowchart of the AIR Hurricane Model for the U.S.

4. *Provide a comprehensive list of complete references pertinent to the model by standard grouping, using professional citation standards.*

The AIR hurricane simulation model is based on well-founded, widely accepted, and state-of-the-art meteorological knowledge and structural engineering expertise.

The following reference materials have been reviewed by AIR researchers and used in the development and refinement of the AIR Hurricane Model for the U.S.

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5. *Provide the following information related to changes in the model from the previously accepted model to the initial submission this year.*
   A. *Model changes:*
      1. *A summary description of changes that affect the personal or commercial residential loss costs or probable maximum loss levels,*
      2. *A list of all other changes, and*
      3. *The rationale for each change.*

For the current submission there are a number of changes to the AIR Hurricane Model for the U.S.

A summary description of changes that affect the personal or commercial residential loss costs or probable maximum loss levels is provided below.

Event Generation Component (i.e. Catalog): AIR's historical storm set has been updated, incorporating track information from the September 29, 2015 version of HURDAT2. Annual landfall frequency along landfall location in the stochastic catalog have been updated accordingly and an updated stochastic catalog has been generated.

Building Vulnerability Component: The changes in the vulnerability component of the model since the previously accepted model include:

a) Separate vulnerability functions have been developed for buildings built according to the minimum requirements of the Florida Building Code 2010. Unique building categories (described in Appendix 9) were identified in the entire state by taking into consideration the design wind speed, the terrain exposure category, and the requirements of Wind-borne Debris Region and High-Velocity Hurricane Zone.
b) The pre-computed factors which adjust the base wind structural vulnerability accordingly when the user provides no year built information, as opposed to a known year built, have been updated to be relevant through 2016. This includes adjusting the underlying year built weighting assumptions to utilize the latest census and tax assessor data regarding building stock age.
c) Vulnerability adjustments that account for structural aging and building technology changes, along with aging and deterioration of roofs in particular, have been updated to be relevant through 2016.
d) Combining the effects of building code related updates and aging, building technology related vulnerability changes; adjustments to the modeled year built categories for Florida have been incorporated. The year built categories have been updated to: pre-1995, 1995-2001, 2002-2011 and Post-2011.
e) The application of the "certified structures" secondary risk feature has been extended for commercial occupancies
f) The implementation of the "roof year built" secondary risk feature has been enhanced to default to a new roof for those structures that are built within the last ten years
g) Enhancements are made to the "seal of approval" secondary risk feature.
h) Enhancements in the resolution of the model towards treating unknown year built factors and the Individual Risk Module (IRM)

Geographical or Other Updates:

a) The ZIP Code and Industry Exposure databases are updated each year. ZIP codes have been updated to April 2016. AIR's Industry Exposure Database for the U.S. has been updated as of 12/31/2015. The Industry Exposure Database update affects estimated industry losses and resulting demand surge factors. This is a technical update.
b) Improved methodology for validating and back-filling address information during Touchstone import processing when the user inputs latitude/longitude data. Users sometimes input

incorrect/invalid partial or full area-level information along with latitude and longitude coordinates. This enhancement corrects/augments/backfills this data using more accurate methodology.

Other Changes are made to the model to improve functionality or performance:

a) Technical updates to the storm surge model when modeling aggregated exposures
b) Technical updates related to supporting additional construction codes, exception handling and re-use intensity

B. Percentage difference in average annual zero deductible statewide loss costs based on the 2012 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named "hlpm2012c.exe*" for:*

1. All changes combined, and

The overall change in the average annual zero deductible statewide residential loss cost is -0.1%

2. Each individual model component change.

Event Generation Component: These updates have resulted in a 0.5% decrease in losses.

Hazard Component: There are no changes in the hazard component of the model.

Building Vulnerability Component: These updates have resulted in a 0.1% increase in losses.

Geographical or Other Data Update: These updates have resulted in a 0.3% increase in losses.

C. *Color-coded maps by county reflecting the percentage difference in average annual zero deductible statewide loss costs based on the 2012 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named* "hlpm2012c.exe" *for each model component change:*

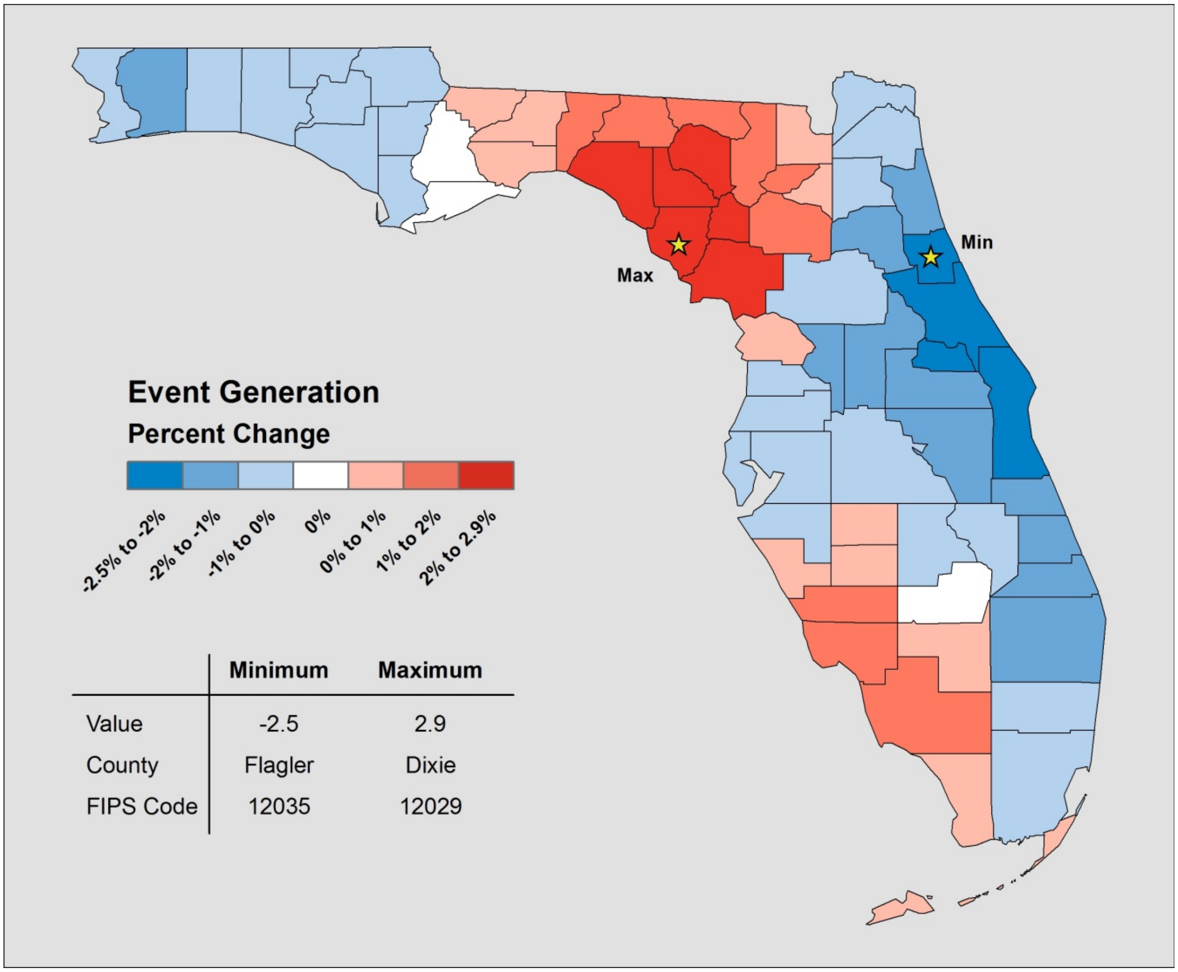


Figure 4. Event Generation Percentage Impact on Average Annual Zero Deductible Statewide Loss Costs

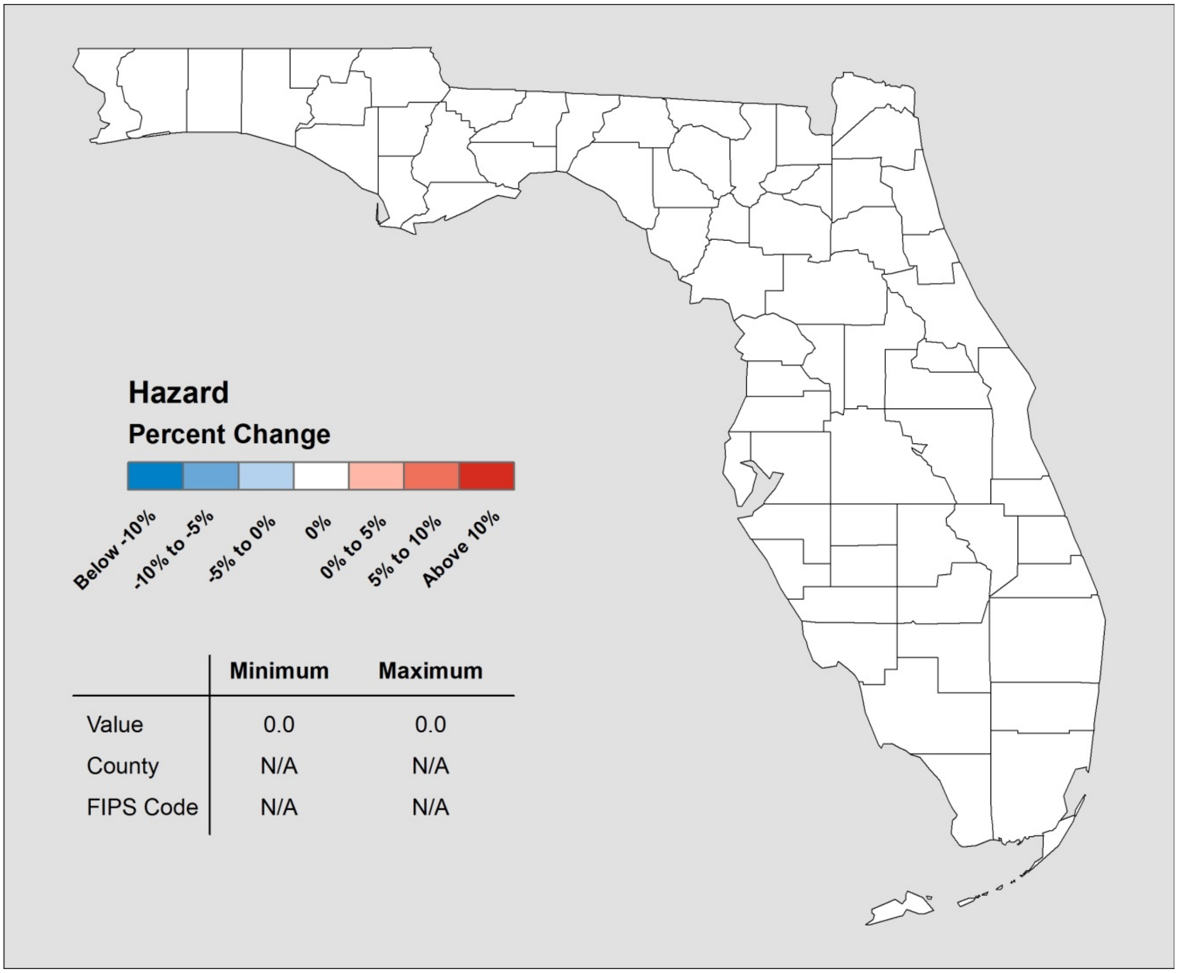


Figure 5. Hazard Percentage Impact on Average Annual Zero Deductible Statewide Loss Costs

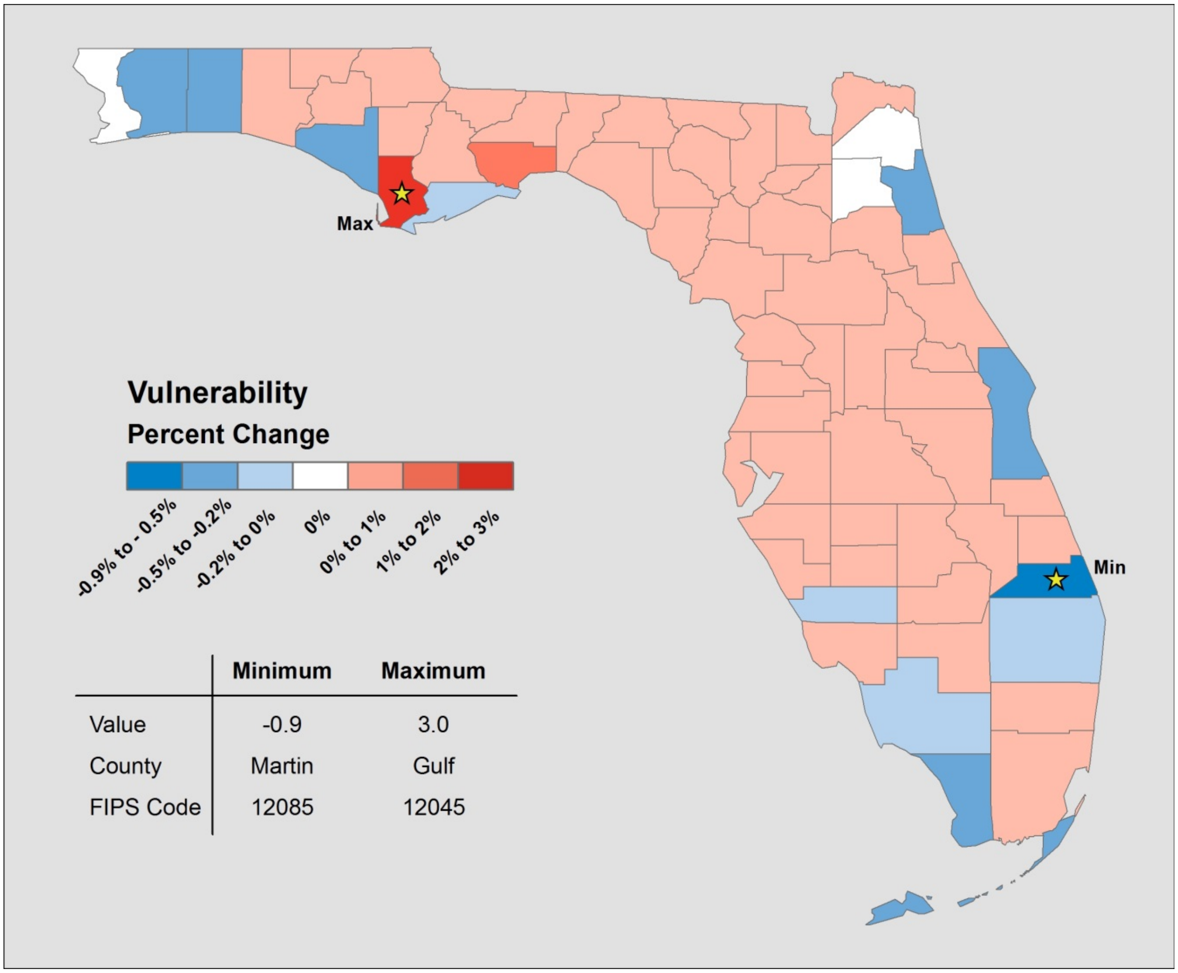


Figure 6. Vulnerability Percentage Impact on Average Annual Zero Deductible Statewide Loss Costs

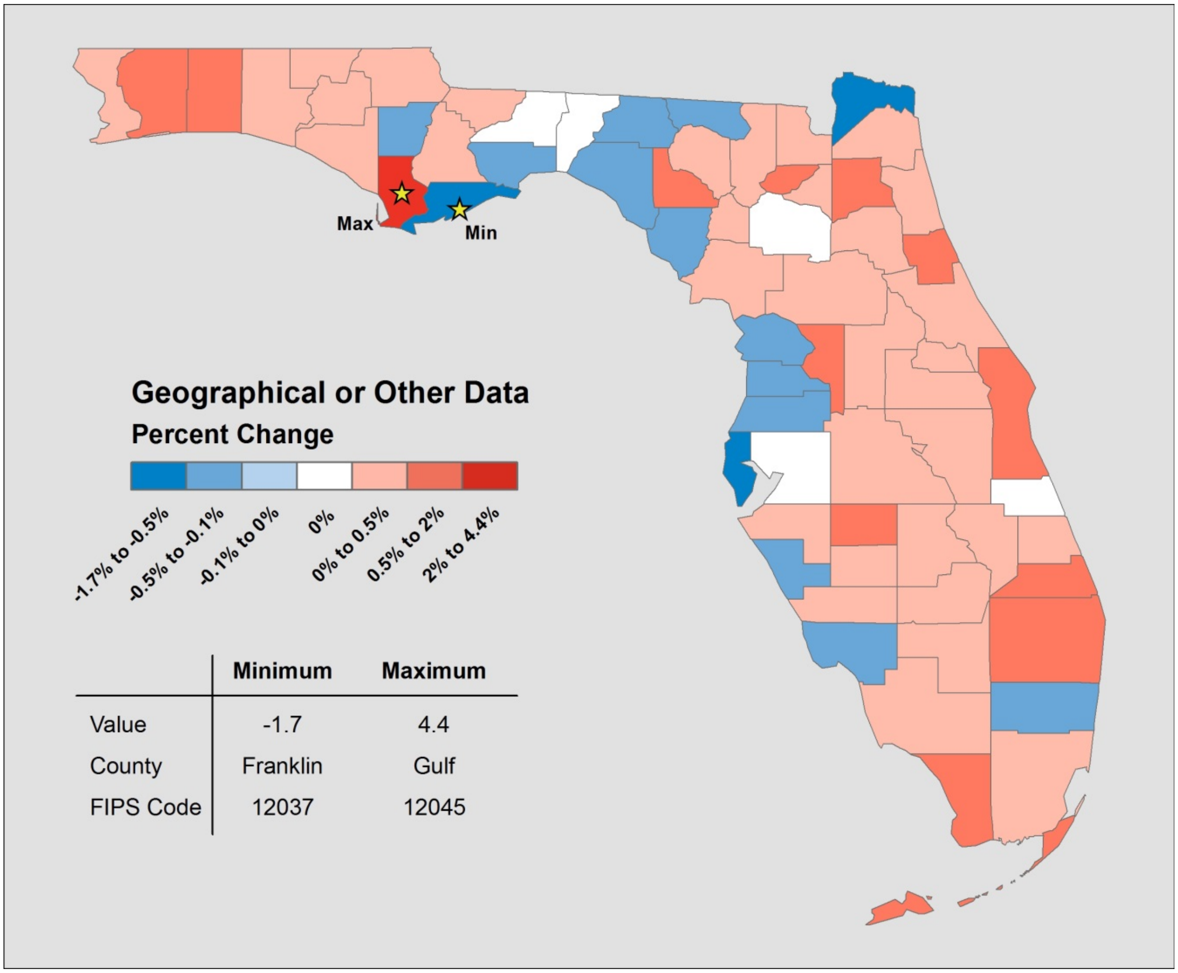


Figure 7. Geographic or Other Data Impact on Average Annual Zero Deductible Statewide Loss Costs

D. *Color-coded map by county reflecting the percentage difference in average annual zero deductible statewide loss costs based on the 2012 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named* "hlpm2012c.exe" *for all model components changed.*

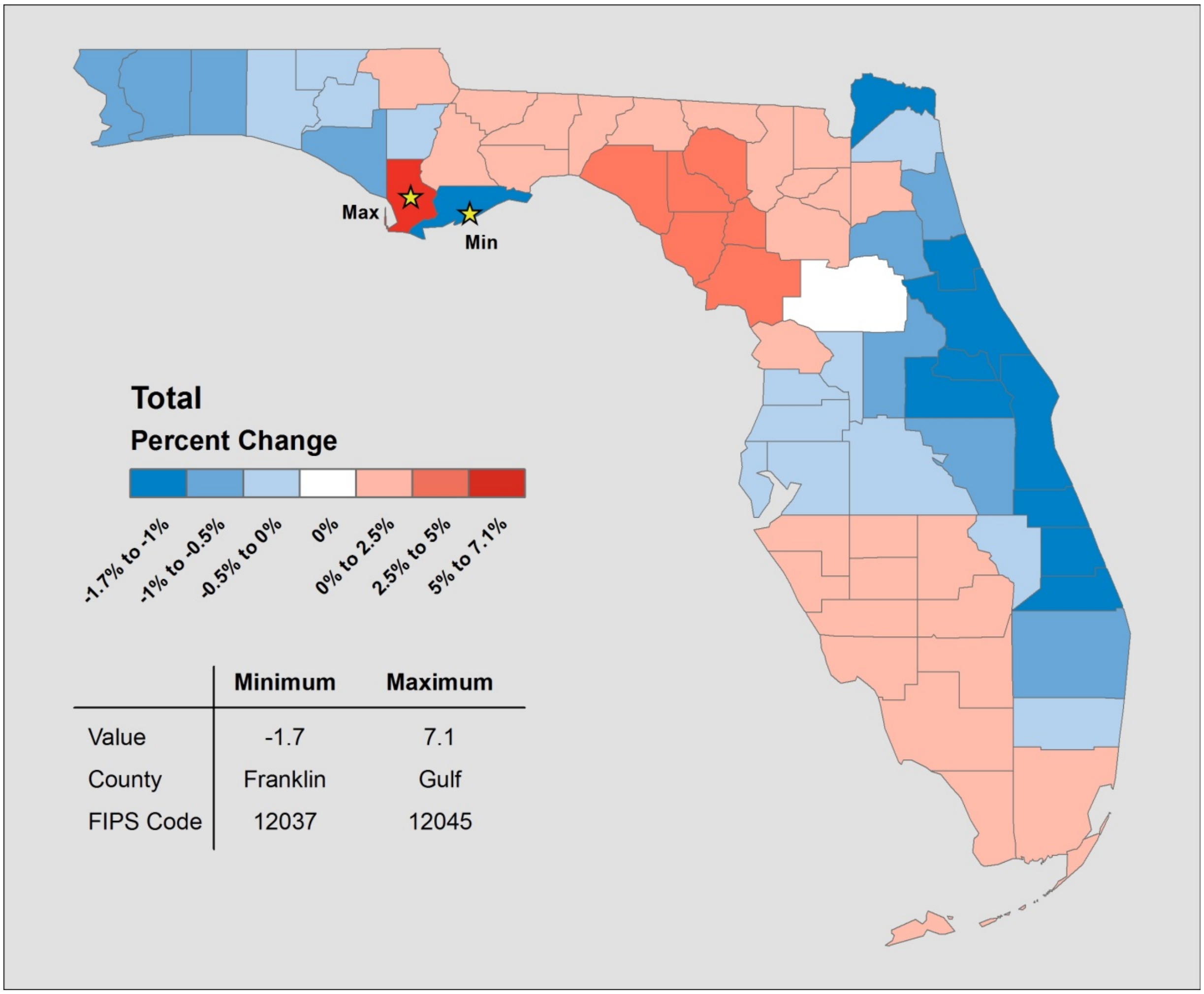


Figure 8. Total Percentage Impact on Average Annual Zero Deductible Statewide Loss Costs

6. *Provide a list and description of any potential interim updates to underlying data relied upon by the model. State whether the time interval for the update has a possibility of occurring during the period of time the model could be found acceptable by the Commission under the review cycle in this* Report of Activities*.*

The following updates to underlying data relied upon by the model may be made during 2017 and during the review cycle in this Report of Activities.

1. The ZIP Code database may be updated.

2. The Industry Exposure database may be updated—the Industry Exposure Database update affects estimated industry losses and resulting demand surge factors.

G-2 Qualifications of Modeling Organization Personnel and Consultants Engaged in Development of the Model

A. Model construction, testing, and evaluation shall be performed by modeling organization personnel or consultants who possess the necessary skills, formal education, and experience to develop the relevant components for hurricane loss projection methodologies.

AIR employs a large, full-time professional staff in actuarial science, computer science, insurance and reinsurance, mathematics, meteorology and other physical sciences, software engineering, statistics, and structural engineering. Most have advanced degrees and more than 80 hold Ph.D. credentials. These are the academic disciplines required to properly develop, test, and evaluate hurricane loss projection methodologies.

B. The model and model submission documentation shall be reviewed by either modeling organization personnel or consultants in the following professional disciplines with requisite experience: structural/wind engineering (licensed Professional Engineer), statistics (advanced degree), actuarial science (Associate or Fellow of Casualty Actuarial Society or Society of Actuaries), meteorology (advanced degree), and computer/information science (advanced degree). These individuals shall certify Forms G-1 through G-6, Expert Certification forms, as applicable.

All modifications to AIR's currently accepted model have been reviewed by modeler personnel or independent experts as indicated in Table 1.

All AIR staff and independent experts abide by the standards of professional conduct adopted for their respective professions.

Table 1. AIR Modeler Personnel and Independent Experts

Name	Professional Discipline	Years of Professional Experience	Education Level	Qualification
Uhlhorn, Eric	Meteorology and Physical Oceanography	23	Ph.D., University of Miami	Advanced degree
Huang, Suilou	Statistics	23	M.S. Statistics, University of Rhode Island (Ph.D. Oceanography, University of Rhode Island)	Advanced degree
Friedland, Carol*	Civil Engineering	9	Ph.D., Louisiana State University	Advanced degree, licensed P.E.
Wang, Heidi	Actuarial Science	13	M.S., Actuarial Science	FCAS
Pourghasemi, Narges**	Computer Science	18	M.S., Computer Science, University of New Hampshire	Advanced degree

*Independent expert Dr. Carol Friedland, Ph.D., P.E., C.F.M., consulting engineer and professor at the Louisiana State University, reviewed the vulnerability components of the AIR Hurricane Model for the U.S.

**Independent software engineer Ms. Narges Pourghasemi reviewed the software engineering components of the AIR Hurricane Model for the U.S.

Relevant Forms: G-1, General Standards Expert Certification
G-2, Meteorological Standards Expert Certification
G-3, Statistical Standards Expert Certification

G-4, Vulnerability Standards Expert Certification
G-5, Actuarial Standards Expert Certification
G-6, Computer/Information Standards Expert Certification

Disclosures

1. *Organization Background*
   A. *Describe the ownership structure of the modeling organization engaged in the development of the model. Describe affiliations with other companies and the nature of the relationship, if any. Indicate if the organization has changed its name and explain the circumstances.*

AIR Worldwide Corporation is a second-tier subsidiary of Verisk Analytics, Inc., a publicly held company. AIR has subsidiaries or offices in San Francisco, London, Munich, Hyderabad, Beijing, Tokyo, and Singapore. AIR is directly or indirectly the owner of AIR Worldwide Limited in London, Verisk Analytics India Private Limited in India, Verisk Analytics GmbH in Germany, and Verisk Analytics Japan LLC in Japan.

   B. *If the model is developed by an entity other than the modeling organization, describe its organizational structure and indicate how proprietary rights and control over the model and its components is exercised. If more than one entity is involved in the development of the model, describe all involved.*

The AIR Hurricane Model for the U.S. is developed, maintained and enhanced by full-time professional staff employed by AIR.

   C. *If the model is developed by an entity other than the modeling organization, describe the funding source for the development of the model.*

The AIR Hurricane Model for the U.S. is developed exclusively by full-time professional staff employed by AIR.

   D. *Describe any services other than hurricane modeling provided by the modeling organization.*

AIR provides catastrophe risk assessment and management products and services to primary insurance companies, reinsurers, intermediaries, involuntary markets, state funds and other insurance industry organizations such as ISO and the NCCI. We also provide services to investment banks, investors in catastrophe bonds and corporate and government risk managers. During or after a major catastrophe event in the world, we provide ALERT services (AIR Loss Estimates in Real Time) to give information and, for certain events, loss estimates to clients and interested parties.

   E. *Indicate if the modeling organization has ever been involved directly in litigation or challenged by a governmental authority where the credibility of one of its U.S. Hurricane Model versions for projection of loss costs or probable maximum loss levels was disputed. Describe the nature of each case and its conclusion.*

AIR has never been involved in litigation or been challenged by a statutory authority with respect to the credibility of its Hurricane Model for the U.S.

2. *Professional Credentials*
   A. *Provide in a tabular format (a) the highest degree obtained (discipline and university), (b) employment or consultant status and tenure in years, and (c) relevant experience and responsibilities of individuals currently involved in the acceptability process or in any of the following aspects of the model:*
      1. *Meteorology*
      2. *Statistics*
      3. *Vulnerability*

4. *Actuarial Science*
5. *Computer/Information Science*

The individuals currently involved in the primary development of the model are listed in the tables below. Note that all of the individuals named are full-time employees of AIR.

Table 2. Professional Credentials

2.A.1. Meteorology		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
Sylvie Lorsolo Ph.D., Geosciences (Atmospheric Sciences), Texas Tech University	4	Dr. Lorsolo, a Senior Scientist, joined AIR in 2012 as an Atmospheric Scientist in the Research Department. Most recently, Sylvie worked as an Assistant Scientist for the NOAA/Hurricane Research Division at the University of Miami where she focused on observational studies of the hurricane boundary layer and developed expertise on collecting and analyzing airborne data for a better understanding of hurricane intensity change. Prior to that, Sylvie was a Research Assistant at Texas Tech University, where she studied hurricane structure at landfall and was responsible for field experiment design for land falling tropical cyclones. She also conducted damage surveys after hurricane landfall and tornado events. In addition, Dr. Lorsolo earned her Ph.D. in Geosciences from Texas Tech University.
Eric Uhlhorn Ph.D., Meteorology and Physical Oceanography, University of Miami	1	Dr. Uhlhorn joined AIR in 2015 as a Principal Scientist in the Research Department. Eric most recently worked as a Meteorologist for NOAA/Hurricane Research Division, where he used in situ and remote sensing observational data from aircraft to gain better understanding of tropical cyclone surface wind field structure. Prior to that, he worked as a Senior Research Associate III for the Cooperative Institute for Marine and Atmospheric Studies for the University of Miami. Eric earned his Bachelor of Science Degree in Meteorology from Florida State University, his Master of Science Degree in Physical Oceanography from Florida Institute of Technology and his Ph.D. in Meteorology and Physical Oceanogrpahy from the University of Miami.
Richard Yablonsky Ph.D., Oceanography (Physical), University of Rhode Island	2	Dr. Yablonsky joined AIR in 2014 and is currently a Senior Scientist in the Research Department, where he leads the Storm Surge Team. Since joining AIR, Richard has been directly or indirectly involved in a variety of projects, including tsunami hazard modeling and all aspects of tropical cyclone hazard modeling (storm surge, precipitation, frequency, track, and intensity). Previously, Richard worked as a Marine Research Scientist (2013-2014) and a Marine Research Associate (2009-2013) at the University of Rhode Island's Graduate School of Oceanography in Narragansett, RI, specializing in modeling of air-sea interaction in tropical cyclones. Richard has also held a Visiting Scientist Appointment at the Developmental Testbed Center in Boulder, CO (2014). Richard obtained a Ph.D. in Oceanography from the University of Rhode Island (2009) and three degrees from North Carolina State University: M.S. in Atmospheric Science (2004), B.S. in Meteorology (2002), and B.A. in Chemistry (2002).

2.A.2. Statistics		
(a) **Name, Education**	**(b)** Years at AIR	**(c)** Relevant Experience
Tomas Girnius Ph.D., Applied Mathematics, California Institute of Technology	13	Dr. Girnius is a principal scientist and manager at AIR Worldwide. During eleven years at AIR, Dr. Girnius has been model manager for both the AIR U.S. California Wildfire Model and the AIR Australia Bushfire Model; has been involved in several updates to AIR Severe Thunderstorm Models for U.S. and Canada; and has contributed to both the catalog and loss estimation modules of earlier releases of the AIR Hurricane Model for the U.S. Before joining AIR, Dr. Girnius worked as a researcher at two defense think tanks (Center for Naval Analyses and The Aerospace Corporation), as a software developer at the Smithsonian Astrophysical Observatory and, later, at Thomson Financial/Omgeo. Dr. Girnius received his Ph.D. from the California Institute of Technology (Thesis: Ray Tracing in Complex Three-Dimensional Earth Models), and his A.B. from Harvard University—both in Applied Mathematics.
Suilou Huang Ph.D., Oceanography, University of Rhode Island	4	Dr. Huang is a senior scientist in the Research Department, Statistics and Applied Mathematics group, at AIR. Since she joined AIR in 2013, she has been using her statistics expertise, data analysis, and computer programming skills in a variety of projects such as developing the Canada Tropical Cyclone catalog, U.S. and Australia Wildfire models, U.S. hurricane catalog update, providing support to the AIR Hurricane Model for the U.S. submissions to the Louisiana State Hurricane Commission and FLHCM, and providing client support. In addition, she also gives statistical training courses to AIR employees. Prior to AIR, Dr. Huang's previous job duties in the United States include being an associate technical staff at MIT Lincoln Laboratory, a guest scientist at Woods Hole Oceanographic Institution, and a research scientist/adjunct faculty at New Mexico Institute of Mining and Technology. Dr. Huang holds a B.A. in Chemistry from Sun Yat-Sen University, China, M.S. in Statistics from University of Rhode Island, and a Ph.D. in Oceanography from the University of Rhode Island
Scott Stransky M.S., Atmospheric Science, Massachusetts Institute of Technology	9	Mr. Stransky is an Assistant Vice President and Principal Scientist in AIR's research and modeling group, and manages the Statistics and Applied Mathematics Group, which is responsible for stochastic modeling, cyber risk, supply chain risk, and life and health risk. He leads the development of AIR's tropical cyclone stochastic catalogs. In addition, he is the model manager for the U.S. and Canada severe thunderstorm models. He also manages the research and development of AIR's tropical cyclone models for the Caribbean and Hawaii. He participated in post-disaster damage surveys for the 2008 Super Tuesday Tornados in the Southeastern U.S., the 2008 Southern California wildfires, 2011's Hurricane Irene in the Bahamas, the Moore Tornado in 2013, and Hawaii's Tropical Storm Iselle in 2014. Mr. Stransky earned a B.S. in Mathematics with Computer Science from the Massachusetts Institute of Technology (MIT) and an M.S. in Atmospheric Science, also from MIT. His Masters research involved numerical modeling of rotating fluids in the laboratory setting and extrapolating the results to real-world weather models. His thesis was entitled: "Real-time state estimation of laboratory flows". His work has been published in academic journals such as *Geophysical Research Abstracts* and *Lecture Notes in Computer Science*, and was presented at IEEE's conference on Computer Vision and Pattern Recognition.
Susan Tolwinski-Ward	3	Dr. Tolwinski-Ward is a statistical climatologist with expertise in data-model fusion and uncertainty quantification, and has been working on modeling

Ph.D., Applied Mathematics, University of Arizona		tropical cyclones as a senior scientist with AIR since 2013. She holds a Ph.D. in Applied Mathematics from the University of Arizona with a minor concentration in Atmospheric Sciences. Prior to beginning work at AIR, she was a National Science Foundation Mathematical Sciences Postdoctoral Research Fellow at the Institute for Mathematics Applied to Geosciences at the National Center for Atmospheric Research.

While many outside experts have been consulted on various aspects of the vulnerability functions, the primary full-time employees currently involved in model development are:

2.A.3. Vulnerability		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
Sarah Bobby Ph. D., Civil and Environmental Engineering and Earth Sciences, University of Notre Dame	1	Dr. Bobby joined AIR in 2015 as an Engineer in our Research Department. Prior to working with AIR, Dr. Bobby worked as a Graduate Research Assistant for the University of Notre Dame where she created an in-house probabilistic risk assessment program for the fragility/damage analysis of structures under wind and seismic hazards through the integration of hazard and structural models. Dr. Bobby earned her B.S in Civil Engineering as well as her Ph. D. in Civil and Environmental Engineering and Earth Sciences both from the University of Notre Dame.
Jayanta Guin Ph.D., Civil Engineering, State University of New York, Buffalo	19	Dr. Guin is Executive Vice President and Chief Research Officer responsible for operational and strategic management of the AIR Research and Modeling team. Under his leadership the team has expanded the global coverage of natural catastrophe models and continues to enhance existing models. He has more than ten years of experience in probabilistic risk analysis for natural catastrophes worldwide. Dr. Guin has led the research effort on a number of capital markets transactions that involved transfer of risk due to earthquakes, cyclones and windstorms. Prior to his graduate studies, he worked as a structural engineer with a leading design consultant in India. Dr. Guin received his B.S. in Civil Engineering from Jadavpur University in India. He earned his M.S. and Ph.D. in Civil Engineering from the State University of New York, Buffalo, with a specialization in dynamic soil-structure interaction and computational mechanics. As a member of the Computational Mechanics Laboratory at SUNY, Buffalo, Dr. Guin gained extensive experience in finite-element and boundary-element analyses for a wide range of engineering problems.
Tim Johnson Ph. D., Civil Engineering, Florida Institute of Technology	1	Dr. Johnson joined AIR in 2015 as an Engineer in our Research Department. Prior to working with AIR, Dr. Johnson worked as a Vulnerability Modeler/Graduate Research Assistant for the Florida Public Hurricane Loss Model where he worked as the lead engineer in the vulnerability model team of the FPHLM. Dr. Johnson earned his Bachelors, Masters and Ph.D. in Civil Engineering from Florida Institute of Technology.
Cagdas Kafali Ph.D., Civil and Environmental Engineering, Cornell University	9	Dr. Cagdas Kafali is Vice President and a Senior Principal Engineer in AIR's Research and Modeling group, working primarily on wind vulnerability of civil engineering systems. He has been involved in the development of many of AIR's wind models, particularly the Asia-Pacific typhoon models and the European Extratropical Cyclone model, and more recently the U.S. and Canada wind storm models. Dr. Kafali holds an M.S. in Structural Engineering from Case Western Reserve University and a Ph.D. in Civil Engineering from Cornell University with a minor in Applied Mathematics. In his dissertation he developed a probabilistic methodology for assessing performance of structural/nonstructural systems in a multi-hazard environment.

2.A.3. Vulnerability		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
Bahareh (Bria) Kordi Ph. D., Wind Engineering, The University of Western Ontario, Canada	4	Dr. Kordi is a Senior Engineer in our Research and Modeling Department working primarily on vulnerability of civil engineering systems to atmospheric perils. Dr. Kordi joined AIR in 2012 as an Engineer in our Research and Modeling Department. Prior to AIR, Dr. Kordi was a Post-Doctoral Researcher in the Boundary Layer Wind Tunnel Lab (BLWTL) at The University of Western Ontario, where she investigated dynamic wind loading on low-rise structures. Prior to that, Dr. Kordi worked as a Graduate Research Assistant at the BLWTL, where she investigated and assessed the damage potential of wind-borne debris from low-rise structures on neighboring houses. Dr. Kordi earned her Ph.D. in Wind Engineering from The University of Western Ontario, Canada, and her M.S. and B.S. in Civil Engineering from Sharif University of Technology and Amirkabir University, respectively, both in Tehran, Iran.
Farid Moghim Ph. D., Structural Engineering, Northeastern University	3	Dr. Moghim is a Senior Engineer in our Research and Modeling Department working on wind vulnerability of civil engineering systems. He has been involved in the development of U.S. and Canada wind storm models. Prior to joining AIR, Dr. Moghim held a position as a Research Assistant at Northeastern University, where he was responsible for proposing an innovative performance-based simulation framework for high-rise buildings against wind hazards. Dr. Moghim has earned a Bachelor of Science degree in Civil Engineering from Isfahan University of Tech., a Master of Science degree in Earthquake and Structural Engineering from Isfahan University of Tech., and a Ph.D. in Structural Engineering from Northeastern University.
Karthik Ramanathan Ph.D., Civil and Environmental Engineering, Georgia Institute of Technology	4	Dr. Ramanathan is a Manager and Senior Engineer in our Research and Modeling Department working primarily on the wind and flood vulnerability of civil engineering systems. Dr. Ramanathan joined AIR in 2012 as an Engineer in our Research and Modeling Department. Prior to AIR, he worked as a Graduate Research Assistant with the School of Civil and Environmental Engineering at Georgia Institute of Technology where he earned both his Ph.D. and M.S. in Civil and Environmental Engineering with a special focus in Earthquake Engineering and Structural Reliability. Prior to joining Georgia Tech, Dr. Ramanathan obtained an M.S. from the University of Pittsburgh in Civil and Environmental Engineering with a special emphasis in Structural Engineering and Mechanics.

2.A.4. Actuarial Science		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
Brandie Andrews B.S., Mathematics Wheaton College	10	Ms. Andrews is a Vice President within AIR's Consulting and Client Services Group. She has been with AIR for ten years and in that time has acted as the primary modeler for a large number of insurance, reinsurance, and securitization projects. She is currently the leader of the Regulatory and Public Policy market segment. In this role Ms. Andrews ensures compliance with all regulatory requirements of catastrophe models and assists clients in dealing with regulators and rating agencies. She has taught classes on exposure data, interpretation of model results and the financial model at the AIR Institute. Prior to joining AIR, Ms. Andrews spent more than ten years in the actuarial field in ratemaking and reserving. She earned a B.A. in Mathematics from

2.A.4. Actuarial Science		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
		Wheaton College and has passed five Casualty Actuarial Society Exams. Ms. Andrews has achieved the designation of Certified Catastrophe Modeler by completing the requirements of the AIR Institute Certification Program.
Jason Kowieski B.S., Mathematics-Actuarial Science, University of Wisconsin-Eau Claire	3	Mr. Kowieski is currently a Senior Risk Consultant servicing Regulatory and Rating Agencies in the Risk Consulting group at AIR. He joined AIR in 2013 as a Risk Consultant in the Consulting and Client Services Department with 5 years combined of insurance and software industry experience. Most recently, he worked as an Actuarial Analyst in the P&C Loss Reserving Department of American Family Mutual Insurance Company where he worked on reserving for short tail auto and residual lines losses, reserving for catastrophe loss, reporting of ceded losses for occurrence and aggregate catastrophe reinsurance programs, annual preparation of Schedule P data for the Annual Statements of the American Family Insurance Group companies, and additional reporting and analytical assignments. Prior to this, Mr. Kowieski worked as a Project Manager at Epic Systems assisting with setup and implementation of enterprise billing software in a multi-hospital system. Mr. Kowieski has earned a B.S. in Mathematics with an Actuarial Science emphasis and a B.S. in Economics from the University of Wisconsin-Eau Claire.
Christy Shang M.S., Mathematics, University of Connecticut	5	Ms. Shang is a Senior Risk Consultant in the Consulting and Client Services group at AIR. She works in the Regulatory and Public Policy market segment, where she ensures compliance with all regulatory requirements of catastrophe models and assists clients in dealing with regulators and rating agencies. Ms. Shang holds a B.A. in Economics from Boston University and an M.S. in Mathematics from the University of Connecticut.
Ekatherina Wagenknecht B.S., Earth, Environmental, and Ocean Sciences, University of Massachusetts-Boston	2	Ms. Wagenknecht joined AIR in 2014 as a Risk Analyst in our Consulting Department. Prior to joining AIR, Katie first worked as a geologist, in an academic lab at school (UMass Boston). In this position, she assisted with taking geological and environmental projects from conception to publication. Katie wrapped up her undergraduate career by spending four months in Australia, where she worked on a joint project venture between UMass Boston and the University of Queensland. Post-graduation, she worked at an environmental consulting and engineering firm (Apex Companies, LLC) as an environmental scientist. After that, she explored her interests in computer science by working in tech support at the Intuit QuickBase Cambridge office before joining AIR. She holds a Bachelor of Science in Earth, Environmental and Ocean Sciences.
Heidi Wang M.S., Actuarial Science, University of Illinois at Urbana Champaign	6	Ms. Wang is a senior manager in the Business Development group at AIR. She works on promoting and developing catastrophic related models for agriculture segment as well as supporting the actuarial work at AIR. Prior to joining AIR, Ms. Wang worked for different consulting companies and most recently worked as an Actuarial Manager at Liberty Mutual Insurance Company in which she managed premium analysis as well as reserve studies for different lines of business for Commercial Market. She has earned her M.S. in Actuarial Science from the University of Illinois at Urbana Champaign.

2.A.5. Computer Science		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
Laxmi Balcha M.S., Software Engineering Brandeis University	10	Ms. Balcha is an Assistant Vice President in software development group, working with teams on Touchstone Initiatives and releases. She joined AIR in 2006 to oversee AIR Products data platform architecture. She previously worked at EMC Corporation and has 18 years of Software Industry experience in US and Overseas. She holds a B.S. in Electronics and Communications Engineering from Osmania University, and a M.S. in Software Engineering from Brandeis University. She is also a Certified Public Accountant (Institute of Chartered Accountants of India), Certified in Statistical Methods and Applications (Gold Medalist) from Indian Statistical Institute, a Certified Catastrophe Modeler and a Certified Ham Radio Operator from NIAR.
Subhashis Barik B.E Chem. Engineering, NIT Rourkela MBA, ICFAI Hyderabad	13	Mr. Barik joined AIR Hyderabad in January 2003 as a Data Analyst and is currently Senior Manager in the Model Quality group. This group tests all model implementations and related features in Touchstone. He holds a Bachelor's degree in Chemical Engineering from the National Institute of Technology, Rourkela, India, and a Master's in Business Administration from ICFAI University, Hyderabad. Prior to joining AIR, he was an Assistant Manager at HBLNife Power Systems for two years, implementing Japanese manufacturing concepts in the factory. He also has five years of experience in the Chemical Unit of Indian Rare Earths, Orissa under the Department of Atomic Energy.
Broto Chakrabarti Bachelor of Commerce, Bhawanipore College, Kolkata, India	7	Mr. Chakrabarti is a Software Engineering Manager in the Software Development Group at AIR. He joined AIR in 2009 as a Project Manager in AIR's Software Development Group.
Suryanarayana Datla M.E., Structural Dynamics, IIT, Roorkee, India	15	Mr. Datla joined AIR Hyderabad in February 2001 and is currently Vice President of Research and Director for the Model group in Hyderabad. Mr. Datla has more than 18 years of experience in developing catastrophe loss estimation models. His current responsibilities include implementation of catastrophic risk assessment models developed for various regions and perils worldwide into AIR products. He is also involved in development of catastrophe models for various regions/perils and manages the GIS and Flood Research teams in Hyderabad. Mr. Datla holds a M.E. (Masters in Engineering) in Structural Dynamics from IIT Roorkee, India. Prior to joining AIR, he was a senior engineer at RMS India Office at Delhi for three years where he played a crucial role in the development of earthquake, tornado, and hurricane models. In addition, he conducted post-disaster surveys for Gujarat (1998) and Orissa (1999) cyclones.
Burcu Davidson M.S., Computer Science, Suffolk University, Boston.	17	Ms. Davidson is the Vice President of Software Development at AIR. She joined AIR in 1999. Previously, she worked as an engineer at Turkish Telecom in Ordu, Turkey.
Phaninath Dheram M.Phil, Computer Science Jawaharlal Nehru University, New Delhi	4	Mr. Dheram joined AIR in 2012 as Manager and is currently the Senior Manager of the Model implementation Group in Hyderabad. For three years prior to coming to AIR Mr. Dheram was an independent software development consultant. For nearly 11 years before that he worked for Mentor Graphics India Pvt Ltd. in Hyderabad developing software tools for electronic circuits design.
Jonathan Dodds B.A., Computer Science, U. Mass. Boston	3	Mr. Dodds is a Senior Software Engineer in the Software Development Group at AIR. He is the technical lead for Release Engineering, responsible for build and release processes. He has 25 years of experience in the software industry.

2.A.5. Computer Science		
(a) Name, Education	(b) Years at AIR	(c) Relevant Experience
Jonathan Holden M.S., Hydrology, University of New Hampshire	10	Mr. Holden is a Vice President of AIR's Product Management group and has more than 15 years of product management experience. He oversees product development and new product initiatives. He joined AIR in 2006 as a senior program manager. He previously worked for EMC Microsoft Technology Practice (formerly Internosis, Inc.) as a senior project manager. Mr. Holden holds a B.A. in Geoscience from Franklin and Marshall College and an M.S. in Hydrology from the University of New Hampshire.
Kiran Kalvagadda M.S., Computer Science, Central Michigan University	10	Mr. Kalvagadda is a Software Engineering Manager in the Software Development Group at AIR. He joined AIR in 2006.He previously worked for VISaer of Lowell as a .NET Developer.
Karl Kieninger B.A., Economics, University of Virginia	2	Mr. Kieninger joined AIR in 2015 as a Senior Database Engineer in our Software Development Department. Prior to working with AIR, Karl worked as a Senior Developer for eHana LLC where he participated in agile development of web-based electronic health record system. He also worked as a Senior SQL Developer for Alere Accountable Care Solutions where he developed TSQL and PL/SQL routines for HIPAA compliant HIX platform.
Visweswara Kokkonda Bachelor of Technology, Electronics and Communication Engineering, JNTU, India.	4	Mr. Kokkonda joined AIR, Hyderabad office in July 2011 as a Database Engineer in the Software group and is now a Senior Database Engineer. Prior to joining AIR, he worked at Primaccess Technologies Ltd as a Software Programmer, developing Web Applications using ASP.Net, C#, Vb.Net, Ajax, Webservices, JavaScript, MSSQL Server, MySQL, and PostgreSQL. He is a Microsoft-certified SQL Server Developer.
John Lu M.S., Electrical Engineering, University of Kentucky	3	Mr. Lu is the Manager of Software Quality Assurance (SQA) in the Product Management Department at AIR. He joined AIR in 2013 as a Lead SQA Engineer. Previously, he was a QA Manager at Fidelity Investments, where he led a test automation project in an Agile development group. He was also responsible for the design of an automated test suite for the Fidelity Portfolio Processing application.
Alex McCollom B.S., Mathematics Boston University	13	Mr. McCollom is the Manager of IT Infrastructure in the Technical Services group at AIR. He joined AIR in 2003. Prior to joining AIR, he was a Senior Windows Administrator/Network Architect at Cantata Pharmaceuticals and Cereon Genomics. He was also an Information Technology Manager, supporting Windows and Solaris servers, at Charles River Analytics.
Dinesh Mohan B.S., Computer Engineering, Michigan State University	1	Mr. Mohan joined AIR in 2015 as a Senior Software Quality Assurance Engineer in the Product Management Department. Prior to working at AIR, he worked as a QA Analyst at ESPN.
Siva Lakshman Rao Nagulapati M.C.A., SCSVMV University, Chennai, India	1	Mr. Siva Lakshman is the Manager of Software Quality Assurance (SQA), AIR Hyderabad. Prior to joining AIR in 2015, he worked in property and casualty, credit card reporting, cloud computing, and migration projects.
Ram Nagulpally M.S., Mechanical Engineering, University of Arizona	4	Mr. Nagulpally is Assistant Vice President and head of AIR's Quality Assurance group. He joined AIR in 2012 as Director of QA in the Product Management department. Most recently, he served as a Consulting Director of Quality Assurance and Support at Reveal Data Corporation , where he successfully managed delivery of the first Unicode compliant localization product and built a structured team to support the rapid growth of early stage start up. Prior to that, Mr. Nagulpally was Director of

2.A.5. Computer Science		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
		Operations for Geomagic, Inc. where he delivered localized versions of software simultaneously in six different languages and operating systems. He earned his M.S in Mechanical Engineering (Structural Mechanics) from the University of Arizona.
Gayatri Natarajan B.S., Electronics and Communications Engineering, Madras University, India	10	Ms. Natarajan is an Assistant Vice President in the Product Management department at AIR. As Product Manager for Touchstone she manages product releases, leads the scoping and requirements for the implementation of models, analytics and hazard layers, and coordinates development activities and delivery of software products to completion. She also the leads the product management strategy for open platforms, flexibility and other key initiatives. Ms. Natarajan received her B.S. in Electronics and Communications Engineering from Madras University in India and was awarded the silver medal for top rank in her university.
Robert Newbold M.S., Information Systems, M.B.A Boston University	14	Mr. Newbold is Executive Vice President of Business Development and Client Services, Americas. He is responsible for the Americas business development team and for providing support and client service to AIR clients in the insurance, reinsurance, securitization, and intermediary markets in the Americas and Bermuda. Rob has been involved in a wide range of consulting engagements at AIR, including loss analyses, portfolio optimizations, economic impact analyses, and the management of more than 125 catastrophe bonds. Mr. Newbold received an M.B.A. as well as an M.S. in Information Systems from Boston University Graduate School of Management. He received a B.S. in Systems Engineering from the University of Virginia
Ryan Ogiste B.A., Business and Communications, Providence College	10	Mr. Ogiste joined AIR in 2006 as a Client Services Consultant. Ryan currently holds the position of client service consultant in the Product Management group. Prior to joining AIR, he worked in Client Services at John Hancock Life Insurance.
Swarna Latha Pasupulati M.S., Computer Applications Osmania University, Hyderabad	7	Ms. Pasupulati is an Assistant Manager for the Software Development group in Hyderabad. She joined AIR, Hyderabad Office in October 2009 as a Senior Software Engineer in the Software group. Prior to joining AIR, Hyderabad, she worked in the statistical and educational domains for Cranes Software International Ltd., Bangalore and NISAI Technologies, Hyderabad. She has more than 11 years of experience in the field of software development. She earned her Master's degree in Computer Applications and her Bachelor of Science degree from Osmania University in Hyderabad.
Sudhir Kumar Potharaju B.S., Electronics and Communications, Osmania University	15	Mr. Potharaju is the Senior Vice President of the Software Development group. He is responsible for the Software Development, Product Management, and Quality Assurance teams, providing overall vision and direction to these groups as well as strategic execution of AIR's product and technology roadmap. He joined AIR as a software engineer at AIR Hyderabad and moved two years later into a senior software engineer position within the Software Development group in Boston. Prior to working at AIR, Mr. Potharaju worked at the Electronics Corporation of India Ltd. (ECIL) and was involved in design, coding and testing of various projects. He completed his engineering degree in Electronics and Telecommunications at IETE, Osmania University Campus, in 1998.
Andrew Rahedi M.A., Physics, Wesleyan University	**8**	Mr. Rahedi is the Manager of the Core Quality Assurance Team. He joined AIR in 2008 as a Core Quality Assurance Associate in the Product Management group. Previously he was with the Hartford Life Insurance Company where he worked as a Statistical Modeler. Andrew holds an M.A.

2.A.5. Computer Science		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
		in Physics from Wesleyan University.
Barbara Rosenstroch M.Engr, Nuclear Engineering and Applied Physics, Cornell University	**4**	Ms. Rosenstroch is a Senior Technical Writer in the Software Development Group. She is responsible for the development and maintenance of the Computer/Information Standards documentation for the Florida Commission on Hurricane Loss Projection Methodology process. In addition, she is in charge of the Using the Model in Touchstone series of documents, as well as the Getting Started guides, and contributes content to the Touchstone Online Help. Previously, she was in charge of creating the documentation for the Touchstone APIs. Before joining AIR, she worked as a Senior Technical Writer at Nokia Inc. in Burlington, MA where she managed and created content for the Web Developer's Library. Also at Nokia, she held the position of Senior UI Designer, designing new features for mobile phone applications software. Barbara earned a Master of Engineering degree in Nuclear Engineering and Applied Physics from Cornell University and a Bachelor of Science degree in Nuclear Engineering from Columbia University. She had a 20 year career as a nuclear engineer, performing radiation protection and shielding analyses for nuclear power plants, as well as leading projects in spent fuel storage, radioactive waste disposal, and decontamination and decommissioning.
Indumathi Sagyari B.Tech,Computer Science, JNT University, Hyderabad	9	Ms. Indumathi Sagyari is a Lead Engineer working in the Model Implementation Group at Hyderabad. She joined AIR's Hyderabad Office in January 2008 as a Senior Software Engineer. Prior to joining AIR, she worked at CMC Lts, Hyderabad for two years.
Praveen Sandri Ph.D., Civil Engineering, Texas Tech University	19	Dr. Sandri is the Executive VP and the Managing Director of AIR's office in Hyderabad, India. He is responsible for the strategic management of the Indian Operations which provides services in the areas of software development, model implementation, GIS, model and product testing, analytics and data services along with providing client services and business development initiatives in India and the Middle East regions. He has more than 20 years of experience in probabilistic risk analysis for natural and man-made catastrophes and has been instrumental in the development of various catastrophe models worldwide. At AIR, he specialized in the area of structural and wind engineering aspects of the AIR hurricane modeling technology. Prior to joining AIR, Dr. Sandri was a research associate at the Wind Engineering Research Center of Texas Tech University where he worked in the area of wind engineering and was the Manager of the Wind Engineering Research Field Laboratory (WERFL). He applied expert systems and artificial neural networks to wind engineering applications. He was the project leader for the development of WIND-RITE™, a knowledge-based expert system for the Insurance Institute for Property Loss Reduction, and he developed the "Expert System as an Alternate Code Compliance Methodology" for the Florida Housing Finance Agency.
Ikram Shaik Mohammed Master of Computer Applications (MCA), Osmania University, Hyderabad, India	1	Mr. Shaik Mohammed is a Security Architect in AIR's Technical Services Department. He has 15 years of experience in Cloud Security, IT Security Policies and Procedures, Network and Security Architecture, IT GRC Process Automation, ERP Security, Risk Management, Regulatory and Compliance Management, Secure SDLC and Application Security, and Business Continuity Management, carrying out projects in the Banking and Financial Services, Energy and Utilities, Healthcare, and Retail industries. Mr. Shaik Mohammed has worked extensively on industry standards and best practices like Cloud Security Alliance (CSA), ISF Standard of Good Practice, ISO27001, NERC CIP, COBIT framework, NIST, PCI DSS

2.A.5. Computer Science		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
		(supported PFI-PCI Forensic Investigation), Data Security Standards, Sarbanes-Oxley Act (SOX), and SSAE16(SOC1, SOC2)/SAS70. Prior to joining AIR, he worked with Wipro Technologies on compliance and security analysis. He also worked as Technical Lead at GE Capital International Services, where he led a 5-person implementation team in projects spanning 45 countries.
Scott Sperling B.A., Economics, Boston University	4	Mr. Sperling is a Senior Core QA Analyst in the Product Management Department at AIR. He previously worked for the Massachusetts Division of Banks conducting on-site examinations of banks' financial books and internal models. Scott holds a B.A. in Economics with a minor in Statistics from Boston University.
Anush Mani Subramanian MBA, Finance, Great Lakes Institute of Management, India	4	Mr. Subramanian is a Senior Product Consultant in the Product Management department. He joined AIR in 2012 as a Product Consultant. His prior experience is in analyzing and managing projects in the Insurance, Capital Markets and Electronic Medical Records (EMR) domains. Most recently, he worked as a Business Analyst for State Street Corporation, where he performed Data Analysis activities for the financial data repository team. Prior to that, Mr. Subramanian was a Lead Business Analyst for the Electronic Medical Records Department at eClinicalWorks, where he trained the users of the product to achieve better efficiency in operational workflows. He earned his MBA in Finance from Great Lakes Institute of Management, India.
Nick Wainer B.CET, Wentworth Institute of Technology	4	Nicholas Wainer is currently a Technical Support Analyst, and joined AIR in 2012 as an IT Co-Op in the Technical Services Department. Prior to AIR, Nicholas was employed as a Clerical Assistant at Wentworth Career Services Department in Boston, MA. Currently, he is working towards his Bachelor of Computer Engineering Technology at Wentworth Institute of Technology in Boston, MA.
Yingqun Wang M.S., Computer Science, California State University	9	Ms. Wang joined AIR in 2007 as a Software Engineer in the Software Development group. She now is a team lead within the Touchstone Software Development group. She previously worked as a Programmer Analyst at the University of California. Ms. Wang holds an M.S. in Computer Science from California State University in San Bernardino, CA.
David Wilson MBA., Wallace E. Carroll Graduate School of Management, Boston College	13	Mr. Wilson is a Director of Product Management at AIR. He manages the Data Products Group, which includes responsibility for updating the spatial mapping layers, postal and boundary data, U.S. address service/geocoding, and property-specific databases. Prior to joining AIR in 2003, Mr. Wilson worked as a Product Manager at Vality Technology (which was acquired by Ascential Software, and later IBM) as a Product Manager for data quality and geocoding products. He received his B.Sc. degree in Mathematics from the State University of New York at Albany, and his MBA. from the Wallace E. Carroll Graduate School of Management at Boston College.
Alex Wong B.S., Computer Science Northeastern University	9	Mr. Wong is a Senior Software Engineer in the Software Development group. He has played an integral part in launching Touchstone, working primarily in the application services development for the platform. Before coming to AIR in 2007, he was a Web Application Developer for Ziggs Inc. Mr. Wong graduated from Northeastern University with a B.S. in Computer Science.
Yili Yao M.S., Computer Science, State University of New	12	Ms. Yao is a Principal Database Engineer in the Software Development group. She has been with AIR since 2004.She works on the Touchstone platform, developing multiple Oracle and SQLServer databases that provide

2.A.5. Computer Science		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
York at Stony Brook		the U.S. address service with geocoding, property building characteristics, data quality scoring, and benchmarking for AIR's risk modeling software. She also works on exposure data conversion, loss analysis, data import and export. Prior to joining AIR, Ms. Yao worked at Level (3) Communications (Genuity/GTE Internetworking/BBN) as a Software Development/Sustaining Engineer. She has a B.A. from Clark University and an M.S. in Computer Science from the State University of New York at Stony Brook.

2.A.6. Data Management and Exposures		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
Jonathan Cusick B.S., Natural Resources Ecology, University of Vermont	1	Mr. Cusick joined AIR in 2015 as an Analyst in our Research and Modeling Department. Prior to working with AIR, Jonathan worked as a GIS Analyst for MIT where he was responsible for interior space mapping, network analysis, geocoding, and geodatabase design. Mr. Cusick has earned his Bachelor of Science Degree in Natural Resource Ecology with a minor in Geospatial Technologies form the University of Vermont.
Anthony Hanson M.A., Economics, Boston College	10	Mr. Hanson is a senior principal analyst in the Exposures Group. He joined AIR in 2005 as database engineer and focused on software performance improvements by changing the way the analytical engine accessed the database to increase scalability from eight engines to a minimum of 40. In 2008 he moved to the research department as a senior analyst where he has continued to automate and streamline database operations. Mr. Hanson has more than 14 years' experience designing database systems for commercial software; two products from the ground up. His last employer, the Hampden County Corrections Department, is still using the electronic medical record he designed to provide cost effective health care to a high risk population.
Cheryl Hayes M.A., Environmental Studies, Boston University	16	Ms. Hayes is an assistant vice president and manager of the Exposures team in the Research and Modeling Group. She has led a multi-disciplinary team in the development of comprehensive, high resolution industry exposure databases (IEDs) for more than 100 countries worldwide. During her tenure at AIR, she has been instrumental in streamlining the development process for the industry exposure databases and has worked to advance the quality of IEDs. She has worked on many consulting projects including the recent IBC Earthquake project and the FEMA Flood Insurance Risk Study. Prior to joining AIR Cheryl worked at Liberty Mutual as an analyst in the environmental department. Ms. Hayes holds her B.A. in Political Science from Mount Holyoke College and her M.A. in Environmental Studies from Boston University.
John Rowe M.S., Structural Engineering, City University London and Technical University of Denmark, Copenhagen	20	Mr. Rowe is Vice President, director of research operations. Before being promoted, he was manager of AIR's Exposures Group. Previously, he worked on the catalogs and wind damage function development for numerous countries. He also worked on the development of the AIR storm surge flood model for the U.K. Mr. Rowe holds his M.S. in Structural Engineering from City University London and the Technical University of Denmark, Copenhagen. He specialized in numerically modeling the behavior of structures.

2.A.6. Data Management and Exposures		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Experience**
Ben Spaulding Ph.D., Geography, University of Connecticut.	6	Dr. Spaulding is a Senior Manager, and joined AIR in 2010 as a Manager in the Data Management Group in our Research Department. Prior to AIR, he worked as a Project Manager with Progeos Inc. in Tolland, Connecticut. Dr. Spaulding earned both an M.A., and Ph.D. in Geography from The University of Connecticut.
Jiaxin Yu B.S., Environmental Science, University of Vermont	5	Ms. Yu joined AIR in 2011 as an Analyst in our Research Department. She is currently a Senior Analyst. Prior to joining AIR, she worked as a Research Technician developing a web application and database to track habitat fragmentation for the Vermont Cooperative Fish and Wildlife Research Unit at UVM. Ms. Yu has earned her B.S. in Environmental Science from University of Vermont.

2.A.7. Editorial		
(a) Name, Education	**(b) Years at AIR**	**(c) Relevant Editorial Experience**
Jonathan Kinghorn B.A., Combined Arts, University of Leicester	4	Mr. Kinghorn is a Senior Writer/Editor with the Marketing and Communications and Consulting Client Services Groups. He is a published author and certified museum curator. Before joining AIR Mr. Kinghorn served in Corporate Communications at Abt Associates. Prior to that he was with the *New England Antiques Journal,* the IBM Institute for Knowledge Management, and the Beacon Press.

B. *Identify any new employees or consultants (since the previous submission) engaged in the development of the model or the acceptability process.*

The following new employees have worked on the model or acceptability process since the previous submission. (Note that a "new" employee is new to the model development, to the acceptability process, or to both):

- Eric Uhlhorn, see Disclosure 2.A.1 above
- Richard Yablonsky, see Disclosure 2.A.1 above
- Sarah Bobby, see Disclosure 2.A.3 above
- Tim Johnson, see Disclosure 2.A.3 above
- Bahareh (Bria) Kordi, see Disclosure 2.A.3 above
- Farid Moghim, see Disclosure 2.A.3 above
- Jason Kowieski, see Disclosure 2.A.4 above
- Ekatherina Wagenknecht, see Disclosure 2.A.4 above
- Broto Chakrabarti, see Disclosure 2.A.5 above
- Burcu Davidson, see Disclosure 2.A.5 above
- Jonathan Dodds, see Disclosure 2.A.5 above
- Kiran Kalvagadda, see Disclosure 2.A.5 above
- Karl Kieninger, see Disclosure 2.A.5 above
- Visweswara Kokkonda, see Disclosure 2.A.5 above
- John Lu, see Disclosure 2.A.5 above
- Alex McCollom, see Disclosure 2.A.5 above
- Dinesh Mohan, see Disclosure 2.A.5 above
- Siva Lakshman Rao Nagulapati, see Disclosure 2.A.5 above
- Ryan Ogiste, see Disclosure 2.A.5 above
- Barbara Rosenstroch, see Disclosure 2.A.5 above
- Indumathi Sagyari, see Disclosure 2.A.5 above
- Ikram Shaik Mohamed, see Disclosure 2.A.5 above
- Scott Sperling, see Disclosure 2.A.5 above
- Nick Wainer, see Disclosure 2.A.6 above
- Jonathan Cusick, see Disclosure 2.A.5 above
- Jiaxin Yu, see Disclosure 2.A.6 above

The consultants listed below have worked on the acceptability process:

- Dr. Carol Friedland, Ph.D., P.E., C.F.M.
- Narges Pourghasemi

C. *Provide visual business workflow documentation connecting all personnel related to model design, testing, execution, maintenance, and decision-making.*

The AIR Hurricane Model for the U.S. Workflow is illustrated in Figure 9.

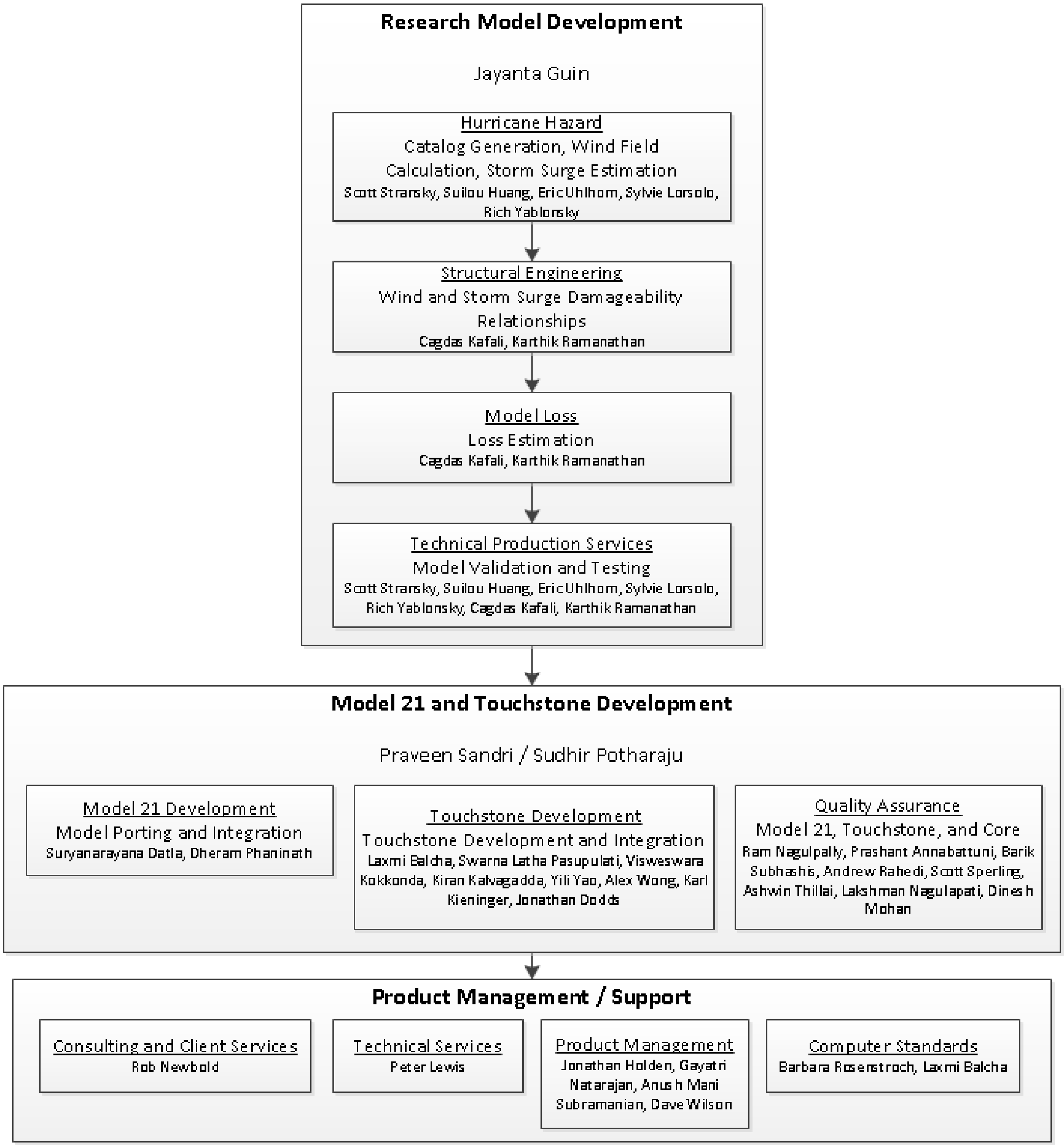


Figure 9. AIR Hurricane Model for the U.S. Workflow

3. *Independent Peer Review*
   A. *Provide reviewer names and dates of external independent peer reviews that have been performed on the following components as currently functioning in the model:*
      1. *Meteorology*

Reviewed by Dr. Kerry Emanuel, Dr. Peter Black, and Dr. Robb Contreras in 2010.

2. *Statistics*

This component has not been reviewed by independent experts.

3. *Vulnerability*

Reviewed by Dr. Joseph Minor, PE in 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, and 2009.

Reviewed by Dr. Carol Friedland and Dr. Marc Levitan in 2010.

Reviewed by Dr. Carol Friedland in 2012, 2014, and 2016.

4. *Actuarial Science*

Reviewed by John W. Rollins, FCAS, MAAA, in both 2010 and 2012.

5. *Computer/Information Science*

Reviewed by Dr. Mark Wolfskehl in 2002.

Reviewed by Dr. John Kam in 2003, 2004, and 2005.

Reviewed by Ms. Narges Pourghasemi in 2006, 2007, 2008, 2010, 2012, and 2016.

B. *Provide documentation of independent peer reviews directly relevant to the modeling organization's responses to the current standards, disclosures, or forms. Identify any unresolved or outstanding issues as a result of these reviews.*

Dr. Friedland's CV is included in Appendix 7 on page 377.

Narges Pourghasemi's CV is included in Appendix 7 on page 378.

C. *Describe the nature of any on-going or functional relationship the organization has with any of the persons performing the independent peer reviews.*

AIR has no on-going functional relationship with any of the persons who performed independent reviews, nor with any of their employees or consultants, nor with any independent organization.

4. *Provide a completed Form G-1, General Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].*

A completed Form G-1 is provided on page 211.

5. *Provide a completed Form G-2, Meteorological Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].*

A completed Form G-2 is provided on page 212.

6. *Provide a completed Form G-3, Statistical Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].*

A completed Form G-3 is provided on page 213.

7. *Provide a completed Form G-4, Vulnerability Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].*

A completed Form G-4 is provided on page 214.

8. Provide a completed Form G-5, Actuarial Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

A completed Form G-5 is provided on page 215.

9. Provide a completed Form G-6, Computer/Information Standards Expert Certification. Provide a link to the location of the form [insert hyperlink here].

A completed Form G-6 is provided on page 216.

G-3 Insured Exposure Location

A. ZIP Codes used in the model shall not differ from the United States Postal Service publication date by more than 24 months at the date of submission of the model. ZIP Code information shall originate from the United States Postal Service.

ZIP Codes used in the model are updated annually with information provided by the United States Postal Service (USPS). The USPS issue date of the information currently used in the model is April 2016.

B. ZIP Code centroids, when used in the model, shall be based on population data.

The AIR Hurricane Model for the U.S. uses population-weighted ZIP Code centroids.

C. ZIP Code information purchased by the modeling organization shall be verified by the modeling organization for accuracy and appropriateness.

The methodology employed by AIR's vendor for computing population centroids is identical to the computational methods promulgated by the U.S. Census Bureau.

Additional quality control measures are performed by AIR to verify the positional accuracy of the population centroid in relation to the ZIP Code boundaries and ensure their appropriateness. These measures comprise a set of procedures that overlay the population-weighted centroids with the ZIP Code boundaries.

D. If any hazard or any model vulnerability components are dependent on ZIP Code databases, the modeling organization shall maintain a logical process for ensuring these components are consistent with the recent ZIP Code database updates.

To ensure the accuracy of ZIP Code definitions across all ZIP Code dependent aspects of the model, the ZIP centroid and code definitions are accessed directly from the centralized ZIP Code database. Upon completion, the resulting data files are crosschecked against the database values as a consistency and accuracy check.

E. Geocoding methodology shall be justified.

To perform loss analyses, Touchstone must first identify the latitude and longitude coordinates (geocode) for the exposure locations. Touchstone's Address Service is used to identify the geocode value for these exposures. Detailed information regarding the geocoding methodology shall be presented during the on-site presentation with the Professional Team.

Relevant Form: G-1, General Standards Expert Certification

Disclosures

1. *List the current ZIP Code databases used by the model and the model components to which they relate. Provide the effective (official United States Postal Service) date corresponding to the ZIP Code databases.*

The current ZIP Code database is referred to as, ZipAll2016_Output. The database was compiled from a host of data sets obtained from third party vendors. Data obtained from Nielsen included Tomtom's MultiNet product, which was developed using the following: United States Postal Service (USPS) ZIP+4 Data File, USPS City/State File, USPS Delivery Statistics File, USPS National 5-Digit ZIP and Post Office Directory, USPS Postal Bulletin, Local U.S. Post Offices, nationwide and USPS ZIP+4 State Directories.

For this update, data from the U.S. ZIP roster for the first quarter of 2016 was used as the most current ZIP list available prior to software finalization. This data was obtained in April 2016 from a third party vendor, ZIPInfo, with an effective date of April 1, 2016. The product name is ZIPList5Max.

The ZIP Code database is used to locate an exposure for purposes of the Hazard and Vulnerability components of the model. It is also used to determine the valid ZIP Codes.

2. *Describe in detail how invalid ZIP Codes are handled.*

A ZIP Code is defined to be "invalid" if it does not match the list of currently valid ZIP Codes.

An invalid ZIP Code is first checked against AIR's master database of ZIP Codes for all years from 1990 through 2016. This database includes ZIP Codes that were valid in previous years but later became invalid. Any invalid ZIP Code matched to a ZIP Code in this master database is reassigned to the currently valid ZIP Code.

The model produces a list of ZIP Codes that do not appear in AIR's master database of valid ZIP Codes. Exposure in any remaining invalid ZIP Code is not modeled. The insurer may choose to allocate or map these exposures back into the exposure data set; this is not done within the model.

3. *Describe the data, methods, and process used in the model to convert among street addresses, geocode locations (latitude-longitude), and ZIP Codes.*

To perform loss analyses, Touchstone must first identify the latitude and longitude coordinates (geocode) for the exposure locations. The address information provided by the client can vary in terms of its resolution (i.e., just a ZIP Code or very detailed street address information) and quality. Touchstone's Address Service is used to parse U.S. street address data, validate the address, and identify the geocode value for these exposures. Detailed information regarding these processes shall be presented during the on-site presentation with the Professional Team.

The data, methods and processes used in the model to convert among street addresses, geocode locations and ZIP Codes are discussed below.

Parse and Standardize the Address (U.S. Street-Level Data only)

Mailing address information—as distinct from physical street address information—is not needed for geocoding or location-based analyses. However, this mailing information is common in client portfolios. As a result, the Touchtone Address Service recognizes these address structures and separates them from the core physical street address components. In addition to providing a standard parsed output, the address processing also performs some basic standardization of expected values in some of the parsed output fields, according to USPS Publication 28 rules. The following fields will have expected values standardized: Street Pre-Directional, Street Type, Street Post-Directional, and State Codes.

Validate the Address (U.S. Street-Level Data only)

Once the address has been parsed and standardized, it is matched to a USPS-provided dataset in order to enhance the address and also append additional location attributes. By matching to the USPS data, the address components can be corrected, added (when omitted) or enhanced. For example, spelling errors can be corrected, pre- and/or post- directional(s) added, ZIP Code verified and ZIP+4 added to the address to improve the address content and quality. Also during this process, two city names can be returned (city or city alias).

To appropriately determine the match level for the input address, the Address Service assigns a match "score" value to each address component. The total of the score determines the best street match. The matched data source and/or subsequent geocoding methods determine the match level.

The street matching process is performed using cascade or waterfall match logic and is designed to provide for high-confidence matches even when some incorrect or incomplete input address information is provided. The cascade match logic will be available to the Professional Team.

Geocoding (Area-level, Street-Level, and Geocode data)

There are generally three levels of location data that a client can provide, and Touchstone has a different process for each. When the client provides non-street-level location data (country, CRESTA, area, subarea, and/or postal data), the Touchstone Address Service interprets this data and provides the geocode for the centroid, based on the resolution level location of the exposure data. Alternately, if the client provides street-level data and a corresponding street match is found, the Address Service produces the corresponding latitude/longitude combinations (when available). Lastly, clients can also provide the exposure's geocode (latitude/longitude pair) directly in the import data. This will be the case when the client has used a third party to geocode its exposure locations.

The Address Service generates two primary geocoding match levels. In Touchstone these codes are stored as the EnhancedGeocodeMatchLevel and the GeoMatchLevel (which is the same as the legacy CLASIC/2 match level). A match code is also generated to show how the street match was determined, which is referred to as the ValidatorMatchCode.

Geocoding Area-Level Address Data

Touchstone supports one or more location information schemes for supplying non-street-level location data (i.e. country, CRESTA, area, subarea, and/or postal) for exposures in each supported country. For all countries, the supported resolution levels for exposure data fall into one or more of the following categories defined in Table 3.

Table 3. Exposure Location Data Resolution Levels

Resolution Level	Geographic Resolution	Description	Examples
Highest resolution	Subarea 2	*A Sonpo, Locality, Postal Area Unit, or other name/code describing a very small, precise area*	• Not applicable in the United States • Mexico: Locality code 310020014 (Dzitiná, Acanceh, Yucatan) • New Zealand: Postal Area Unit 570100 (Wilford, Wellington)
⇑	Postal Area	*A Postal, Parish, District, LDU, Yubin, or other name/code describing a small area*	• U.S.: Postal code 02116 (Boston, MA) • Canada: LDU code V3W4G3 (Surrey, BC)
⇑	Subarea	A County, FSA, Municipio, District, Ward/KU, Province, or other name/code describing a larger area within a region of a country	• U.S.: County name Suffolk • Canada: FSA code K2T (Kanata, Ottawa)
Lowest Resolution	CRESTA/Area	*A CRESTA, State, District, Region, or other similar code describing a major area within a country or the country as a whole*	• U.S.: State code MA (Massachusetts) • Chile: CRESTA code 3 (Santiago)

For non-street-level resolution data, the Address Service uses the information in the AIRGeography database to match each set of location information at a specific geocode match level. Touchstone supports the geocode match levels shown in Table 4 for supplied non-street-level address data.

Table 4. Touchstone Geocode Match Levels for Non-Street-Level Address Data

Resolution Level	Geocode Matching Level on the UI	Geocode Match Level Code	Enhanced Geocode Match Level Code	Description
Highest resolution	Postal Code Centroid	POST	POST	Touchstone geocodes the exposure at the centroid for the corresponding postal area.
⇑	City Centroid	CITY	CITY	Touchstone geocodes the exposure at the centroid for the corresponding city.
⇑	CRESTA Centroid	CRES	CRES	Touchstone geocodes the exposure at the centroid for the corresponding CRESTA area.
⇑	County Centroid	CNTY	SUBA	Touchstone geocodes the exposure at the centroid for the corresponding county.
⇑	Country	COUN	COUN	Touchstone geocodes the exposure at the centroid for the country.
Lowest Resolution	None	NONE	NONE	Touchstone cannot determine the geocode.

Geocoding Street-Level Address Data

When geocoding street-level addresses, this stage of the process typically follows the address validation/enhancement step to ensure that the most complete (and validated) address data is used for matching to the underlying geocoding street data.

For street-level resolution data, The Address Service uses the AIRAddressServer database to match the location information at a specific geocode match level. When a matching street segment is found, an interpolation is performed to determine the appropriate relative position of the address between the geocoding endpoints of the matching street segment. The interpolated geocode is then offset perpendicular from the centerline and to the appropriate odd or even side of the street. If a matching street segment cannot be found, the geocoding process falls back to some level of area centroid (street, ZIP9, postal code, city, or county), providing a less accurate geocode.

Touchstone supports the geocode match levels shown in Table 5 for street-level address data.

Table 5. Touchstone Geocode Match Levels for Street-Level Address Data

Resolution Level	Geocode Matching Level on the UI	Geocode Match Level Code	Enhanced Geocode Match Level Code	Description
Highest resolution	Point	PT	PT	The highest resolution geocoding available because it is obtained from GPS or satellite images directly on the building. Since this data is obtained as part of the on-site commercial building inspection process, point matches are available only in some commercial building records via augmentation.
⇑	Parcel	PRCL	PRCL	Touchstone places the geocode at the centroid for the land parcel of a given property. This level is the second highest available geocoding resolution. No interpolation is required because each parcel centroid in this parcel-level dataset has a specific address for matching. This level of resolution is only available in some commercial building records via augmentation.
⇑	Address (Exact)	ADDR	SEGI	*Street Segment Imputed:* Touchstone finds the address in a street segment that has a geocode for the endpoints. All key street components match to expected values and acceptable city/state or ZIP Code values. Touchstone calculates (interpolates) the relative location of the address between the segment endpoints.
⇑	Relaxed	RLXA	SEGI	*Street Segment Imputed:* Touchstone imputes a geocode from a matched street segment. However, if the street number is out of range or if some of the key street components, such as street name, directional(s), or street type, are changed during the street validation match, then the highest possible Geo. Match Level Code is a “Relaxed” match.
⇑	Address (Exact)	ADDR	BLCK (Zip9 Centroid)	The streetseqnumstart and streetseqnumend of the street segment are the same (Zip9 Single Address).
⇑	Address (Exact)	ADDR	BLCK (Zip9 Centroid)	The address is found in a street segment, but the street segment has no geocodes available. However, a Zip9 Centroid is available.
⇑	Relaxed	RLXA	BLCK (Zip9 Centroid)	Only a Zip9 is included, or the Zip9 cannot be validated.
⇑	Relaxed	RLXA	STRI	Street Imputed: The address is not found in a street segment, but the address is between the start and end range for the matched street. Touchstone calculates (interpolates) the location of the address between the street endpoints.
⇑	Relaxed	RLXA	STRC	Street Centroid: The street number is not available on the input address, but the street is short enough to have a useful centroid. The house number could be missing from or incorrect in the input address.
⇑	Postal Code Centroid	POST	POST	The street address is not found, and street centroid is not available, or the street is too long to have a useful centroid. Touchstone returns a population-weighted ZIP Code centroid if one is available.

Resolution Level	Geocode Matching Level on the UI	Geocode Match Level Code	Enhanced Geocode Match Level Code	Description
⇑	City Centroid	CITY	CITY	The street address is not found, and street centroid is not available, or the street is too long to have a useful centroid. In addition, Touchstone does not have Zip5 data for this location. That is, no postal centroid is available. Touchstone returns a city centroid.
⇑	County Centroid	CNTY	SUBA	Touchstone places the geocode at the center of the county (from the Area Code database). In this case, no postal or city centroid information is available.
⇑	Country	COUN	COUN	Touchstone places the geocode at the center of the country.
Lowest Resolution	None	NONE	NONE	Touchstone cannot determine the geocode.

Geocoding Latitude and Longitude Coordinates

When a client chooses to supply (and preserve) latitude and longitude coordinates as input data, the Address Service uses these user-supplied geocodes directly in loss analyses. Further, the Address Service performs a lookup of each supplied geocode and attempts a point-in-polygon analysis on the supported ZIP Code boundary data, to determine the appropriate ZIP Code to backfill for the location. If a match is found, the related ZIP Code in the AIRGeography database is queried to fill as much additional location information with the supported area, subarea, and ZIP Code information for the corresponding exposure. The detailed methodology used to backfill the location information shall be presented to the Professional Team. Touchstone supports the geocode match levels shown in Table 6 for user-supplied geocodes.

Table 6. Touchstone Geocode Match Levels for User Supplied Geocodes

Geocode Matching Level on the UI	Geocode Match Level Code	Enhanced Geocode Match Level Code	Description
User Supplied	USER	USER	The user has provided the geocode. The accuracy of this type of geocode depends upon the precision of the user supplied data.
None	NONE	NONE	Touchstone cannot determine the geocode.

4. *List and provide a brief description of each model ZIP Code-based database (e.g., ZIP Code centroids).*

There are three databases that are responsible for the storage of ZIP Code-based data, ZIPAll, AIRGeography, and AIRAddressServer.

ZIPAll Database: ZIPAll is the process of mapping all unique ZIP Codes that AIR has found to exist in the past years to the current list of modelable ZIP Codes that are in all U.S. based models for the current model year. The ZIPAll database stores the results of this process and is prepared by the Exposures group within Research. This database is available for internal consumption only and is not released to clients.

AIRGeography Database: The AIRGeography database stores geography-based information derived from the ZIPAll database. It is used by the Touchstone application to geocode area-level address data (when street-level data is not available). This database is maintained by GIS specialists and database engineers. This read-only database is provided to clients as part of the Touchstone installation process.

AIRAddressServer Database: The AIRAddressServer database stores geography-based information derived from the Topologically Integrated Geographic Encoding and Referencing (TIGER) data set and the ZIPAll database. It is used by the Touchstone application to 1) Match parsed street-level addresses to the USPS street data in order to validate the address prior to geocoding and 2) Match the resulting street-level address data to the TIGER street data to determine the geocode value. This database is maintained by GIS specialists and database engineers. This read-only database is provided to clients as part of the Touchstone installation process.

5. *Describe the process for updating model ZIP Code-based databases.*

The methods for updating the ZIP Code-based databases are as follows.

ZIPAll Database: The development of the ZIPAll database involves assessing the validity of population weighted centroids for bounded ZIP Codes from the data provider Nielsen, and mapping all other known ZIP Codes to those bounded ZIP Codes if they are not provided in Nielsen's ZIP Code mapping. ZIP Codes are updated annually with information provided by the United States Postal Service (USPS). Current centroids are compared to prior centroids and metrics, such as distance moved and boundary area change, are created. The most recent census blocks are mapped to the new boundaries using spatial SQL to create an independent verification of the vendor-provided centroids. Any additional ZIP Codes that are created by the USPS after the Nielsen mapping are mapped to bounded ZIP Codes using a point in polygon algorithm and spatial SQL.

AIRGeography Database: The development of the AIRGeography database is a collaborative effort between the Exposures, Product Management, and Database groups. After updates from the ZIPAll database are applied to the tGeography table, count verification and data is compared for all the U.S. records. If discrepancies are found, the Product Management GIS specialist confers with the Exposure's group to identify the source of the error. When all discrepancies have been resolved, the GIS specialist releases the final version of the tGeography table to the Database group. The Database group uses SQL scripts to append the tGeography table to the AIRGeography database, and also to update the other tables in the AIRGeography database. The updates are validated before being finalized for inclusion in the software.

AIRAddressServer Database: The development of the AIRAddressServer database is a collaborative effort between the Exposures, Product Management, and Database groups. The Exposures group provides the ZIPAll database. The GIS specialist in the Product Management group takes the latest commercial release of the ZIPList5 Max data from the ZIPInfo vendor, which matches the same timeline as the versions of the U.S. Postal Service ZIP+4 national and TIGER shapefile data releases, and conflate these separate data sources into the integrated AIRAddressServer database. Various fields counts in the integrated database are then compared to the prior year's integrated database. In addition, address service batch processes are run to compare batch geocoding and address validation match results to the prior versions results.

G-4 Independence of Model Components

The meteorological, vulnerability, and actuarial components of the model shall each be theoretically sound without compensation for potential bias from the other two components

All components of the AIR Hurricane Model for the U.S. are theoretically sound and independently derived. No component compensates for any potential bias in any of the other components. Furthermore, each component is validated independently.

Relevant Form: G-1, General Standards Expert Certification

G-5 Editorial Compliance

The submission and any revisions provided to the Commission throughout the review process shall be reviewed and edited by a person or persons with experience in reviewing technical documents who shall certify on Form G-7, Editorial Review Expert Certification that the submission has been personally reviewed and is editorially correct.

All sections of this submission have been reviewed for grammatical correctness, typographical accuracy, and completeness by an experienced technical editor and writer from AIR's communications staff. The primary reviewer read the Report of Activities as of November 1, 2015, and understood the submission requirements prior to working on AIR's submission.

Relevant Forms: G-1, General Standards Expert Certification
G-2, Meteorological Standards Expert Certification
G-3, Statistical Standards Expert Certification
G-4, Vulnerability Standards Expert Certification
G-5, Actuarial Standards Expert Certification
G-6, Computer/Information Standards Expert Certification
G-7, Editorial Review Expert Certification

Disclosures

1. *Describe the process used for document control of the submission. Describe the process used to ensure that the paper and electronic versions of specific files are identical in content.*

The primary reviewer, upon dissemination of individual standards with respective updates from the Report of Activities, maintained contact with personnel responsible for individual standards and supervised each set of standards via AIRPort, a third party application employed by AIR. All updates and changes—by the primary reviewer and/or personnel responsible for standards—were made to the document using Track Changes in Microsoft Word to ensure the progression of the standards changes was properly documented.

Upon completion of the individual standards by personnel, the primary reviewer was notified and responsible for uploading the final document into a separate folder on AIRPort. All final standards were uploaded by the final reviewer only, who then compiled the final submission document in electronic and print form. All personnel providing edits signed off on the end product submission to verify that the content is accurate and reflects their edits. The final reviewer then compared the final submission document in both electronic and print forms.

2. *Describe the process used by the signatories on Forms G-1 through G-6 (Expert Certification forms) to ensure that the information contained under each set of standards is accurate and complete.*

The signatories on Forms G-1 through G-6 read their respective parts of the submission and confirmed with those who contributed to the relevant sections of the Standards that all data were accurate. They then signed off on the respective Standards section with the primary reviewer, who compiled the final submission document in electronic and print form.

3. *Provide a completed Form G-7, Editorial Review Expert Certification. Provide a link to the location of the form [insert hyperlink here].*

A completed Form G-7 is provided on page 217.

Florida Commission on Hurricane Loss Projection Methodology

2015 Meteorological Standards

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. *The Base Hurricane Storm Set is the National Hurricane Center HURDAT2 as of June 9, 2015 (or later), incorporating the period 1900-2014. Annual frequencies used in both model calibration and model validation shall be based upon the Base Hurricane Storm Set. Complete additional season increments based on updates to HURDAT2 approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these data. Peer reviewed atmospheric science literature may be used to justify modifications to the Base Hurricane Storm Set.*

Model calibration and validation of storm parameters, including annual frequency, make use of the National Hurricane Center's (NHC) latest version of HURDAT2, incorporating the period 1900–2014 and valid as of September 29, 2015.

B. *Any trends, weighting, or partitioning shall be justified and consistent with currently accepted scientific literature and statistical techniques. Calibration and validation shall encompass the complete Base Hurricane Storm Set as well as any partitions.*

No temporal trending, weighting or partitioning was applied to the Base Hurricane Storm Set. Calibration and validation are based on the complete historical set starting in 1900.

Relevant Forms: G-2, Meteorological Standards Expert Certification
M-1, Annual Occurrence Rates
A-2, Base Hurricane Storm Set Statewide Losses
S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year
S-5, Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled

Disclosures

1. *Specify the Base Hurricane Storm Set release date and the time period used to develop and implement landfall and by-passing hurricane frequencies into the model.*

The Base Hurricane Storm Set consists of the latest version of HURDAT2 supplemented with landfall data from Appendix A in the NOAA Technical Memorandum NWS NHC-6 (Blake et al., 2011). This version of HURDAT2 is valid as of September 29, 2015, and spans the years 1900–2014. Implicit within this version of HURDAT2 is the Reanalysis Project update, which incorporates reanalysis for storms up to and including 1955. Some storms outside the reanalysis project period have also been modified.

2. *If the modeling organization has made any modifications to the Base Hurricane Storm Set related to landfall frequency and characteristics, provide justification for such modifications.*

Storms that have not yet been reanalyzed are modified to include landfall points (latitude, longitude, and central pressure) in a similar manner as for the reanalyzed storms in HURDAT2. The landfall points are taken from the supplemented landfall data defined in Disclosure 1. The landfall points are added to the raw six-hourly HURDAT2 data set, thus precluding discontinuities in the track.

3. *If the model incorporates short-term, long-term, or other systematic modification of the historical data leading to differences between modeled climatology and that in the Base Hurricane Storm Set, describe how this is incorporated.*

The model does not incorporate any short-term or long-term modifications to the historical data. The modeled climatology is based on the entire Base Hurricane Storm Set starting in 1900.

4. *Provide a completed Form M-1, Annual Occurrence Rates. Provide a link to the location of the form [insert hyperlink here].*

A completed Form M-1 is provided on page 219.

M-2 Hurricane Parameters and Characteristics

Methods for depicting all modeled hurricane parameters and characteristics, including but not limited to windspeed, radial distributions of wind and pressure, minimum central pressure, radius of maximum winds, landfall frequency, tracks, spatial and time variant windfields, and conversion factors, shall be based on information documented in currently accepted scientific literature.

Methods for depicting all modeled hurricane characteristics are based on information documented in currently accepted scientific literature. All hurricane parameters have been derived from appropriate sources and validated against available observational data sets.

Relevant Forms: G-2, Meteorological Standards Expert Certification
S-3, Distributions of Stochastic Hurricane Parameters

Disclosures

1. *Identify the hurricane parameters (e.g., central pressure, radius of maximum winds) that are used in the model.*

The hurricane parameters used in the model are identified below:

- Intensity (based on central pressure)
- Peripheral pressure adjustment
- Radius of maximum winds
- Landfall location
- Forward speed
- Storm heading at landfall
- Track (latitude and longitude)
- Gradient wind reduction factor
- Peak weighting factor

2. *Describe the dependencies among variables in the windfield component and how they are represented in the model, including the mathematical dependence of modeled windfield as a function of distance and direction from the center position.*

Most hurricane parameters are considered independent of one another. The following variables are dependent on latitude:

- Central pressure
- Forward speed
- Storm heading
- Air density coefficient
- Coriolis parameter
- Peripheral pressure
- Filling rate

The air density coefficient, Coriolis parameter, and peripheral pressure are direct functions of latitude; the latitudinal dependence for the rest of the parameters is modeled by coastal segment.

The radius of maximum winds is represented using a regression model of the form Rmax = f (Cp, latitude) + ε (error term).

The wind field radial profile is based on the formulation introduced by Willoughby et al. (2006) and depends on Rmax, Vmax and latitude as well as distance from the eye. The wind increases as a power of radius inside the eye and it decays exponentially outside the eye, following a smooth transition between the two regions.

The direction from the center position is included in the asymmetry term, which is proportional to the forward speed of the storm and the cosine of the angle between the wind direction and the storm moving direction.

The adjustment to the gradient wind reduction factor (used to convert upper level winds to surface winds) is dependent on the distance from the eye and an additional factor associated with each storm called the peak weighting factor (used to reflect the vertical slant in the hurricane eye and derived from the research of Powell et al. (2009); (see also Standard M-2, Disclosure 3). The gradient wind reduction factor and the peak weighting factor are generated jointly from a bounded bivariate normal distribution.

Also entering the wind calculation are the friction and gust factors, both depending on the effective roughness length which in turn is determined from the land use land cover data (see also Standard M-4), and a maritime adjustment (derived from the research of Powell et al., 2003) which is dependent on the windspeed.

3. *Identify whether hurricane parameters are modeled as random variables, functions, or fixed values for the stochastic storm set. Provide rationale for the choice of parameter representations.*

The hurricane parameters used in the model (variables which are modeled via probability distributions) are identified below:

Intensity: The model utilizes central pressure as the primary hurricane intensity variable. The historical data are modeled using Weibull distributions where the parameters are estimated for each of the thirty-one 100-nautical-mile coastal segments as well as for larger coastal regions, with the final distribution being a mixture of the two. The Weibull form was selected based on goodness-of-fit tests with actual historical data. The use of the Weibull distribution is discussed in more detail in Standard S-1, Disclosure 1.

Radius of Maximum Winds: The probability distribution for radius of maximum winds (R_{max}) is modeled using a regression model of the form: $R_{max} = f(Cp, \text{latitude}) + \varepsilon$, where $f(Cp, \text{latitude})$ represents the mean of R_{max} for given values of central pressure and latitude. The error term, ε, is assumed to be normally distributed. The parameters in this regression model are estimated using data available in NOAA Technical Report NWS-38 (Neumann 1991), the HURDAT2 Reanalysis Project, and the DeMaria Extended Best Track Dataset (EBTRK). The final distribution is truncated using limits that depend on central pressure and are consistent with the range of historically observed values. R_{max} also varies after landfall, following an autoregressive model.

Landfall Location: There are 62 potential landfall segments in the model, each representing ~50 nautical miles of smoothed coastline from Texas to Maine. In Florida, there are 17 landfall segments. The southernmost Florida segment includes a consideration for the Florida Keys. Historical hurricane occurrences since 1900 are used to estimate a smoothed locational frequency distribution. The smoothing technique maintains areas of high versus low frequency and also accounts for the lack of historical landfalls in certain portions of the coastline. Once a segment is chosen, the landfall location is assigned randomly along the segment, from a uniform distribution.

Forward Speed: Forward speed is modeled using a lognormal distribution with parameters estimated for each 100-nautical-mile coastal segment. Separate distributions are estimated for each of these segments to capture the dependence of this variable upon geographical location, particularly latitude. Forward speed is allowed to vary after landfall, following an autoregressive model. The bounds on forward speed are latitude dependent.

Storm Heading: The probability distributions for storm heading at landfall are defined on the 50-mile coastal segments. Upper and lower bounds are placed, based on geographical constraints. The distributions used are mixtures of Normal distributions bounded based on geography and the historical record.

Gradient Wind Reduction Factor (GWRF): The model uses a stochastic GWRF, which varies from storm to storm. The mean value, the distribution about the mean and the radial profile of the GWRF have been developed based on analyses of dropsonde data from 2002 to 2005 (GPS dropsonde data are provided courtesy of the NOAA/AOML/Hurricane Research Division in Miami, Florida), as well as results from published literature (Franklin et al. 2003, Powell et al. 2009). As described in Standard M-2, Disclosure 2, for a given storm, the GWRF is adjusted based on the Peak Weighting Factor (see below) and the distance from the eye. Both parameters (GWRF and PWF) are generated jointly using a bounded Bivariate Normal Distribution (based on Casella and Berger, 1990).

Peak Weighting Factor: The PWF is a stochastic parameter used to reflect the vertical slant in the hurricane eye (Powell et al., 2009). As mentioned above, the PWF and GWRF are generated jointly using a bounded Bivariate Normal Distribution.

The following hurricane parameters are modeled as functions:

Peripheral Pressure: The model uses a latitude dependent peripheral pressure, parameterized based on the work of Knaff and Zehr (2007) as well as analyses of historical storms.

Radial Adjustment to the Gradient Wind Reduction Factor: The stochastically drawn GWRF also varies with distance from the eye and PWF, following a Radial Adjustment Function (RAF). (See also Standard M-2, Disclosure 10.)

4. *Describe if and how any hurricane parameters are treated differently in the historical and stochastic storm sets and provide rationale.*

Hurricane parameters are treated identically in the historical and the stochastic storm sets, except that parameters for historical hurricanes are derived from historical data sources (and are treated as fixed values) rather than being drawn from distributions fitted to the historical data. In addition, for historical storms peripheral pressure is allowed to deviate from the latitude-based mean value based on synoptic analysis to make use of environmental conditions occurring at the time of the event . See also M-2, Disclosure 3.

5. *State whether the model simulates surface winds directly or requires conversion between some other reference level or layer and the surface. Describe the source(s) of conversion factors and the rationale for their use. Describe the process for converting the modeled vortex winds to surface winds including the treatment of the inherent uncertainties in the conversion factor with respect to location of the site compared to the radius of maximum winds over time. Justify the variation in the surface winds conversion factor as a function of hurricane intensity and distance from the hurricane center.*

The model first computes the maximum wind at upper levels and then brings this wind to the surface level (10 meters) via a conversion factor. This factor, the Gradient Wind Reduction Factor (GWRF) described in Standard M-2, Disclosure 3, represents a model parameter which varies stochastically by storm, and for a particular storm varies by location as a function of the PWF and distance from Rmax. The Radial Adjustment Function (RAF) adjusts the GWRF as a function of distance to the eyewall (r) and hours after landfall. Because Rmax varies with time, the RAF is also variable in time for a given storm. The GWRF is independent of storm intensity.

Justification for varying GWRF with distance from the storm center is based on analyses of the spatial distribution of GWRF using operational dropsonde data (data is publicly available from NOAA/AOML/Hurricane Research Division in Miami, Florida). Furthermore, these analyses combined with results from published literature (Franklin et al., 2003; Powell et al., 2009) justify varying GWRF by storm. The mean values of the stochastically drawn GWRF, the distribution about the mean, and the form of the RAF have been developed based on these data and research.

6. *Describe how the windspeeds generated in the windfield model are converted from sustained to gust and identify the averaging time.*

Input to the vulnerability module is 1-minute sustained wind, thus there is no need to convert winds to (3-second) gusts. Conversion of 10-minute averaged wind speeds to 1-minute sustained winds is based on accepted engineering relationships (Simiu and Scanlan, 1996, N. Cook, 1985, and ESDU Engineering Sciences Data, 1994). The conversion factor varies from 1.12 to 1.26, depending on the land use/land cover distribution about a location.

7. *Describe the historical data used as the basis for the model's hurricane tracks. Discuss the appropriateness of the model stochastic hurricane tracks with reference to the historical hurricane data.*

The model is part of an Atlantic basin-wide model that includes Canada, Mexico, Central America, the Caribbean Islands, and the U.S. mainland. The methodology used to generate the basin-wide tracks is developed using historical track information. The starting latitude and longitude of each storm is simulated from a bivariate probability distribution derived from historical genesis locations using a bivariate Gaussian smoothing technique. The dependence structure in the historical data at successive six-hourly time intervals is quantified and used to develop time series models that describe the track direction, forward speed and central pressure as the storm moves across the basin.

The analysis of the data shows that first-order Markov models are appropriate for track direction and forward speed. Higher order dependence present in the central pressure along the track is represented using a second-order autoregressive time series model. The parameters of these models are estimated using a procedure that captures the spatial variability in the behavior of the storms in different parts of the Atlantic basin.

The HURDAT2 database provides data at synoptic times, with the inclusion of data at non-synoptic times for critical events of a storm lifetime (time of landfall, maximum intensity, etc.). The dataset allows for a resolution that is sufficient to capture the evolution of each storm across the Atlantic basin. The inclusion of the landfall point for reanalyzed storms as well as recent storms provides the model the necessary information to appropriately change the storm characteristics once it moves inland. In the case of storms that have not yet been reanalyzed, the model uses detailed landfall information available in Appendix A in NOAA Technical Memorandum NWS NHC-6, Tropical Cyclone Reports from NHC (available at http://www.nhc.noaa.gov/pastall.shtml), peer-reviewed publications, UNISYS, Extended Best Track Dataset, and NOAA Technical Reports NWS-23 (Schwerdt et al., 1979) and NWS-38 to generate storm characteristics at landfall.

The landfall information, including locational frequency and storm intensity, is also used to eliminate tropical storms landfalls and generate post-landfall hurricane tracks. The Atlantic basin-wide tracks are integrated with the post-landfall hurricane tracks using a spline smoothing technique that ensures consistency in intensity, radius of maximum winds and storm heading across the tracks. The methodology produces realistic tracks that resemble the full range of diverse storm tracks that have been observed historically across the Atlantic basin and the U.S. mainland.

8. *If the historical data are partitioned or modified, describe how the hurricane parameters are affected.*

The data have not been temporally partitioned, but for the purpose of parameter estimation the data is grouped by coastal segment, as described in Standard M-2, Disclosure 9. For storms that have not yet been reanalyzed, the landfall information was added to the database. Depending on what information is available in HURDAT2, a track point could be added (time, latitude, longitude, and central pressure) or only intensity information (central pressure).

9. *Describe how the coastline is segmented (or partitioned) in determining the parameters for hurricane frequency used in the model. Provide the hurricane frequency distribution by intensity for each segment.*

To determine hurricane probabilities along the coast of Florida, the actual number of hurricane occurrences is tabulated for approximately 50-nautical-mile segments. For intensity distributions, 100-nautical-mile segments are used (i.e. consecutive 50-nautical-mile segments). The number of occurrences for each segment is then smoothed by setting it equal to a weighted average of the landfall counts for each segment and the surrounding segments.

The intent of the smoothing procedure is to eliminate or reduce the random variation in the limited historical data while maintaining areas of high and low risk. The smoothing is based on a procedure well-documented in the literature (e.g., NOAA Technical Report NWS-38, page 75). The historical hurricane frequency distribution by intensity for each 100-mile coastal segment is shown in Figure 10.

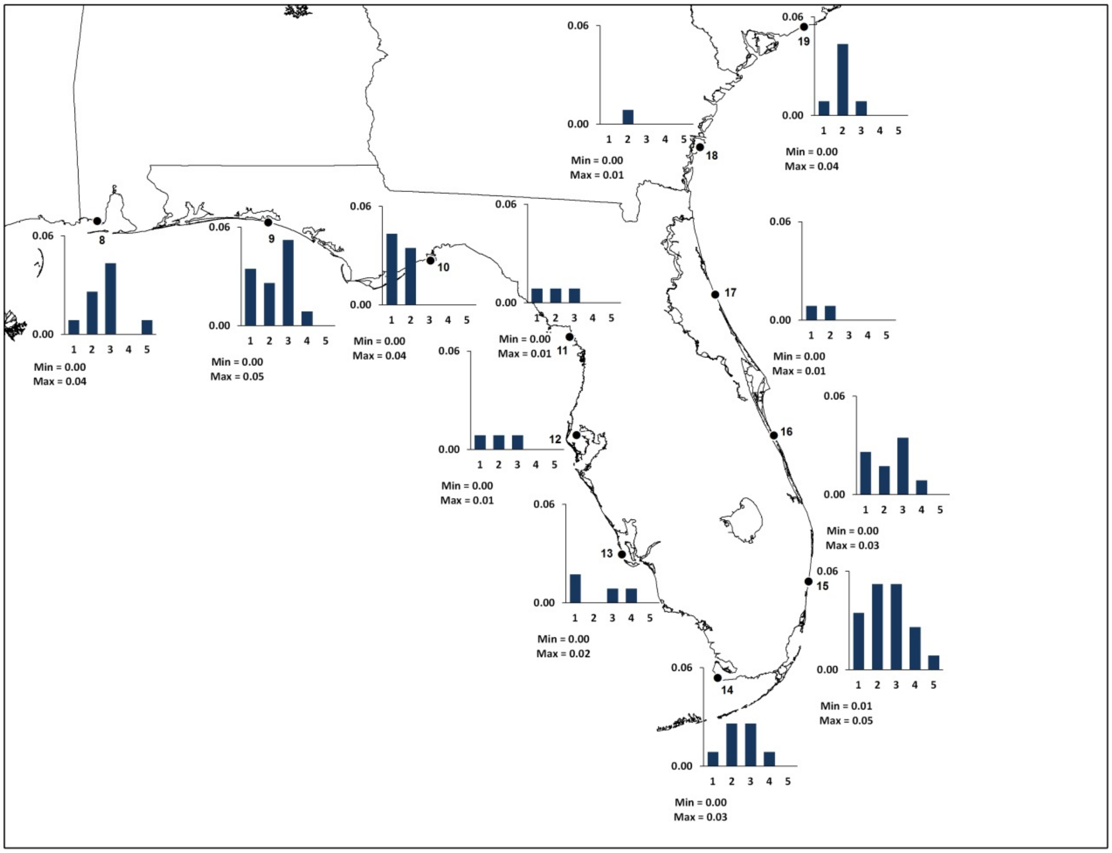


Figure 10. Historical Hurricane Frequency by Coastal Segment, 1900–2014

10. *Describe any evolution of the functional representation of hurricane parameters during an individual storm life cycle.*

The radius of maximum winds and the forward speed associated with a storm change post-landfall following specific autoregressive models.

The adjustment to the stochastically drawn GWRF has a time evolution post landfall: the adjustment is constant for three hours after landfall and then it decreases to zero over the next six hours. Hence no adjustment is applied to the GWRF after nine hours after landfall. This evolution is in line with the research that references the effects of a maritime environment (Powell et al., 2009).

M-3 Hurricane Probabilities

A. Modeled probability distributions of hurricane parameters and characteristics shall be consistent with historical hurricanes in the Atlantic basin.

The modeled probability distributions for landfall location, hurricane intensity, forward speed, radius of maximum winds, storm heading at landfall and gradient wind reduction factor are consistent with observed historical hurricanes in the Atlantic basin and are bounded by observed extremes.

The probability distribution for landfall location is defined on 50-nautical-mile coastal segments. Goodness-of-fit tests show a close agreement between historical and modeled landfall frequencies by Florida segments. Also, for the state as a whole, the modeled average annual frequency of 0.57 landfalling hurricanes per year agrees closely with the average annual historical frequency of 0.55 landfalling hurricanes per year.

Hurricane intensity is modeled as a mixture of Weibull distributions. Weibull distributions are fitted to the historical data for each 100-nautical-mile coastal segment. Separate Weibulls are then estimated for various regions along the coast. The intensity distribution used for each segment is a mixture of the regional Weibulls and the segment Weibull with appropriate weights applied. The Weibull distribution was selected based on goodness-of-fit tests with actual historical data. The Weibull scale and shape parameters, α and β, are estimated using the maximum likelihood estimation method. The use of Weibull distributions is discussed further in Standard S-1, Disclosure 1.

Forward speed is modeled using a Lognormal distribution. Use of this distribution is documented in the literature. The average simulated forward speed for landfalling hurricanes in the region is 13.8 mph and the average forward speed calculated from hurricanes occurring between 1900 and 2014 is 13.9 mph. The maximum forward speed varies by coastal segment.

The radius of maximum winds is simulated using a regression model in which the mean is a function of central pressure and latitude. The model incorporates the fact that stronger storms tend to have a smaller radius than less intense storms. Also, due to the dependence on latitude, the average radius increases as one moves poleward. The average simulated radius for landfalling hurricanes in the region is 26.5 miles. The average radius calculated from historical storms occurring between 1900 and 2014 is 25.4 miles.

Landfall angle (or storm heading) is measured clockwise (+) or counterclockwise (-) with 0 representing due North. Separate distributions for storm heading at landfall are fitted to each 50-nautical-mile segment of coastline. Storm heading is modeled as combined Normal distributions, and bounded based on the historical record, geographical constraints and meteorological expertise. Diagnostic checks show a reasonable agreement between historical and modeled values.

The probability distribution for the gradient wind reduction factor is a Normal distribution with parameters estimated from data derived using the regression equation from Powell et al. (2009), with input based on HURDAT data. The fitted Normal distribution is consistent with that described in the paper. The mean of both the modeled distribution and the historical data is 0.88.

The fitted probability distribution of the peak weighting factor is similarly consistent with the empirical distribution of the factor, as derived from the recent work of Powell et al. (2009). The empirical distribution of the factor is skewed but can be approximated by a Normal distribution after an inverse power transformation of the data. The mean of both the modeled distribution and the historical data is 1.08.

B. Modeled hurricane landfall frequency distributions shall reflect the Base Hurricane Storm Set used for category 1 to 5 hurricanes and shall be consistent with those observed for each coastal segment of Florida and neighboring states (Alabama, Georgia, and Mississippi).

The modeled hurricane probabilities for category 1-5 hurricanes reasonably match the historical record through 2014 and are consistent with those observed for each geographical area of Florida, Alabama, Georgia and Mississippi. The annual probabilities are shown in Table 34 of Form M-1.

C. Models shall use maximum one-minute sustained 10-meter windspeed when defining hurricane landfall intensity. This applies both to the Base Hurricane Storm Set used to develop landfall frequency distributions as a function of coastal location and to the modeled winds in each hurricane which causes damage. The associated maximum one-minute sustained 10-meter windspeed shall be within the range of windspeeds (in statute miles per hour) categorized by the Saffir-Simpson Scale.

Saffir-Simpson Hurricane Scale:

Category	Winds (mph)	Damage
1	74 – 95	Minimal
2	96 – 110	Moderate
3	111 – 129	Extensive
4	130 – 156	Extreme
5	157 or higher	Catastrophic

The model uses maximum 1-minute sustained 10-meter windspeed when defining hurricane landfall intensity for both the Base Hurricane Storm Set and the modeled windspeeds. The Saffir-Simpson scale is used to determine the values in Form M-1.

Relevant Forms: G-2, Meteorological Standards Expert Certification
M-1, Annual Occurrence Rates
A-2, Base Hurricane Storm Set Statewide Losses
S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year
S-3, Distributions of Stochastic Hurricane Parameters

Disclosures

1. *Provide a complete list of the assumptions used in creating the hurricane characteristic databases.*

No assumptions are made in developing these databases. The primary databases used are given in Table 7 below.

Table 7. Primary Databases

Database	Model Component	Public/Proprietary
Track, forward speed, storm angle from HURDAT2	Event Generation	Public
V_{max}, landfall, intensity from HURDAT2	Event Generation	Public
Smoothed coastline file with 62 landfall segments	Event Generation	Proprietary
Surface terrain characteristics (land use) from NLCD 2011	Wind Speed Generation	Public
ZIP Code centroid database	Wind Speed Generation	Proprietary
Rmax from Extended Best Track (EBT) and NOAA WSR88D RADAR data	Event Generation	Public
HRD dropsonde data for development of PWF and GWRF	Wind Speed Generation	Public

2. *Provide a brief rationale for the probability distributions used for all hurricane parameters and characteristics.*

A summary of the rationale for the probability distributions used for the hurricane parameters is provided in Form S-3 of the Statistical Standards on page 239.

M-4 Hurricane Windfield Structure*

*(*Significant Revision)*

A. Windfields generated by the model shall be consistent with observed historical storms affecting Florida.

The modeled windfield is consistent with the distribution of observed winds for historical storms affecting Florida.

B. The land use and land cover (LULC) database shall be consistent with National Land Cover Database (NLCD) 2011 or later. Use of alternate data sets shall be justified.

The land use and land cover database is consistent with National Land Cover Database (NLCD) 2011.

C. The translation of land use and land cover or other source information into a surface roughness distribution shall be consistent with current state-of-the-science and shall be implemented with appropriate geographic information system data.

The model uses the latest United States Geological Survey (USGS) National Land Cover Database 2011 (NLCD 2011) data as published in 2014 (Homer, et al., 2012, Jin, et al., 2013). Appropriate roughness lengths are assigned to each category based upon accepted scientific literature (Cook, 1985, Simiu and Scanlan, 1996, Grimmond and Oke, 1999, Grell et al., 1995, Chen and Dudhia, 2001, and Benjamin et al., 2002).

D. With respect to multi-story buildings, the model windfield shall account for the effects of the vertical variation of winds if not accounted for in the vulnerability functions.

The effect of vertical variation of winds is accounted for in the vulnerability functions.

Relevant Forms: G-2, Meteorological Standards Expert Certification
M-2, Maps of Maximum Winds
A-2, Base Hurricane Storm Set Statewide Losses

Disclosures

1. *Provide a rotational windspeed (y-axis) versus radius (x-axis) plot of the average or default symmetric wind profile used in the model and justify the choice of this wind profile.*

The windspeed radial profile is developed based on the radial variation of upper level winds as described in Willoughby et al. (2006). In this formulation, the profile was developed as a statistical fit to the observations, using reconnaissance data from 493 hurricanes during the 1977 to 2000 time period from flights in the Atlantic and Eastern Pacific basins. The profile is defined by three equations: one for the area inside the eyewall, one for the eyewall region, and one for the area outside the eyewall. Reasonable validation against observational data justifies the use of this wind profile. Figure 11 shows the wind profile for an average Florida storm.

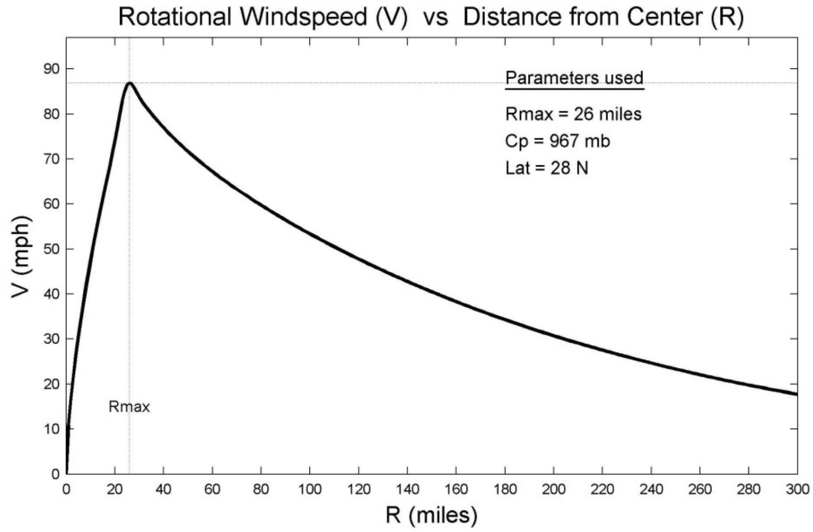


Figure 11. Symmetric Gradient Wind Profile
(Assuming Updated Florida Mean Values of Rmax, Cp and Latitude)

2. *If the model windfield has been modified in any way from the previous submission, provide a rotational windspeed (y-axis) versus radius (x-axis) plot of the average or default symmetric wind profile for both the new and old functions. The choice of average or default symmetric wind profile must be consistent for the new and old functions.*

The model windfield has not been modified since the previous submission.

3. *If the model windfield has been modified in any way from the previous submission, describe variations between the new and old windfield functions with reference to historical storms.*

The model windfield has not been modified since the previous submission.

4. *Describe how the vertical variation of winds is accounted for in the model where applicable. Document and justify any difference in the methodology for treating historical and stochastic storm sets.*

Vertical variability in boundary layer winds is accounted for implicitly in the use of a log-law profile for developing adjustment factors for friction and averaging time specific to a location’s surface roughness value. As discussed under Standard M-4.A above, the vulnerability module accounts for the effect of the vertical variation of winds through the development of vulnerability functions for structures with varying heights. There are no differences in the treatment of historical and stochastic storms.

5. *Describe the relevance of the formulation of gust factor(s) used in the model.*

The model uses a factor to convert 10-minute to 1-minute sustained wind. This conversion is based on accepted engineering relationships (Simiu and Scanlan, 1996, N. Cook, 1985, and ESDU Engineering Sciences Data, 1994) and varies from 1.12 to 1.26, as a function of land use land cover.

6. *Identify all non-meteorological variables (e.g., surface roughness, topography) that affect windspeed estimation.*

Surface roughness and averaging distance are non-meteorological variables that affect wind speed estimation. Topographic effects are not considered in the local wind estimation process.

7. *Provide the collection and publication dates of the land use and land cover data used in the model and justify their timeliness for Florida.*

The model uses the National Land Cover Database 2011 (NLCD 2011), which is the most recent national land cover product available from the Multi-Resolution Land Characteristics (MRLC) Consortium. The NLCD 2011 is a digital, satellite-derived land use/land cover database containing information collected in 2011. The hurricane model covers 30 states, including Florida, and therefore requires a consistent and unified U.S. LULC database. The dataset used in the model is the most recent national LULC data available.

8. *Describe the methodology used to convert land use and land cover information into a spatial distribution of roughness coefficients in Florida and neighboring states.*

The model uses the NLCD 2011 classifications by category and assigns appropriate roughness lengths based upon available scientific literature. These classifications are provided at 30-meter resolution, and are then resampled to 220 meters.

Local roughness factors are used to define an effective roughness for a given location. The effective roughness is the average surface roughness for an area out to an upstream radius of 6.2 miles (10 km) for the gust factor and 9.3 miles (15 km) for the friction factor. The effective roughness is representative of the mean land surface acting on the wind field (ESDU Engineering Sciences Data, 1994).

To define ZIP Code level properties, the values within a radius of 5-km of the population based ZIP Code centroid are averaged. This particular averaging radius was used to approximate the mean area for modeled ZIP Codes, 75 km^2, as determined via GIS analysis.

9. *Demonstrate the consistency of the spatial distribution of model-generated winds with observed windfields for hurricanes affecting Florida. Describe and justify the appropriateness of the databases used in the windfield validations.*

Spatial variability of winds across the footprint of a hurricane is a function of a variety of factors. These factors include (a) the radial profile of winds from eye to periphery, (b) the radius of maximum winds, (c) the forward speed, (d) the latitude, (e) the local surface roughness characteristics and (f) filling. Each of these factors is accounted for in the windfield formula and is therefore reflected in model-generated wind speeds. Figure 12 and Figure 13 demonstrate that the distribution of model-generated winds for two historical storms (Hurricanes Charley 2004 and Dennis 2005) is consistent with the distribution of observed winds.

This process is justified by using data from appropriate sources, including data from Tropical Cyclone Reports, standard METAR reports, and Texas Tech University. Additionally appropriate quality control procedures were applied to the data in order to flag any questionable observations. In some cases, such as observations at non-standard height or averaging time, adjustments were made using published techniques.

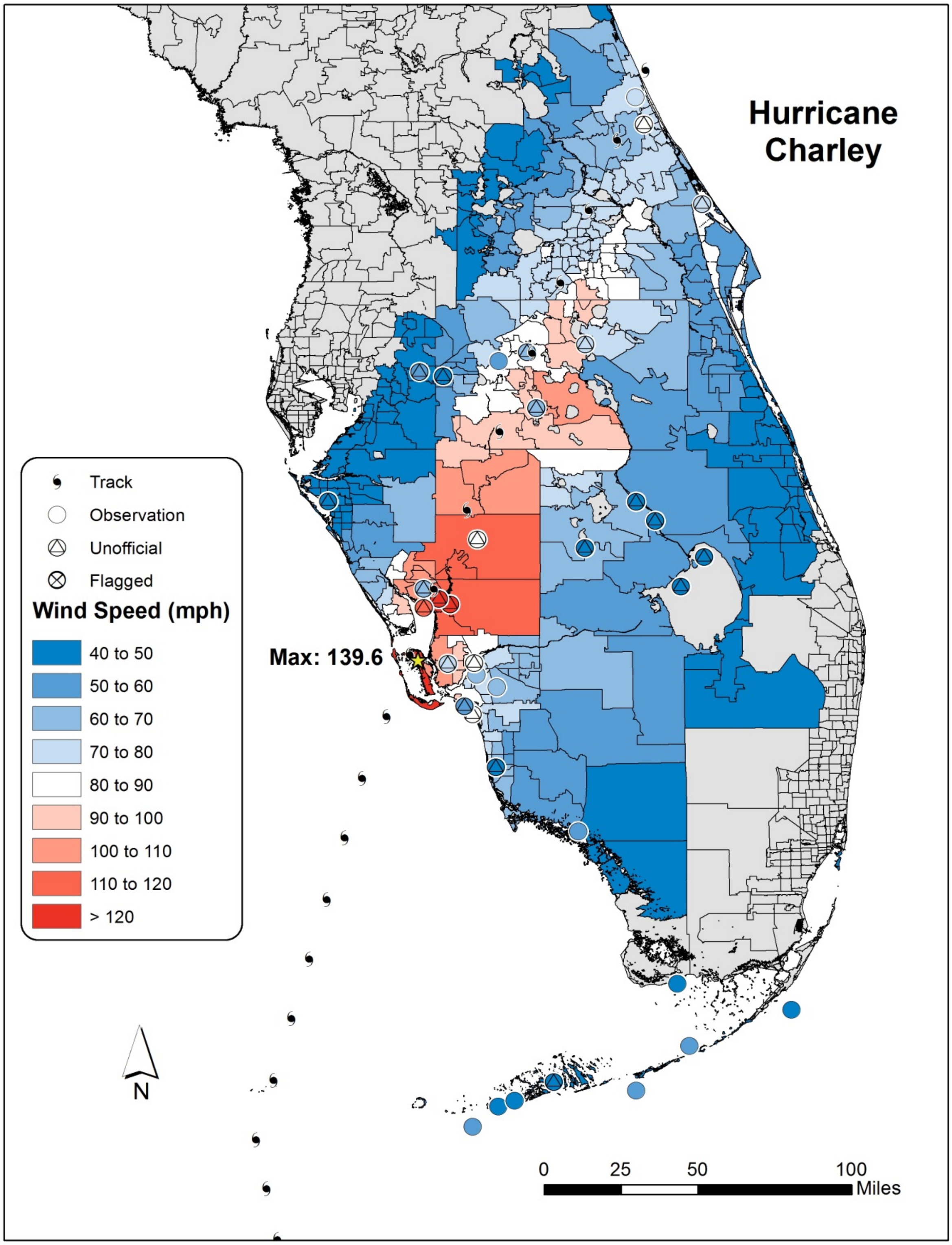


Figure 12. Observed and Modeled Wind Speeds, Hurricanes Charley (2004)

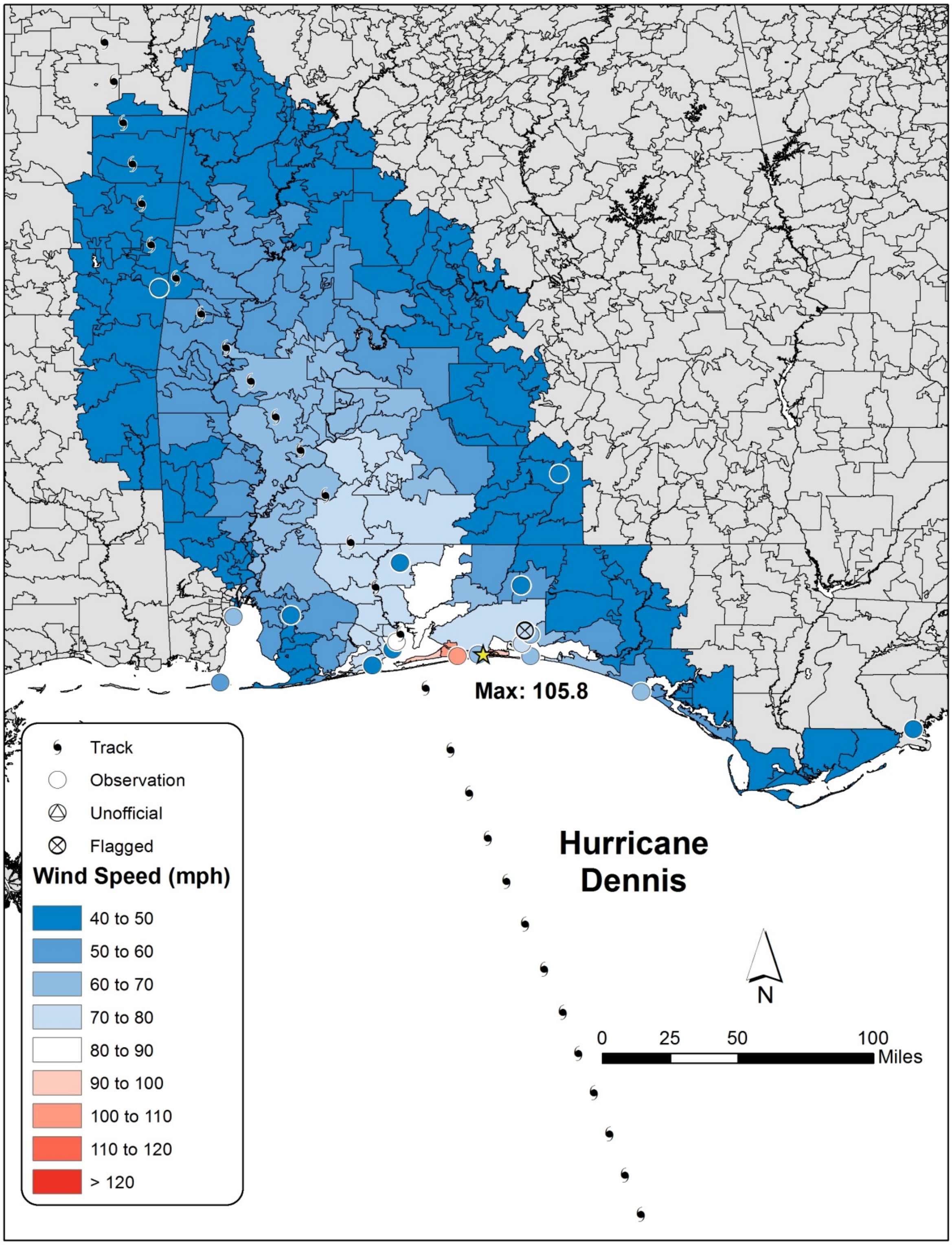


Figure 13. Observed and Modeled Wind Speeds, Hurricanes Dennis (2005)

10. *Describe how the model's windfield is consistent with the inherent differences in windfields for such diverse hurricanes as Hurricane King (1950), Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005).*

Historical data shows that tropical cyclones affecting Florida can be quite diverse. Sources of diversity in the windfields of Florida hurricanes include intensity at landfall, storm decay after landfall, forward speed and radius of maximum winds. The windfield model accounts for the response of hurricane winds to each of these parameters.

The landfalling hurricanes of 2004 and 2005 provide a good sample of diversity in these storm parameters. In these seasons, hurricane intensity spanned the spectrum from very intense (e.g., Charley 2004) to weak (e.g., Katrina 2005, Florida landfall). The rate of intensity decay after landfall (typically referred to as filling) in some storms was relatively slow (e.g., Wilma 2005) while in others it was rapid (e.g., Charley 2004). Forward speed varied from slow (e.g., Jeanne 2004) to fast (e.g., Wilma 2005, King 1950). And finally, the radius of maximum winds varied from small (e.g., Charley 2004, King 1950) to large (e.g., Wilma 2005).

Despite the diversity in these basic storm parameters, all of which relate directly to the windfield, the modeled wind speeds are realistic and unbiased. To better demonstrate this, we include below a comparison between modeled and observed winds for Charley (2004), Jeanne (2004) and Wilma (2005).

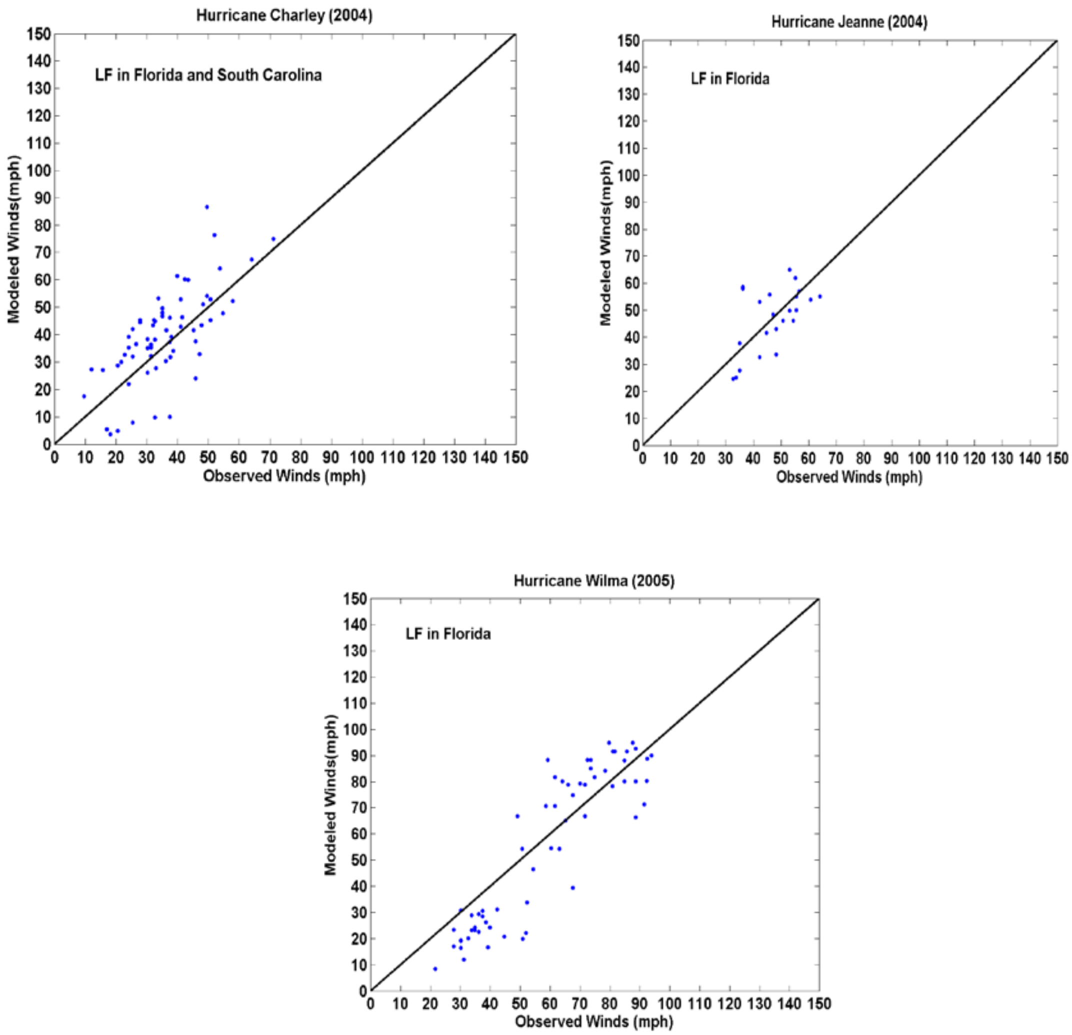


Figure 14. Scatter Plots of Modeled vs. Observed Winds for Hurricane Charley (2004), Jeanne (2004) and Wilma (2005)

11. *Describe any variations in the treatment of the model windfield for stochastic versus historical storms and justify this variation.*

The treatment of the model windfield does not vary between stochastic and historical storms.

12. *Provide a completed Form M-2, Maps of Maximum Winds. Explain the differences between the spatial distributions of maximum winds for open terrain and actual terrain for historical storms. Provide a link to the location of the form [insert hyperlink here].*

A completed Form M-2 can be found on page 224. The use of open versus actual terrain generally results in higher wind speeds in the open terrain cases due to the lower average friction relative to actual terrain. However, because the open terrain roughness is slightly higher than the values for water some exceptions do occur in areas adjacent to the coast. In these areas, replacing the water roughness value with that for open terrain results in decreased winds compared to the actual terrain case.

M-5 Landfall and Over-Land Weakening Methodologies

A. *The hurricane over-land weakening rate methodology used by the model shall be consistent with historical records and with current state-of-the-science.*

The model's over-land weakening rates, or filling rates, compare favorably with the historical records for storms of all intensities and are consistent with filling rate methodologies published in recent peer reviewed journals.

B. *The transition of winds from over-water to over-land within the model shall be consistent with current state-of-the-science.*

The transition of winds from over-water to over-land within the model is determined explicitly using local land cover information that varies by wind direction. The methodology used is based on established meteorological and engineering relationships for boundary layer winds. The methodology has been refined using the latest high-fidelity state-of-the-science wind data from recent research field projects.

Relevant Form: G-2, Meteorological Standards Expert Certification

Disclosures

1. *Describe and justify the functional form of hurricane decay rates used by the model.*

Once over land, the hurricane moves away from its source of energy, i.e., warm ocean water. As a result, the eye "fills" and the central pressure increases (winds degrade) with increasing time after landfall. The filling functions give the reduction in the pressure deficit (i.e. the difference between the central storm pressure and the pressure at the periphery of the storm) as a function of time since landfall. A faster forward speed will cause a hurricane to maintain its intensity further inland than a slow moving storm with the same initial intensity (pressure deficit).

The functional form of the pressure deficit decay function is:

$$\Delta P_t = P_p - P_{eye \cdot lf}\left(1 + LF_{offset} * t^{C_1} * \exp(-C_2 * t)\right)$$

where:

ΔP_t	= Pressure deficit at a given time after landfall
P_p	= Atmospheric pressure at the periphery of the storm
$P_{eye .lf}$	= Central pressure of the storm at landfall
LF_{offset}	= Initial reduction of the pressure deficit at landfall
T	= Time after landfall in hours
C_1	= Time shaping constant
C_2	= Exponential decay rate constant

Note that the function parameters vary by coastal region and smoothing algorithms are applied such that there is no sudden jump between regions.

This formulation is justified as it computes the necessary change in intensity parameter relevant to the model (i.e. change in central pressure as a function of time). The hurricane filling functions provide reliable weakening rates for the state of Florida and neighboring states and are consistent with inland decay functions, such as those developed by Kaplan and DeMaria (1995), further justifying their use.

Perturbations to the model's standard filling relationships are allowed to account for the low probability of tropical cyclones undergoing an episodic period of re-intensification after landfall. The implementation of such filling perturbations is motivated by the work of Bosart and Lackmann (1995), Hart and Evans (2001) and Arndt et al. (2009), and is based on observed historical storms. The procedure is only applied to storms which would likely undergo a transitioning phase and eventually reach 42° latitude. Within the state of Florida, such perturbations occur only in a very small number of stochastic events.

2. *Provide a graphical representation of the modeled decay rates for Florida hurricanes over time compared to wind observations.*

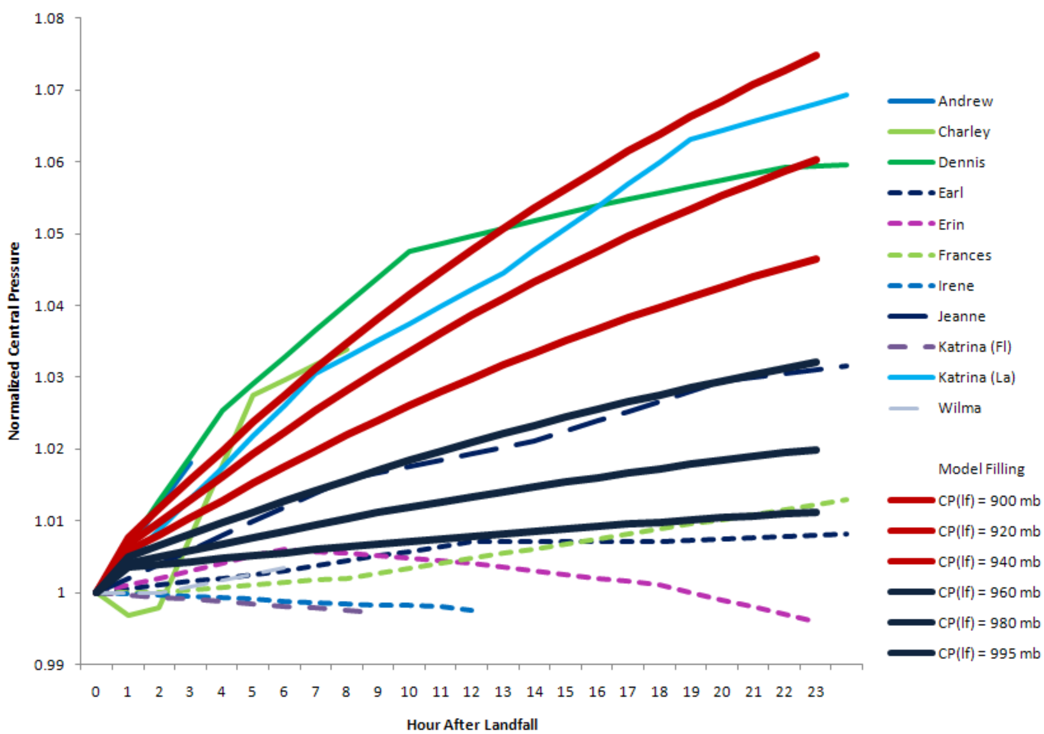


Figure 15. Modeled filling as a Function of Hour After Landfall for Weak (Blue) and Strong (Red) Hurricanes as Compared to Historical Florida Hurricanes

The model uses filling in terms of central pressure. Figure 15 shows the modeled filling as a normalized rate relative to the landfall central pressure at a range of storm intensities. The same plotting methodology was applied to central pressure for recent historical Florida events (1975-2005) for comparison.

3. *Describe the transition from over-water to over-land boundary layer simulated in the model.*

A hurricane travelling inland encounters different types of terrain, and the associated wind speeds will adjust to the new underlying surface. The distance over which this adjustment takes place is used to define an averaging distance. As the wind encounters the land surface, downwind of any large scale water body (e.g. ocean, Lake Okeechobee), a new boundary layer develops. The use of the averaging distance allows for a smooth and realistic transition at the boundary between these two surfaces. An adjustment is made to wind speeds modeled near the coast to account for the period before which over-water winds have settled to the underlying land surface. This adjustment is a function of the percentage of water within the directional averaging distance, as well as wind speed and is based on the work of Powell et al., (2003).

In addition, the direction of the wind at a given time is also considered. The wind direction at a given location is computed during each modeled wind computation time step, and the land characteristics upwind of the location are used in making the local wind adjustments.

4. *Describe any changes in hurricane parameters, other than intensity, resulting from the transition from over-water to over-land.*

The radial profile of the stochastically drawn gradient wind reduction factor is adjusted to account for the disruption of the hurricane due to landfall. Over a six-hour transition period starting three hours after landfall, the gradient wind adjustment factor along the profile converges to a constant value. For multiple landfalling storms, the radial profile is restored over water and allowed to decay again during subsequent landfalls.

5. *Describe the representation in the model of passage over non-continental U.S. land masses on hurricanes affecting Florida.*

The impact of any non-continental U.S. land masses on hurricanes affecting Florida is implicit in the historical data used to develop modeled storm parameters. Because of this, the impact of such land masses is inherently accounted for in all simulated storms.

6. *Describe any differences in the treatment of decay rates in the model for stochastic hurricanes compared to historical hurricanes affecting Florida.*

Historical hurricanes affecting Florida use the actual observed changes in central pressure as determined from historical data. Central pressure for Florida hurricane events in the stochastic model decay after landfall using the decay function discussed in Standard M-5, Disclosure 1.

M-6 Logical Relationships of Hurricane Characteristics

A. *The magnitude of asymmetry shall increase as the translation speed increases, all other factors held constant.*

The magnitude of asymmetry increases as the translation speed increases, all other factors held constant.

B. *The mean windspeed shall decrease with increasing surface roughness (friction), all other factors held constant.*

The mean windspeed decreases with increasing surface roughness (friction), all other factors held constant.

Relevant Forms: G-2, Meteorological Standards Expert Certification
M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds

Disclosures

1. *Describe how the asymmetric structure of hurricanes is represented in the model.*

The term that resolves the asymmetric structure of the hurricane is a function of the translation speed of the storm and the angle between the wind direction and the storm moving direction. This contribution (expressed as a wind in miles per hour) is *added* to the total wind associated with the storm.

2. *Provide a completed Form M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds. Provide a link to the location of the form [insert hyperlink here].*

A completed Form M-3 is provided on page 231.

3. *Discuss the radii values for each wind threshold in Form M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds, with reference to available hurricane observations such as those in HURDAT2. Justify the appropriateness of the databases used in the radii validations.*

Table 8. HURDAT2 Radii Values for Each Wind Threshold in Form M-3

Cp (mb)	Outer Radii > 73 mph (mi)			Outer Radii > 40 mph (mi)		
	Min	Max	Median	Min	Max	Median
990	2.88	86.31	11.51	17.26	345.23	100.69
980	5.75	73.36	20.14	37.40	414.28	138.09
970	7.19	123.71	28.77	51.79	483.33	140.97
960	11.51	123.71	43.87	57.54	460.31	176.93
950	11.51	96.38	51.79	76.24	460.31	159.67
940	21.58	109.32	59.70	83.43	477.57	163.99
930	23.02	94.94	64.01	86.31	241.66	176.93
920	33.08	86.31	51.79	122.27	187.00	150.32
910	60.42	94.94	77.68	143.85	201.39	179.81
900	57.54	92.06	74.80	189.88	197.07	193.47

The wind radii values in Form M-3 have been compared to data from the HURDAT2 dataset (see Table 8 above) for the 40 and 73 mph wind radii. Comparisons are generally favorable, particularly for hurricane force wind radii. The median extent of HURDAT2 hurricane force wind radii (73 mph) are consistent with modeled 2nd quartile values. Also, 1st and 3rd modeled quartile hurricane force wind radii fall within the HURDAT2 minimum and maximum ranges, except for the smallest and most intense storms. Median tropical storm force wind radii tend to be slightly lower in the model than the values stated in HURDAT2. No comparisons to the 110 mph wind radii are available since HURDAT2 does not provide these values.

Florida Commission on Hurricane Loss Projection Methodology

2015 Statistical Standards

S-1 Modeled Results and Goodness-of-Fit

A. *The use of historical data in developing the model shall be supported by rigorous methods published in currently accepted scientific literature.*

The historical data have been used to develop the probability distributions for key model variables such as annual hurricane frequency, landfall location, central pressure, radius of maximum winds, forward speed, and track direction. Where appropriate, spatial smoothing and meteorological adjustments have been used to overcome spatial gaps and other limitations caused by the relative scarcity of the historical data.

The probability distributions used for individual input variables include Negative Binomial for annual landfall frequency, Weibull for central pressure and Lognormal for forward speed. The parameters of these distributions have been estimated using the maximum likelihood method. The adequacy of the fit has been examined using established procedures such as the Kolmogorov-Smirnov and the Shapiro-Wilk tests. Graphical comparisons using quantile-quantile (Q-Q) plots and other procedures have also been performed to confirm the agreement between the historical data and the fitted probability distributions.

B. *Modeled and historical results shall reflect statistical agreement using currently accepted scientific and statistical methods for the academic disciplines appropriate for the various model components or characteristics.*

Agreement between modeled and historical hurricane characteristics is confirmed using widely accepted scientific and statistical methods. The simulated values have been carefully examined and determined to be reasonable based both on statistical and meteorological grounds.

Relevant Forms: G-3, Statistical Standards Expert Certification
M-1, Annual Occurrence Rates
S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year
S-2, Examples of Loss Exceedance Estimates
S-3, Distributions of Stochastic Hurricane Parameters
S-4, Validation Comparisons
S-5, Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled

Disclosures

1. *Provide a completed Form S-3, Distributions of Stochastic Hurricane Parameters. Identify the form of the probability distributions used for each function or variable, if applicable. Identify statistical techniques used for estimation and the specific goodness-of-fit tests applied along with the corresponding* p*-values. Describe whether the fitted distributions provide a reasonable agreement with the historical data. Provide a link to the location of the form [insert hyperlink here].*

A completed Form S-3 is provided on page 239.

Annual Frequency of Occurrence

Storm frequency is modeled using a Negative Binomial distribution fitted to the number of annual hurricane landfalls in the U.S. since 1900. An analysis of the historical data shows the variance in excess of the mean; therefore, choice of Negative Binomial to model landfall frequency is more appropriate than a Poisson distribution, which assumes equality in mean and variance. The Negative Binomial is also known as a gamma-Poisson mixture, with the assumption that the mean of the Poisson is continuous and follows a gamma distribution. These considerations, combined with goodness-of-fit results, justify the use of the Negative Binomial distribution.

The parameters of this probability distribution are estimated using the maximum likelihood method. The adequacy of the fit is examined graphically and tested using Pearson's chi-square goodness-of-fit test. The calculated value of the chi-square test statistic (2.03, with 3 degrees of freedom) is small and its associated p-value (0.56) indicates no lack of fit.

Landfall Location

The probability distribution for landfall location is based on the number of historical hurricane landfalls per approximately 50 nautical mile segment along the coast. Due to the relative scarcity of historical data at this spatial resolution the estimation involves smoothing of the historical frequencies as well as meteorological adjustments to arrive at credible landfall probabilities. The checks performed on the final landfall distribution include graphical and numerical comparisons of historical and simulated landfall frequencies as well as the Kolmogorov-Smirnov goodness-of-fit tests for annual frequency for landfall locations. The resulting p-value is 0.59, indicating no lack-of-fit.

Central Pressure

The probability distribution for central pressure is a Weibull distribution with the shape and scale parameters estimated for each 100-mile coastline segment. The distributions of the historical data on central pressure are typically skewed since very intense hurricanes are less frequent than weak hurricanes. The two-parameter Weibull distribution has a very flexible shape and is able to capture the skewness present in the historical data on central pressure.

The maximum likelihood method is used for the parameter estimation. A second calculation combines the data for six larger regions and computes Weibull parameter estimates for each of these regions. The final probability distribution used for each segment is a mixture of the segment and regional Weibull distributions.

The adequacy of the segment and regional Weibull distributions is tested using the Kolmogorov-Smirnov goodness-of-fit test. The empirical and fitted probability distributions are also compared using Q-Q plots and other graphical methods. In addition, the historical and simulated central pressure distributions are compared graphically for each 100-mile coastal segment. The various checks performed, along with associated p-values, confirm that the fitted distributions provide a reasonable approximation for central pressure. An example of examination for goodness-of-fit about the probability distribution for central pressure can be seen in Figure 21. For Florida and adjacent states, the p-value from the Kolmogorov-Smirnov goodness-of-fit test for the historical and simulated central pressure distributions is 0.89, indicating no lack-of-fit.

Radius of Maximum Winds

For each simulated hurricane, the radius of maximum winds is simulated from a regression model that relates the radius to central pressure and latitude. The error term in this model is assumed to follow a Normal distribution. The parameters are estimated using least squares and standard residual checks are performed to determine the adequacy of the fitted model. The resulting values are bounded based on central pressure to produce a final distribution for the radius. The consistency between historical and simulated values is demonstrated using scatter diagrams, as well as segment-by-segment comparisons of observed and simulated values. For Florida and adjacent states, the p-value from the Kolmogorov-Smirnov goodness-of-fit test for the historical and simulated radius of maximum winds distributions is 0.35, indicating no lack-of-fit.

Forward Speed

Forward speed is generated from a Lognormal distribution with parameters estimated for each 100-mile segment. The parameters are estimated using the maximum likelihood method by computing the mean and variance of the log-transformed data. The adequacy of the fit is again tested using the Shapiro-Wilk goodness-of-fit test and by comparing the empirical and fitted cumulative distribution functions. Q-Q plots were also constructed. In addition, the historical and simulated values are compared graphically for each 100-mile coastal segment. The checks performed, including the examination of p-values, indicate no lack-of-fit and suggest that the lognormal distribution provides a reasonable probability distribution for forward speed. For Florida and adjacent states, the p-value from the Kolmogorov-Smirnov goodness-of-fit test for the historical and simulated forward speed distributions is 0.40, indicating no lack-of-fit.

Storm Heading at Landfall

Landfall angle is measured clockwise (+) or counterclockwise (-) with 0 representing due North. Separate distributions for storm heading at landfall are estimated for each 50–nautical-mile segment of coastline. Storm heading is modeled as combined Normal distributions, and bounded based on the historical record, geographical constraints and meteorological expertise. Diagnostic checks show a reasonable agreement between historical and modeled values. For Florida and adjacent states, the p-value from the Kolmogorov-Smirnov goodness-of-fit test for the historical and simulated storm heading at landfall distributions is 0.66, indicating no lack-of-fit.

Gradient Wind Reduction Factor

The gradient wind reduction factor is modeled using a Normal distribution with parameters estimated from data derived using the regression equation from Powell et al. (2009), with input based on HURDAT data. The adequacy of the fit is tested using the Shapiro-Wilks and Shapiro-Francia goodness-of-fit tests for normality which have p-values of 0.13 and 0.25, respectively. Graphs of the empirical distribution functions and Q-Q plot confirm the adequacy of the fit.

Peak Weighting Factor

The probability distribution of the PWF can be approximated by a Normal distribution applied to an inverse power transformation of PWF. The adequacy of the normal approximation is confirmed by the Shapiro-Wilks and Shapiro-Francia goodness-of-fit tests which have p-values of 0.07 and 0.15, respectively. Graphs of the empirical distribution functions and Q-Q plot confirm the fit. A moderate correlation between GWRF and PWF is incorporated using a bivariate Normal distribution.

Storm Tracks

AIR’s storm track generation procedure is based on the historical storm tracks in the HURDAT database. The track information in this database is available at six-hour time intervals. A time series analysis was performed to determine appropriate models for the dependence present in key model variables from one time period to the next. This included an examination of the autocorrelation function of the original and differenced data corresponding to each model variable.

This analysis showed that a random walk with drift is appropriate for the track direction. A first-order autoregressive model is appropriate for forward speed, while a second-order autoregressive model is required to adequately represent central pressure along the track. To capture the spatial variability in the storm characteristics across the Atlantic basin, the parameters in these models were estimated by binning the data into grids that captured the spatial variation. Diagnostic checks on the model included grid-by-grid comparisons of the historical and simulated storm frequencies and intensity distributions across the basin.

Physical Damage

The vulnerability functions developed by AIR are based on published structural engineering research, wind engineering principles, damage surveys conducted by wind engineering experts and analysis of actual loss data. Over the years, AIR has compiled an extensive database of claims data from clients with large portfolios for historical hurricanes affecting various regions along the coast. Validation has been performed by comparing simulated and actual loss data by state, county, ZIP Code, and by line of business.

2. Describe the nature and results of the tests performed to validate the windspeeds generated.

Extensive comparisons have been performed between model generated wind speeds and observations to check for spatial extent of the winds and their magnitude. Observational data have been gathered from NHC's Tropical Cyclone Reports as well as other data sources, like HURDAT2, dropsonde data, Texas Tech high-resolution data, and various published reports for 36 historical storms (11 Florida storms). Comparisons performed include scatter plots of model winds versus observed winds, wind distribution against distance from the eye and storm model footprint (hourly or over storm lifetime) versus point wind observations, h*Wind data (Landsea et al., 2004; Powell et al., 1998) or Extended Best Track significant wind radii (Demuth et al., 2006). Mean statistics were computed for wind differences over all amplitudes or at different wind bands. Below in Table 9 we include a set of validation tests performed for Hurricane Andrew (1992).

Table 9. Validation Tests Performed for Hurricane Andrew (1992)

Storm	Sample Size	ExplVar (%)	Correlation	MBE (mph)
Andrew	31	82.81	0.91	5.40

where MBE = Mean Bias Error = Mean(ModelWind) - Mean(ObsWind)

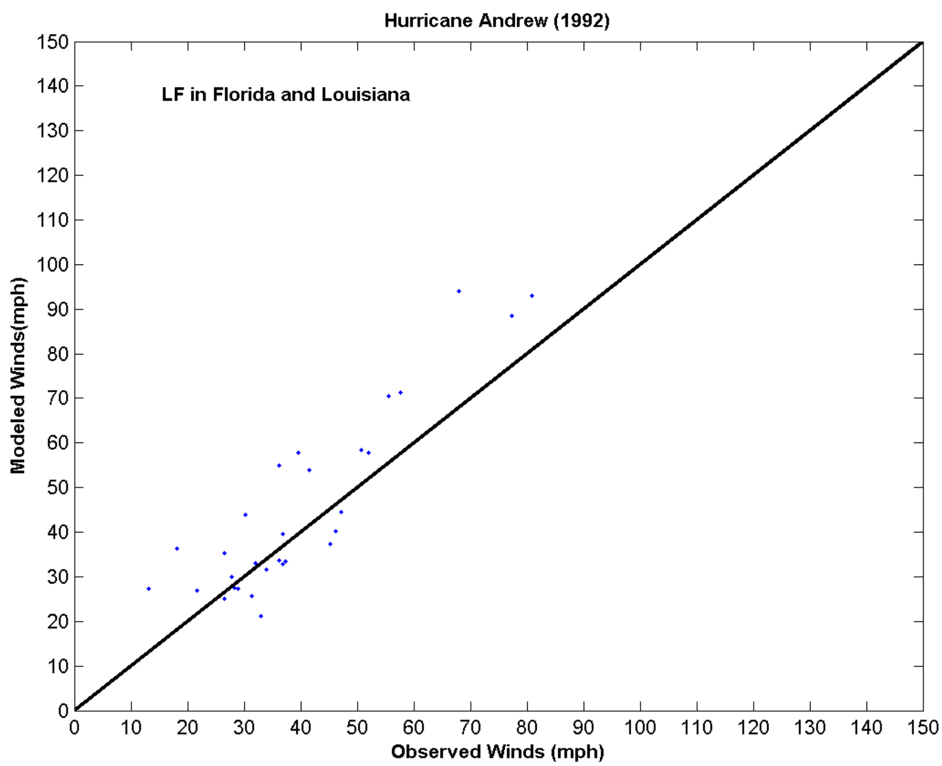


Figure 16. Modeled Versus Observed Surface Winds for Hurricane Andrew (1992)

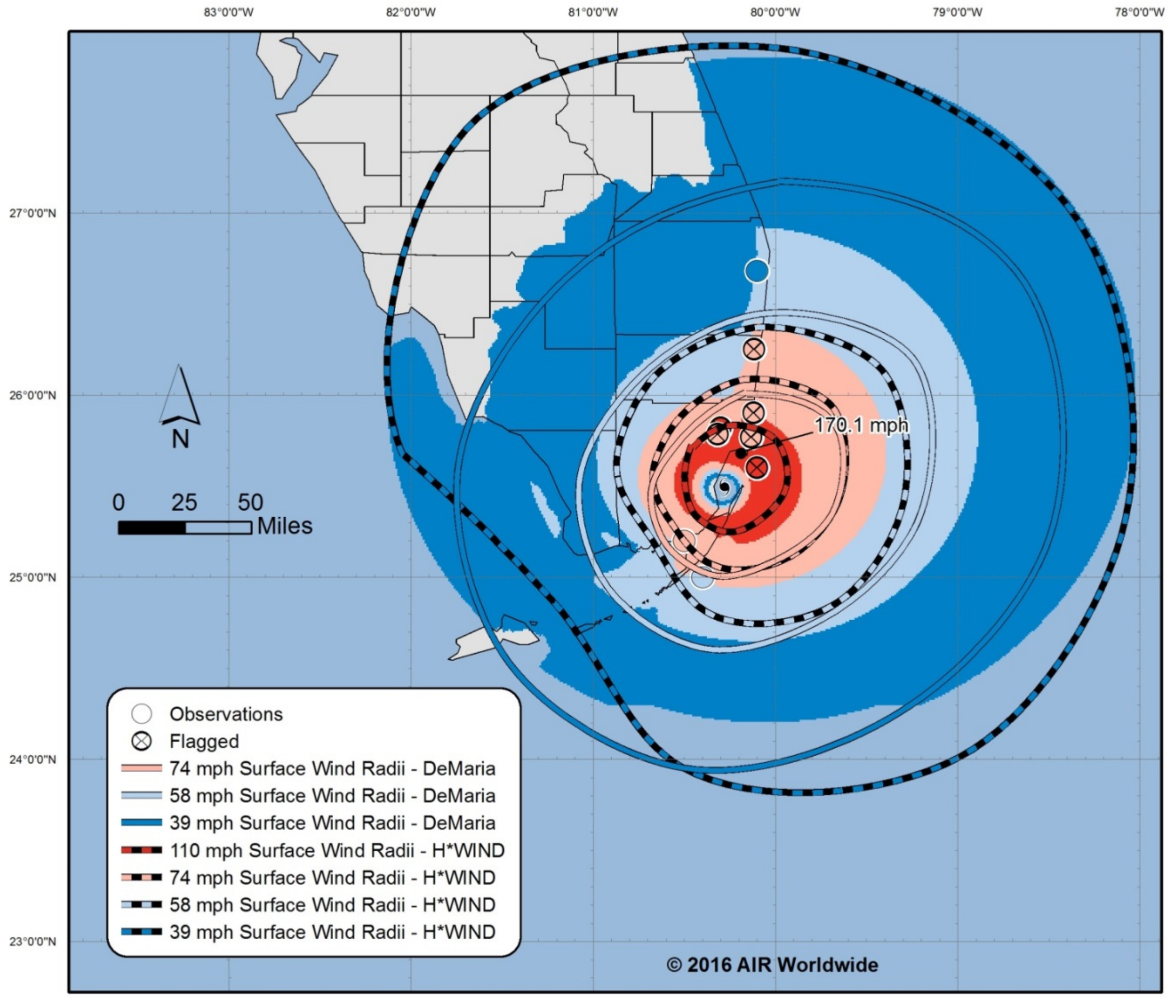


Figure 17. Snapshot of Hurricane Andrew's Footprint at Landfall (Colors). Overlaid are Observed Wind Radii (Contours) Derived From DeMaria and H*wind, Along With Station Wind Observations (Colored Circles)

The minimum wind speed has not been included in Figure 17 and Figure 18. The wind footprints shown on the maps have a minimum wind speed of 40 mph.

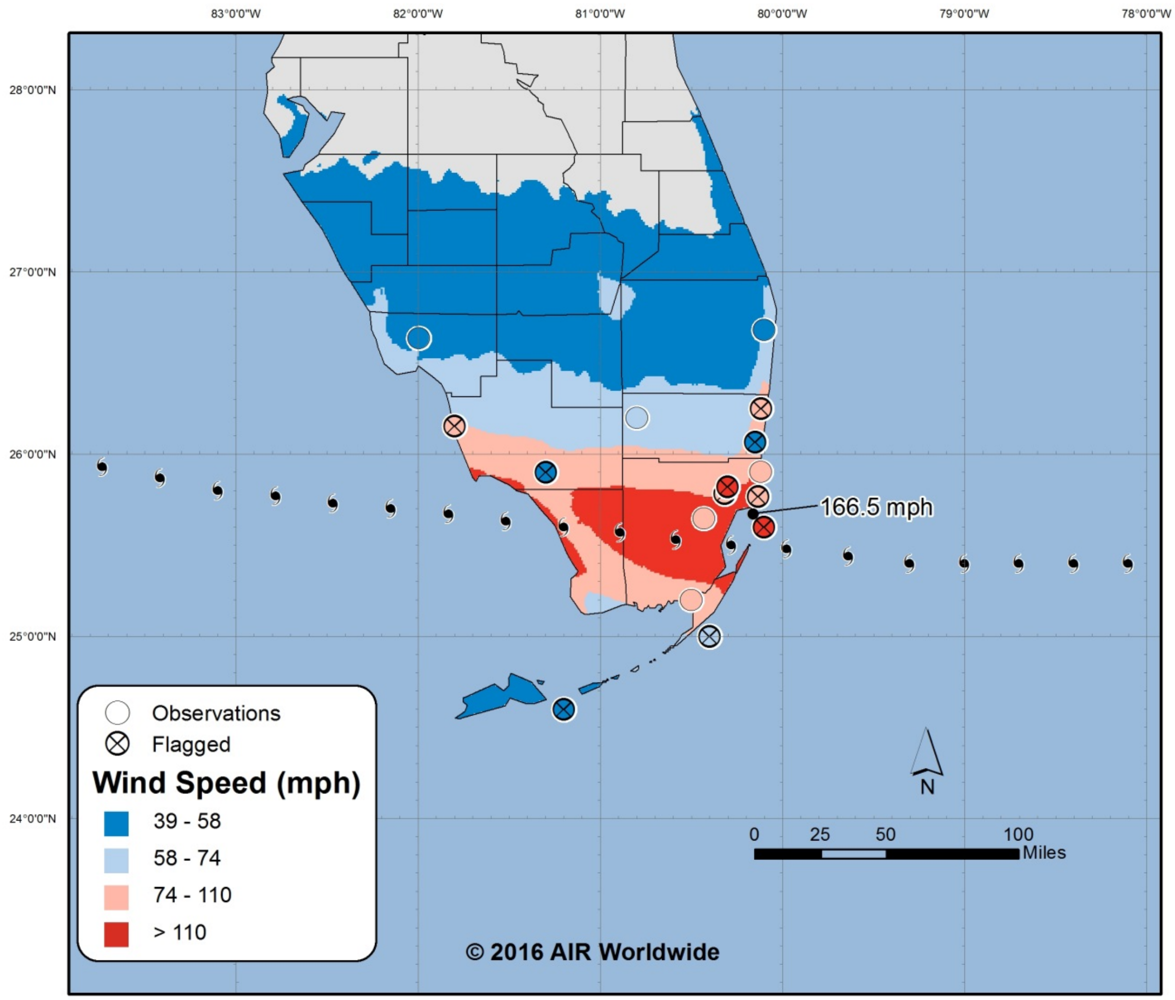


Figure 18. Hurricane Andrew's Maximum Wind Footprint (Colors) Overlaid With Station Wind

3. *Provide the date of loss of the insurance claims data used for validation and verification of the model.*

AIR has actual insurance company loss data for the following storms: Hurricanes Hugo (1989), Bob (1991), Andrew (1992), Erin (1995), Opal (1995), Bertha (1996), Fran (1996), Bonnie (1998), Earl (1998), Frances (1998), Georges (1998), Floyd (1999), Irene (1999), Georges (2001), Charley (2004), Ivan (2004), Frances (2004), Jeanne (2004), Dennis (2005), Rita (2005), Wilma (2005), Katrina (2005), Ike (2008), Irene (2011), and Sandy (2012).

4. *Provide an assessment of uncertainty in probable maximum loss levels and loss costs for output ranges using confidence intervals or other accepted scientific characterizations of uncertainty.*

Past studies conducted by AIR have examined the contribution of model parameters such as central pressure, forward speed, radius of maximum winds and the gradient wind reduction factor to the uncertainty in estimated loss costs and probable maximum loss levels (referred to hereafter in this disclosure as simply “loss costs”). These studies have shown that the gradient wind reduction factor is a large contributor to the uncertainty in the loss costs.

This finding is supported by the results from the Form S-6 analysis performed as part of our 2010 submission. Additional loss runs have been performed to assess the contribution of this factor to the uncertainty in the county-level loss costs. For example, eliminating the stochastic variability and setting its value equal to the distribution mean reduced the estimated losses by approximately 20 percent statewide. A significant reduction in the variance of the loss costs was also observed for most of the counties. By comparison, eliminating the variability in the peak weighting factor did not have a significant impact on the estimated loss costs.

5. *Justify any differences between the historical and modeled results using current accepted scientific and statistical methods in the appropriate disciplines.*

The historical results are based on a sample of 115 years of hurricane experience. Because of sampling variability and other sources of uncertainty, one would not expect an exact agreement between historical and modeled results. However, goodness-of-fit statistics and other measures show a reasonable agreement between historical and modeled results.

6. *Provide graphical comparisons of modeled and historical data and goodness-of-fit tests. Examples include hurricane frequencies, tracks, intensities, and physical damage.*

Annual Landfall Frequency

Figure 19 compares the historical distribution of annual U.S. landfalls to a fitted Negative Binomial distribution. As can be seen, the agreement between the two distributions is quite close and shows no evidence of lack of fit. The calculated value of the Chi-square statistic is 2.03, which for 3 degrees of freedom gives a p-value of 0.56.

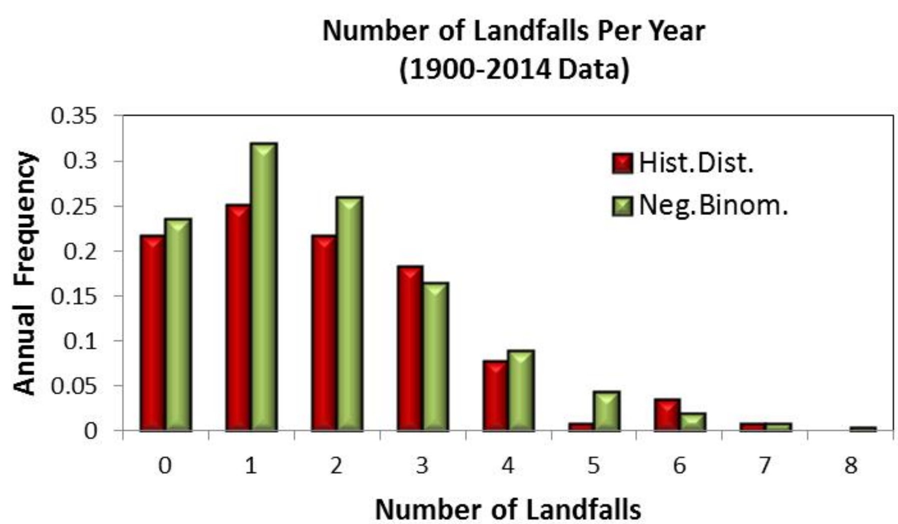


Figure 19. Historical and Modeled U.S. Annual Landfall Probability Distributions

Hurricane Tracks

The maps in Figure 20 compare the tracks of historical and randomly sampled simulated hurricanes making landfall in a 50-mile coastal segment in Southeast Florida. The overall behavior of the historical and simulated tracks is similar.

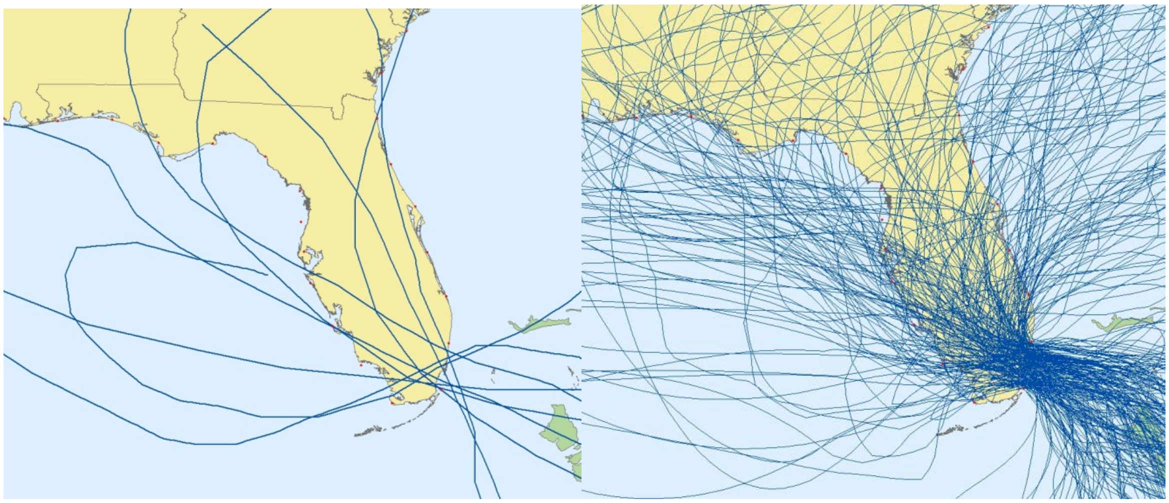
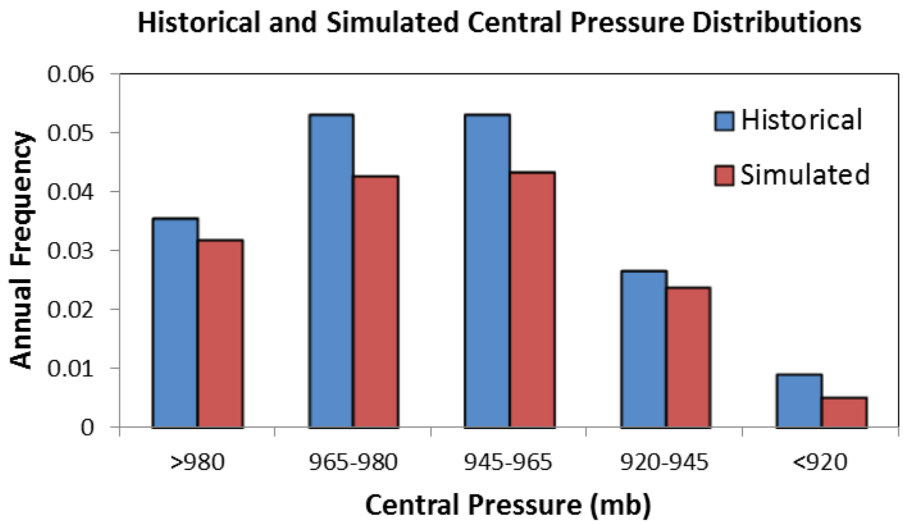


Figure 20. Historical (left) and Simulated (Right) Hurricanes Landfalling in SE Florida

Intensities

Figure 21 compares the historical and simulated central pressure distributions for a 100-mile segment in Southeast Florida. The simulated frequencies are based on Weibull distributions fitted to the historical data. Goodness-of-fit summaries are included to illustrate some of the statistical tests that were performed for this variable.



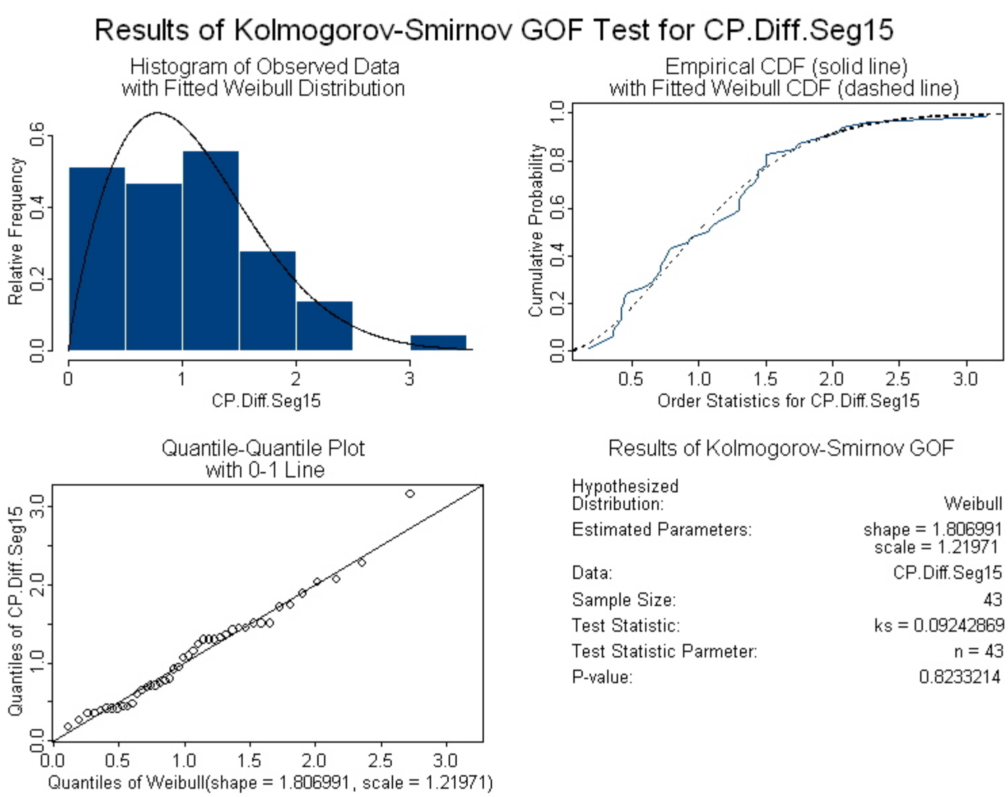


Figure 21. Goodness-of-Fit Comparisons for a 100-Mile Florida Segment

Physical Damage

Figure 22 shows historical and simulated damage ratios versus wind speed for Coverage A based on ZIP Code level data. Each observation refers to an individual ZIP Code. The agreement between the historical and simulated damage ratios is reasonable. This is confirmed by a paired two-sample t-test on the means, which has a p-value of 0.32.

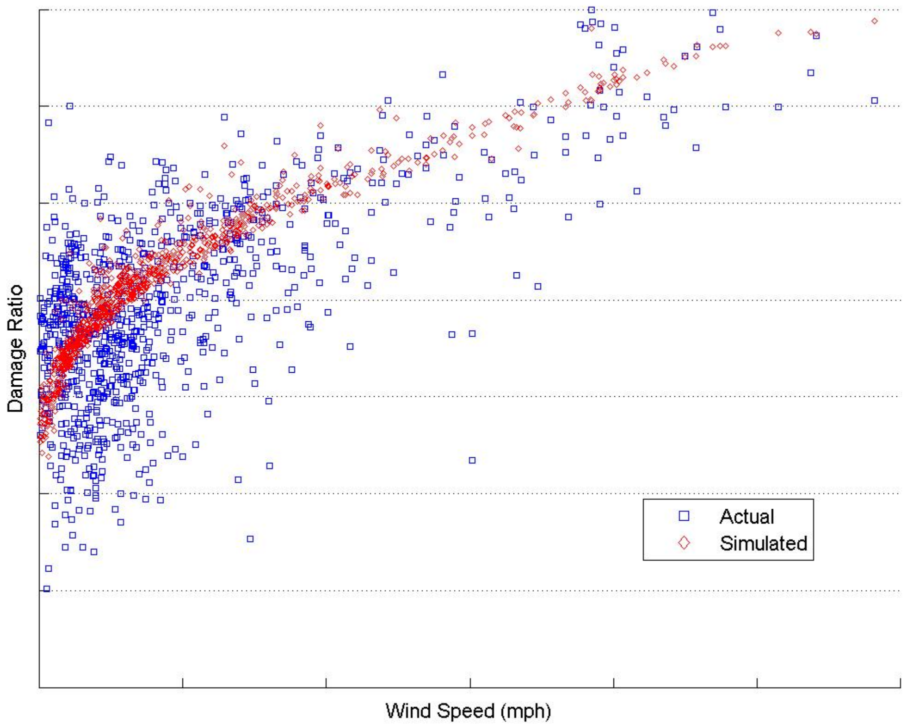


Figure 22. Sample Damage Ratio Comparison

7. *Provide a completed Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year. Provide a link to the location of the form [insert hyperlink here].*

A completed Form S-1 is provided on page 236.

8. *Provide a completed Form S-2, Examples of Loss Exceedance Estimates. Provide a link to the location of the form [insert hyperlink here].*

A completed Form_S-2 is provided on page 237.

S-2 Sensitivity Analysis for Model Output

The modeling organization shall have assessed the sensitivity of temporal and spatial outputs with respect to the simultaneous variation of input variables using currently accepted scientific and statistical methods in the appropriate disciplines and shall have taken appropriate action.

AIR has assessed the sensitivity of temporal and spatial outputs with respect to the simultaneous variation of input variables using currently accepted scientific and statistical methods and has taken appropriate action.

Relevant Forms: G-3, Statistical Standards Expert Certification
S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis

Disclosures

1. *Identify the most sensitive aspect of the model and the basis for making this determination.*

The most sensitive aspects of the model include the gradient wind reduction factor, far field pressure and central pressure. Variation in these parameters can have a large impact on the modeled wind speeds and the resulting losses. This determination is based on past studies conducted by AIR, as well as the Form S-6 analysis performed as part of our submission under the 2009 Standards.

The Form S-6 analysis included six model parameters: central pressure, radius of maximum winds, forward speed, far field pressure, gradient wind reduction factor, and peak weighting factor. The sensitivity analysis for loss costs uses standardized regression coefficients associated with all six input parameters for Category 1, 3, and 5 hurricanes. The results showed that the gradient wind reduction factor has the most influence on the magnitude of the loss costs across all hurricane categories. For Category 1 hurricanes, far field pressure and central pressure have the second and third most influence on the magnitude of the lost costs. However, as the storm category increases the influence of central pressure and far field pressure decreases. The influence of Rmax increases with category and is the second most sensitive parameter for Category 3 and 5 hurricanes.

An analysis of the temporal sensitivities of the loss costs was not performed since the model does not output the loss costs by hour. However, the sensitivities of wind speeds both spatially and temporally were studied using the hypothetical storms in Form S-6.

Figure 23 to Figure 25 show the standardized regression coefficients vs time for Category 1, 3, and 5 hurricanes at landfall. At hour 0, immediately before landfall, modeled wind speeds at the landfall location are most sensitive to the gradient wind reduction factor, followed by Rmax for Category 1 hurricanes. For Category 3 and 5 hurricanes, modeled wind speeds are most sensitive to Rmax, followed by the gradient wind reduction factor.

As noted above, the results presented here refer to wind speeds at the landfall location. However, the sensitivities are location dependent and can vary greatly depending on the specific location selected.

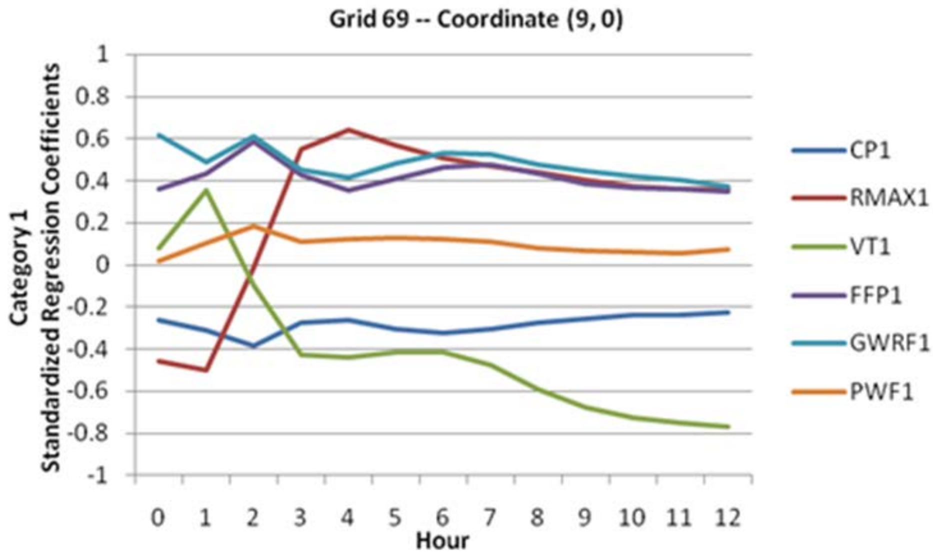


Figure 23. Standardized Regression Coefficients vs. Time at Grid Coordinates (9,0) For Category 1

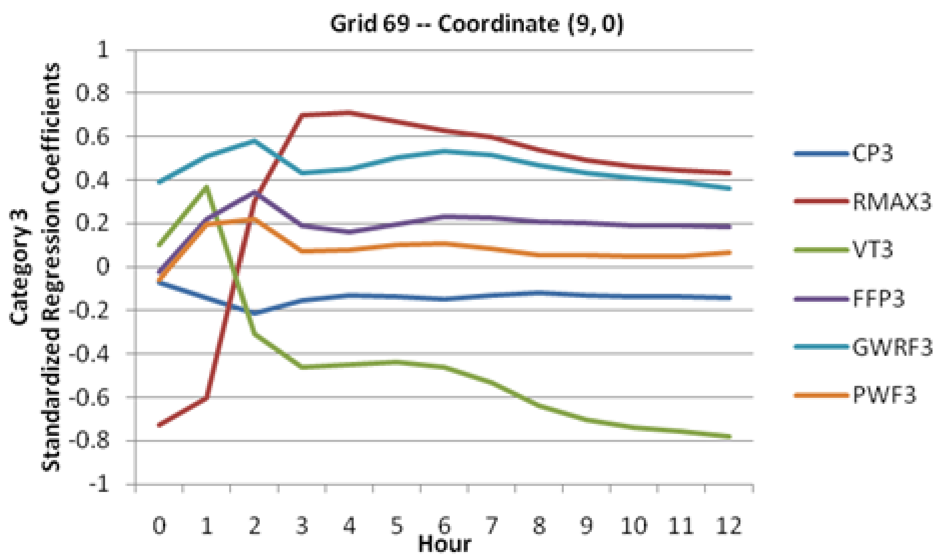


Figure 24. Standardized Regression Coefficients vs. Time at Grid Coordinates (9,0) for Category 3

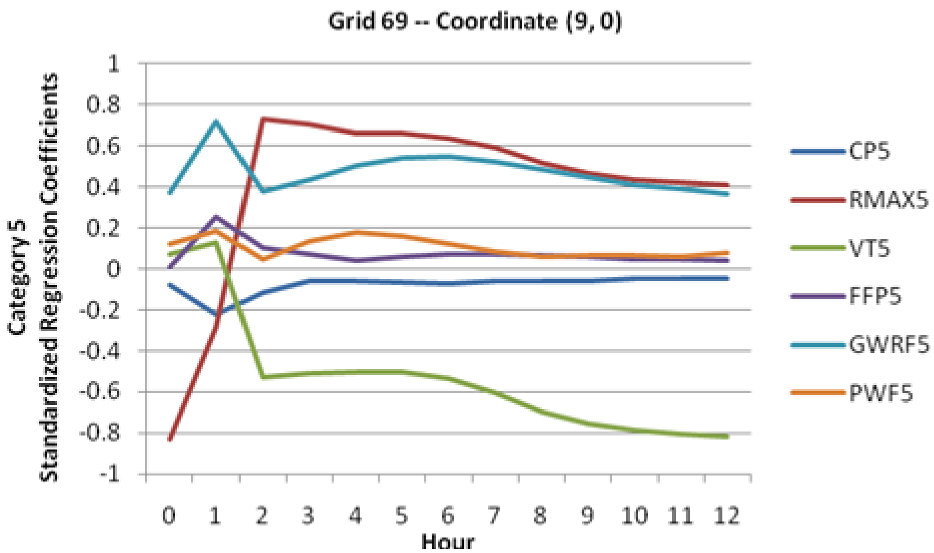


Figure 25. Standardized Regression Coefficients vs. Time at Grid Coordinates (9,0) for Category 5

2. *Identify other input variables that impact the magnitude of the output when the input variables are varied simultaneously. Describe the degree to which these sensitivities affect output results and illustrate with an example.*

No other input variables are identified that impact the magnitude of the output when the input variables are varied simultaneously.

3. *Describe how other aspects of the model may have a significant impact on the sensitivities in output results and the basis for making this determination.*

The modeled loss costs can be sensitive to assumptions about annual landfall frequency as well as landfall location. This is illustrated by studies conducted by AIR to assess the relationship between sea surface temperatures (SST) and hurricane frequency in different coastal regions.

4. *Describe and justify action or inaction as a result of the sensitivity analyses performed.*

The results of the sensitivity analysis have been carefully reviewed and found to be reasonable. No specific action was taken after reviewing the results. However, results from the sensitivity studies performed provide valuable insight into the effects of changing the probability distributions of individual input parameters on modeled wind speeds and lost costs.

5. *Provide a completed Form S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis. (Requirement for models submitted by modeling organizations which have not previously provided the Commission with this analysis. For models previously found acceptable, the Commission will determine, at the meeting to review modeling organization submissions, if an existing modeling organization will be required to provide Form S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis, prior to the Professional Team on-site review). If applicable, provide a link to the location of the form [insert hyperlink here].*

Form S-6 was submitted as a requirement under the 2009 Standards. The results are unchanged.

S-3 Uncertainty Analysis for Model Output

The modeling organization shall have performed an uncertainty analysis on the temporal and spatial outputs of the model using currently accepted scientific and statistical methods in the appropriate disciplines and shall have taken appropriate action. The analysis shall identify and quantify the extent that input variables impact the uncertainty in model output as the input variables are simultaneously varied.

AIR has performed an uncertainty analysis on the temporal and spatial outputs of the model using currently accepted scientific and statistical methods and has taken appropriate action. Our analysis has identified and quantified the extent that input variables impact the uncertainty in model output as input variables are simultaneously varied.

Relevant Forms: G-3, Statistical Standards Expert Certification
S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis

Disclosures

1. *Identify the major contributors to the uncertainty in model outputs and the basis for making this determination. Provide a full discussion of the degree to which these uncertainties affect output results and illustrate with an example.*

The gradient wind reduction factor is a major contributor to the uncertainty in modeled wind speeds as well as loss costs. Far field pressure and central pressure also contribute to uncertainty in loss costs. This determination is based on past studies conducted by AIR, as well as the Form S-6 analysis performed as part of our submission under the 2009 Standards.

The uncertainty analysis performed in Form S-6 showed that the gradient wind reduction factor makes the largest contribution to the uncertainty in loss cost for all categories of hurricanes. For Category 1 hurricanes, far field pressure makes the second largest contribution followed by central pressure, and then Rmax. The contribution of Rmax increases as the storm intensity increases. The peak weighting factor and forward speed, on the other hand, do not make significant contributions to the uncertainty in the loss costs for any of the categories.

The hypothetical storms in Form S-6 were also used to study the uncertainties associated with the spatial distribution and temporal variation of wind speeds. Some results from this analysis are given in Figure 26 to Figure 28, which show the relative influence of different input parameters by hour for Category 1, 3, and 5 hurricanes on wind speeds at the landfall location. At hour 0, immediately before landfall, modeled wind speeds are most influenced by Rmax. At hours 1 and 2, when the landfall location tends to be within the eye wall for the weaker hurricanes, the gradient wind reduction factor dominates while Rmax again becomes important during subsequent hours. For Category 5 hurricanes, which have a smaller Rmax, the contribution of Rmax drops significantly at hour 1 before increasing again at hour 2. As expected, forward speed is an important contributor to uncertainty in wind speeds at the landfall location at later hours when the storms are farther away from the landfall point. All the uncertainties are location dependent and can vary greatly depending on the specific location considered.

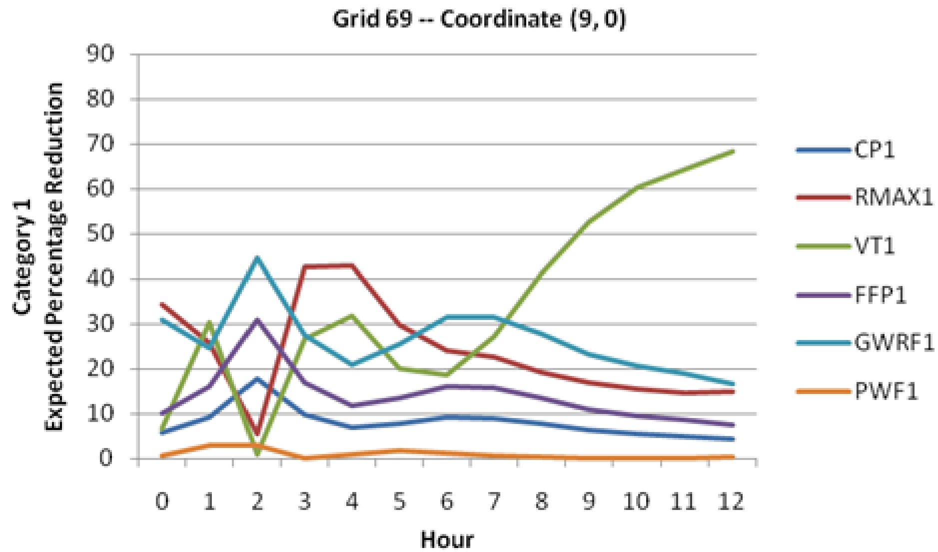


Figure 26. Expected Percentage Reduction vs. Time at Grid Coordinates (9,0) for Category 1

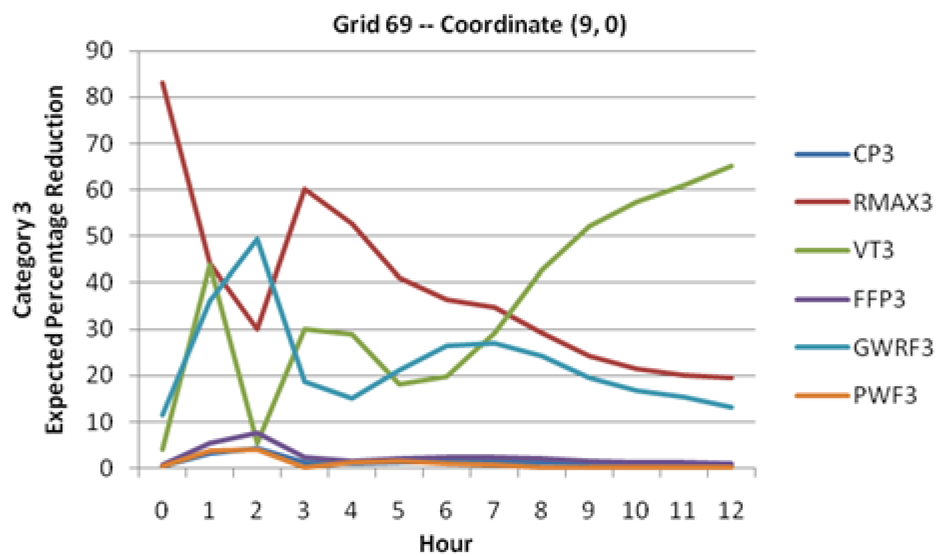


Figure 27. Expected Percentage Reduction vs. Time at Grid Coordinates (9,0) for Category 3

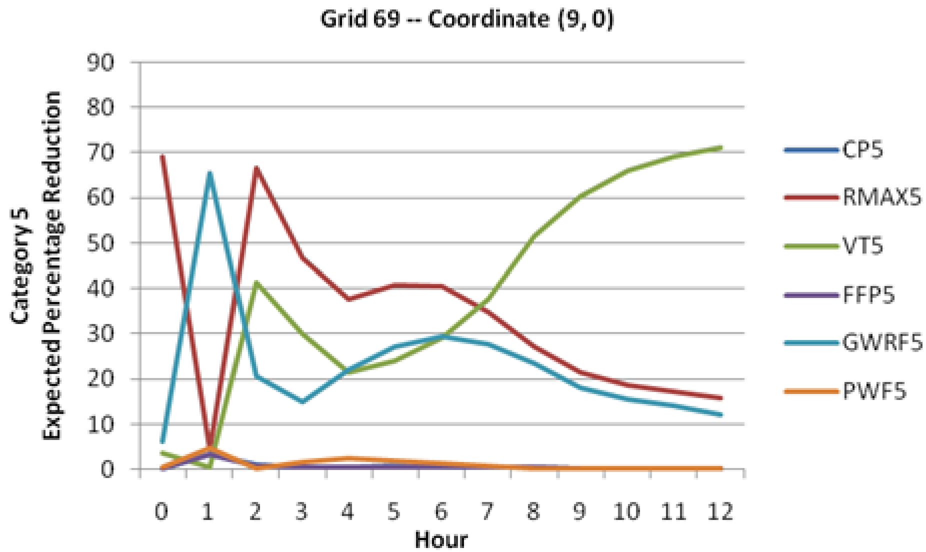


Figure 28. Expected Percentage Reduction vs. Time at Grid Coordinates (9,0) for Category 5

2. *Describe how other aspects of the model may have a significant impact on the uncertainties in output results and the basis for making this determination.*

Our work on the relationship between SST and the frequency and intensity of landfalling storms confirms earlier findings that frequency and intensity have a significant impact on the uncertainty in modeled losses.

3. *Describe and justify action or inaction as a result of the uncertainty analyses performed.*

Past studies performed by AIR have shown that the gradient wind reduction factor is a major contributor to uncertainty in loss costs. These results were considered in the implementation of this parameter in the current version of the model.

4. *Form S-6, Hypothetical Events for Sensitivity and Uncertainty Analysis, if disclosed under Standard S-2, Sensitivity Analysis for Model Output, will be used in the verification of Standard S-3, Uncertainty Analysis for Model Output.*

Form S-6 was submitted as a requirement under the 2009 Standards. The results are unchanged.

S-4 County Level Aggregation

At the county level of aggregation, the contribution to the error in loss cost estimates attributable to the sampling process shall be negligible.

Convergence graphs and inspection of the loss costs for increasing sample sizes indicate the sampling error is negligible for the 50,000-year simulation used to generate the loss costs.

Relevant Form: G-3, Statistical Standards Expert Certification

Disclosure

1. *Describe the sampling plan used to obtain the average annual loss costs and output ranges. For a direct Monte Carlo simulation, indicate steps taken to determine sample size. For an importance sampling design or other sampling scheme, describe the underpinnings of the design and how it achieves the required performance.*

AIR uses constrained Monte Carlo simulation to obtain the average annual loss costs and output ranges. The constrained Monte Carlo method used is designed to expedite convergence and reduce the sampling error in the loss cost estimates. This ensures that the probability distributions for annual landfall frequency, landfall location, and landfall intensity agree with the true underlying probability distributions as closely as possible in a 50,000-year simulation. Convergence tests applied to the resulting loss costs show that the sampling errors in the loss costs are negligible.

S-5 Replication of Known Hurricane Losses

The model shall estimate incurred losses in an unbiased manner on a sufficient body of past hurricane events from more than one company, including the most current data available to the modeling organization. This standard applies separately to personal residential and, to the extent data are available, to commercial residential. Personal residential loss experience may be used to replicate structure-only and contents-only losses. The replications shall be produced on an objective body of loss data by county or an appropriate level of geographic detail and shall include loss data from both 2004 and 2005.

Losses generated by the model's simulation of past hurricane events reasonably replicate actual incurred losses from those events. This is true for both personal residential of various construction types and for manufactured homes, as well as for various coverages. County-level comparisons also show reasonable agreement between modeled and incurred losses.

Relevant Forms: G-3, Statistical Standards Expert Certification
S-4, Validation Comparisons

Disclosures

1. *Describe the nature and results of the analyses performed to validate the loss projections generated for personal and commercial residential separately. Include analyses for the 2004 and 2005 hurricane seasons.*

Table 10 through Table 15 show how AIR's simulated damage ratios compare, in total and by coverage and construction, to the damage ratios of specific client companies for key storms including 2004 and 2005 storms: Hurricanes Andrew, Bonnie, Charley, Erin, Frances, Ivan, Jeanne, Wilma, and Katrina. Note that the losses in the tables have been scaled to protect the identity of the companies

Table 10. Actual Vs. Modeled Losses for Nine Storms and Nine Companies (Personal Residential)

Event	Company	Actual Loss ($)	Modeled Loss ($)
Andrew	A	699,699,029	593,080,181
Andrew	C	30,876,447	57,148,010
Andrew Total		**730,575,476**	**650,228,191**
Bonnie	A	3,658,288	16,028,874
Bonnie	B	1,824,581	1,638,452
Bonnie	D	7,600,011	23,131,022
Bonnie Total		**13,082,881**	**40,798,348**
Charley	G	14,393,377	11,807,198
Charley	I	12,923,883	18,596,866
Charley	J	67,874,885	55,197,031
Charley Total		**95,192,146**	**85,601,095**
Erin	B	2,752,119	5,379,554
Erin	C	11,533,903	20,303,953
Erin Total		**14,286,022**	**25,683,507**
Frances	G	10,767,210	7,492,321
Frances	I	10,766,571	14,274,689
Frances	J	10,712,272	25,846,300
Frances Total		**32,246,053**	**47,613,310**
Ivan	G	3,912,200	3,211,866
Ivan	I	5,943,129	43,579,985
Ivan	J	1,631,417	1,386,491
Ivan Total		**11,486,747**	**48,178,342**
Jeanne	G	2,721,086	5,620,883
Jeanne	I	9,551,018	11,420,138
Jeanne	J	17,743,163	21,831,711
Jeanne Total		**30,015,268**	**38,872,732**
Wilma	M	14,345,569	14,727,460
Wilma	N	152,698,832	163,407,392
Wilma Total		**167,044,401**	**178,134,852**
Katrina	N	22,480,522	37,169,061
Katrina Total		**22,480,522**	**37,169,061**

Table 11. Actual vs. Modeled Losses for Six Storms and Two Companies (Commercial Residential)

Event	Company	Actual Loss ($)	Modeled Loss ($)
Charley	N	65,465,443	104,109,664
Charley Total		**65,465,443**	**104,109,664**
Frances	N	60,324,157	32,512,811
Frances Total		**60,324,157**	**32,512,811**
Ivan	N	22,407,198	23,344,872
Ivan Total		**22,407,198**	**23,344,872**
Jeanne	N	11,708,119	24,062,641
Jeanne Total		**11,708,119**	**24,062,641**
Wilma	M	14,953,340	36,722,877
Wilma	N	125,190,942	97,223,273
Wilma Total		**140,144,282**	**133,946,150**
Katrina	N	7,139,327	12,571,697
Katrina Total		**7,139,327**	**12,571,697**

Table 12. Actual vs. Modeled Losses by Coverage for Nine Storms and Eight Companies (Personal Residential)

Coverage	Event	Company	Actual Loss ($)	Modeled Loss ($)
A	Andrew	A	479,053,020	457,497,406
A	Andrew	C	22,888,773	40,777,935
A	Erin	C	10,474,623	16,899,214
A	Bonnie	A	3,351,850	13,962,016
A	Bonnie	D	5,020,586	20,405,020
A	Charley	G	12,330,422	9,948,090
A	Frances	G	9,755,813	6,622,444
A	Ivan	I	5,089,896	37,674,090
A	Jeanne	I	8,517,935	9,929,322
A	Charley	J	62,338,151	48,972,525
A	Frances	J	10,271,271	23,780,003
A	Wilma	M	14,021,469	13,315,617
A	Wilma	N	51,124,993	40,810,582
A	Katrina	N	6,527,939	4,911,089
Total			**700,766,741**	**745,505,353**

Coverage	Event	Company	Actual Loss ($)	Modeled Loss ($)
C	Andrew	A	176,041,470	85,109,411
C	Andrew	C	6,160,344	12,338,723
C	Erin	C	815,171	3,067,114
C	Bonnie	A	275,299	1,657,182
C	Bonnie	D	2,187,319	2,394,233
C	Charley	G	1,576,019	1,498,720
C	Frances	G	772,325	737,023
C	Ivan	I	697,428	5,193,335
C	Jeanne	I	791,274	1,317,913
C	Charley	J	4,087,662	4,601,785
C	Frances	J	315,552	1,739,687
C	Wilma	M	270,656	1,064,509
C	Wilma	N	1,813,070	3,253,607
C	Katrina	N	233,899	269,149
Total			**196,037,488**	**124,242,391**
D	Andrew	A	44,604,539	50,473,364
D	Andrew	C	1,827,330	4,031,353
D	Erin	C	244,109	337,625
D	Bonnie	A	31,140	409,676
D	Bonnie	D	392,106	331,769
D	Charley	G	486,936	360,389
D	Frances	G	239,072	132,854
D	Ivan	I	155,805	712,560
D	Jeanne	I	241,809	172,904
D	Charley	J	1,449,072	1,622,721
D	Frances	J	125,449	326,610
D	Wilma	M	53,444	347,335
D	Wilma	N	369,507	195,478
D	Katrina	N	48,011	8,135
Total			**50,268,329**	**59,462,773**

Table 13. Actual vs. Modeled Losses by Construction Type for Nine Storms and Eight Companies (Personal Residential)

Construction	Event	Company	Actual Loss ($)	Modeled Loss ($)
Frame	Andrew	A	49,465,744	19,535,873
Frame	Andrew	C	8,987,526	15,452,759
Frame	Erin	C	6,881,690	11,792,698
Frame	Bonnie	B	1,140,291	1,099,038
Frame	Erin	B	2,646,930	2,011,120
Frame	Charley	G	2,435,653	2,112,974
Frame	Frances	G	4,553,820	2,161,864
Frame	Ivan	I	2,325,399	17,491,466
Frame	Jeanne	I	2,939,507	3,254,884
Frame	Charley	J	8,453,254	11,969,390
Frame	Frances	J	2,851,694	4,450,940
Frame	Wilma	M	1,078,031	879,713
Frame	Wilma	N	15,303,256	21,883,319
Frame	Katrina	N	1,380,416	2,233,276
Total			**110,443,211**	**116,329,314**
Masonry	Andrew	A	650,233,285	573,544,307
Masonry	Andrew	C	19,929,848	35,360,531
Masonry	Erin	C	2,987,052	4,610,227
Masonry	Bonnie	B	110,017	72,203
Masonry	Bonnie	A	427,406	1,372,739
Masonry	Charley	G	11,908,319	9,616,716
Masonry	Frances	G	6,135,762	5,242,225
Masonry	Ivan	I	1,029,801	3,636,796
Masonry	Jeanne	I	6,082,968	7,399,024
Masonry	Charley	J	59,301,884	43,051,573
Masonry	Frances	J	7,830,728	21,283,091
Masonry	Wilma	M	12,859,659	12,996,601
Masonry	Wilma	N	115,532,204	104,766,485
Masonry	Katrina	N	11,937,900	17,832,446
Total			**906,306,833**	**840,784,964**
Manufactured Home	Erin	B	105,189	725,754
Manufactured Home	Andrew	C	485,193	2,641,963
Manufactured Home	Erin	C	663,292	3,270,215
Manufactured Home	Wilma	N	15,874,921	16,819,036
Manufactured Home	Katrina	N	1,466,506	975,801
Total			**18,595,101**	**24,432,769**

Table 14. Actual vs. Modeled Losses by Construction Type for Six Storms and Two Companies (Commercial Residential)

Construction	Event	Company	Actual Loss ($)	Modeled Loss ($)
Masonry	Charley	N	14,725,592	19,313,562
Masonry	Frances	N	31,950,677	15,078,699
Masonry	Ivan	N	9,921,781	2,347,541
Masonry	Jeanne	N	5,139,136	10,999,654
Masonry	Wilma	M	11,356,070	30,712,752
Masonry	Wilma	N	57,537,128	49,689,434
Masonry	Katrina	N	4,252,495	7,708,774
Total			**134,882,879**	**135,850,416**
Concrete	Charley	N	2,026,714	1,285,280
Concrete	Frances	N	18,957,693	5,659,568
Concrete	Ivan	N	2,819,463	4,829,600
Concrete	Jeanne	N	1,170,862	4,094,085
Concrete	Wilma	M	2,221,720	2,269,813
Concrete	Wilma	N	60,983,157	35,840,947
Concrete	Katrina	N	2,810,102	3,527,143
Total			**90,989,711**	**57,506,436**

Table 15. Actual vs. Modeled Losses by County for One Company—Hurricane Bonnie

	Actual			Modeled		
County	**Exposure**	**Loss**	**Loss/Exposure**	**Exposure**	**Loss**	**Loss/Exposure**
Brunswick	185,761,296	902,555	0.004859	185,761,296	1,424,756	0.007670
Duplin	9,712,367	10,593	0.001091	9,712,367	62,015	0.006385
Lenoir	60,723,614	5,396	0.000089	60,723,614	315,672	0.005199
Onslow	673,111,082	881,104	0.001309	673,111,082	4,640,068	0.006894
Pender	34,660,493	88,708	0.002559	34,660,493	389,455	0.011236
Total	**963,968,852**	**1,888,356**	**0.001959**	**963,968,852**	**6,831,966**	**0.007087**

2. *Provide a completed Form S-4, Validation Comparisons. Provide a link to the location of the form [insert hyperlink here].*

A completed Form S-4 is provided in Appendix 3 on page 243.

S-6 Comparison of Projected Hurricane Loss Costs

The difference, due to uncertainty, between historical and modeled annual average statewide loss costs shall be reasonable, given the body of data, by established statistical expectations and norms.

The average annual historical statewide personal and commercial residential loss costs, produced using the 2012 FHCF exposure data and the historical storm set covering the period 1900–2014, is $3.505 billion. The average annual statewide personal and commercial residential loss costs, produced by the model using a 50,000-year simulation, is $4.331 billion. The difference between these two sets of numbers is statistically reasonable.

Relevant Forms: G-3, Statistical Standards Expert Certification
S-5, Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled

Disclosures

1. *Describe the nature and results of the tests performed to validate the expected loss projections generated. If a set of simulated hurricanes or simulation trials was used to determine these loss projections, specify the convergence tests that were used and the results. Specify the number of hurricanes or trials that were used.*

Confidence intervals constructed for the difference between the historical and simulated average annual loss costs show that the difference between the two sets of loss costs is statistically reasonable. The validation of projected loss costs also includes comparisons of actual and simulated losses for several historical events that have occurred during the past decade. The use of the AIR Hurricane Model for the U.S. for real-time loss estimation, in particular, has shown that the model provides accurate loss projections once the landfall location, storm tracks, and storm parameters are available with a reasonable degree of certainty. Claims information from data contributing insurers have also been used to validate the simulated loss costs as shown in Standard S-5 above.

As described elsewhere in this document, AIR has carefully validated all model components including meteorological input variables such as annual frequency, landfall location, and storm intensity. Loss cost maps have been inspected for smoothness and consistency and found to reasonably reflect differences in landfall rates and storm characteristics for different parts of Florida.

For the purposes of ratemaking in Florida, insurers may use a stochastic catalog based on 50,000 simulation years. Sample size calculations, convergence charts, and numerical comparisons of loss costs for increasing number of iterations have been used to establish convergence.

2. *Identify and justify differences, if any, in how the model produces loss costs for specific historical events versus loss costs for events in the stochastic hurricane set.*

The methodology for producing loss costs for historical events is the same as that used for generating loss costs for events in the stochastic catalog.

3. *Provide a completed Form S-5, Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled. Provide a link to the location of the form [insert hyperlink here].*

A completed Form S-5 is provided on page 253.

Florida Commission on Hurricane Loss Projection Methodology

2015 Vulnerability Standards

V-1 Derivation of Building Vulnerability Functions*

*(*Significant Revision)*

A. Development of the building vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) laboratory or field testing, (3) rational structural analysis, and (4) post-event site investigations. Any development of the building vulnerability functions based on rational structural analysis, post-event site investigations, and laboratory or field testing shall be supported by historical data.

The original AIR Hurricane Model for the U.S. vulnerability functions, developed in 1985, were primarily based on structural engineering research publications, damage surveys conducted by wind engineering experts, and analyses of available loss data. Over time the original damage functions have been fine-tuned based on component level structural analysis developed by wind engineering experts, the results of post-disaster field surveys from major events both in the U.S. and abroad, recently published research studies, computational simulations, and analysis, and detailed analyses of loss data from clients.

B. The derivation of the building vulnerability functions and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles.

The AIR vulnerability functions have been developed by experts in both wind and structural engineering and based on published engineering research. The functions have been validated based on results of damage surveys and on actual claims data provided by client companies. The methods have been peer reviewed internally and by external experts and are theoretically sound. The vulnerability functions include probability distributions around the mean damage ratios to capture the uncertainty in damage at a given level of wind speed. These probability distributions have also been developed based on published research, as well as findings from damage surveys and actual insurance loss data.

C. Residential building stock classification shall be representative of Florida construction for personal and commercial residential buildings.

The residential building stock classification set is derived from census, tax assessor data, engineering surveys, construction reports, and other similar data sources. Building stock classifications are then chosen to be representative of these datasets, and vulnerability functions are developed accordingly. The occupancy and construction classifications in the AIR Hurricane Model for the U.S. are representative of the building stock in Florida.

D. Building height/number of stories, primary construction material, year of construction, location, building code, and other construction characteristics, as applicable, shall be used in the derivation and application of building vulnerability functions.

The AIR Hurricane Model for the U.S. uses vulnerability functions for approximately 32 different residential construction types enumerated in Disclosure V.1.6. These construction types are dependent upon the primary construction materials of the structural framing and walls, or characteristics of each structure. The model also includes AIR's Individual Risk Model (Appendix 9) that accounts for a wide range of construction characteristics. For residential, single family homes, the vulnerability functions do not vary by height/stories. The building vulnerability functions do vary by height/stories for commercial residential type structures. The model considers three height categories as discussed under Disclosure V.1.6.

The AIR vulnerability model includes temporal and regional adjustments that account for changes in building codes and their enforcement, changes in building construction practices, and other factors affecting the regional vulnerability over time. The model differentiates between different building design regions in Florida, based on building codes and other design guidelines, and the model's vulnerability functions are modified accordingly. It is assumed, for example, that buildings in the southern, coastal part of the state are characterized by a higher degree of wind resistivity than those in more northern and central regions. The model also differentiates buildings built in different time periods throughout Florida. Engineering judgment and published research data went into the initial development of the vulnerability adjustments, and subsequent refinement of these factors has been based upon exposure and loss data provided by clients.

The resulting vulnerability functions reflect the evolution of building codes and the higher level of engineering attention in newer construction relative to older construction. They have been validated by comparing actual losses with simulated losses for different areas and time periods in Florida and have been found to be reasonable and theoretically sound. Claims data from recent hurricanes in Florida indicate that buildings built prior to 1995 are significantly more vulnerable than buildings built after 1995. The AIR Hurricane Model for the U.S. includes year-built categories: pre-1995, 1995-2001, 2002-2011, and post-2011. Between 1995 to 2001 and 2002 to 2011, there is a continuous change in the year-built adjustment to account for structural aging and similar factors. For each year-built category, the Individual Risk Model (Appendix 9) has been used to estimate the vulnerability within the year-built band.

Separate vulnerability functions have been developed for buildings built to the minimum requirements of Florida Building Code (FBC 2001 and more recently FBC 2010). While six unique building categories (described in Appendix 9) were identified in the entire state of Florida by taking into consideration the design wind speed, the terrain exposure category, and the requirements of the Wind-borne Debris Region (WBDR) and High-Velocity Hurricane Zone (HVHZ), as specified in the 2001 Florida Building Code, eleven unique building categories (described in Appendix 9) were identified in the entire state to satisfy the aforementioned considerations of design wind speed, terrain exposure category, WBDR and HVHZ in accordance with the 2010 Florida Building Code. The vulnerability functions for these building categories were derived using the building features and mitigation measures from the AIR Individual Risk Module that meet the minimum requirements of the 2001 and 2010 Florida Building Codes.

E. Vulnerability functions shall be separately derived for commercial residential building structures, personal residential building structures, manufactured homes, and appurtenant structures.

AIR engineers have developed separate vulnerability functions for the primary structure, for both residential and commercial occupancies, as well as for manufactured homes, and appurtenant structures.

F. The minimum windspeed that generates damage shall be consistent with fundamental engineering principles.

The model begins calculating losses when the modeled wind speeds achieve a one-minute sustained value of 40 mph. This minimum wind speed assumption is reasonable based on findings from engineering research, damage surveys and actual claims data from historical events.

G. Building vulnerability functions shall include damage as attributable to windspeed and wind pressure, water infiltration, and missile impact associated with hurricanes. Building vulnerability functions shall not include explicit damage to the building due to flood, storm surge, or wave action.

The wind vulnerability functions in the AIR Hurricane Model for the U.S. do not include any explicit damage of flood, storm surge and wave actions. Wind vulnerability functions in the AIR Hurricane Model for the U.S. have been validated with wind damage data and insurance claims data; they explicitly account for wind speed (which produces wind pressure) as well as implicitly account for damage resulting from water infiltration and missile impact, to the extent that they are reflected in the insurance company loss data.

Relevant Forms: G-4, Vulnerability Standards Expert Certification
V-1, One Hypothetical Event
A-1, Zero Deductible Personal Residential Loss Costs by ZIP Code
A-6, Logical Relationship to Risk (Trade Secret item)

Disclosures

1. *Describe any modifications to the building vulnerability component in the model since the previously accepted model.*

The building vulnerability component of the AIR Hurricane Model for the U.S. has been updated since the release of the previously accepted model. The changes since the previously accepted model include:

a) Separate vulnerability functions have been developed for buildings built according to the minimum requirements of the Florida Building Code 2010. Unique building categories (described in Appendix 9) were identified in the entire state by taking into consideration the design wind speed, the terrain exposure category, and the requirements of Wind-borne Debris Region and High-Velocity Hurricane Zone.
b) The pre-computed factors which adjust the base wind structural vulnerability when the user provides no year built information, as opposed to a known year built, have been updated to be relevant through 2016. This includes adjusting the underlying year built weighting assumptions to utilize the latest census and tax assessor data regarding building stock age.
c) Vulnerability adjustments that account for structural aging and building technology changes, along with aging and deterioration of roofs in particular, have been updated to be relevant through 2016.
d) Combining the effects of building code related updates, aging, and building technology related vulnerability changes, adjustments to the modeled year built categories for Florida have been incorporated. The year built categories have been updated to: pre-1995, 1995-2001, 2002-2011, and post-2011.
e) The application of the “certified structures” secondary risk feature has been extended for commercial occupancies.
f) The implementation of the “roof year built” secondary risk feature has been enhanced to default to a new roof for those structures that are built within the last ten years.
g) Enhancements are made to the “seal of approval” secondary risk feature.
h) These modifications to the vulnerability components of the AIR Hurricane Model for the U.S. have been based on engineering research, computational simulations, damage reports, peer review, and historical loss and insurance claims data provided by insurance companies.

2. *Provide a flow chart documenting the process by which the building vulnerability functions are derived and implemented.*

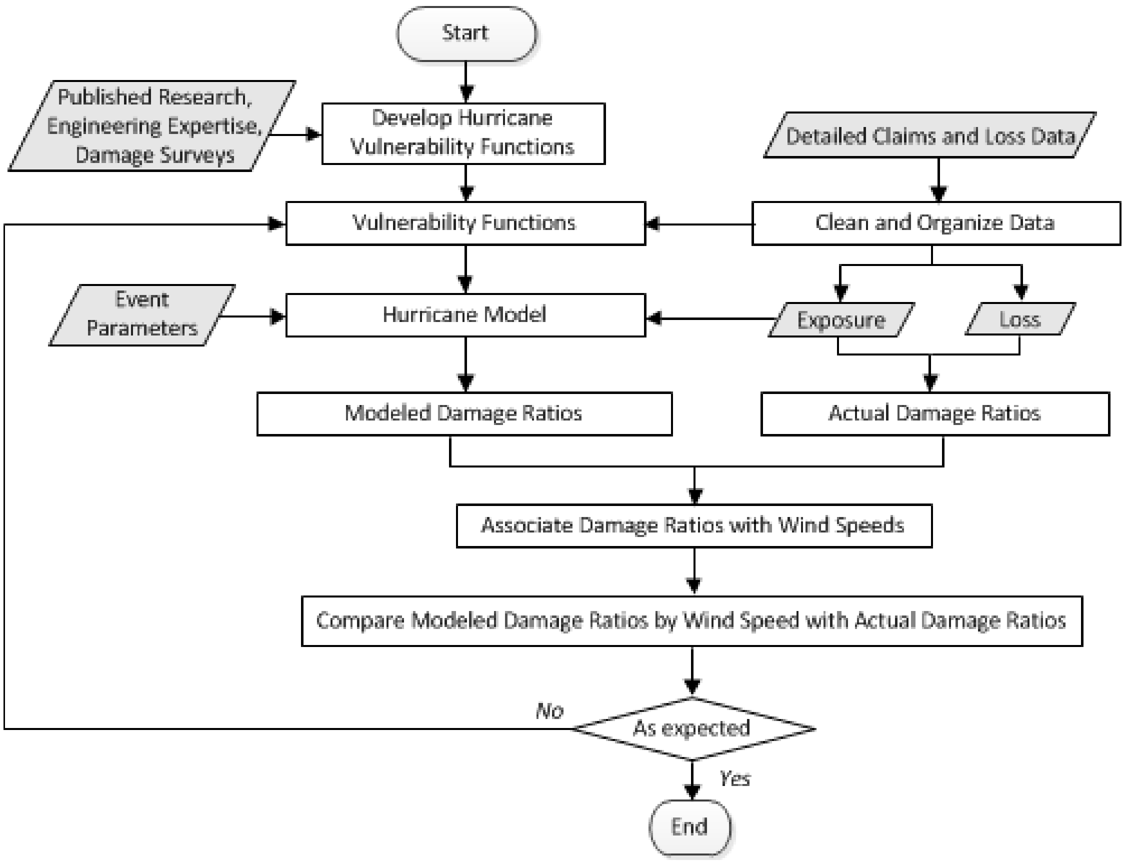


Figure 29. Derivation and Implementation of AIR Vulnerability Functions

3. *Describe the nature and extent of actual insurance claims data used to develop the building vulnerability functions. Describe in detail what is included, such as, number of policies, number of insurers, date of loss, and number of units of dollar exposure, separated into personal residential, commercial residential, and manufactured home.*

Insurance claims and loss data used to develop the model's vulnerability functions comes from multiple sources and client companies. Not all companies or sources provide the same level of detail. Loss data for actual events normally consists of claim counts, paid losses, ZIP Code or location level information, and line of business. Loss data also is frequently provided by date of loss, policy form, coverage, and may contain construction and/or occupancy details and/or secondary characteristics. AIR has been provided with detailed data by several client companies covering in excess of $2.5 trillion of personal, $6 billion of manufactured homes, and $75 billion of commercial residential exposure.

AIR was first provided actual claims data in 1986 when developing the model for the E.W. Blanch Company. Three primary companies submitted detailed loss data for hurricanes Alicia (1983), Diana (1984), Bob (1985), Danny (1985), Elena (1985), Gloria (1985), Juan (1985), and Kate (1985). The loss data included details by county or state, by line of business, claim counts, paid and incurred losses. Detailed exposure data was also available for each company, which included number of risks, amount of insurance and deductibles by five-digit ZIP Code.

In 1989, at the request of a client, AIR performed a "blind" validation test for hurricanes Frederic (1979), Allen (1980), Alicia (1983), Diana (1984), Danny (1985), Elena (1985), Gloria (1985), Juan (1985), and Kate (1985) based on detailed exposure data (also number of risks, amount of insurance and deductibles by five digit ZIP Code). Aggregate losses for each hurricane were provided to AIR after the test. The AIR test results were judged by the client to be "quite good."

Since 1992, many of our primary company clients, from whom we have detailed exposure data, have also provided detailed loss data for hurricanes Andrew, Opal, Erin, Bertha, and Fran for validation purposes. Data sets from several permutations of client company/storm losses have been analyzed. Loss data received from these companies is at the ZIP Code level and often by construction class and coverage.

Additional data has been provided by our clients for 1998 hurricanes Bonnie, Earl, and Georges a well as Tropical Storm Frances. Data sets from several permutations of client company/storm losses have been analyzed. Loss data received from these companies is at the ZIP Code or policy level.

AIR has also received claims data from several client companies for the significant 2004 and 2005 Florida storms: hurricanes Charley, Frances, Ivan, Jeanne, Dennis, Katrina, Rita, and Wilma. More recent data has also been obtained for events since 2008 which have occurred elsewhere in the U.S: hurricanes Ike, Irene, Isaac, and Sandy.

In summary, the AIR simulation model vulnerability functions are based on loss data spanning many companies and hurricanes affecting different geographical areas, not Florida exclusively. New data is analyzed as it becomes available, and any results or findings relevant to the model functionality are incorporated into the appropriate version once all validation of the data is complete. Examples of the comparison between actual loss data and the AIR vulnerability model are shown in Figure 30 through Figure 35.

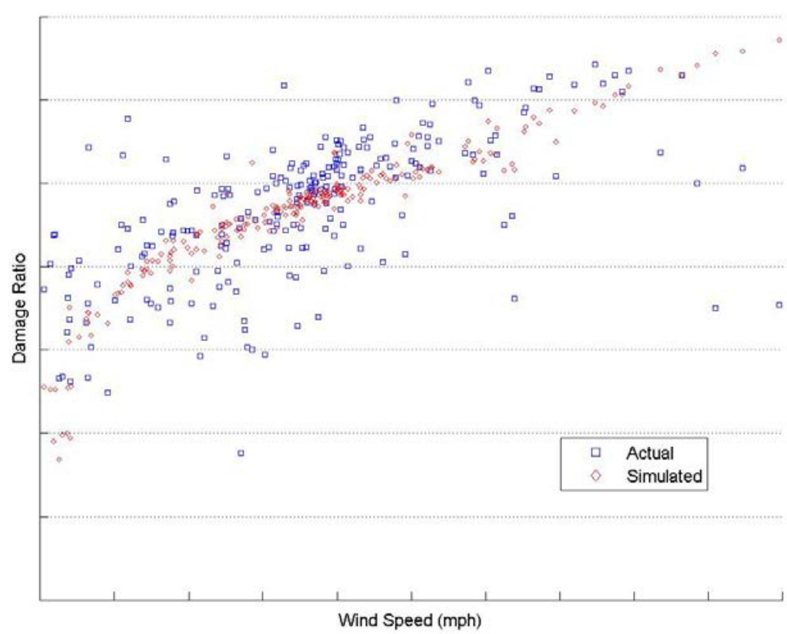


Figure 30. Actual and Simulated Damage Ratios vs. Wind Speed: Coverage A—Single Company, Single Storm

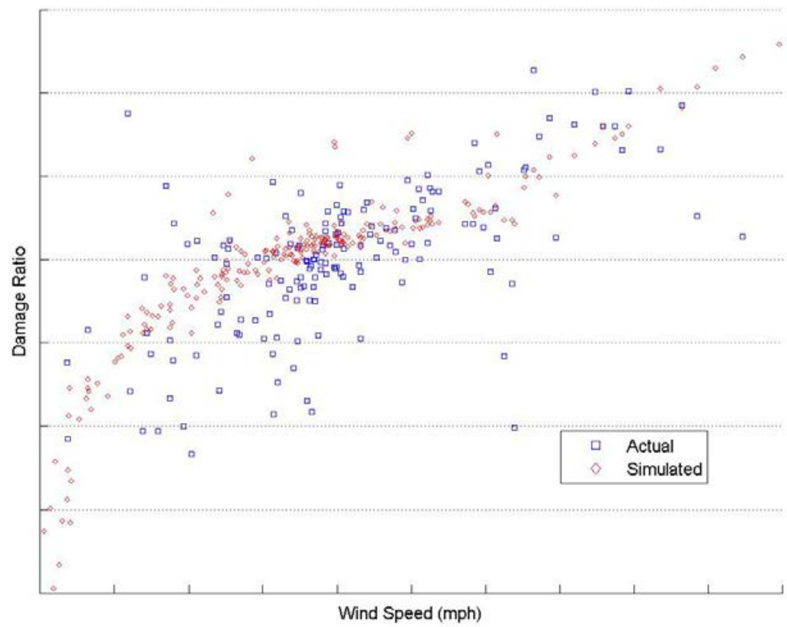


Figure 31. Actual and Simulated Damage Ratios vs. Wind Speed: Coverage C—Single Company, Single Storm

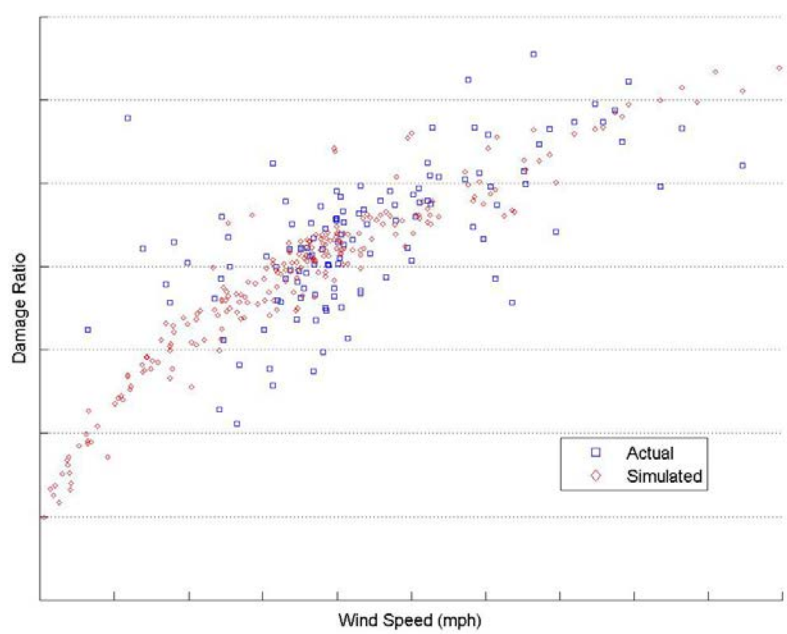


Figure 32. Actual and Simulated Damage Ratios vs. Wind Speed: Coverage D—Single Company, Single Storm

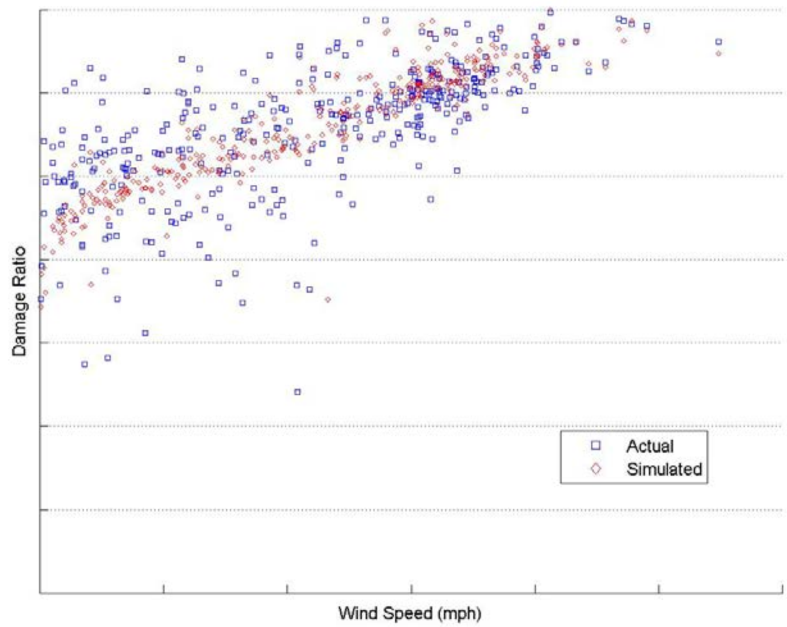


Figure 33. Actual and Simulated Damage Ratios vs. Wind Speed: Manufactured Homes—Single Company, Single Storm

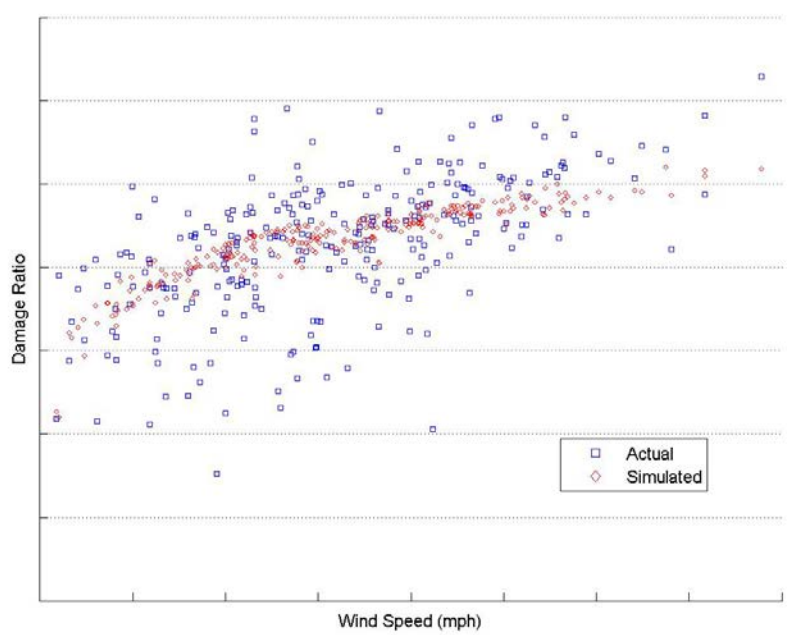


Figure 34. Actual and Simulated Damage Ratios vs. Wind Speed: Frame—Single Company, Single Storm

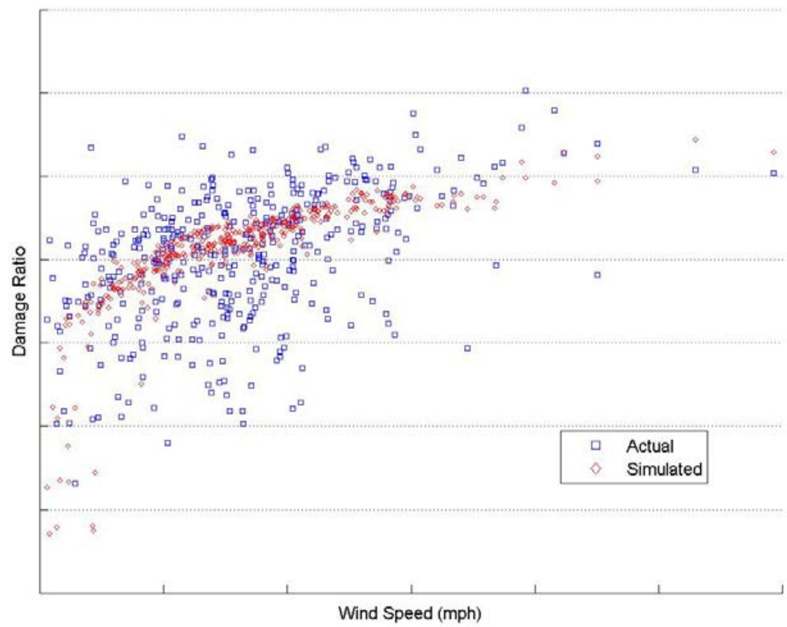


Figure 35. Actual and Simulated Damage Ratios vs. Wind Speed: Masonry—Single Company, Single Storm

4. *Describe the assumptions, data (including insurance claims data), methods, and processes used for the development of the building vulnerability functions.*

The vulnerability functions developed by AIR have been constructed through comprehensive engineering analysis, which includes data derived from post-event damage surveys, expert consultations, and analysis of claims and industry loss data. The engineering analysis relies on fundamental structural engineering principles, the diverse academic and industry background of AIR's engineering team, past and current construction methodologies (including the use of building codes and regulations), and continued assessment of the available engineering and scientific literature (e.g., *Journal of Wind Engineering and Industrial Aerodynamics*, *Journal of Structural Engineering*, etc.).

The vulnerability functions have also been peer reviewed externally by leading experts in structural engineering to acquire an unbiased opinion and point of view. Additionally, when claims or loss data is available, the functions are again assessed to ensure a reasonable outcome. The figure in Disclosure V-1.2 (Figure 29) shows how the development of the vulnerability model through these components interacts.

Figure 36, Figure 37, and Figure 38 demonstrate comparison of insurance claims data with simulated damage ratios for single-family residential wood frame and masonry homes, and manufactured homes (both building and appurtenant structures), respectively, for several different companies and historic events. These results demonstrate consistency between the model and insurance claims at various levels.

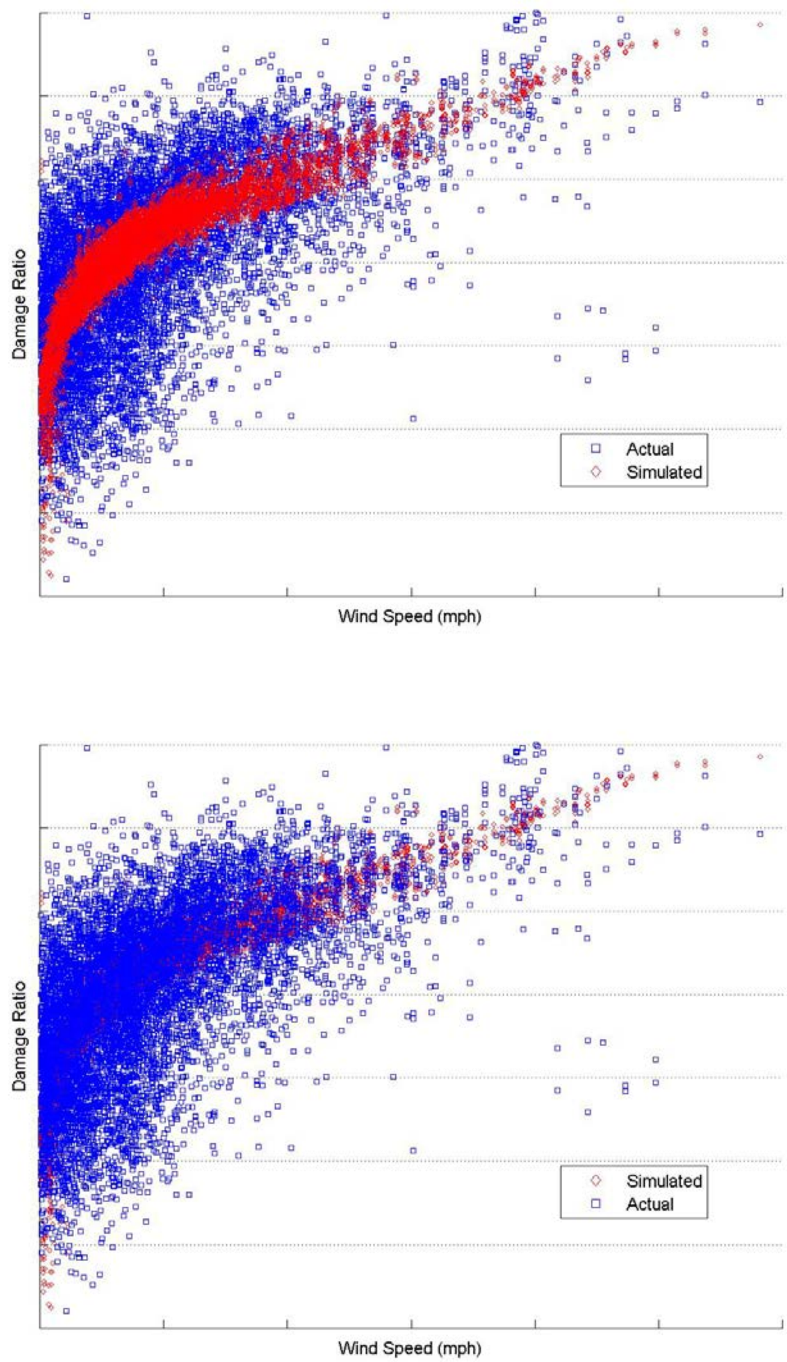


Figure 36. Actual and Modeled Damage Ratios vs. Wind Speed, Frame

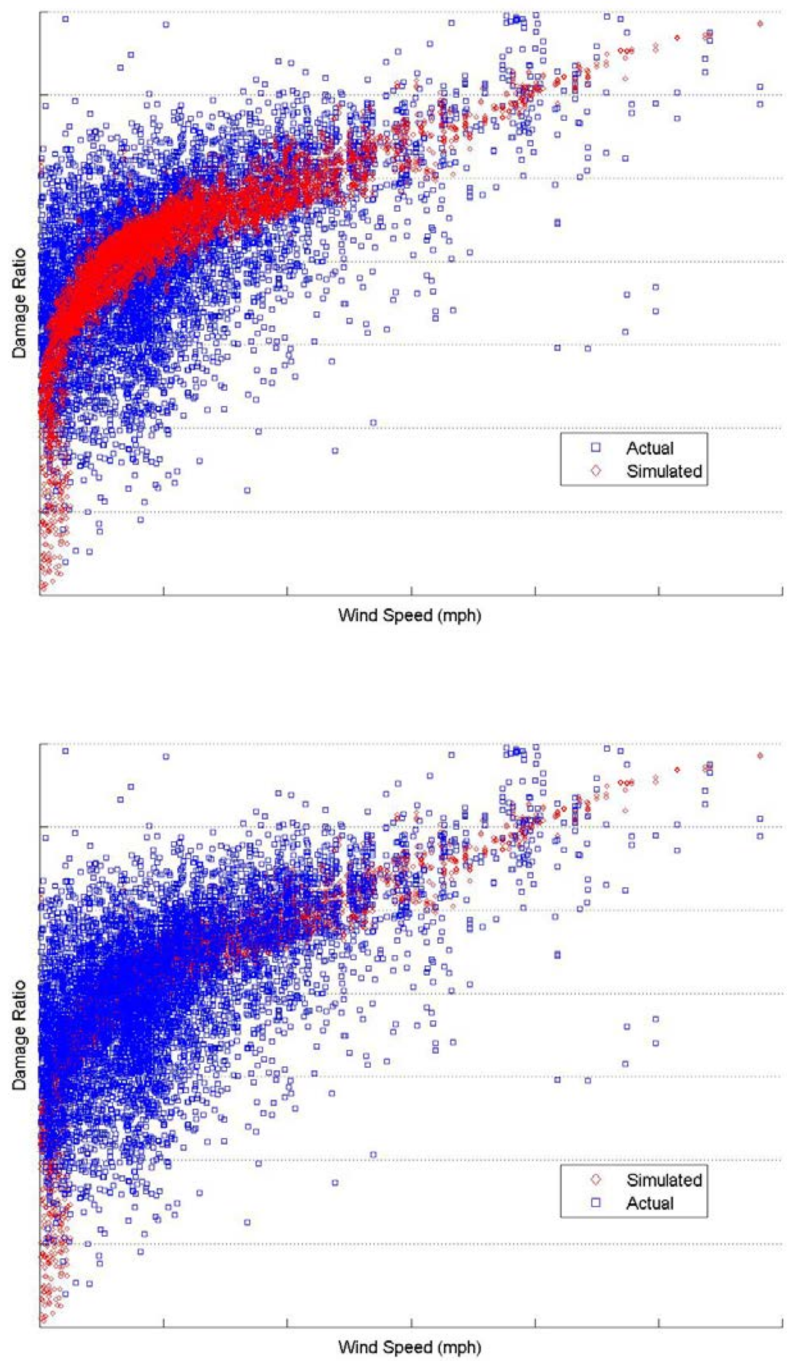


Figure 37. Actual and Modeled Damage Ratios vs. Wind Speed, Masonry

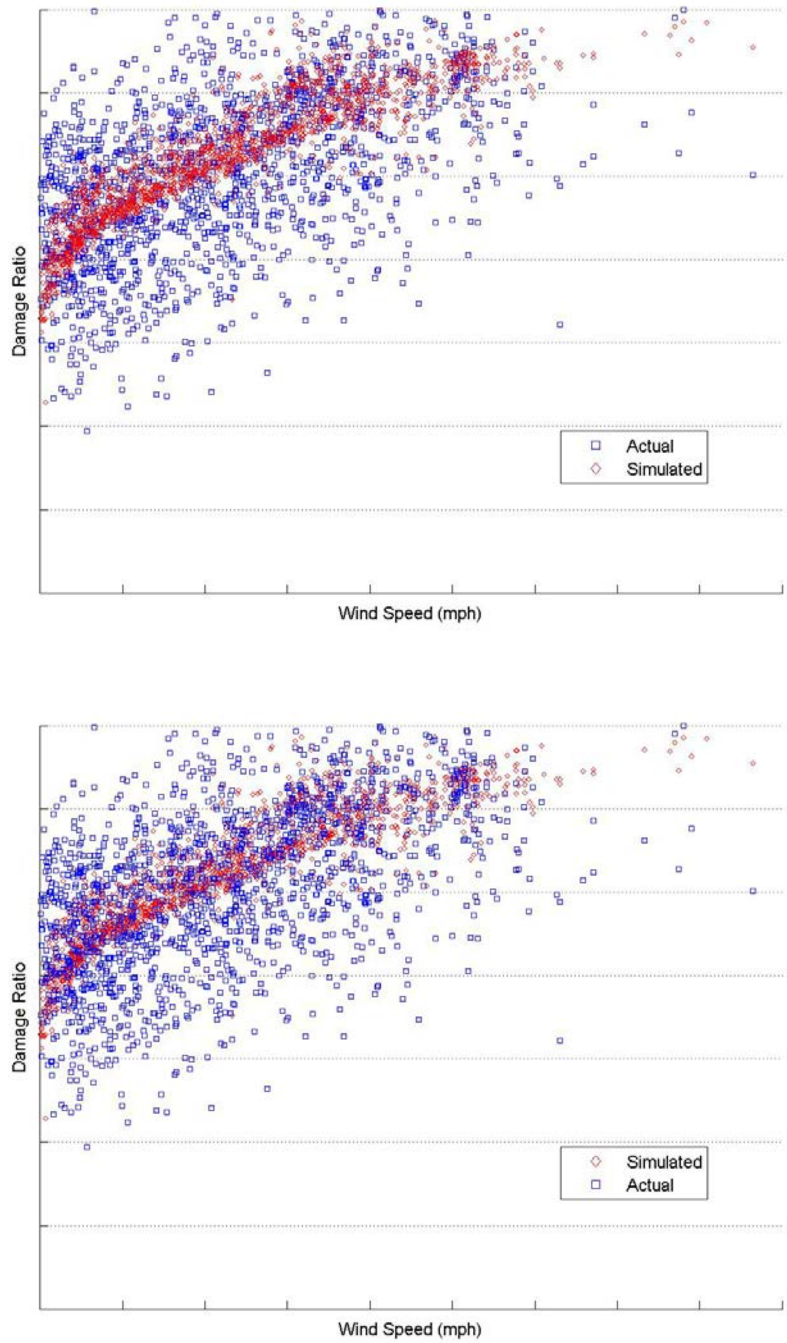


Figure 38. Actual and Modeled Damage Ratios vs. Wind Speed, Manufactured Home

5. *Summarize post-event site investigations, including the source, and provide a brief description of the resulting use of these data in the development or validation of building vulnerability functions.*

AIR engineers and scientists have surveyed all significant loss causing events since Hugo in 1989, including the notable events such as Andrew, Fran, Georges, Floyd, Charley, Frances, Ivan, Jeanne, Dennis, Katrina, Rita, Wilma, Gustav, Ike, Irene, Sandy, and, most recently, Matthew in 2016. Additionally, AIR engineers and scientists have surveyed damage in the aftermath of major storms outside of the mainland U.S., including Hurricane Floyd in the Bahamas, Hurricane Fabian in Bermuda, Tropical Cyclone Yasi in Australia, Hurricane Irene in the Caribbean, Tropical Storm Iselle in Hawaii, and Hurricane Gonzalo in Bermuda. These surveys improve our understanding of the response of structures to winds, including damage mechanisms. Such damage investigations provide, for example, information on the relative vulnerability of various construction types and building components used in the development and validation of the vulnerability relationships.

Based on AIR's damage investigations, buildings can generally be classified as "engineered" or "non-engineered" structures. Most residential dwellings are generally classified as non-engineered. A typical example is a wood frame single-family dwelling, a construction that may not have received much attention from a structural engineer. Most commercial structures—often built in accordance with building codes and under the supervision of a structural engineer—are classified as engineered structures. A typical example of an engineered structure is a high-rise reinforced concrete building.

In general, an engineered building is more wind resistant than a non-engineered building. The 2004 and 2005 post-disaster surveys, conducted by AIR engineers and scientists, indicate that low-rise commercial and residential-commercial wood frame and masonry buildings—that do not get as much engineering attention as the high-rise buildings—have similar vulnerability to their residential counterparts. Recent damage surveys have also indicated that the year-built of a residential dwelling provides important information in determining its vulnerability. Newly-built buildings were observed to perform better than older counterpart buildings.

Wind damage primarily affects non-structural elements, such as windows, cladding or other components of the building envelope. Field surveys indicate that the initial point of failure of wood-framed homes often occurs at the roof, likely due to the improper fastening of the roof covering, sheathing, support structure and building frame. Other roof system failures could be attributed to the lifting and peeling of metal edge flashings, and from here additional damage will propagate. Uplift of the roof edges allows the wind to penetrate underneath the roof membrane, resulting in a pressure rise beneath the membrane and removal of the roof covering. At high wind speeds, the integrity of the entire structure can be compromised, particularly in cases where the roof provides lateral stability by supporting the tops of the building's walls.

Thus, three damage regimes can be identified for residential buildings: a) the low damage regime corresponding to wind speeds of less than about 90 mph, where damage is limited to roof covering and cladding, b) the medium damage regime where damage propagates to roof sheathing, connections and openings and c) the catastrophic damage regime corresponding to wind speeds in excess of 130 mph, where the roof framing is severely damaged, resulting in lateral instability of walls causing further collapse and complete destruction of the building. In the case of engineered buildings, damage typically occurs to non-structural components like mechanical equipment, roofing, cladding and windows; complete structural collapse is extremely rare.

In certain parts of the United States, masonry building systems are the prevalent construction method for residential and commercial residential construction. When masonry is used as the exterior wall material, the walls are normally constructed to full height and then wood floors and the roof are framed into the masonry. Damage investigations have confirmed that such construction results in continuous exterior walls and thus a stronger structural frame, resulting in exterior walls that are more resistant to winds and windborne debris impacts as compared to wood frame buildings.

While exploring the damage caused by Hurricane Georges (1998) and Tropical Storm Frances (1998), AIR engineers validated the effects of wind duration on damage estimation, a fundamental component of the AIR vulnerability model. Damage resulting from a slower moving (longer duration) storm can be higher because of the cumulative effects of wind.

Information obtained from post-disaster damage investigations, has been incorporated in the development and validation of the vulnerability model.

6. *Describe the categories of the different building vulnerability functions. Specifically, include descriptions of the building types and characteristics, building height, number of stories, regions within the state of Florida, year of construction, and occupancy types in which a unique building vulnerability function is used. Provide the total number of building vulnerability functions available for use in the model for personal and commercial residential classifications.*

The AIR building vulnerability functions are categorized by construction, occupancy, and height. Secondary risk characteristics are implemented as a modification to the underlying vulnerability functions and described in Appendix 9, and can be implemented through both direct user input and/or through input of exposure location and year of construction information.

The AIR Hurricane Model for the U.S. has many unique vulnerability functions depending on the building construction type, height, occupancy type, year-built, gross area as well as secondary features .Generalizations of these construction types, which are representative of our vulnerability classifications, are given in Table 16, and the modeled height categories are provided in Table 17. The AIR Hurricane Model for the U.S. includes year-built categories: pre-1995, 1995-2001, 2002-2011 and post-2011. Between 1995 to 2001, and 2002 to 2011, there is a year-by-year change in the year-built adjustment to account for structural aging, a general behavior in the vulnerability as observed in actual loss data. Table 18 lists all the mitigation measures in the AIR Hurricane Model for the U.S.

Table 16. Residential Construction Types in the AIR Hurricane Model for the U.S.

Residential and Apartment or Condominium Buildings	
Construction Type	**General Description**
Wood Frame	Wood frame structures tend to be mostly low rise (one to three stories, occasionally four stories). Stud walls are typically constructed of 2 inch by 4 or 6 inch wood members vertically set 16 or 24 inches apart. These walls are braced by plywood or by diagonals made of wood or steel. Many detached single and low-rise multiple family residences in the United States are of stud wall wood frame construction.
Masonry Veneer	Wood frame structures with one width of non-load bearing concrete, stone or clay brick attached to the stud wall.
Unreinforced Masonry	Unreinforced masonry buildings consist of structures in which there is no steel reinforcing within a load bearing masonry wall, floors, roofs, and internal partitions in these bearing wall buildings are usually of wood.
Reinforced Masonry	Reinforced masonry construction consists of load bearing walls of reinforced brick or concrete-block masonry. Floor and roof joists constructed with wood framing are common.
Reinforced Concrete	Reinforced concrete buildings consist of reinforced concrete columns and beams.
Steel	Steel frame buildings consist of steel columns and beams.
Light Metal	Light Metal buildings are made of light gauge steel frame and are usually clad with lightweight metal or asbestos siding and roof, often corrugated. They typically are lowrise structures.
Unknown	Represents a weighted average of all of the above construction types

	except the manufactured homes
Manufactured Homes	
Construction Type	**General Description**
Manufactured home with no tie-downs	This code would be used for manufactured homes with no anchoring systems present.
Manufactured home with partial tie-downs	This code would be used for manufactured homes when the tie downs are either over-the-top ties, or frame ties but not both or with fewer ties than recommended by the manufacturer.
Manufactured home with full tie-downs	This code would be used for manufactured homes when the anchoring systems are both over-the-top ties, and frame ties. Typically 10 frame ties and 7 over the top ties are required for full tie down in singlewide manufactured homes.
Manufactured Homes	Represents a weighted average of tie-down types, including no tie-downs. This code would be used for manufactured homes (manufactured homes) when the tie down information is unknown.

These construction types are typically provided by primary insurer client companies.

Table 17. Height Bands for Different Construction Types in the AIR Hurricane Model for the U.S.

Occupancy	Construction	Height Categories (# of Stories)
Residential Buildings (Single Family Homes)	All	Any height
Apartment or Condominium Buildings	Wood Frame	1, >1
	Masonry veneer	1, >1
	Unreinforced Masonry	1, 2-3, >3
	Reinforced Masonry	1, 2-3, >3
	Reinforced Concrete	1-3, 4-7, >7
	Steel	1-3, 4-7, >7
	Light Metal	All height
	Unknown	1-3, 4-7, >7

Apartments and condominiums usually receive a similar degree of engineering attention as that of general commercial construction. From a structural viewpoint, therefore, commercial construction and apartments/condominiums are quite similar. Nevertheless, apartments and condominiums have some building components that make them more susceptible to windstorms than other commercial construction. For example, the more vulnerable components found in apartments and condominiums include balconies, awnings, and double sliding glass doors etc. These components often have little engineering attention at the design and construction stages and hence can lead to apartments/condominiums being more vulnerable than commercial construction in general.

For single-family residential structures, vulnerability functions do not vary by height (See Table 17). However, AIR engineers have developed separate vulnerability functions for several height ranges for apartment/condominium structures. Vulnerability functions, through the use of the Individual Risk Model (see Appendix 9), also vary by year-built of construction for both residential and commercial structures to account for changes in the building codes and construction practices, structural aging and other factors. The AIR Hurricane Model for the U.S. includes year-built categories: pre-1995, 1995-2001, 2002-2011, and Post-2011. Between 1995 to 2001, and 2002 to 2011, there is a year-by-year change in the year-built adjustment to account for structural aging, a general behavior in the vulnerability as observed in actual loss data.

Regional variation in vulnerability across Florida and the United States, similar to the year of construction adjustment, is captured through the use of AIR's secondary risk characteristics. Regions are generally delineated through the synthesis of building codes, both through the design wind speed maps provided and through explicit identification of vulnerable areas, such as wind-borne debris regions or the High-Velocity Hurricane Zone (HVHZ) outlined in the Florida Building Code versions 2001 and 2010. The model combines this information with the location details provided by client companies to develop the appropriate vulnerability for the structure.

7. *Describe the process by which local construction practices and building code adoption and enforcement are considered in the development of the building vulnerability functions.*

The AIR Hurricane Model for the U.S. considers the regional variation in building code as explained in Standard V-1 D and Disclosure V.1.6. Depending upon the design wind speed maps, terrain exposure categories, and requirements for Wind-borne Debris Region (WBDR) and the High-Velocity Hurricane Zone (HVHZ), the vulnerability within the State of Florida will vary across multiple regions. Further, variation in local construction practices, building code adoption and enforcement can be captured within the loss estimation model through the use of AIR's secondary risk characteristics (see Appendix 9), in which the users can input detailed building features as appropriate.

8. *Describe the relationship between building structure and appurtenant structure vulnerability functions and their consistency with insurance claims data.*

The building structure and appurtenant structure vulnerability functions are independent, and damage is calculated separately. This means that the damage to appurtenant structures is calculated directly from the impacting hazard, but in a manner consistent with that of the primary building damage calculation. If the structural characteristics of the appurtenant structure are known, the model allows for the flexibility to calculate the damage separately from the primary structure based on its own individual characteristics.

The vulnerability functions for appurtenant structures were developed through analysis of claims data, published research on vulnerability characteristics and through damage surveys when possible. The process for developing vulnerability functions for this coverage type is the same as that presented in Disclosure V.1.2.

Figure 39 demonstrates the comparison of insurance claims data with simulated damage ratios for single-family residential homes (both building and appurtenant structures) for several different companies and historic events. Figure 36 to Figure 38 in Disclosure V.1.4 demonstrate similar comparison for wood frame and masonry single family residential homes and manufactured homes (both building and appurtenant structures). These results demonstrate consistency between the model and insurance claims at various levels, including the results presented in Disclosure V-1.4.

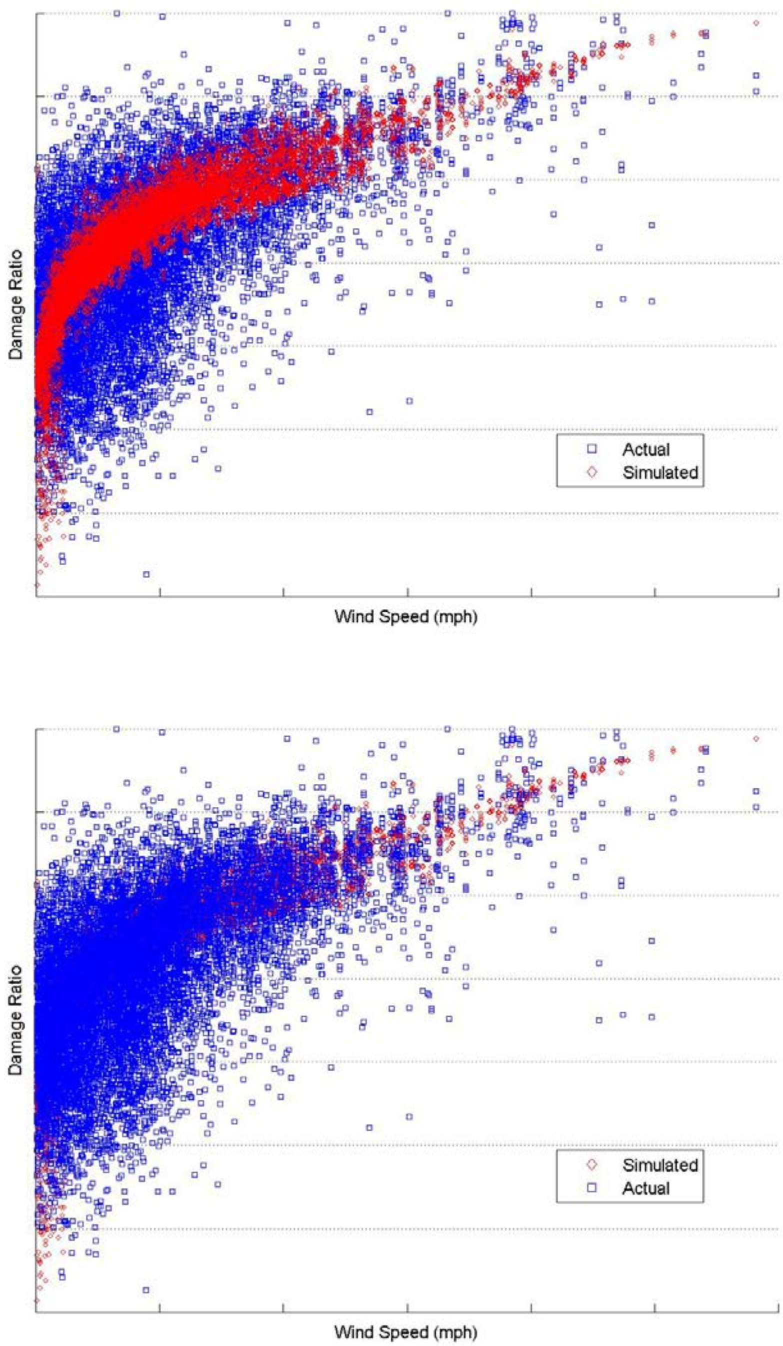


Figure 39. Actual and Modeled Damage Ratios vs. Wind Speed, Structures and Appurtenant Structures

Almost all the data used in the aforementioned validation exhibits demonstrate consistency between insurance claims data and the modeled results for building and appurtenant structures combined rather than individual validation by building or appurtenant structures. The fundamental reason for showing a combined validation stems from the approximate nature of replacement value estimation for appurtenant structures. Since, Florida has not experienced a significant hurricane since 2005, most of the data used in the validation exhbitis are pertinent to hurricanes 2005 and before. Based on AIR's understanding of the client catastrophe modeling process together with analysis of their respective exposure data reveals that the estimation of replacement value for appurtenant structures is approximate and a fraction of the building replacement value. The analyses of a wide majority of client portfolios in the aforementioned time frame shows that appurtnent structure replacement value is approximately estimated to be 10% of the building replacement value. In many portfolios, replacement values for appurtenant structures is not even mentioned, further adding to the complexity of the issue. Similarly, in multiple cases, the claims data for building and appurtenant structures is combined. Although, there are cases where the claims data for building and appurtenant structures are available separately, comparison of actual claim value for appurtenant structures with the modeled loss for these might not be appropriate given the approximate representation/crude estimation of their replacement value. Owing to the aforementioned reasons, combining building and appurtenant structures together in their validation is the best approach. In the future as more detailed exposure and claims data become available, validation by building and appurtenant structures separately can be exhibited.

9. *Describe the assumptions, data (including insurance claims data), methods, and processes used to develop building vulnerability functions for unknown residential construction types or for when some building characteristics are unknown.*

The vulnerability functions used for a residential exposure where the construction is unknown are obtained through a weighted averaging of the known vulnerability curves of the individual residential construction classes within a particular state/region. For example, typical construction types/classes that may be used for residential single-family dwellings are wood frame and masonry. In most cases these are the typical construction types/classes used to classify residential structures as identified in the data provided by our client companies or through census/tax assessor data. The composite vulnerability curve, used when the construction type is listed as unknown, is based on a building-inventory weighted average of the different construction classes within the area considered (i.e. state, region, etc.).

The AIR Hurricane Model for the U.S. supports regional variation in vulnerability when the construction characteristic is unknown. The regional variation is based upon AIR‘s knowledge of building code procedures and practices in place, adjusting the vulnerability curves accordingly. Thus, an unknown vulnerability function exists for each occupancy class and within a region, based on the distribution and vulnerability of known structures from industry sources (see response to Standard V.1.C in this section).

It should be noted that the unknown construction vulnerability for residential occupancy does not apply weight from the manufactured home type. In most cases, the client is able to supply manufactured home exposures separately. Since the vulnerability of manufactured homes is much greater than that of other construction types, it would not be appropriate to use this construction class in the composite function for residential "unknown." Please refer to Appendix 9 for a full discussion of the secondary characteristic methodology which accounts for regional variations in construction and other secondary risk characteristics.

10. *Describe how vulnerability functions are selected when input data are missing, incomplete, or conflicting.*

In the AIR Hurricane Model for the U.S., knowledge about the local building inventory as captured in the proprietary industry exposure database is used to develop vulnerability functions in the absence of input data. Disclosure V-1.9 discusses how the AIR Hurricane Model for the U.S. generates a vulnerability function for unknown construction classes. A similar approach is followed for other characteristics such as occupancy, height and year built. In addition to this, engineering assumptions are made to develop vulnerability functions that accurately reflect the wind vulnerability of structures. These assumptions are made such that they conform to local building codes in effect at the time of construction, their level of enforcement, and local construction practices. In this case, vulnerability functions for each year are pre-calculated. These pre-calculated vulnerability functions are a result of utilizing the secondary risk characteristics presented in Appendix 9. The individual known year vulnerability functions are then combined to create a vulnerability function for unknown year of construction, and that combination is a weighted average of the distribution of housing stock age based on AIR's industrial exposure (incorporating census and tax assessor data).

11. *Identify the one-minute average sustained windspeed and the windspeed reference height at which the model begins to estimate damage.*

The model begins to estimate damage to structures when the one minute sustained wind speed, at a reference height of 10 meters, is greater than (or equal to) 40 miles per hour.

12. *Describe how the duration of windspeeds at a particular location over the life of a hurricane is considered.*

The vulnerability model calculates damage utilizing a complete time profile of wind speeds (above 40 mph, as described in Disclosure V.1-11) for each location affected, thus capturing the effects of wind duration on structures. Design wind loads are routinely exceeded in tropical cyclones, often with only moderate intensity. With no reserve strength, a fastener or connector that has been pulled out from an uplift load can compromise the integrity of the building envelope. Wind damage is manifested at the weak links in a structural system. As each connector is overwhelmed, loads are transferred to the next point of vulnerability. The longer the duration of high winds, the longer this process continues and the greater the resulting damage from overwhelmed connections. More information can be obtained from the following research paper: "Statistical Analysis of 2004 and 2005 Hurricane Claims Data," Proceedings of the 11th Americas Conference on Wind Engineering, San Juan, Puerto Rico, June 22-26, 2009. (Available at: http://www.iawe.org/Proceedings/11ACWE/11ACWE-Jain.Vineet2.pdf.)

The cumulative effects of winds can be examined using a dynamic approach. In order to estimate damage to a property at any point in time, it is important to take into account the extent of the damage that has occurred in the preceding period. Each damage ratio is applied in succession to the remaining undamaged portion of the exposure from the preceding period. Figure 40 illustrates this process.

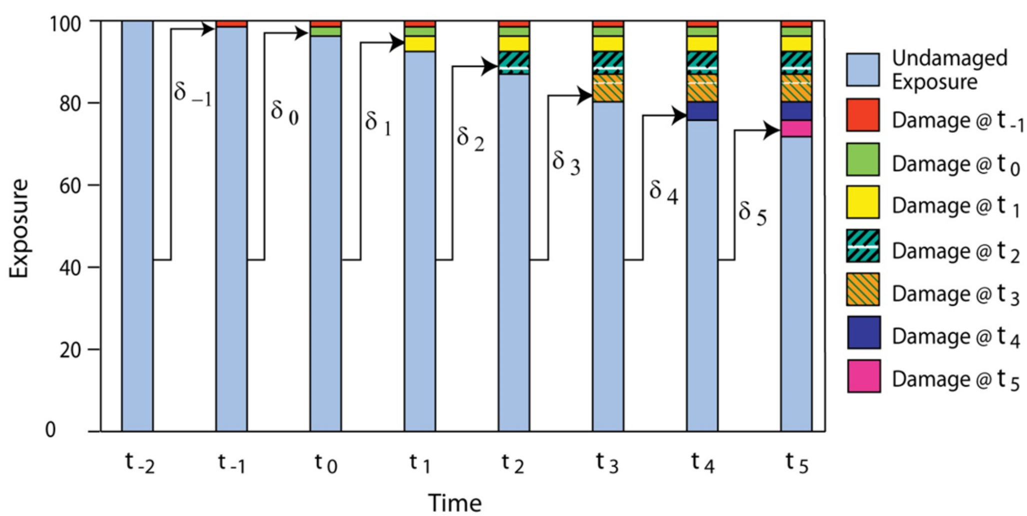


Figure 40. Process of Accounting for the Impact of Wind Duration

At t_{-2}, before the hurricane has made landfall, there is zero or negligible damage. At time t_{-1}, prior to landfall with peripheral wind speeds above 40 mph, the damage ratio δ_{-1} is calculated as a percentage of the full replacement value. At t_0, when the storm makes landfall, the damage ratio δ_0 is applied to the percentage of the property that was left undamaged in the previous period. This process continues until wind speeds once again fall below 40 mph.

Calculating damage only when winds are at their maximum, for example at t_3, and applying a single damage ratio, δ_3, to the full replacement value would ignore the cumulative effects of prolonged winds. Thus, the damage estimation module of the AIR Hurricane Model for the U.S. considers the complete time profile of wind speeds at each location.

13. *Describe how the model addresses wind borne missile impact damage and water infiltration.*

The AIR vulnerability model implicitly accounts for the impact of wind borne debris and water infiltration damage, to the extent that such damage is captured or reflected in the insurance claims data which underlies the model validation. To the extent that the client knows the site conditions of the exposure, the impact of various debris sources on the vulnerability can be captured using additional secondary characteristic selections, as outlined in Appendix 9. Similarly, the ability of a structure to resist water infiltration through various mitigation features can also be captured using secondary characteristic selections.

14. *Provide a completed Form V-1, One Hypothetical Event. Provide a link to the location of the form [insert hyperlink here].*

A completed Form V-1 is provided on page 257.

V-2 Derivation of Contents and Time Element Vulnerability Functions

A. Development of the contents and time element vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) tests, (3) rational structural analysis, and (4) post-event site investigations. Any development of the contents and time element vulnerability functions based on rational structural analysis, post-event site investigations, and tests shall be supported by historical data.

The AIR Hurricane Model for the U.S. vulnerability functions for contents and time element impact, are primarily based on engineering and insurance related research publications, damage surveys conducted by wind engineering and damage experts, and analyses of available loss data. Over time, the damage functions have been fine-tuned based on the results of post-disaster field surveys from major events both in the U.S. and abroad, recently published research studies, computational simulations and analysis if possible, and on detailed analyses of loss data from clients.

B. The relationship between the modeled building and contents vulnerability functions and historical building and contents losses shall be reasonable.

The relationship among the modeled structure damage ratios and modeled contents damage ratios is reasonable based on comparisons to client data, as shown in Figure 41. Comparisons between the model result and insurance claims data are also demonstrated in Disclosure V-2.3.

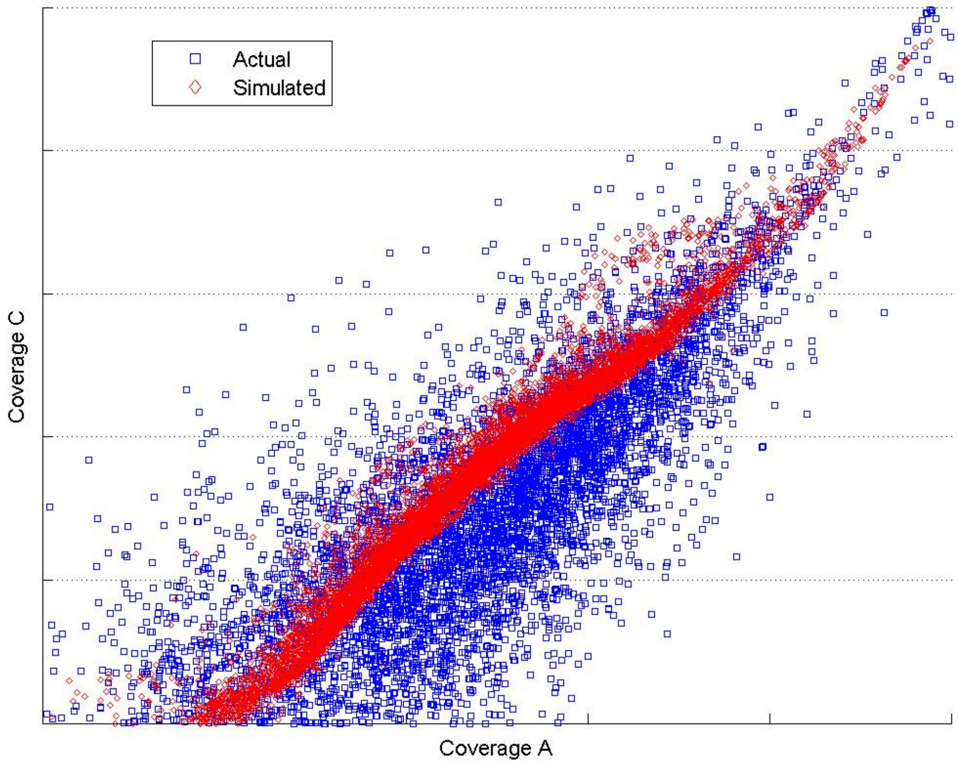


Figure 41. Relationship of Content (Coverage C) Mean Damage Ratio to Building (Coverage A) Damage Ratio for Historical Data and Modeled Results

C. Time element vulnerability function derivations shall consider the estimated time required to repair or replace the property.

Losses due to time element coverage are based on (i) the mean building damage, (ii) the time estimated to make repair to or to reconstruct the damaged building, and (iii) the estimated cost of time element coverage per a time period. Implicit in the estimated time to make repairs are any estimated losses that may occur due to damage to the surrounding infrastructure and incurred costs to temporarily relocate the displaced occupants.

D. The relationship between the modeled building and time element vulnerability functions and historical building and time element losses shall be reasonable.

Comparisons between the model result and insurance claims data are also demonstrated in Disclosure V-2.6. The relationship among the modeled building mean damage and the time element mean damage is reasonable based on comparisons to client data, as shown in Figure 42. The resulting historical claims data shown includes data from companies who may have made assumptions about time element losses based on structural damage.

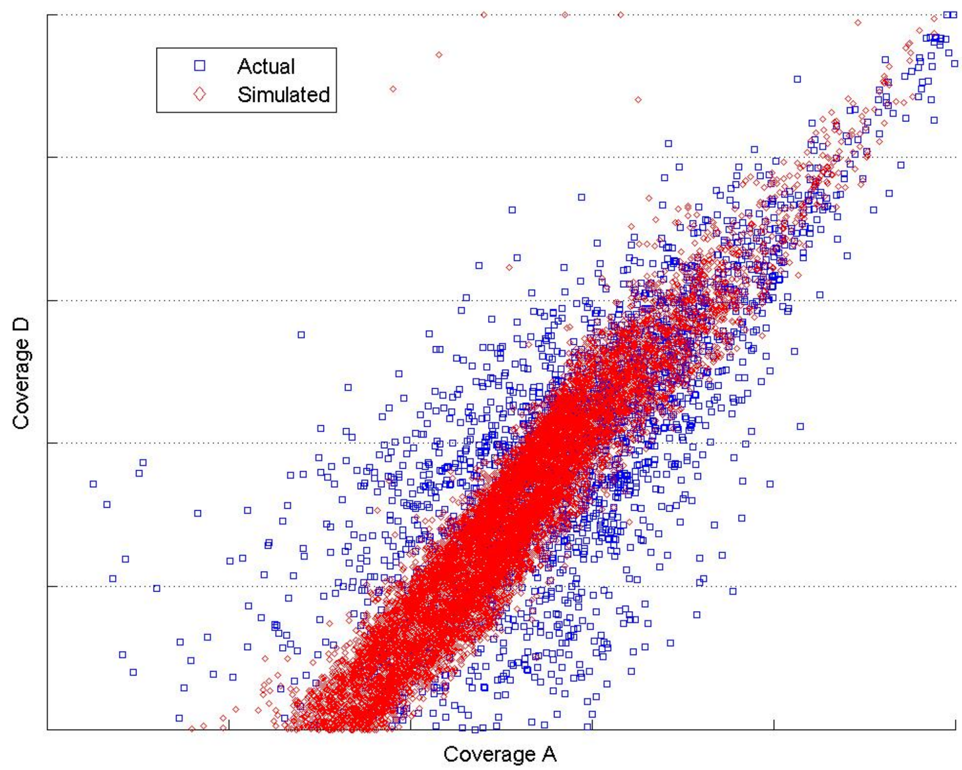


Figure 42. Relationship of Time Element (Coverage D) Mean Damage Ratio to Building (Coverage A) Damage Ratio for Historical Data and Modeled Results

E. *Time element vulnerability functions used by the model shall include time element coverage claims associated with wind, flood, and storm surge damage to the infrastructure caused by a hurricane.*

The vulnerability model considers time element losses or claims that can arise from damage to the infrastructure, as a result of wind, flood, and storm surge, to the extent that such losses are reflected in damage survey or insurance claims data used for validation purposes.

Relevant Form: G-4, Vulnerability Standards Expert Certification
A-6, Logical Relationship to Risk (Trade Secret item)

Disclosures

1. *Describe any modifications to the contents and time element vulnerability component in the model since the previously accepted model.*

There have been no modifications to the contents or time element vulnerability components of the AIR Hurricane Model for the U.S. since the previously accepted model, as they relate to wind.

2. *Provide a flow chart documenting the process by which the contents vulnerability functions are derived and implemented.*

The process for deriving and implementing the contents vulnerability functions in the AIR Hurricane Model for the U.S. is the same as that used for developing and implementing the building vulnerability functions, as outlined in Disclosure V-1.2.

3. *Describe the assumptions, data (including insurance claims data), methods, and processes used to develop and validate the contents vulnerability functions.*

In the AIR Hurricane Model for the U.S., the contents vulnerability is a function of the building vulnerability, such that the resulting contents mean damage ratio is a function of the building mean damage ratio. The model has distinct content vulnerability relationships for both single-family residential structures and commercial residential structures. The damage ratio for single-family residential contents is typically lower than the corresponding building damage ratio, for a given wind speed, as building damage is usually required before contents damage typically occurs. For commercial residential structures, which tend to be larger in size and have a higher level of engineering attention, there can be significant damage to contents even for minor non-structural damage. Typically, these types of structures experience damage to cladding, windows and sliding doors, which drive the potential for significant contents damage.

AIR validates the model’s content vulnerability functions at many levels, from an aggregate industry level loss perspective down to claims at individual policies or locations. When the client provides exposure information related to contents coverage, AIR will supply the provided information to the model, including insurance policy terms. The subsequent claims data corresponding to the exposure may or may not include loss information which contains the application of policy terms. AIR will compare the claims data, based on the knowledge of whether the values provided include policy conditions, with modeled output that contains both loss information before the application of policy conditions (ground-up) and after the application of policy terms (gross). This process is used for contents loss validation in the same way that is used for building vulnerability validation.

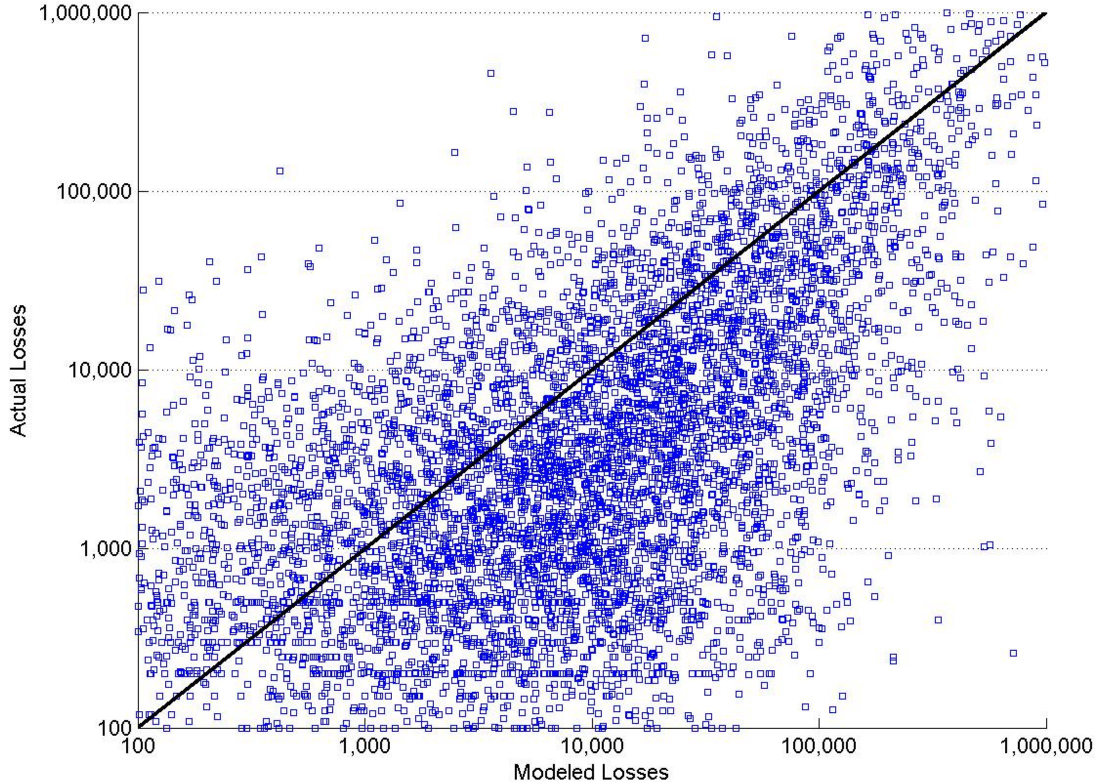
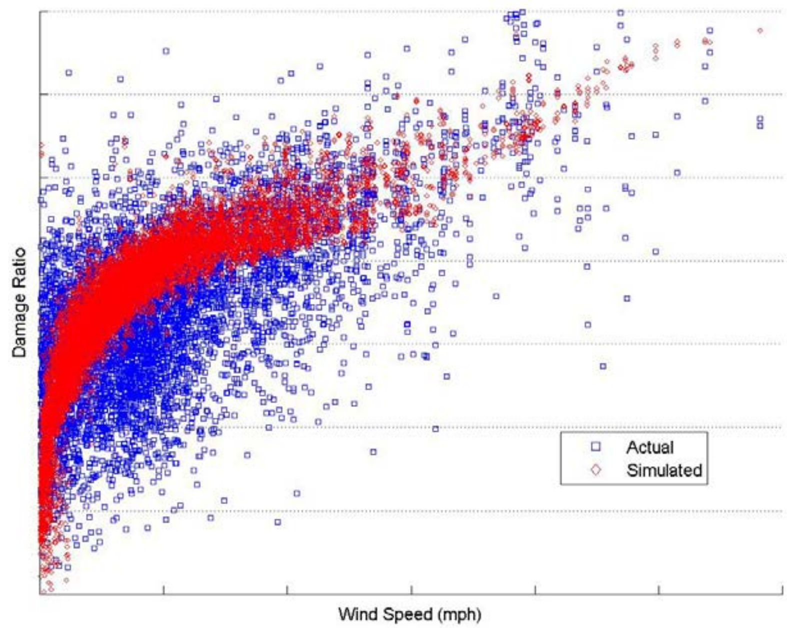


Figure 43. Actual and Modeled Content (Coverage C) Losses

Figure 43 and Figure 44 show actual content damage ratios, based on claims data provided from clients, compared with modeled content damage ratios for the same exposure. The data provided was compared across multiple company data sets and for various storms. These results indicate that the modeled results validate well with actual claims and loss data.



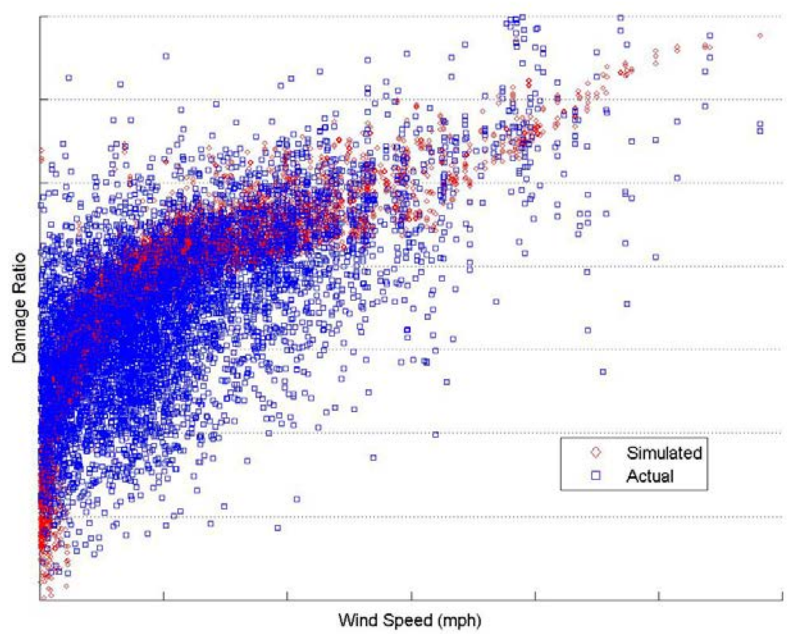


Figure 44. Actual and Modeled Damage Ratios vs. Wind Speed, Contents

4. *Provide the total number of contents vulnerability functions. Describe whether different contents vulnerability functions are used for personal residential, commercial residential, manufactured home, unit location for condo owners and apartment renters, and various building classes.*

The contents vulnerability is a function of the building vulnerability. There are two basic content vulnerability functions, one each for residential and commercial residential structures. Since the content vulnerability function is a function of the building vulnerability function, the resulting content vulnerability as a function of the hazard is unique for each construction/occupancy type described in V-1.

5. *Provide a flow chart documenting the process by which the time element vulnerability functions are derived and implemented.*

The process for deriving and implementing the time element vulnerability functions in the AIR Hurricane Model for the U.S. is the same as that used for developing and implementing the building vulnerability functions, as outlined in Disclosure V-1.2.

6. *Describe the assumptions, data (including insurance claims data), methods, and processes used to develop and validate the time element vulnerability functions.*

The basic time element vulnerability functions for personal and commercial residential structures are based on the mean building damage, the time it takes to repair/reconstruct the damaged building and the estimated cost for the time element per time period. At lower wind speeds, the damage to the building is minimal and the time to repair is minimal. However, when higher wind speeds result in significant building damage the time it takes to repair/reconstruct can be very long. The time element vulnerability model accounts for losses resulting from expenses incurred while the building is being repaired/reconstructed. The vulnerability functions also account for other direct and indirect losses to the extent that they are in the validation data.

AIR validates the model's time element vulnerability functions at many levels, from an aggregate industry level loss perspective down to claims at individual policies or locations. When the client provides exposure information related to time element coverage, AIR will supply the provided information to the model, including policy characteristics and terms. The subsequent claims data corresponding to the exposure may or may not include loss information which contains the application of policy characteristics and terms. AIR will compare the claims data, based on the knowledge of whether the values provided include policy conditions, with modeled output that contains both loss information before the application of policy conditions (ground-up) and after the application of policy terms (gross). This process is used for time element loss validation in the same way that is used for building vulnerability validation.

Figure 45 and Figure 46 show a comparison between the modeled time element (Coverage D) losses and the actual loss data provided by client companies for the same exposure. These results show the actual and simulated damage ratios for time element losses, based on claims data provided from various companies across various historical storms.

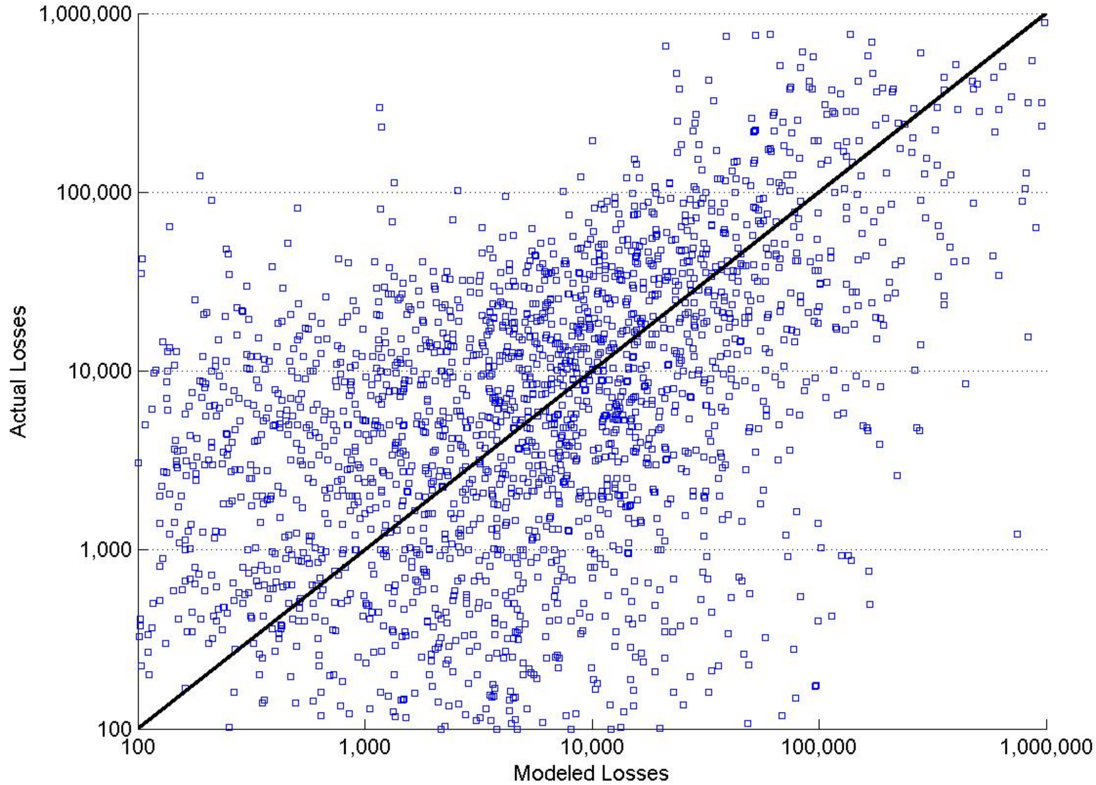


Figure 45. Actual and Modeled Time Element (Coverage D) Losses

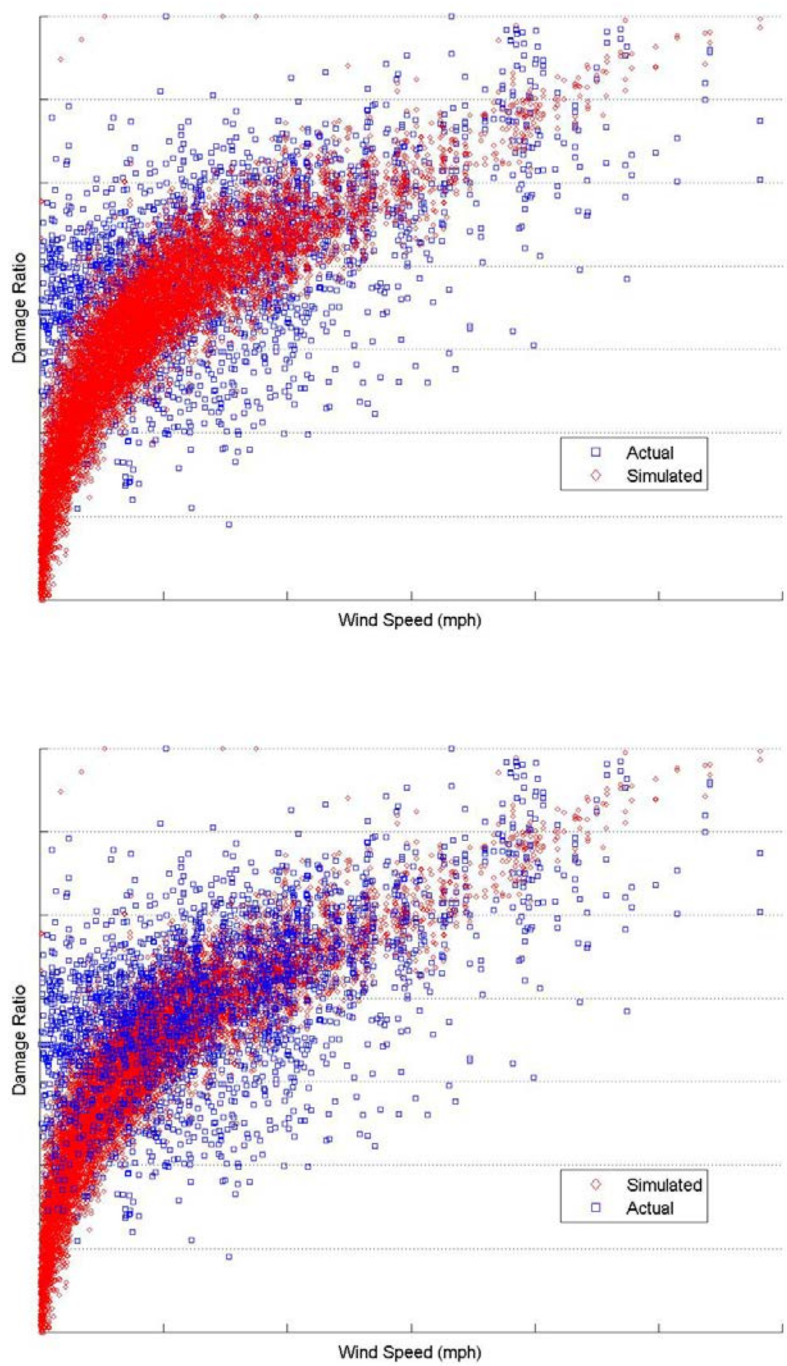


Figure 46. Actual and Modeled Damage Ratios vs. Wind Speed, Time Element

7. *Describe how time element vulnerability functions take into consideration the damage (including damage due to storm surge, flood, and wind) to local and regional infrastructure.*

Time element losses are calculated independently for the wind and storm surge perils in the AIR Hurricane Model for the U.S. Model users can choose to include, exclude, or include a portion of the losses from storm surge in the reported time element loss estimates. No storm surge losses for time element coverage are included in the submitted loss costs. The AIR Hurricane Model for the U.S. does not explicitly estimate losses from precipitation induced flood damage.

AIR does not explicitly model damage to local and regional infrastructure. Validation data for time element coverage reflects actual losses paid by insurance companies. To the extent this data includes losses from damage to infrastructure, losses are then implicitly accounted for by AIR vulnerability functions within the development, calibration, and validation. Thus, modeled time element losses implicitly take into consideration damage to local and regional infrastructure.

8. *Describe the relationship between building structure and contents vulnerability functions.*

The contents vulnerability functions for residential and commercial residential construction are a function of the mean building damage. These relationships are developed using claims data, published engineering studies, and expert engineering judgment. The AIR Hurricane Model for the U.S. calculates contents damage separately from building damage.

9. *Describe the relationship between building structure and time element vulnerability functions.*

Time element vulnerability functions for residential and commercial construction are functions of the mean building damage and the time it takes to repair or reconstruct the damaged building. Implicit in the time needed to make repairs is damage to the impacted infrastructure, as well as costs for temporarily relocating or other needs. Published building construction/restoration data and expert engineering judgment have been used to establish the functional relationship between building damage and loss of use.

10. *Describe the assumptions, data* (*including insurance claims data), methods, and processes used to develop contents and time element vulnerability functions for unknown residential construction types and for when some of the primary characteristics are unknown.*

The contents and time element vulnerability functions are a function of the building vulnerability function, and there are separate basic content and time element functions for residential and commercial exposures. The development of an unknown residential construction vulnerability function or development of unknown vulnerability functions when other characteristics are not known is described in Disclosure V-1.9. Thus, an unknown residential content or time element damage function will be the residential content or time element vulnerability function as a function of an unknown residential building damage function.

V-3 Mitigation Measures

A. Modeling of mitigation measures to improve a building's hurricane wind resistance, the corresponding effects on vulnerability, and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles. These measures shall include fixtures or construction techniques that enhance the performance of the building and its contents and shall consider:

- ***Roof strength***
- ***Roof covering performance***
- ***Roof-to-wall strength***
- ***Wall-to-floor-to-foundation strength***
- ***Opening protection***
- ***Window, door, and skylight strength.***

The modeling organization shall justify all mitigation measures considered by the model.

The secondary risk characteristics, a part of AIR's Individual Risk Model documented in Appendix 9, account for the effects of mitigation measures, and were developed using an engineering based framework in a structured approach. Based on structural engineering expertise and building damage observations made in the aftermath of historical hurricanes, key building features have been identified as having a significant impact on building losses. These features include fixtures or construction techniques that enhance roof strength; roof-covering performance; roof-to-wall strength; wall-to-floor-to-foundation strength; opening protection; and window, door, and skylight strength. Options for each feature are identified based on construction practice. Algorithms for modifying the vulnerability functions, for both structural and nonstructural components, are developed based on engineering principles and building performance observations.

The module supports any combination of multiple building features impact on the overall building damage and produces a modification function to the vulnerability function. The modification function captures the changes to building vulnerability that result when certain building features are present and when information on such building features is known. The modification function varies with the wind intensity to reflect the relative effectiveness of a building feature when subject to different wind speeds.

The building vulnerability component of the AIR Hurricane Model for the U.S. explicitly addresses construction built in accordance to the Florida Building Code versions, FBC2001 and FBC 2010. Methods for estimating the effects of mitigation measures, as described in Appendix 9, are theoretically sound. Disclosure V.3.7 provides an understanding of the treatment of uncertainty in AIR's Hurricane Model for the U.S.

B. Application of mitigation measures that enhance the performance of the building and its contents shall be justified as to the impact on reducing damage whether done individually or in combination.

The methods of applying mitigation measures are reasonable, both individually and in combination. The mitigation measures are applied using the Individual Risk Methodology, which follows a structured, logical approach that groups building characteristics according to their function. In this way the methodology reflects the contribution of each characteristic to the overall building performance. The result is a modified damage function that reflects the impact of one or more selected building characteristics appropriately.

Weightings are used to combine the effects of multiple features whose interaction is complex and not necessarily additive. For example, when considering the roof system, roof age, roof pitch, roof covering, roof decking and attachment, and roof geometry modify the performance of the roof as a whole and therefore the weight should be used as a multiplier. The weights are dependent on wind speed and construction class, and are appropriately selected to reflect the importance of a feature at certain levels of a building's damage state.

There exists limited detailed damage and insurance company claims data with information about mitigation measures. The model has been validated using damage reports from previous hurricanes, engineering judgment, and loss data whenever available.

The Individual Risk Methodology is described in further detail in Appendix 9.

Relevant Forms: G-4, Vulnerability Standards Expert Certification
V-2, Mitigation Measures – Range of Changes in Damage
V-3, Mitigation Measures – Mean Damage Ratios and Loss Costs (Trade Secret item)
A-6, Logical Relationship to Risk (Trade Secret item)

Disclosures

1. *Describe any modifications to mitigation measures in the model since the previously accepted model.*

The following are some of the modifications to the wind mitigations measures, outlined in Appendix 9, used in the model since the previously accepted version:

- The application of the "certified structures" secondary risk feature has been extended for commercial occupancies
- The implementation of the "roof year built" secondary risk feature has been enhanced to default to a new roof for those structures that are built within the last ten years

Enhancements are made to the "seal of approval" secondary risk feature.

2. *Provide a completed Form V-2, Mitigation Measures – Range of Changes in Damage. Provide a link to the location of the form [insert hyperlink here].*

A completed Form V-2 is provided in Excel format, and is included on page 260. Note that AIR's Form V-2 includes more than the minimum mitigation measures required.

3. *Provide a description of the mitigation measures used by the model, whether or not they are listed in Form V-2, Mitigation Measures – Range of Changes in Damage.*

Table 18 includes all mitigation measures that are available in the AIR Hurricane Model for the U.S. Please note that Table 45 provides the modification factor corresponding to these features, except for the seal of approval, which augments the impact of other relevant mitigation features.

Table 18. Mitigation Measures in the AIR Hurricane Model for the U.S.

Mitigation Measures	Description
Building Condition	A general qualitative description of building condition from visual inspection
Tree Exposure	Describes the tree hazard around the building
Small Debris Source	Describes the potential of small debris in a radius of 200 feet
Large Missile Source	Describes the potential of large missiles in a radius of 100 feet
Roof Geometry	Describes the shape of the roof
Roof Pitch	Addresses the roof slope
Roof Covering	The nature of material used to cover the roof
Roof Deck	Material and construction type of the roof deck of building
Roof Cover Attachment	Nature of the connections used to secure the roof covering to the roof deck
Roof Deck Attachment	Nature of the connections used to secure the roof deck to the underlying roof support system
Roof Anchorage	Nature of connections used to secure the roof support systems to the walls
Wall Type	Materials used for external walls of the building
Wall Siding	Materials used for weathering protection of walls
Glass Type	Type of glass used in building
Glass Percentage	The percent area of the walls covered by glass
Window Protection	Describes the nature of wind protection systems used
Exterior Doors	Describes the nature of the exterior doors in the building
Foundation Connection	Connection type between the structure and foundation
Roof Attached Structures	Description of the mechanical and other equipment on top of roofs
Wall Attached Structures	Components of a property that are not an integral part of the main building but are physically attached to it
Appurtenant Structures	Components of a property that are not an integral part of the main building and are not connected to it
Roof Year Built	The year the roof was put in place
Seal of Approval	Accounts for level of professional engineering attention given to the design of the structure
Certified Structures*	Indicates whether the building at the location has achieved an Insurance Institute for Business and Home Safety (IBHS) FORTIFIED designation

*A combination of multiple mitigation measures aforementioned in this table is enabled to represent a particular certified structure designation.

4. *Describe how mitigation measures are implemented in the model. Identify any assumptions.*

AIR's Individual Risk Model is integrated in the hurricane loss projection model to estimate the impact of mitigation features on building vulnerability. When any combination of the individual mitigation features listed in Table 18 is provided, the individual risk model calculates the corresponding credits and applies them to the base vulnerability functions to obtain refined vulnerability functions for buildings with mitigation features. AIR's Individual Risk Model has been developed using a structured, engineering based framework that applies structural engineering expertise and building damage observations made in the aftermath of actual hurricanes, including the 2004-05 events (See Appendix 9 for details). Options for each feature are identified based on general construction practices.

Algorithms for modifying the vulnerability functions for both structural and nonstructural components are developed based on engineering principles and observations of building performance. The module supports the effects of combination of building features on building damage, and produces a modification function to the vulnerability function. The modification function captures the changes to building vulnerability that result when certain building features are present and when information on such building features is known. The modification function varies with the wind intensity to reflect the relative effectiveness of a building feature when subjected to different wind speeds.

There are two primary metrics in the model—rates and weights—for evaluating the impact of a mitigation feature on overall building performance. The rate is a weighted value assigned to the various options for building or environmental features. The rate for any given option of a particular feature reflects the relative prevalence of use among the available options, and is independent of other features. That is, the value is designed such that the most commonly used option is assigned a value close to 1.0. The implication is that a building with this option is expected to perform very similarly to the average, or "typical" building represented by the base damage functions. If no information is available on the option, the default value is 1.00, which means that the base damage function is used without modification.

The second metric, the weight, is a value of one of two types. The first weight type is used to develop simple weighted averages which are used to evaluate the loss contribution of several features that together constitute a system, such as roof. They are dependent on wind speed; that is, the contribution of each feature varies with wind speed. For example, a roof may consist of three features: roof covering, roof deck, and roof attachment. The loss contribution to the roof system from these three features is expected to be different at different wind speeds. At low wind speeds, the roof covering drives the damage since it is at relatively low wind speeds that damage to roof covering occurs. As wind speeds increase, the roof deck becomes vulnerable. In this case, roof deck failure will result in loss of roof covering regardless of the type (or option) of roof covering present. Therefore, as wind speed increases, the weight for roof deck increases. In contrast, at higher wind speeds, the weight for roof covering decreases because it is already lost. The sum of the weights for a system should add up to 1.0.

The second type of weight metric is used to combine the effects of features whose interaction is complex and not necessarily additive. These are introduced to evaluate features that modify the performance of the system. If we consider roof system as an example, the age, pitch, and geometry of the roof all modify the performance of the system as a whole. The weight, therefore, should be used as a multiplier. These weights are appropriately selected to reflect the importance of a feature at certain levels of a building's damage state.

5. *Describe how the effects of multiple mitigation factors are combined in the model and the process used to ensure that multiple mitigation measures are correctly combined.*

Disclosure V.3.4 describes in detail the process of combining the effect of different mitigations. The impact of different features is combined in a logical way that is based on the engineering principles and damage observations. As with the building, content, and time element vulnerability models, the functionality of the modeled mitigation factors is compared against historical insurance loss data for validation. This comparison ensures that the modeled assumptions are combined/handled properly.

6. *Describe how building and contents damage are affected by performance of mitigation measures. Identify any assumptions.*

Standard V.3.A and Disclosure V.3.4 describe in detail how the impact of mitigation measures is captured in deriving building vulnerability functions. AIR's Individual Risk Model is integrated in the hurricane loss projection model to estimate the impact of mitigation features on building vulnerability. When any combination of the mitigation features listed in Table 18 is provided, the Individual Risk Model calculates the corresponding credits and applies them to the base vulnerability functions to obtain refined vulnerability functions for buildings with mitigation features.

Content damage is calculated using the building damage for residential and commercial residential exposures in the AIR model. Since mitigation measures are explicitly accounted for when estimating building damage in the model, consequently content damage will account for such measures as well.

7. *Describe how mitigation measures affect the uncertainty of the vulnerability. Identify any assumptions.*

The AIR model captures uncertainty in damage at a given location from an event by characterizing the damage ratio, defined as the repair cost divided by the replacement value, as a random variable and defining its probability law. The vulnerability function is a representation of mean damage ratio as a function of hazard and there is a probability distribution around the mean damage ratio, which changes at different levels of damage. When mitigation measures are used, the vulnerability function (mean damage ratio) changes to reflect the refined vulnerability due to the chosen mitigation features, which in turn changes the probability distribution of damage. Accordingly, mitigation measures implicitly affect the uncertainty in vulnerability by changing the mean damage ratio in the model. An underlying assumption is that a significant portion of the uncertainty in damage at a given location can be attributed to uncertainty in wind loads (wind speed, its evolution over time, and how wind interacts with the building structure) acting on the structure.

Florida Commission on Hurricane Loss Projection Methodology

2015 Actuarial Standards

A-1 Modeling Input Data and Output Reports

A. *Adjustments, edits, inclusions, or deletions to insurance company or other input data used by the modeling organization shall be based upon accepted actuarial, underwriting, and statistical procedures.*

Any adjustments, edits, inclusions or deletions made to client company or other input data are based upon accepted actuarial, underwriting and statistical procedures.

B. *All modifications, adjustments, assumptions, inputs and input file identification, and defaults necessary to use the model shall be actuarially sound and shall be included with the model output report. Treatment of missing values for user inputs required to run the model shall be actuarially sound and described with the model output report.*

Modeling input data is provided by the user for each catastrophe loss analysis. Each input file is identified by the user. Documentation for the minimum data required and expected default values can be found in Touchstone documentation, the model output report(s) and on AIR's data specifications website, www.unicede.com. Upon import, Touchstone validates the data provided. If there is insufficient data provided by the user, the errors will be captured in the model output report(s), and the record is removed from the analysis. All modifications, adjustments, assumptions, inputs and input file identification, and defaults necessary to use the model are actuarially sound and are included with the model output reports and documentation. Treatment of missing values required to run the model is actuarially sound and described in Touchstone documentation and the model output report(s).

Relevant Form: G-5, Actuarial Standards Expert Certification

Disclosures

1. *Identify insurance-to-value assumptions and describe the methods and assumptions used to determine the property value and associated losses. Provide a sample calculation for determining the property value.*

To calculate losses, the model requires replacement value be entered by the user, and entry of insured limits is strongly recommended. Loss amounts are capped at insured limit by coverage. The model makes no insurance to value assumptions in the absence of provided limits, and it does not determine property value directly. An insurer may make specific assumptions to the input data if they are aware that insurance-to-value issues exist in their book.

Table 19. Sample Calculation for Adjusting Input Values for ITV Assumptions

	Building Limit
Original Limit	$100,000
Underinsurance Assumption	15%
Adjusted Limit	($100,000 / (1.00 - 0.15) = $117,650

AIR recommends the user input the Adjusted Limit for the example shown above, to account for the underinsurance assumption.

2. *Identify depreciation assumptions and describe the methods and assumptions used to reduce insured losses on account of depreciation. Provide a sample calculation for determining the amount of depreciation and the actual cash value (ACV) losses.*

The model makes no depreciation assumptions in the absence of provided inputs, and it does not determine depreciation value directly. If insurance contracts contain ACV provisions, the insurer must determine the amount of depreciation to input for each record. This value can be entered with the input exposure data, and Touchstone will adjust the gross loss estimates accordingly.

Table 20. Sample Calculation for Determining ACV Losses*

	Actual
Replacement Value	$100,000
Limit	$100,000
Depreciation Factor	0.6
Ground-up Loss Estimate	$50,000
Gross Loss Estimate	Min [($50,000 x 0.6) , $100,000]

** ignoring application of deductible and secondary uncertainty*

3. *Describe the methods used to distinguish among policy form types (e.g., homeowners, dwelling property, manufactured home, tenants, condo unit owners).*

The AIR Hurricane Model for the U.S. can distinguish all policy form types. The way the model distinguishes policy form types is through exposure coding. Exposures are distinguished based on vulnerability characteristics, such as construction type and occupancy. Policy form (i.e. dwelling property) can also be carried as a reporting field, but it is not explicitly modeled. For all policy forms, losses are estimated separately based on vulnerability characteristics coded on the exposure and by coverage for coverage A, B, C, and D or any combination. The model can produce loss costs for defined groups of policies if vulnerability characteristics are known. Such characteristics are described in Standard V-1.

4. *Provide a copy of the input form(s) used by the model with the model options available for selection by the user for the Florida hurricane model under review. Describe the process followed by the user to generate the model output produced from the input form. Include the model name and version identification on the input form. All items included in the input form submitted to the Commission should be clearly labeled and defined.*

There is no single required input form for exposure data being imported into the software. It is flexible enough to handle many types of input formats. Comma Separated Value (.csv) files are commonly used to import data into Touchstone. The Import section of the Touchstone Online Help describes the format of csv files that can be used to import detailed exposure information into Touchstone and the Exposure Data Validation section of the Touchstone Online Help details the exposure data elements that can be input for the derivation of loss estimates from the model.

A sample of an input form used by the model is shown below. During the import process, the user can set default import assumptions, shown in Figure 48.

Modeling Organization:	**AIR Worldwide**											
Model Name & Version Number:	**AIR Atlantic Tropical Cyclone Model v16.0.0 as Implemented in Touchstone 4.1.0**											
Sample Input Data												
Contract ID	Location ID	State	County	Postal	Country	Currency	Num Risks	Repl Value Building	Repl Value Other Structures	Repl Value Contents	Repl Value Time Element	Repl Value Days
3_OF_0000_00_0dol_0_00_0_0_0	3_OF_0000_00_0dol_0_00_0_0_0_00041_011	FL	11	41	US	USD	1	100000	10000	50000	150	1
3_OM_0000_00_0dol_0_00_0_0_0	3_OM_0000_00_0dol_0_00_0_0_0_00041_011	FL	11	41	US	USD	1	100000	10000	50000	150	1
3_MH_0000_01_0dol_0_00_0_0_0	3_MH_0000_01_0dol_0_00_0_0_0_00041_011	FL	11	41	US	USD	1	50000	5000	25000	150	1
3_OF_0000_00_0dol_0_00_0_0_0	3_OF_0000_00_0dol_0_00_0_0_0_00042_009	FL	9	42	US	USD	1	100000	10000	50000	150	1
3_OM_0000_00_0dol_0_00_0_0_0	3_OM_0000_00_0dol_0_00_0_0_0_00042_009	FL	9	42	US	USD	1	100000	10000	50000	150	1
:	:	:	:	:	:	:	:	:	:	:	:	:
...cont'd												
Construction Code	Occupancy Code	Year Built	Number Stories	Peril	Limit Type	Limit A	Limit B	Limit C	Limit D	Deductible Type	Deductible	
101	301	0	0	PWH	C	100000	10000	50000	20000	CB	0	
111	301	0	0	PWH	C	100000	10000	50000	20000	CB	0	
191	301	0	1	PWH	C	50000	5000	25000	10000	CB	0	
101	301	0	0	PWH	C	100000	10000	50000	20000	CB	0	
111	301	0	0	PWH	C	100000	10000	50000	20000	CB	0	
:	:	:	:	:	:	:	:	:	:	:	:	
Definitions:												
Limit Type = how the limits are applied; a limit type of C, for example, specifies the limits are applied by coverage												
Deductible Type = how the deductibles are applied; a type of CB, for example, specifies the deductibles are applied by coverage												

Figure 47. Sample Input File

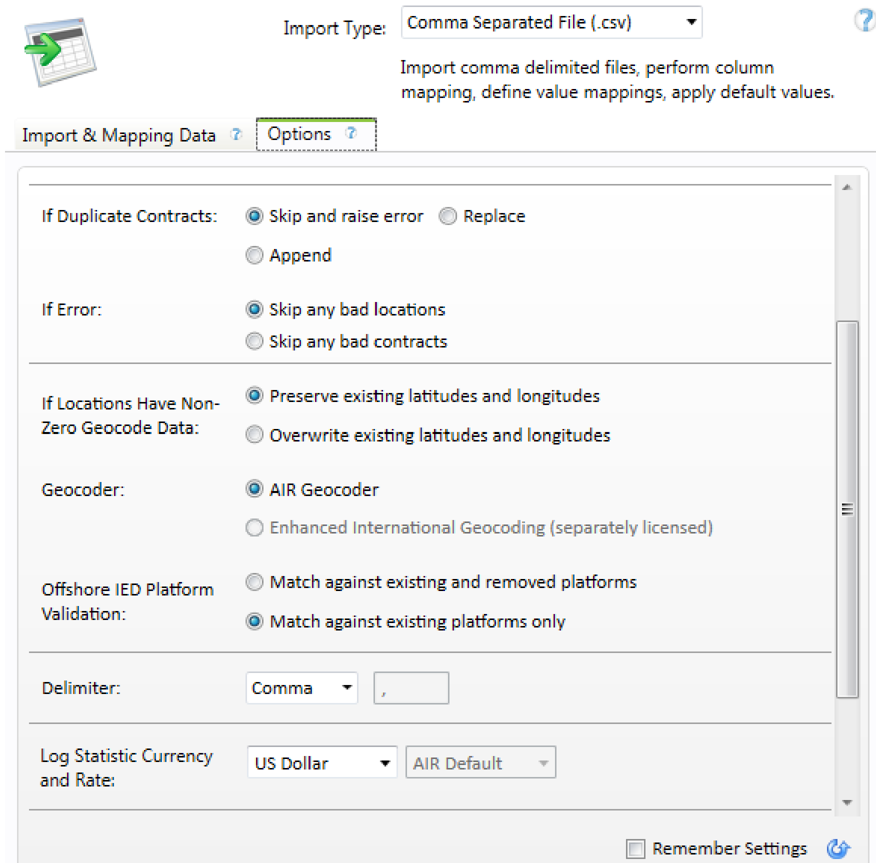


Figure 48. Model Input Options

The process followed by the user to generate the model output produced by such input is shown in Figure 49.

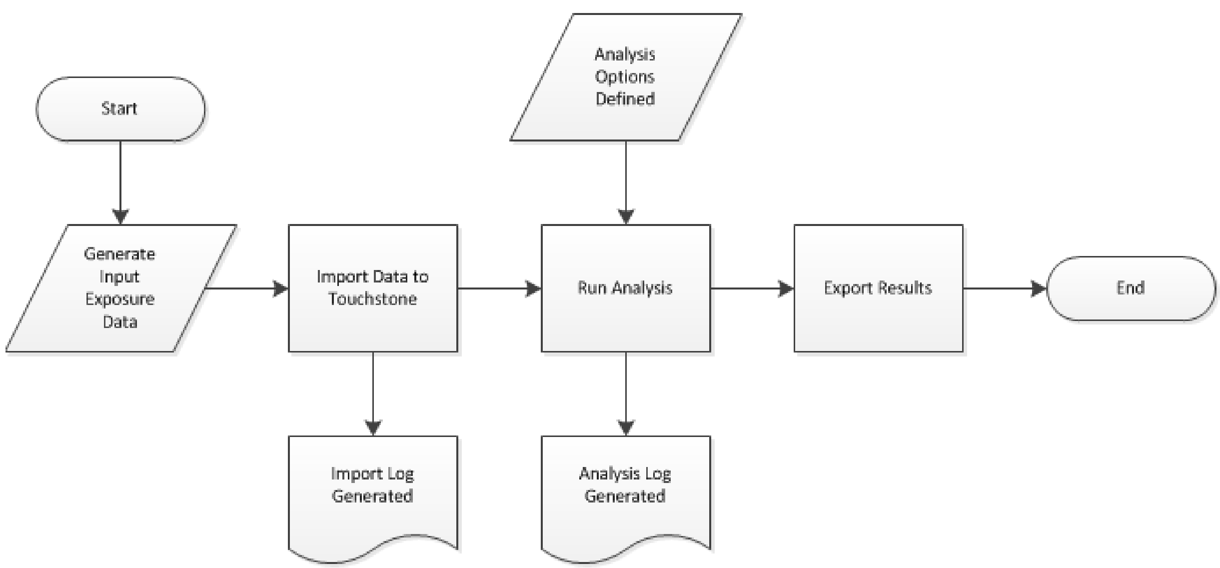


Figure 49. Creating Model Output

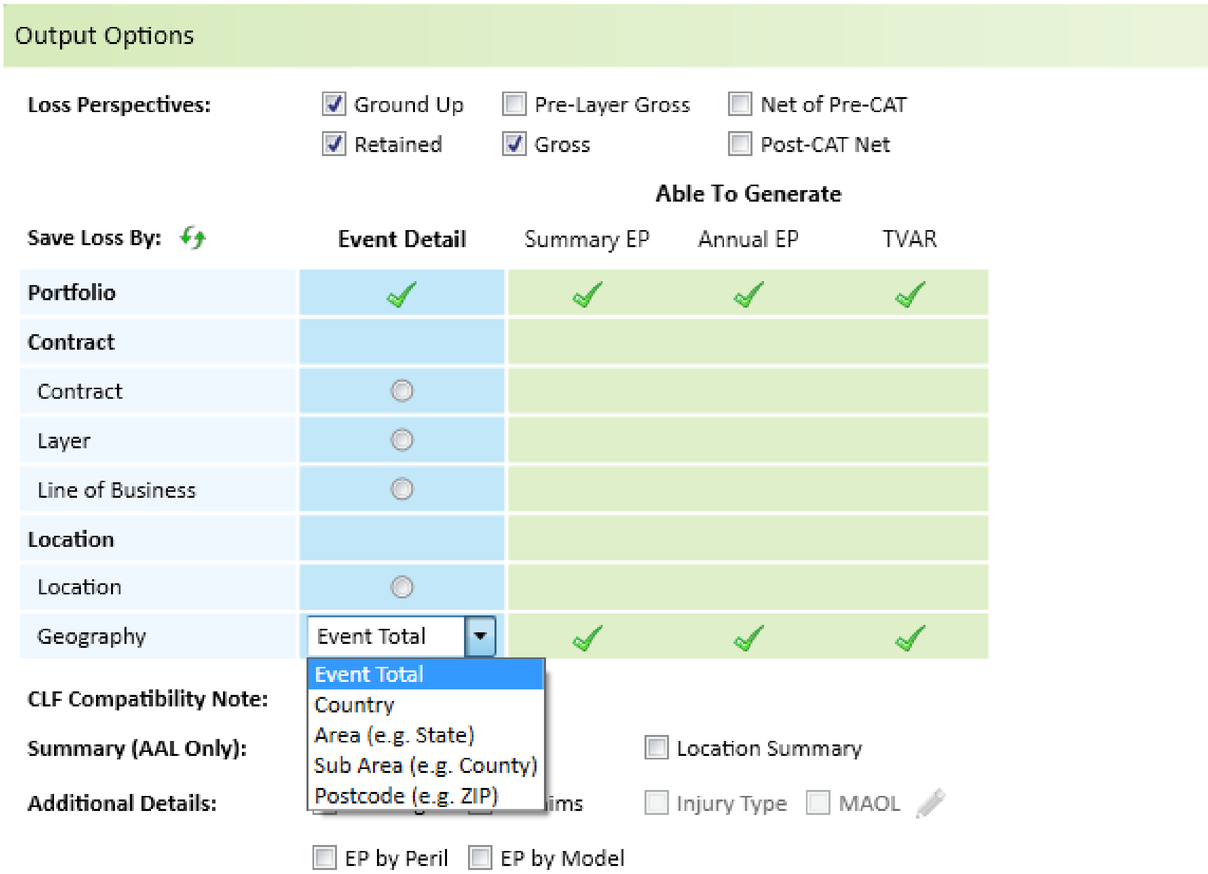


Figure 50. Output Options Dialog Box Displayed in the Touchstone User Interface

Figure 50 above shows the options available to the user for output detail, which are defined when the analysis is set up. These settings can be customized depending on the user's needs. The output options do not change the loss estimates, just the perspective and detail at which the estimates are reported from the software.

5. *Disclose, in a model output report, the specific inputs required to use the model and the options of the model selected for use in a residential property insurance rate filing. Include the model name and version identification on the model output report. All items included in the model output report submitted to the Commission shall be clearly labeled and defined.*

In addition to the input exposure data, the user must define specific inputs (or analysis options) in order to run a catastrophe loss analysis. These inputs are disclosed in Touchstone's analysis log, a sample of which is included in Appendix 6.

As a user initiates an analysis in Touchstone, they must customize their analysis options. Analysis options govern which settings are turned on and off for a particular analysis. Certain analysis options affect the resulting loss estimates in Florida, while others do not. AIR has identified the following analysis options as required for rate making in Florida. Table 21 is divided into two parts: required and optional analysis settings. AIR recommends the required settings to be used, while optional settings may be customized by the user depending on their portfolio and reporting needs.

Table 21. Catastrophe Peril Analysis Options Applicable for Florida Rate Making

Analysis Option	Setting	Notes
Required Settings		
Event Set	*50K US AP (2015) - Standard*	The event sets that are included in the list depend on the countries and perils licensed. The 50k or 100k Standard event set must be used.
Peril	Only check *Tropical Cyclone - Wind*	Losses from wind are covered by residential policies. Storm surge losses must be excluded. Storm surge is an abnormal rise in sea level accompanying a hurricane or other storm. Users can include an estimate of the separately modeled storm surge losses when calculating losses for tropical cyclone events. When the storm surge peril box is unchecked, the model will only report wind modeled losses, and exclude storm surge losses.
Demand Surge	*On*	The demand surge analysis option inflates loss results to reflect the increased cost of labor and materials following a major catastrophe. As the industry loss rises, so will the cost to repair and replace properties damaged in the event; the greater the industry loss for an event, the greater the Demand Surge factor used in the calculations. Touchstone comes with a standard demand surge curve for the U.S.
Correlation	*Off*	The correlation analysis option allows users to choose to apply correlation factors between loss distributions during an analysis. This option generally applies in the case of multi-contract or multi-location commercial policies.
Flexibility Option (a.k.a. Loss Modification Factor)	*None (displayed in Analysis Log as "Not Available")*	Touchstone allows users to apply a loss modification factor directly to ground-up losses that AIR models produce. This function enables users to perform sensitivity analyses on potential portfolio losses. Selecting None will produce only the AIR default loss perspective, therefore this is the required setting for any Florida rate filing analyses.
Event Set Filter	*Do Not Apply*	Applying an event set filter enables a user to run a standard loss analysis for a user-defined subset of events in the selected event set. For rate filing in Florida, no event set filters should be applied

Analysis Option	Setting	Notes
Optional Settings		
Average Properties	*Automatic, On* or *Off*	When the input exposures are coded at a ZIP Code resolution, the Average Properties option enables Touchstone to apply average physical properties, such as soil type and land use/land cover data, at a region-specific geographic resolution, during a loss analysis. Touchstone automatically assigns the properties based on the geocode match level assigned during import. For example, Average Properties will be turned on if exposures are geocoded to the ZIP Code centroid level.
Invalid Construction/Occupancy Pairs	*Use System Default* or *Ignore*	A location that has an invalid construction/occupancy combination (e.g. Manufactured Home construction with an occupancy of automotive manufacturing) will be included or excluded in a loss analysis depending on the user's selection. If the Use System Default option is chosen, the software will convert the invalid codes into an unknown construction and general commercial occupancy. If the Ignore option is chosen, the location will not be analyzed.
Apply Location Terms for Residential Contracts	*Use AIR Default behavior or Deductibles Before Limit*	The AIR default behavior for application of location terms for residential contracts applies the policy limit before the deductible. The option, Deductibles Before Limit, applies the deductible before the limit. See response to Standard A-5.A for an example of the AIR Default behavior.
Disaggregation	*On or Off*	When enabled, the Disaggregation Financial Settings parameter distributes aggregate (coarse resolution) location data down to a finer resolution to locations where exposures are likely to be located based on lines of business represented in AIR's Industry Exposure Database. This process enables Touchstone to apply policy terms appropriately across an entire (distributed) region rather than applying them only across the centroid of the region; this generates more accurate loss results for risk locations with poor quality data because it avoids analysis of aggregate exposures at a single-point location. For additional data on disaggregation, please see the Touchstone document *Exposure Disaggregation in Touchstone*.

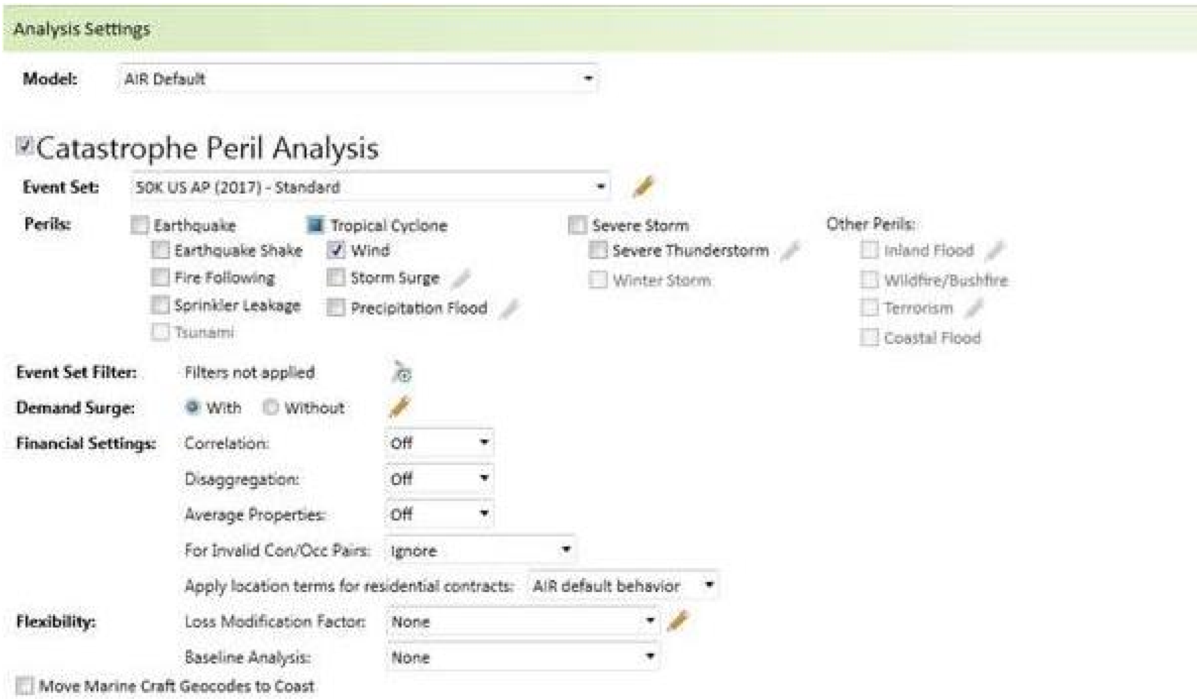


Figure 51. Catastrophe Peril Analysis Dialog Box Displayed in the Touchstone User Interface

Figure 51 above shows the catastrophe peril analysis dialog box in Touchstone.

6. *Describe actions performed to ensure the validity of insurer or other input data used for model inputs or validation/verification.*

Touchstone applies validation rules during exposure data import, as well as within the exposure-related portions of the Touchstone user interface. When a validation error occurs, Touchstone writes the error to the import log file, giving the user the ability to correct the issue before continuing with the analysis. A sample import log is contained in Appendix 6. AIR's www.unicede.com website contains documentation for the extensive validations performed to ensure the validity of insurer or other input data used for modeling.

7. *Disclose if changing the order of the model input exposure data produces different model output or results.*

Changing the order of the model input data does not impact results of loss analyses.

8. *Disclose if removing and adding policies from the model input file affects the output or results for the remaining policies.*

Adding or removing policies from the model input file does not impact the Ground up, Retained (by insured), or Gross (net of policy terms) results of a loss analysis. Net of Pre-Cat and Post-Cat Net results may be impacted, as they may reflect the impact of reinsurance treaties that may be dependent on losses for the portfolio as a whole or the aggregation of losses over a certain threshold.

A-2 Event Definition

A. ***Modeled loss costs and probable maximum loss levels shall reflect all insured wind related damages from storms that reach hurricane strength and produce minimum damaging windspeeds or greater on land in Florida.***

Modeled loss costs and probable maximum loss levels reflect all insured wind related damages from storms that reach hurricane strength and produce minimum damaging windspeeds or greater on land in Florida.

Relevant Forms: G-5, Actuarial Standards Expert Certification
A-2, Base Hurricane Storm Set Statewide Losses

Disclosures

1. *Describe how damage from model generated storms (landfalling and by-passing) is excluded or included in the calculation of loss costs and probable maximum loss levels for Florida.*

The calculation of loss costs and probable maximum losses includes the losses from all hurricanes that make landfall in Florida or are Florida bypassers. Damage is included in the calculation of loss costs and probable maximum losses from the time the hurricane first causes damaging wind speeds on land in Florida.

2. *Describe how damage resulting from concurrent or preceding flood or hurricane storm surge is treated in the calculation of loss costs and probable maximum loss levels for Florida.*

Wind and surge losses are calculated independently in the AIR Hurricane Model for the U.S. For a given location, the model separately calculates the losses from wind and surge perils. Model users have the option to include, exclude or include only a percentage of the surge losses along with wind losses in the reported loss estimates. For purposes of this submission, surge losses were completely excluded from the reported results.

A-3 Coverages

A. The methods used in the calculation of building loss costs shall be actuarially sound.

The AIR Hurricane Model for the U.S. represents losses to building coverage separately from contents, and appurtenant structures and time element. The methods used in the calculation of building coverage loss costs are actuarially sound.

B. The methods used in the calculation of appurtenant structure loss costs shall be actuarially sound.

The AIR Hurricane Model for the U.S. represents losses to appurtenant structure coverage separately from building, contents, and time element. The methods used in the calculation of appurtenant structure coverage loss costs are actuarially sound.

C. The methods used in the calculation of contents loss costs shall be actuarially sound.

The AIR Hurricane Model for the U.S. represents damages to contents separately from buildings, appurtenant structures and time element since some policies cover contents only and others provide no contents coverage. The methods used in the calculation of contents loss costs are actuarially sound.

D. The methods used in the calculation of time element loss costs shall be actuarially sound.

The AIR Hurricane Model for the U.S. represents losses to time element (also referred to as Additional Living Expense, or "ALE") coverage separately from building, contents and appurtenant structures. The methods used in the calculation of time element coverage loss costs are actuarially sound.

Relevant Form: G-5, Actuarial Standards Expert Certification

Disclosures

1. *Describe the methods used in the model to calculate loss costs for building coverage associated with personal and commercial residential properties.*

The model uses a catalog of simulated events to estimate hurricane losses for each exposure location that is input. For a given location, each event produces a range of wind speeds over the duration of the event. The model applies a vulnerability analysis to each location and, given the intensity of each simulated event, a probability distribution of damage is developed for the property at the policy coverage level (buildings, appurtenant structures, contents, and time element). The model has distinct relationships for personal and commercial residential structures.

AIR's stochastic event catalogs are designed to produce a complete and stable range of potential annual experience of catastrophe activity. Once complete, a catastrophe loss analysis yields estimated hurricane losses for building coverage. Loss costs are calculated as the sum of the estimated hurricane building coverage losses over all stochastic events, divided by the number of years in the simulation and by insured exposure.

2. *Describe the methods used in the model to calculate loss costs for appurtenant structure coverage associated with personal and commercial residential properties.*

The model estimates hurricane losses for appurtenant structure coverage associated with personal and commercial residential properties using the method described in Disclosure 1. The model has distinct appurtenant structures relationships for personal and commercial residential structures. Loss costs are calculated as the sum of the estimated hurricane appurtenant structures coverage losses over all stochastic events, divided by the number of years in the simulation and by insured exposure.

3. *Describe the methods used in the model to calculate loss costs for contents coverage associated with personal and commercial residential properties.*

The model estimates hurricane losses for contents coverage associated with personal and commercial residential properties using the method described in Disclosure 1. The model has distinct contents coverage relationships for personal and commercial residential structures. Loss costs are calculated as the sum of the estimated hurricane contents coverage losses over all stochastic events, divided by the number of years in the simulation and by insured exposure.

4. *Describe the methods used in the model to calculate loss costs for time element coverage associated with personal and commercial residential properties.*

The model estimates hurricane losses for time element coverage associated with personal and commercial residential properties using the method described in Disclosure 1. The model has distinct time elements coverage relationships for personal and commercial residential structures. Loss costs are calculated as the sum of the estimated time element building coverage losses over all stochastic events, divided by the number of years in the simulation and by insured exposure.

A-4 Modeled Loss Cost and Probable Maximum Loss Considerations

A. Loss cost projections and probable maximum loss levels shall not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

The AIR Hurricane Model for the U.S. produces pure loss estimates. Modeled loss costs and probable maximum loss levels do not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margins.

B. Loss cost projections and probable maximum loss levels shall not make a prospective provision for economic inflation.

The model does not make a prospective provision for economic inflation. Clients' in-force exposures, projected exposures or hypothetical exposures are input to the model.

C. Loss cost projections and probable maximum loss levels shall not include any explicit provision for direct hurricane storm surge losses.

Model users have the option to include, exclude or include only a percentage of the surge losses along with wind losses in the reported loss estimates. For this submission, modeled loss costs and probable maximum loss levels do not include any explicit provision for direct hurricane storm surge losses.

D. Loss cost projections and probable maximum loss levels shall be capable of being calculated from exposures at a geocode (latitude-longitude) level of resolution.

Loss cost projections and probable maximum loss levels are capable of being calculated from exposures at a geocoded (latitude-longitude) level of resolution.

E. Demand surge shall be included in the model's calculation of loss costs and probable maximum loss levels using relevant data and actuarially sound methods and assumptions.

Loss costs and probable maximum loss levels in AIR's submission reflect use of a function to account for the effects of temporary cost inflation resulting from increased demand for materials and services to repair and rebuild damaged property after a major catastrophe event ("demand surge"). AIR's demand surge function has been developed using relevant data and actuarially sound methods and assumptions.

Relevant Form: G-5, Actuarial Standards Expert Certification

A-8, Probable Maximum Loss for Florida

Disclosures

1. *Describe the method(s) used to estimate annual loss costs and probable maximum loss levels. Identify any source documents used and any relevant research results.*

For a given set of exposures (i.e. replacement values) by coverage, by ZIP Code or other geographical grouping and by construction type, losses are estimated and aggregated over events in our catalog, which comprises thousands of simulated years. Average annual losses by location are calculated by dividing the total losses for all simulated storms by the number of simulated years. Losses can be stated on a 'ground-up,' a 'gross' basis net of only direct policy conditions such as limits and deductibles, or a 'net' basis net of reinsurance recoveries. For this submission, losses are stated on a ground-up or gross basis as requested in the Forms.

Loss costs for a given ZIP Code or county are calculated by dividing the average annual losses for all locations within a geographical area by the corresponding insured exposure.

Probable maximum losses (PMLs) are calculated by ranking the largest loss within each simulated year (or aggregation of the annual losses) to the provided exposure data set from highest to lowest, then identifying the event loss (or the annual aggregate loss) whose rank matches the "exceedance probability" (EP) requested under the relative frequency interpretation of probability. A PML is meaningless without an associated "return period", and a return period associated with a PML is the reciprocal of the exceedance probability.

For example, among the largest simulated events in each year, the event whose loss ranks 1,000th highest among all events would have an exceedance probability of 1,000/50,000 or 2%. The corresponding return period for this probable maximum loss would be 1/(2%), or 50 years.

It follows that probable maximum losses vary according to the loss perspective (ground-up, gross or net) requested, as the event loss rankings may differ net of policy or reinsurance conditions.

2. *Identify the highest level of resolution for which loss costs and probable maximum loss levels can be provided. Identify all possible resolutions available for the reported output ranges.*

Loss costs can be provided at any geographic level desired: state, county, ZIP Code, rating territory, grid square, or specific location (described by a latitude-longitude pair). The reported output ranges in this submission (Form A-4, Output Ranges) use 5-digit ZIP Code resolution. Probable maximum loss levels can also be provided at any geographic level desired. The process for developing probable maximum losses is the same regardless of the starting data (i.e. event losses for Florida or event losses for a specific ZIP Code). It follows that probable maximum losses vary according to the geographic level (i.e. statewide losses or losses for a single Florida ZIP Code) requested, as the event loss rankings may differ.

3. *Describe how the model incorporates demand surge in the calculation of loss costs and probable maximum loss levels.*

Evidence from major catastrophic events in past years suggests that after a major event, increased demand for materials and services to repair and rebuild damaged property can put pressure on prices, resulting in temporary inflation. This phenomenon is often referred to as demand surge and it results in increased losses to insurers.

Key Factors Leading to Demand Surge

Sudden increase in demand: A catastrophic event causes widespread damage to property, which leads to a sharp increase in the need for building materials and services. Demand for resources such as labor, transportation, equipment and storage also increases sharply in the affected area. Resource availability in any regional economy is typically sufficient to accommodate normal demand, even taking into account some buffer. However, an unexpected increase in demand can lead to shortages and price increases.

Time element losses: When there is widespread damage to property, low regional capacity to meet the increased demand can result in longer than normal repair times. This, in turn, results in greater business interruption losses and additional living expenses. Infrastructure damage, delayed building permit processes, and a shortage of available building inspectors are also factors in increasing time element loss.

How the Model Incorporates Demand Surge

AIR has related the amount of demand surge in a particular event to the amount of total industry-wide insurable losses from the event. The factor is dependent on coverage. A table incorporated into the software contains the corresponding demand surge factors, by coverage, for different levels of industry-wide losses.

For a given event, the demand surge factors by coverage are applied to the corresponding ground-up losses, based on the industry-wide loss for that event. Policy conditions are then applied probabilistically. The sum of these losses by coverage yields the total event loss with demand surge included.

Very few data points exist to create and validate a demand surge curve, resulting in significant uncertainty about the level of demand surge following an event.

4. *Provide citations to published papers, if any, or modeling organization studies that were used to develop how the model estimates demand surge.*

No published papers on demand surge were used to develop how the model estimates demand surge. AIR has prepared a white paper for its clients documenting the development of demand surge estimates in the model. This paper may be shared as trade secret material.

5. *Describe how economic inflation has been applied to past insurance experience to develop and validate loss costs and probable maximum loss levels.*

Past insurance experience used to develop and validate loss costs and probable maximum loss levels is used without applying economic inflation. Actual insured claims losses are compared with modeled losses, which are produced using actual insured exposures from the time of the historical hurricane.

A-5 Policy Conditions

A. The methods used in the development of mathematical distributions to reflect the effects of deductibles and policy limits shall be actuarially sound.

The methods used in the development of mathematical distributions to reflect the effects of deductibles and policy limits are actuarially sound. The AIR damageability functions generate a mean damage ratio for a given wind speed. For any estimated mean damage ratio, there is a mixed probability distribution, $f_{\overline{D}}$, that includes finite probabilities of damage at zero and 100 percent. This representation of the damage ratio fits well with observed data. A sample distribution is shown in Figure 52.

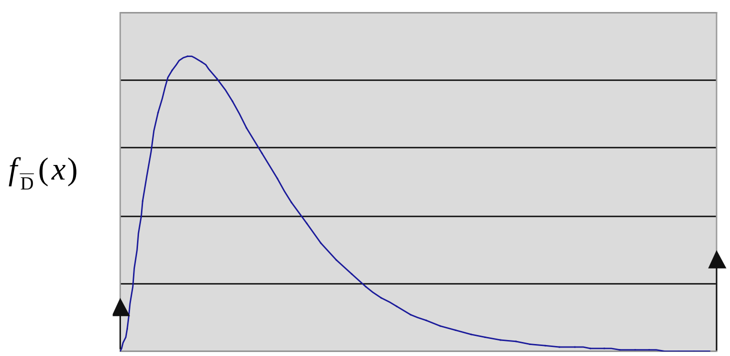


Figure 52. Probability Distribution Around the Mean Damage Ratio

Thus, the effects of deductibles, coinsurance and other policy conditions can be properly calculated, as this sample insured loss calculation illustrates:

$$\text{Expected Insured Loss} = \int_{x=0}^{1} f_{\overline{D}}(x) \max\left\{0,\ \text{Coins\%} * \left[\min\left(\text{x} * \text{RV}, \text{PL}\right) - \text{DED}\right]\right\} dx$$

where	Coins%	=	Coinsurance Percentage
	RV	=	Replacement Value
	PL	=	Policy Limit
	DED	=	Deductible
	x	=	Random Variable for Damage Ratio

In application, $f_{\overline{D}}(x)$ is discretized and numerical integration is used to estimate the expected insured loss.

B. The relationship among the modeled deductible loss costs shall be reasonable.

The relationship among the modeled deductible loss costs is reasonable. Loss costs do decrease as deductibles increase, other factors held constant.

C. Deductible loss costs shall be calculated in accordance with s. 627.701(5)(a), F.S.

The AIR Hurricane Model for the U.S. explicitly enables the application of annual deductibles in accordance with s. 627.701(5)(a), F.S. The statute requires the application of the hurricane deductible to the first event, and the greater of the remaining hurricane deductible and the all other perils deductible to losses from subsequent events in the same calendar year.

Relevant Form: G-5, Actuarial Standards Expert Certification

Disclosures

1. *Describe the methods used in the model to treat deductibles (both flat and percentage), policy limits, and insurance-to-value criteria when projecting loss costs and probable maximum loss levels.*

For any estimated mean damage, there is a probability distribution around that mean. Thus, expected damages above different deductible levels can be readily calculated. Flat dollar deductibles are applied directly while deductibles that are a percentage of coverage amount are converted to the flat dollar equivalent (i.e. ded % * insured value) and applied. The model calculates losses to replacement costs and caps losses at policy limits. Insurance-to-value is addressed by the user and described further in A-1, Disclosure 1.

2. *Describe whether, and if so how, the model treats policy exclusions and loss settlement provisions.*

Policy exclusions, with the exception of exclusions for flood, and loss settlement provisions are implicitly factored into the model as much as they are included in claims data used for calibrating damage functions. Impacts of exclusions and settlement provisions that are implicitly accounted for are not explicitly quantified when developing damage factors. Losses explicitly attributed to the flood peril are excluded and may be accounted for in other modeled perils.

3. *Provide an example of how insurer loss (loss net of deductibles) is calculated. Discuss data or documentation used to validate the method used by the model.*

Example:

(A)		*(B)*	*(C)*	*(D)=(A)*(C)*	*(E)=(D)-(B)*
Building Value	*Policy Limit*	*Deductible*	*Damage Ratio*	*Zero Deductible Loss*	*Loss Net of Deductible*
100,000	*90,000*	*500*	*2%*	*2,000*	*1,500*

The following are examples of how insurer losses (net of deductibles) are calculated.

Table 22. Calculating Losses Net of Deductibles

(A) Structure Value	**Policy Limit**	**(B) Deductible**	**(C) Mean Damage Ratio**	**(D)=(A)*(C) Zero Deductible Loss**	**(E) Loss Net of Deductible***
100,000	90,000	500	2%	2,000	1,688
100,000	90,000	500	5%	5,000	4,573

*The calculation of the Loss Net of Deductible reflects the model's use of a full probability distribution of damage and is based on actuarial theory of deductibles and limits as illustrated in the Expected Insured Loss equation. The literature source is Hogg, R.V. and Klugman, S. A., *Loss Distributions*, John Wiley and Sons, 1984.

The probability distributions of damage are validated using engineering studies and actual loss data.

4. Describe how the model treats annual deductibles.

Annual frequency of event occurrence is a key model parameter. Each simulated year may have zero, one, or multiple events. This approach for generating the event catalog makes it straightforward to determine the probability and losses of multiple-event seasons.

The functionality to calculate losses net of an annual deductible was enabled during 2005 in the software. Prior to this, the user would have performed the calculations outside the software. The deductible is applied in Touchstone as follows: for the first hurricane event in a year, apply the hurricane deductible to the loss distribution. Calculate the “applicable deductible” for this event (see definition below), and then calculate the “remaining deductible” as (hurricane deductible - applicable deductible). The deductible that will apply to the next event is the higher of the “remaining deductible” and the all other perils deductible. The remaining deductible is recalculated and stored after each event per location.

Applicable Deductible = Σ min(loss, deductible)*probability_j,

where the summation covers from $j = 1$ to the number of points in the damage ratio distribution and probability_j is the probability of loss at the jth point in the distribution.

Example: User enters $10,000 as the hurricane deductible (DED1) and $500 as the all other perils deductible (DED2). Suppose a first event occurs with a loss of $7,000, and the applicable deductible is calculated as $7,000, with a remaining deductible of $3,000. Note that for the next event in the same year, the deductible will be max ($3,000, $500), or $3,000.

Suppose a second event occurs in the year, and the applicable deductible is calculated as $2,700. The remaining hurricane deductible is max ($300, $500), or $500. In other words, from this point on, the $500 all other perils deductible would apply to each subsequent event in the year.

One final note: the application of the all other perils deductible only applies to years when there are multiple events—the full hurricane deductible of $10,000 will apply if there is only a single event in a given year.

A-6 Loss Output and Logical Relationships to Risk

A. The methods, data, and assumptions used in the estimation of probable maximum loss levels shall be actuarially sound.

The AIR Hurricane Model for the U.S. uses actuarially sound methods, data and assumptions in the estimation of probable maximum loss levels.

B. Loss costs shall not exhibit an illogical relation to risk, nor shall loss costs exhibit a significant change when the underlying risk does not change significantly.

The AIR Hurricane Model for the U.S. produces loss costs that are logical in relation to risk and do not exhibit a significant change when the underlying risk does not significantly change.

C. Loss costs produced by the model shall be positive and non-zero for all valid Florida ZIP Codes.

The loss costs are positive and non-zero for all ZIP Codes. Loss cost maps by ZIP Code are provided in Form A-1.

D. Loss costs cannot increase as the quality of construction type, materials and workmanship increases, all other factors held constant.

Loss costs do not increase as the quality of construction, material or workmanship increases, all else being equal. Loss cost maps for wood frame, masonry and manufactured home construction types are provided in Form A-1.

E. Loss costs cannot increase as the presence of fixtures or construction techniques designed for hazard mitigation increases, all other factors held constant.

Loss costs do not increase as the presence of fixtures or construction techniques designed for hazard mitigation increases, all else being equal. Loss cost sensitivity tests performed in Form A-6 demonstrate this. Form A-6 will be available on-site for Professional Team's review.

F. Loss costs cannot increase as the wind resistant design provisions increase, all other factors held constant.

Loss costs do not increase as the wind resistant design provisions increase, all other factors held constant. Loss cost sensitivity tests performed in Form A-6 demonstrate this. Form A-6 will be available on-site for Professional Team's review.

G. Loss costs cannot increase as building codes enforcement increases, all other factors held constant.

Loss costs do not increase as the quality of building codes and enforcement increases, all else being equal. Loss cost sensitivity tests performed in Form A-6 demonstrate this. Form A-6 will be available on-site for Professional Team's review.

H. Loss costs shall decrease as deductibles increase, all other factors held constant.

Loss costs do decrease as deductibles increase, all else being equal. Loss cost sensitivity tests performed in Form A-6 demonstrate this. Form A-6 will be available on-site for Professional Team's review.

I. The relationship of loss costs for individual coverages, (e.g., building, appurtenant structure, contents, and time element) shall be consistent with the coverages provided.

The relationship of losses for building, appurtenant structures, contents and additional living expense to the total loss as produced by the model is reasonable. Loss cost sensitivity tests performed in Form A-6 demonstrate this. Form A-6 will be available on-site for Professional Team's review.

J. Output ranges shall be logical for the type of risk being modeled and apparent deviations shall be justified.

Output Ranges are logical. There are no deviations other than those inherent to the underlying data in the calculation of average loss costs. These are explained in Disclosure 14 below.

K. All other factors held constant, output ranges produced by the model shall in general reflect lower loss costs for:

1. masonry construction versus frame construction,

Output ranges produced by the model reflect lower loss costs for masonry construction versus frame construction.

2. personal residential risk exposure versus manufactured home risk exposure,

Output ranges produced by the model reflect lower loss costs for personal residential versus manufactured home construction risk exposure.

3. inland counties versus coastal counties, and

Output ranges produced by the model reflect lower loss costs, in general, for inland counties versus coastal counties.

4. northern counties versus southern counties.

Output ranges produced by the model reflect lower loss costs, in general, for northern counties versus southern counties.

L. For loss cost and probable maximum loss level estimates derived from and validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) coinsurance, and (4) contractual provisions shall be appropriate based on the type of risk being modeled.

AIR uses historical insured hurricane losses received from clients for validation purposes. This loss data typically includes both exposure and loss details including construction characteristics and policy provisions such as coverage and deductible. The flow chart below in Figure 53 demonstrates the work flow associated with receiving, validating and using client data.

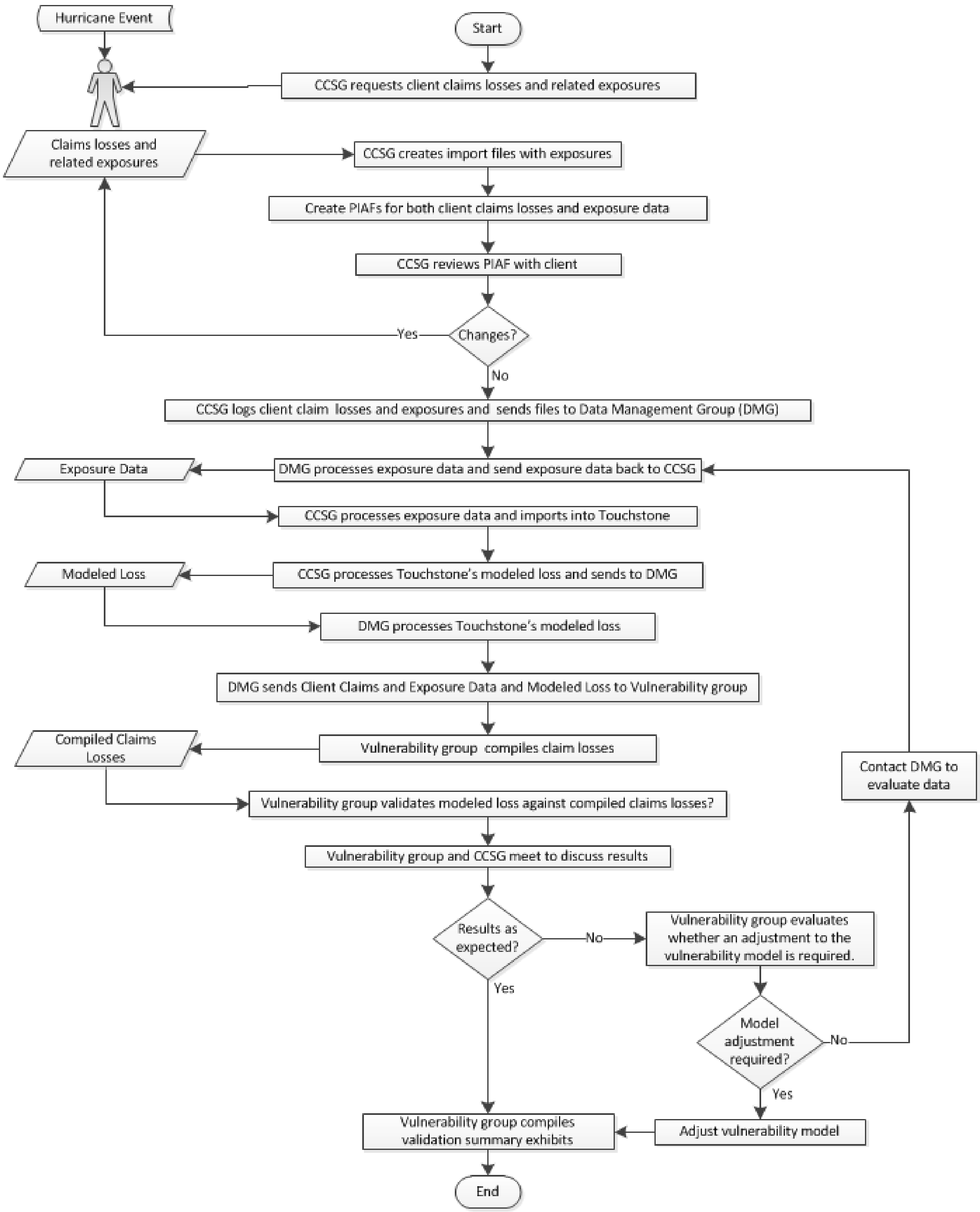


Figure 53. Historical Claims Data Workflow

AIR communicates with clients and sends out a letter requesting information on claim payment practices, coinsurance, contractual provisions, and relevant underwriting practices underlying those losses.

All assumptions underlying any adjustments are discussed with and reviewed by our clients; therefore all assumptions as well as any actuarial modifications made are appropriate.

Relevant Forms: G-5, Actuarial Standards Expert Certification
A-1, Zero Deductible Personal Residential Loss Costs by ZIP Code
A-2, Base Hurricane Storm Set Statewide Losses
A-3, 2004 Hurricane Season Losses
A-4, Output Ranges
A-5, Percentage Change in Output Ranges
A-6, Logical Relationship to Risk (Trade Secret item)
A-7, Percentage Change in Logical Relationship to Risk
A-8, Probable Maximum Loss for Florida
S-2, Examples of Loss Exceedance Estimates
S-5, Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled

Disclosures

1. *Provide a completed Form A-1, Zero Deductible Personal Residential Loss Costs by ZIP Code. Provide a link to the location of the form [insert hyperlink here].*

A completed Form A-1 is provided on page 271.

2. *Provide a completed Form A-2, Base Hurricane Storm Set Statewide Losses. Provide a link to the location of the form [insert hyperlink here].*

A completed Form A-2 is provided on page 275.

3. *Provide a completed Form A-3, 2004 Hurricane Season Losses. Provide a link to the location of the form [insert hyperlink here].*

A completed Form A-3 is provided on page 320.

4. *Provide a completed Form A-4, Output Ranges. Provide a link to the location of the form [insert hyperlink here].*

A completed Form A-4A is provided on page 321.

5. *Provide a completed Form A-5, Percentage Change in Output Ranges. Provide a link to the location of the form [insert hyperlink here].*

A completed Form A-5 is provided on page 347.

6. *Provide a completed Form A-7, Percentage Change in Logical Relationship to Risk. Provide a link to the location of the form [insert hyperlink here].*

A completed Form A-7 is provided on page 357.

7. *Provide a completed Form A-8, Probable Maximum Loss for Florida. Provide a link to the location of the form [insert hyperlink here].*

A completed Form A-8 is provided on page 366

8. *Describe how the model produces probable maximum loss levels.*

The method the model uses to estimate probable maximum loss levels is discussed in A-4, Disclosure 1.

9. *Provide citations to published papers, if any, or modeling organization studies that were used to estimate probable maximum loss levels.*

No published papers were used to estimate probable maximum loss levels (PML). Standard probability theory supports AIR's event-ranking methodology for assembling PMLs.

10. *Describe how the probable maximum loss levels produced by the model include the effects of personal and commercial residential insurance coverage.*

The probable maximum loss levels produced by the model incorporate the process described in A-4, Disclosure 1. The calculation of the probable maximum loss is consistent across all exposure types whether they be personal or commercial residential insurance coverage, as described in A-1, Disclosure 3.

11. *Explain any difference between the values provided on Form A-8, Probable Maximum Loss for Florida, and those provided on Form S-2, Examples of Loss Exceedance Estimates.*

There are no differences between the values provided on Form A-8 and those provided on Form S-2.

12. *Provide an explanation for all anomalies in the loss costs that are not consistent with the requirements of this standard.*

Loss costs for frame construction are greater than for masonry in nearly every ZIP Code. However, the county weighted average loss costs can depart from this when there is more exposure in high loss cost ZIP Codes for masonry construction than for frame. The following example illustrates how the county weighted average loss cost can be greater for masonry than for frame.

Table 23. County Weighted Average Loss Costs for Masonry and Frame

ZIP Code	Construction	Exposure	Loss Cost per 1,000
A	Masonry	10,000	4.0
A	Frame	1,000	5.0
B	Masonry	1,000	1.0
B	Frame	10,000	2.0
County Avg.	Construction		
	Masonry		3.73
	Frame		2.27

Anomalies of this type have been background-shaded in orange in Form A-4.

13. *Provide an explanation of the differences in output ranges between the previously accepted model and the current model.*

The differences in the output between the prior year and the current year submission are due to the model updates described in G-1, Disclosure 5.

14. *Identify the assumptions used to account for the effects of coinsurance on commercial residential loss costs.*

The model captures the effects of coinsurance through the use of the location level participation field in the input exposures provided by the user. This field reflects the percentage of the risk covered by the insurer. Insurers may make specific assumptions to allow for any coinsurance adjustments.

Florida Commission on Hurricane Loss Projection Methodology

2015 Computer/Information Standards

CI-1 Documentation

A. Model functionality and technical descriptions shall be documented formally in an archival format separate from the use of letters, slides, and unformatted text files.

AIR Worldwide maintains an extensive collection of both client-facing and internal documentation, which is presented using defined documentation templates, style sheets, and content structure. The documentation makes apparent the application name, version number, as well as revision history detail. This documentation is formally developed independently from letters, slides, and unformatted text files.

The internal and client-based documentation shall be available for review by the Professional Team.

B. The modeling organization shall maintain a primary document repository, containing or referencing a complete set of documentation specifying the model structure, detailed software description, and functionality. Documentation shall be indicative of accepted model development and software engineering practices.

AIR Worldwide creates and maintains its internal and client-based documentation using accepted model development and software engineering practices. All documentation is maintained within source control and carefully managed throughout the development process.

Access to documentation maintained within the AIR Intranet (AIRPort) by internal users is validated by Windows®-authenticated user name and password. The client-based documentation, available via the Client Portal and Developer's Zone sites on the AIR public website, is accessed using a registered username/password combination.

The client-based documentation includes:

- MS Office suite-based documentation. Documentation types include, but are not limited to, user manuals and how-to guides, white papers, technical documentation, model documentation, and marketing material. This documentation is available to clients from the Client Portal site of the AIR public website.
- MSDN-style API documentation, which is presented as an HTML web-based documentation set. This documentation set is available to clients from the Developer's Zone site of the AIR public website. This documentation is also available in PDF format.
- MSDN-style Database documentation, which is presented as an HTML, web-based documentation set. This documentation set is available to clients from the Developer's Zone site of the AIR public website. This documentation is also available in PDF format.
- Topic-based User Help system, which is available to the user via the software application.

The internal documentation, which is available to AIR employees via AIRPort, includes:

- MS Office suite-based documentation. Documentation types include, but are not limited to, requirements, user stories, design documents, architecture documents, test plans, and project schedules.
- FCHLPM-specific documentation set, which includes:
  - HTML web-based User Help system, which is designed to present model and software topics as specified by the FCHLPM.

- MS Office suite-based documentation that provides detailed discussion regarding the development of the model and software. This documentation is hyperlinked directly from the FCHLPM User Help system, and is also available independently from a designated FCHLPM documentation repository on AIRPort.
- MSDN-style Database documentation, which is presented as an HTML web-based documentation set. This documentation is hyperlinked directly from the FCHLPM User Help system. This documentation differs from the client-based documentation set in that it defines databases that are not released to the client (i.e. ZIPAll).

The internal and client-based documentation, as well as the sites from which they are available, shall be available for review by the Professional Team.

C. All computer software (i.e., user interface, scientific, engineering, actuarial, data preparation, and validation) relevant to the model shall be consistently documented and dated.

All components as defined by the Requirements are fully documented and dated, and such documentation shall be available for review by the Professional Team.

D. The modeling organization shall maintain (1) a table of all changes in the model from the previously accepted model to the initial submission this year and (2) a table of all substantive changes since this year's initial submission.

The document *Enhancements and Florida Commission Documentation Mapping* identifies the updates specific to the AIR Hurricane Model for the U.S. version 16.0.0 and Touchstone application version 4.1.0 as required to satisfy General Standard G-1, Disclosure item 5-A, as well as the changes from the previously accepted submission.

E. Documentation shall be created separately from the source code.

The AIR Hurricane Model for the U.S. and the Touchstone software documentation are developed and maintained independently from the source code. Both the formal documentation and detailed in-line comments within the source code shall be available for review by the Professional Team.

Relevant Form: G-6, Computer/Information Standards Expert Certification

CI-2 Requirements

The modeling organization shall maintain a complete set of requirements for each software component as well as for each database or data file accessed by a component. Requirements shall be updated whenever changes are made to the model.

All requirements for the AIR Hurricane Model for the U.S. and Touchstone are documented and reviewed; each version release contains a unique set of requirements documentation. These requirements are used extensively to develop design documentation and test plans.

The requirements documents, which are available via AIRPort, include the following information:

- Purpose/Objective
- Business Requirement – Specification/Impact
- Model Updates – Specification/Impact
- Software Updates – Specification/Impact

The workflow in Figure 54 illustrates the Requirements development and review process.

Relevant Form: G-6, Computer/Information Standards Expert Certification

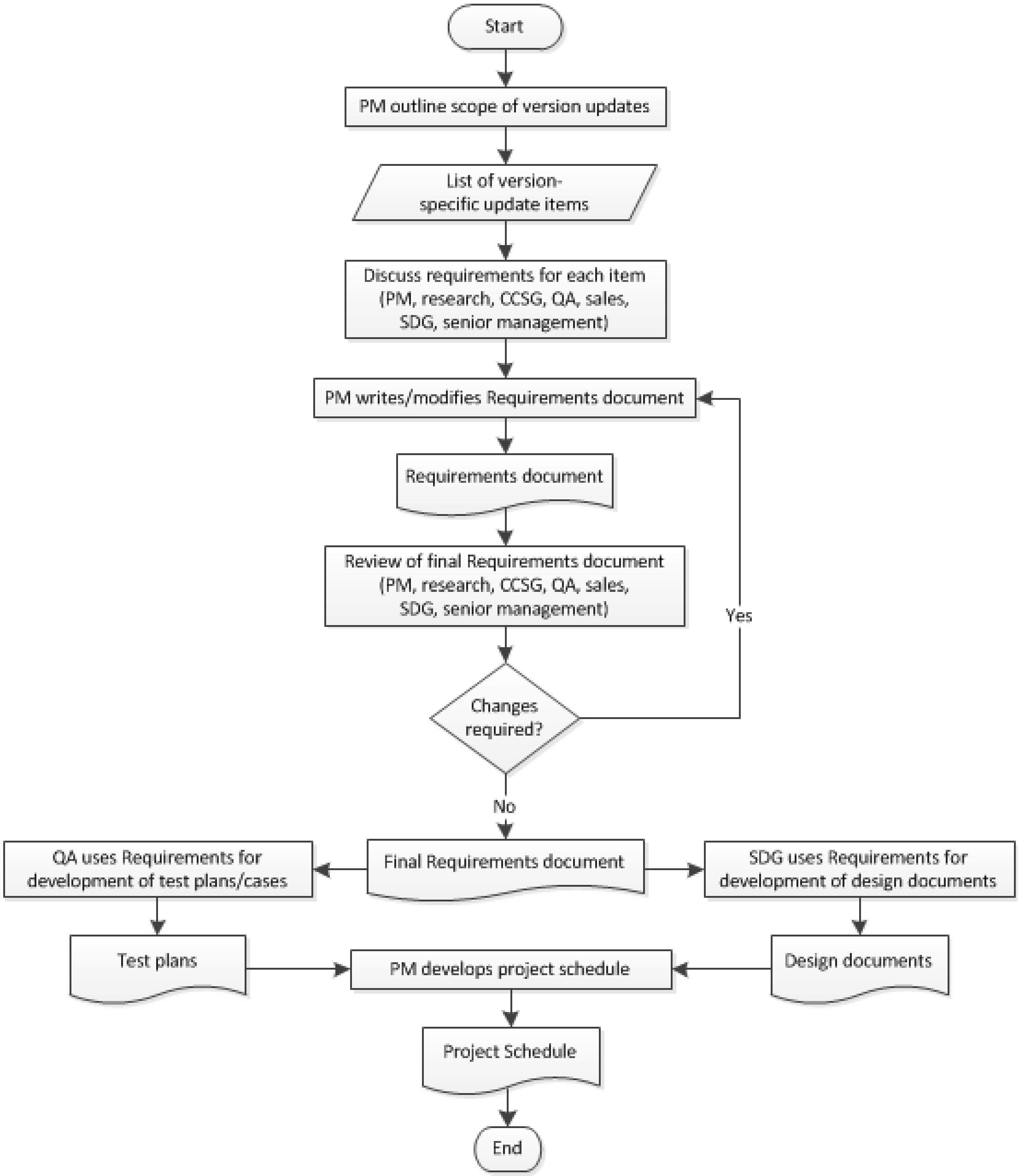


Figure 54. The Requirements Development and Review Process

Documentation specifying model and software requirements shall be available for verification by the Professional Team.

Disclosure

1. Provide a description of the documentation for interface, human factors, functionality, documentation, data, human and material resources, security, and quality assurance.

The Touchstone interface, human factors, and functionality are documented in the Touchstone User Help system, which is accessed through the software application. AIR also provides various “How-To” guides, which are designed to aid the user in regards to specific Touchstone functionality (for example, *Using Hazard Analysis in Touchstone* and *Using the AIR Hurricane Model for the U.S. in Touchstone*). These documents are available to clients via the Client Portal site on the AIR public website.

The AIR Hurricane Model for the U.S. data files are discussed within the component-specific documents.

The MSDN-style Touchstone database documentation defines the schema, tables, and columns for the Touchstone databases. It is presented as an HTML web-based documentation set available to clients from the Developer’s Zone site of the AIR public website. This documentation is also available in PDF format.

AIR maintains a User Help system that specifically addresses the topics relevant to the FCHLPM Computer Standards; the topics presented in the FCHLPM User Help system include:

- Touchstone Lifecycle Overview, which includes detailed discussion of version change management, model and software application development, testing, packaging and release, and client support. Additional support documentation is hyperlinked from within this Help system, such as model component data files and test plans.
- Touchstone architecture, including hyperlinks to detailed architecture documentation.
- AIR Worldwide FCHLPM Process Overview, which includes discussion of responsibilities, communication, and the Report of Activities. Additional FCHLMP process-specific support documentation that is hyperlinked from this Help system includes Line Counts, Version Change History, Output Range Reports, Probable and Maximum Loss.

CI-3 Model Architecture and Component Design

The modeling organization shall maintain and document (1) detailed control and data flowcharts and interface specifications for each software component, (2) schema definitions for each database and data file, (3) flowcharts illustrating model-related flow of information and its processing by modeling organization personnel or consultants, and (4) system model representations associated with (1)-(3). Documentation shall be to the level of components that make significant contributions to the model output.

Relevant Form: G-6, Computer/Information Standards Expert Certification

Component-specific documents contain detailed control and data flow diagrams, class diagrams, and interface specifications that illustrate the design and architecture of the AIR Hurricane Model for the U.S. and of Touchstone, including their components and sub-components. These documents shall be available to the Professional Team.

The MSDN-style Database documentation defines the schema, tables, and columns for the Touchstone databases. This documentation is hyperlinked directly from the FCHLPM User Help system. This documentation differs from the client-based documentation set in that it defines databases that are not released to the client, such as the ZIPAll database.

The FCHLPM User Help system presents detailed process workflows for all aspects of the design, development, implementation, and testing of the AIR Hurricane Model for the U.S. and the Touchstone software; these workflows shall be available for review by the Professional Team.

System model representations associated with each software component are available in the model architecture and design documentation.

The workflows in Figure 55 to

Figure 61 illustrate the model and software design, development, implementation and testing processes. Model and software development custodians shall be available to explain the functional behavior of any model or software component and to respond to questions concerning changes in code, documentation or data for that component.

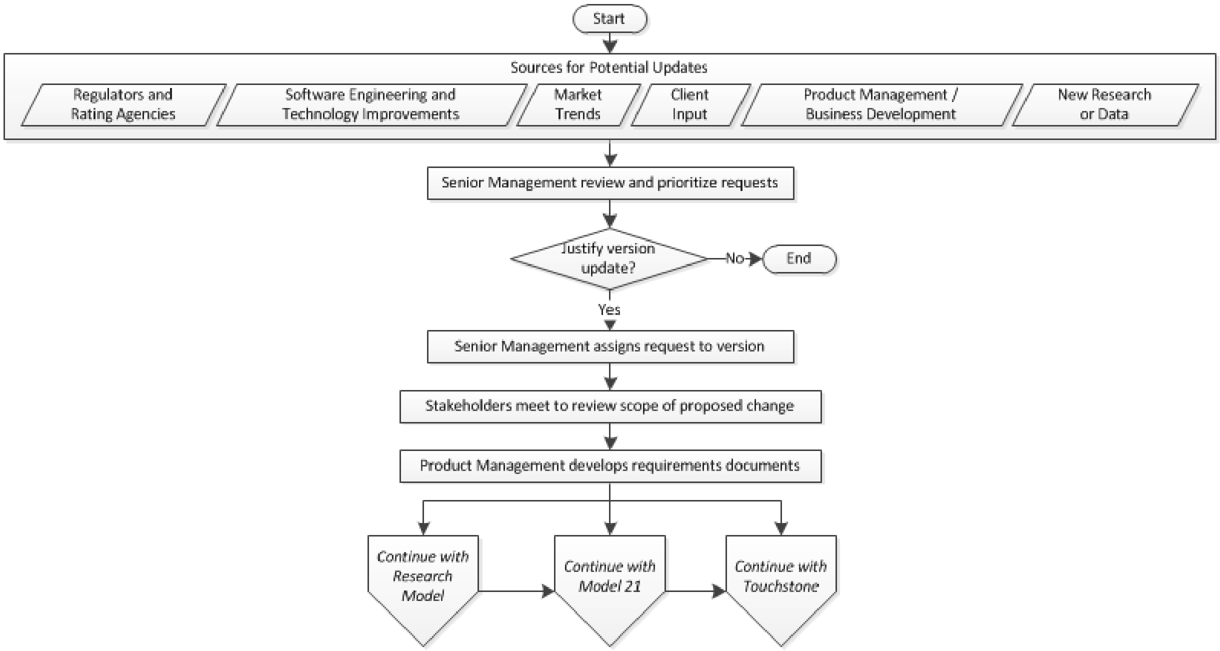
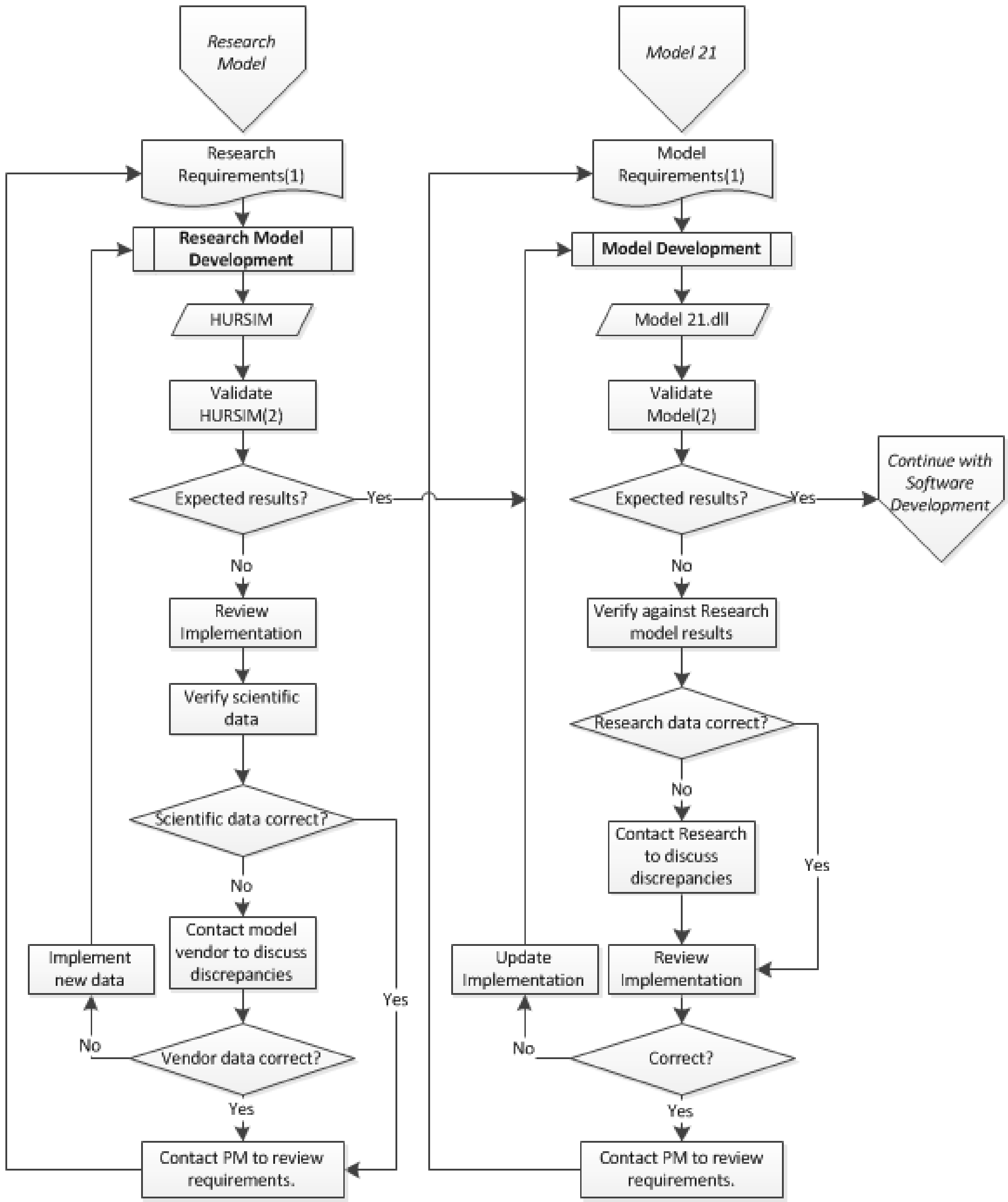


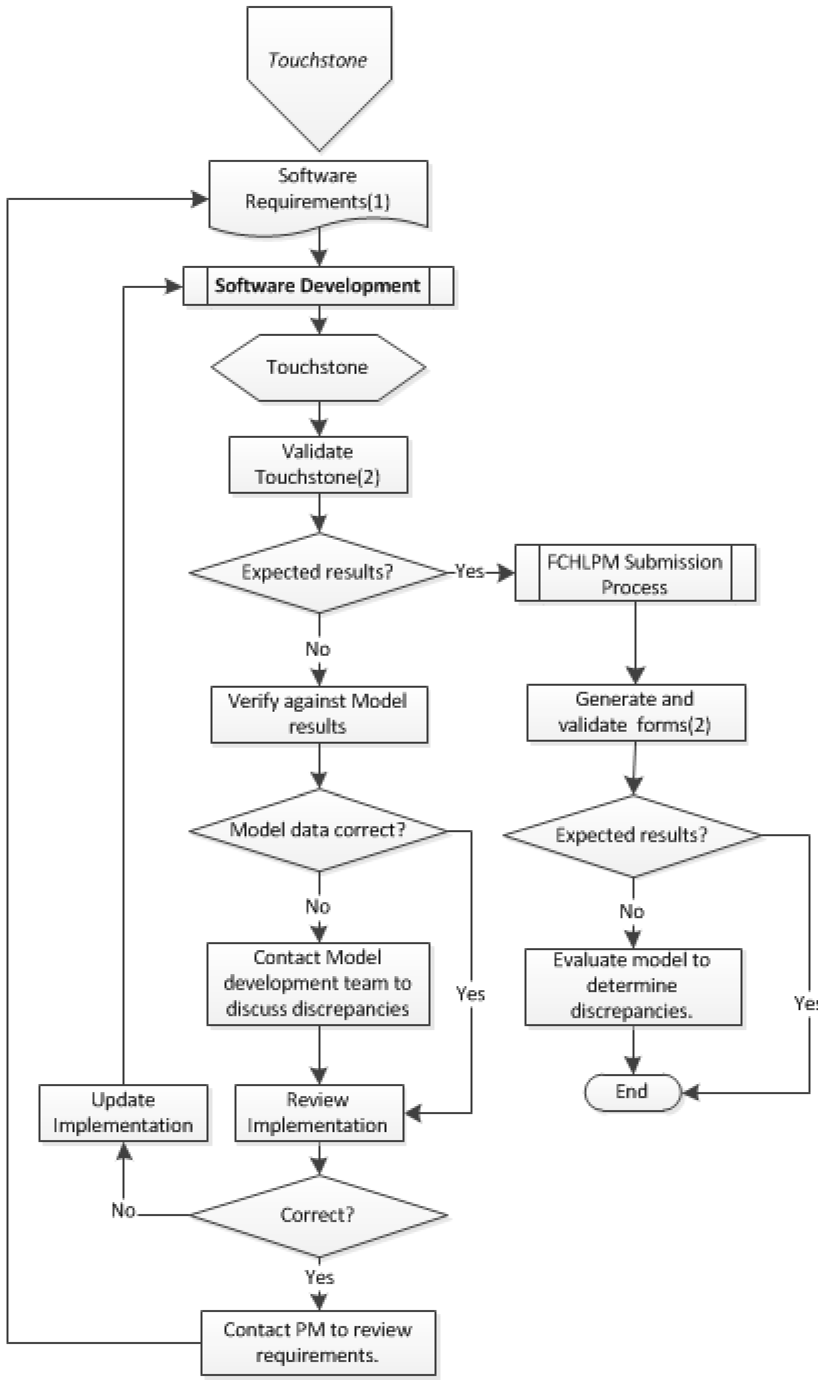
Figure 55.a. Development and Implementation High Level Overview



1) Requirements documentation is the foundation for the development of the design, testing, and other support documentation. Development of these documents is integrated into the Research Model, Model, and Software Development processes.

2) Validation includes: run test cases and analyze results, verify loss results, and review documentation.

Figure 55.b. Development and Implementation Overview Continued



1) Requirements documentation is the foundation for the development of the design, testing, and other support documentation. Development of these documents is integrated into the Research Model, Model, and Software Development processes.

2) Validation includes: run test cases and analyze results, verify loss results, and review documentation.

Figure 55.c. Development and Implementation Overview Continued

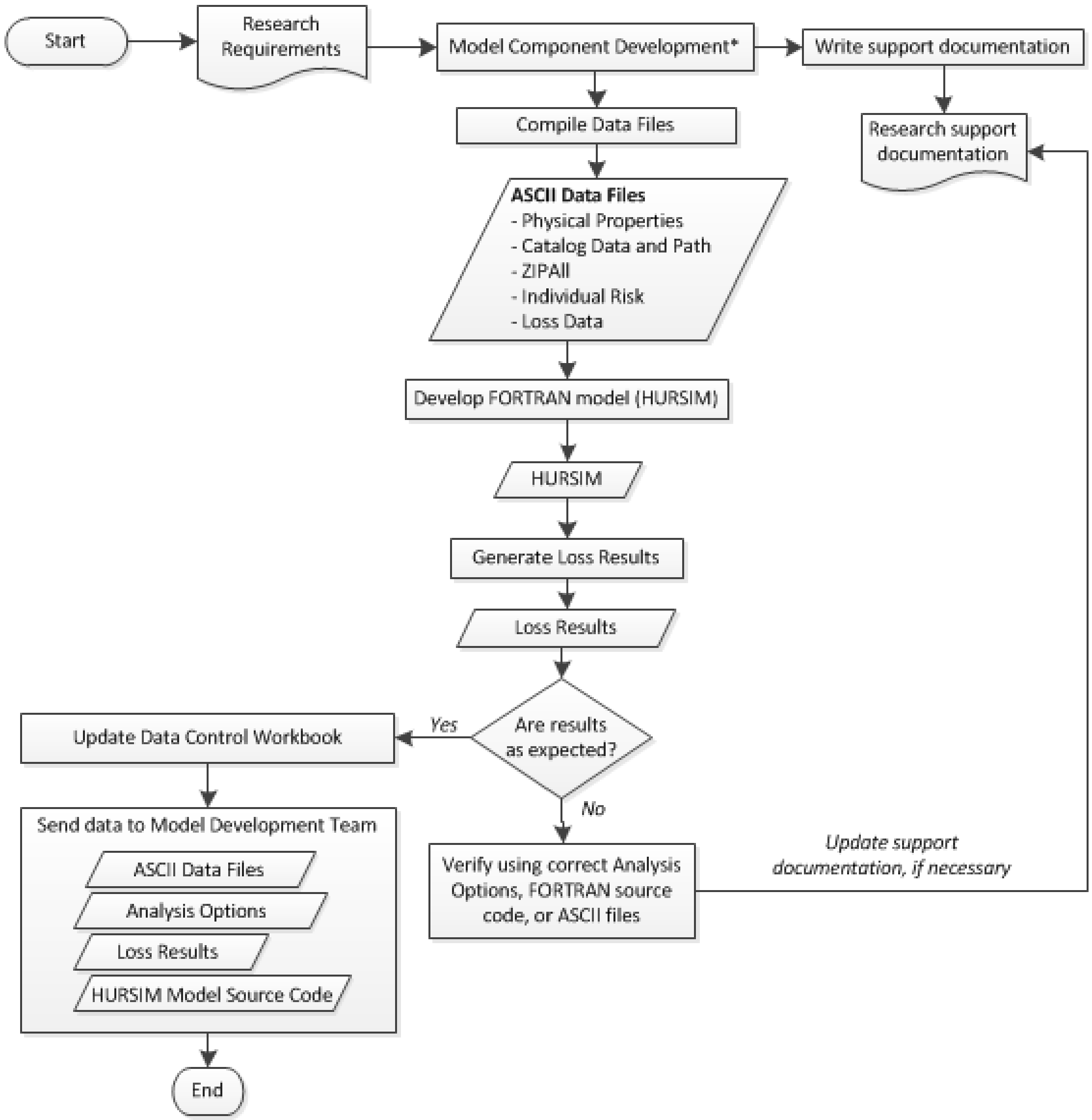


Figure 56. Model Development—Research Group

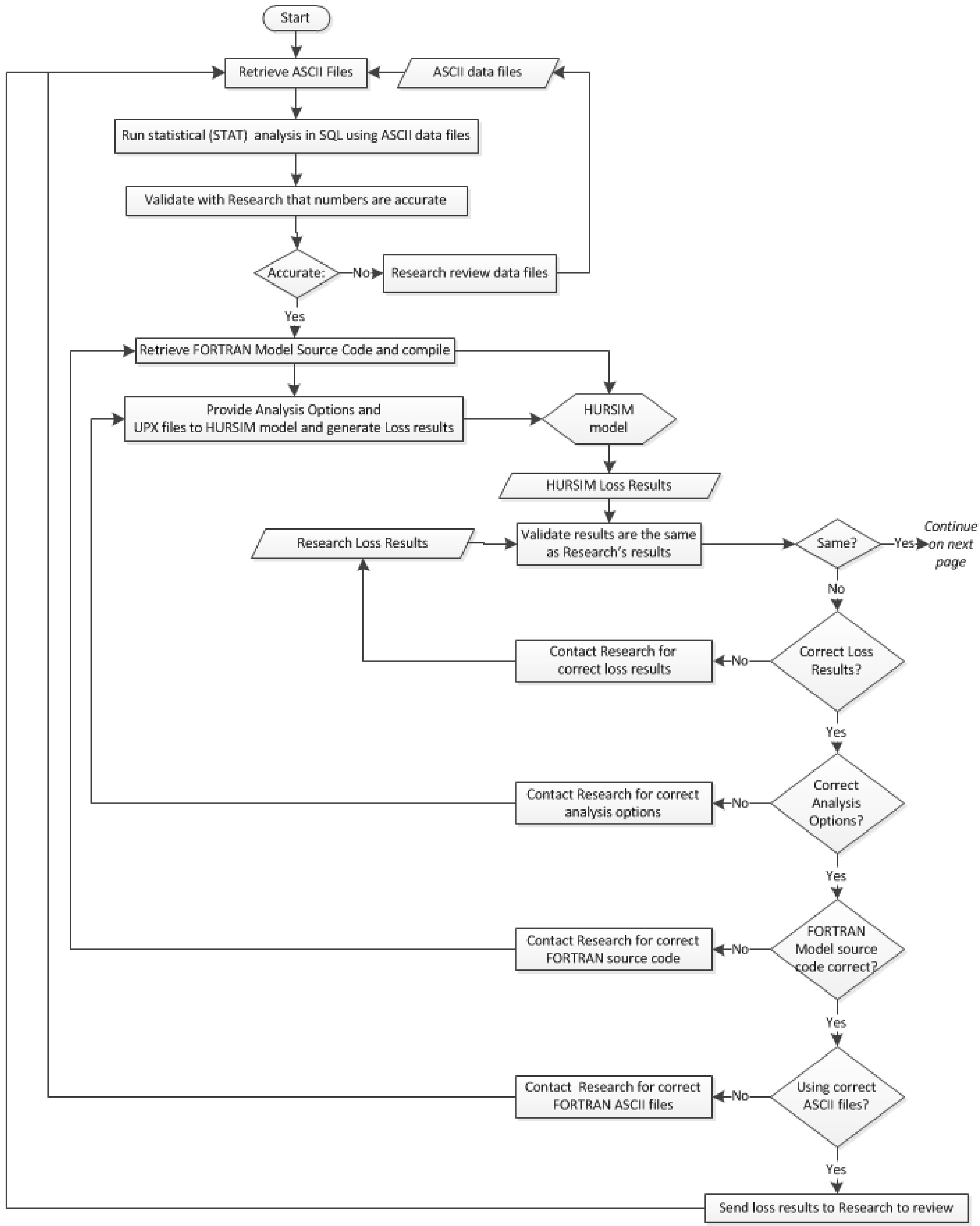


Figure 57. Model Porting and Implementation of Model 21.dll into Touchstone

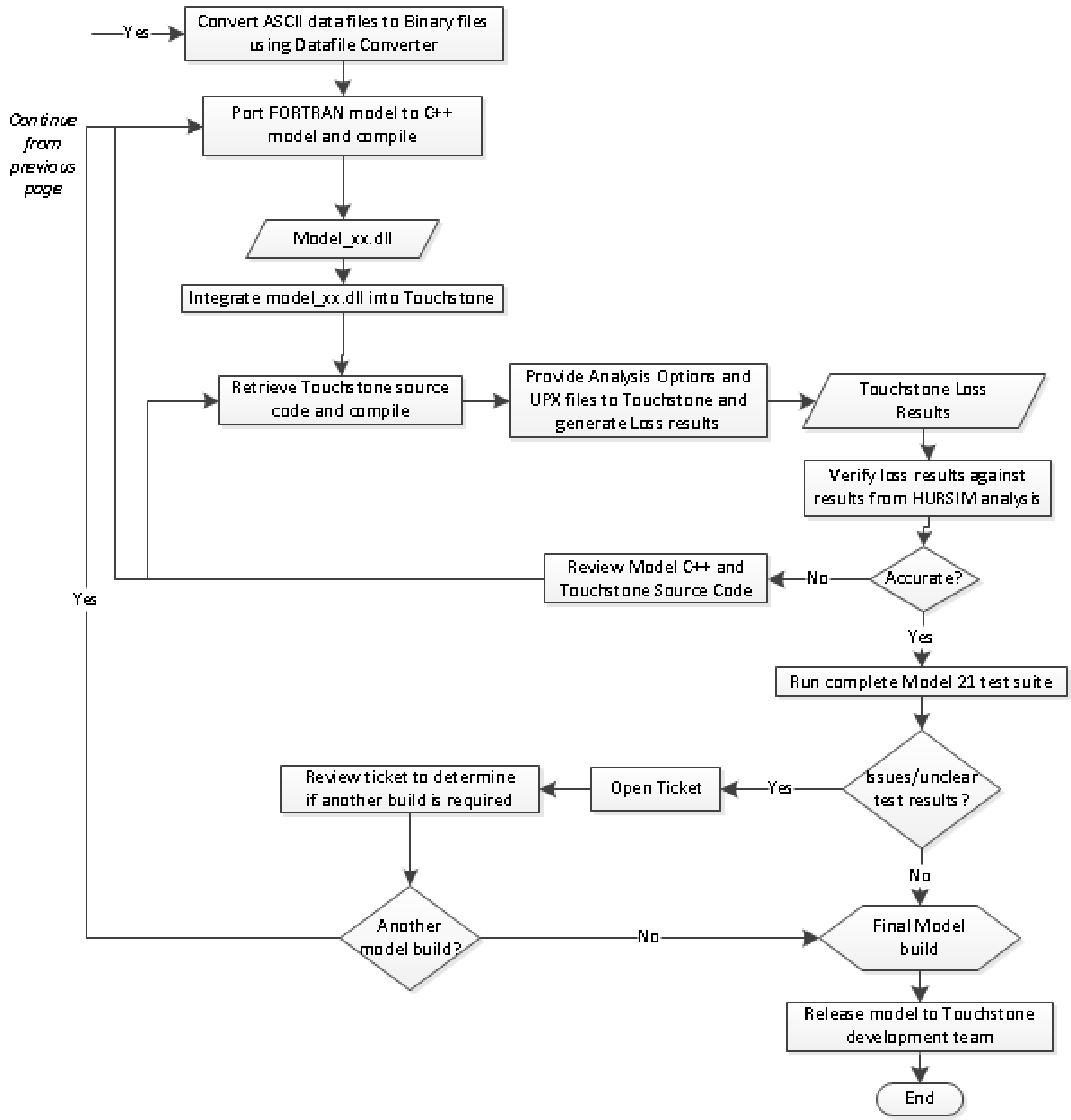


Figure 58. Model Porting and Implementation of Model 21.dll into Touchstone (continued)

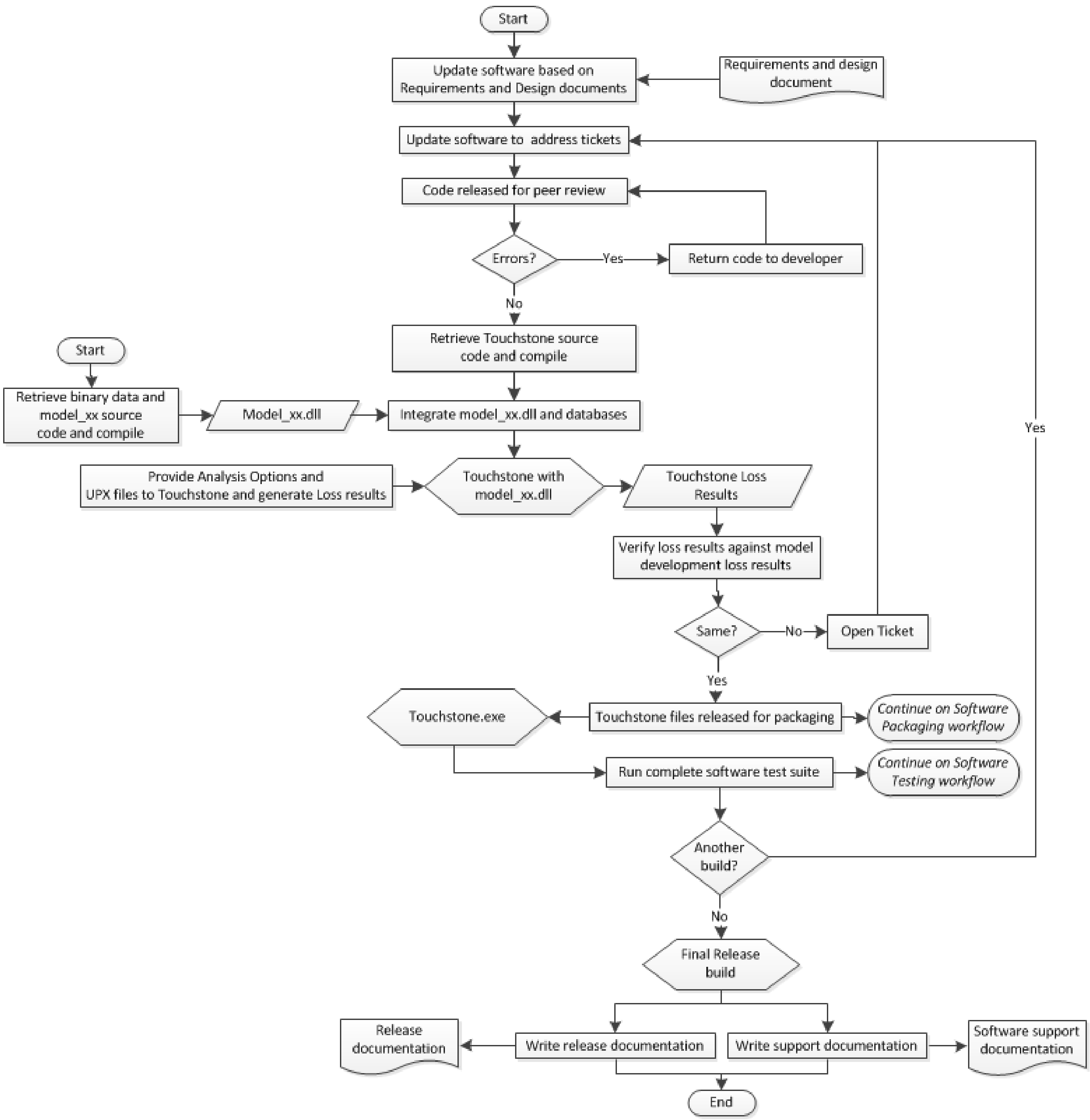


Figure 59. Touchstone Development

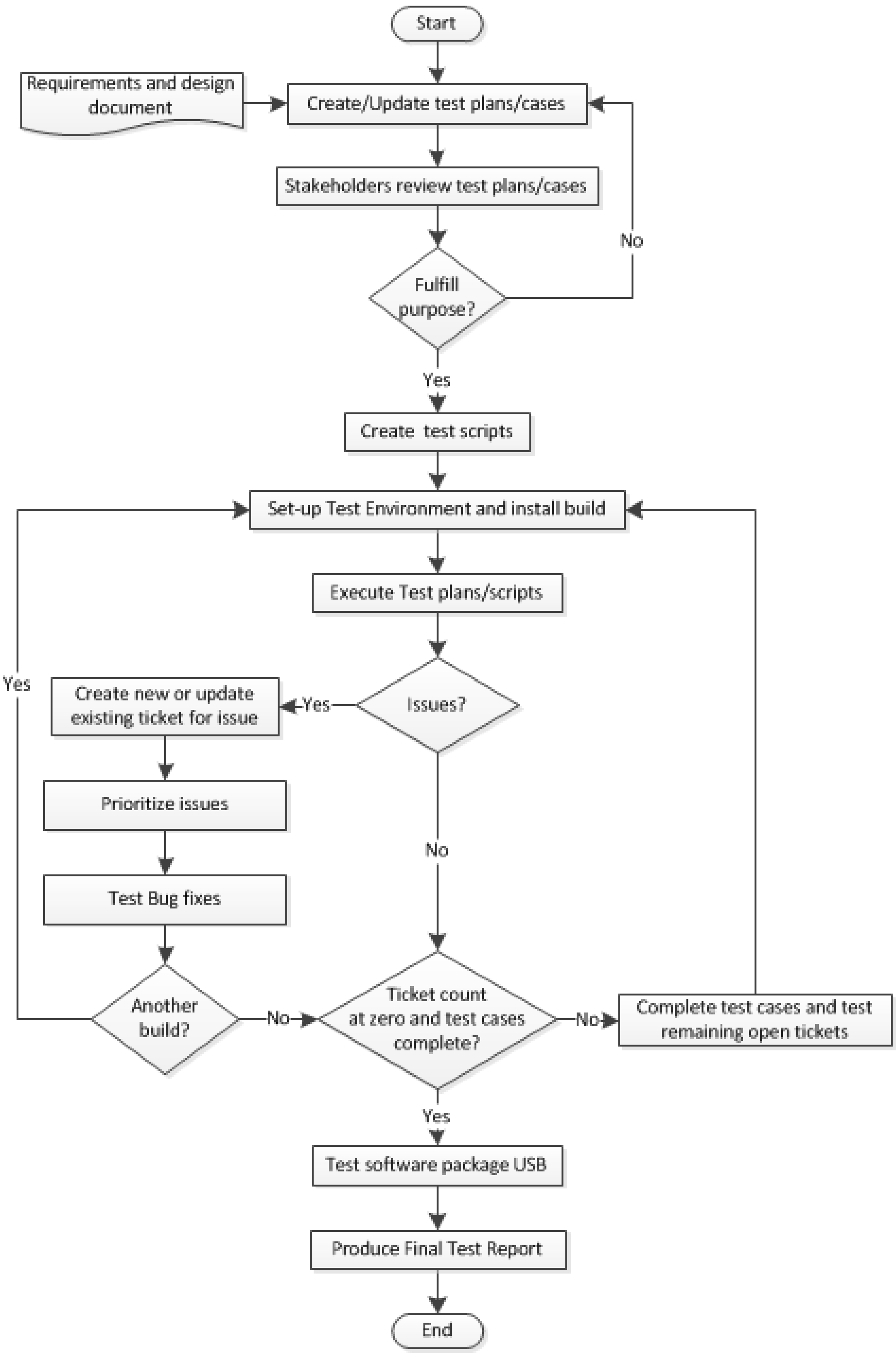


Figure 60. Touchstone Testing

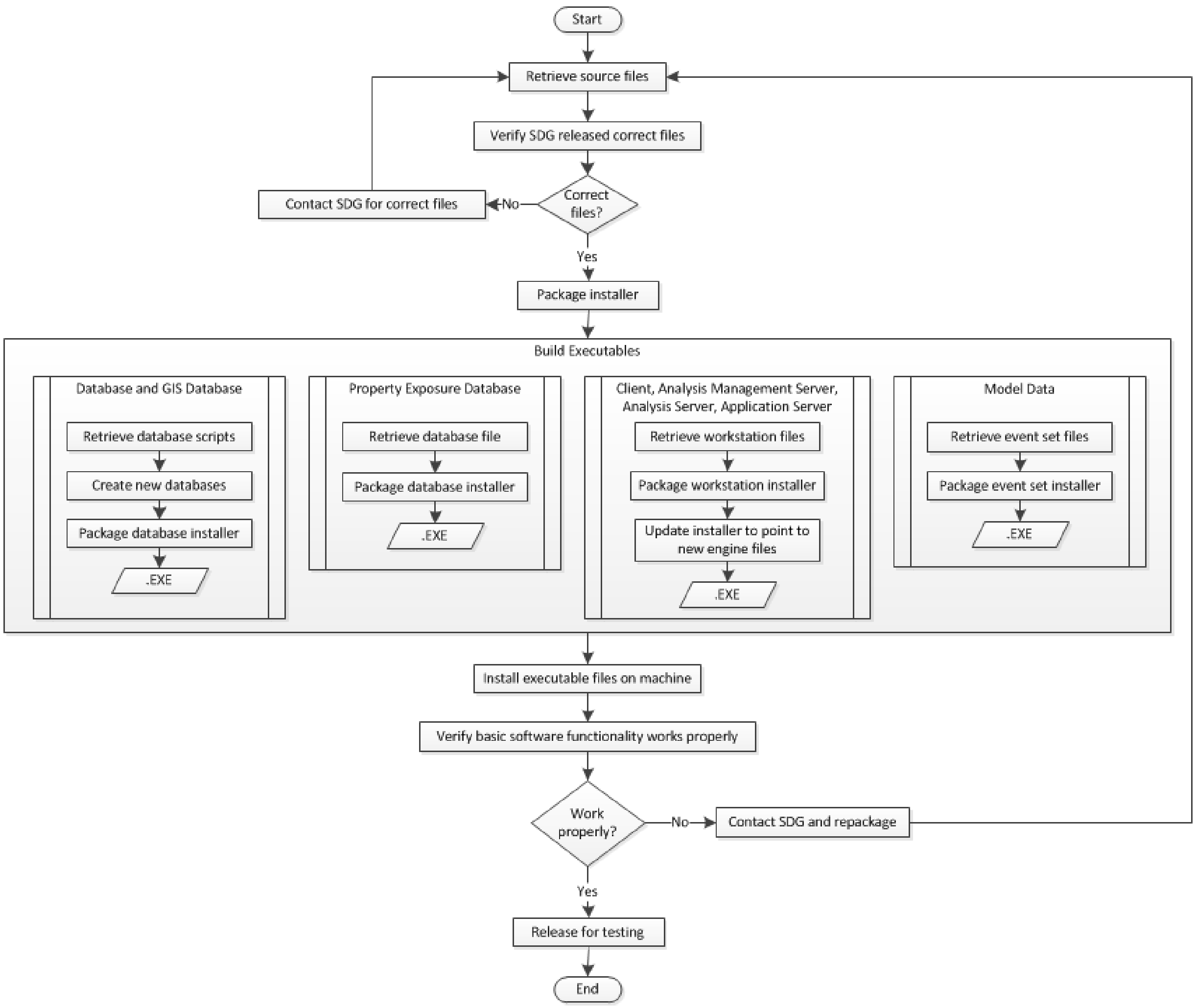


Figure 61. Touchstone Packaging and Release

CI-4 Implementation*

*(*Significant Revision)*

A. The modeling organization shall maintain a complete procedure of coding guidelines consistent with accepted software engineering practices.

AIR maintains a complete set of software engineering practices and coding guidelines that are followed by the software developers, including FORTRAN, C++/COM, C#/.Net, Java and SQL. These guidelines are documented in the FCHLPM User Help system.

B. The modeling organization shall maintain a complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components.

The FCHLPM User Help system discusses the development of the model components. AIR maintains separate support material for these components, which provides detailed discussion regarding the procurement and verification of the data; these documents are hyperlinked directly from the FCHLPM User Help system and are available for review by the Professional Team.

The FCHLPM User Help system also describes the database development and integration process, specifically for those databases that require modification as part of the AIR Hurricane Model for the U.S. revision cycle; these databases include the ZIPAll, AIRGeography, and AIRAddressServer. Topics discussed include: updating the ZIPAll database, updating the ZIP Codes within AIRGeography and AIRAddressServer databases, and validating the ZIP data.

Model component and database development custodians shall be available to discuss the data procurement, implementation, and verification processes.

C. All components shall be traceable, through explicit component identification in the model representations (e.g., flowcharts), down to the code level.

AIR has developed documentation that provides component identification from documentation diagrams which are fully traceable down to the code level. Model and software development custodians shall be available to demonstrate traceability using items from the document *Enhancements and Florida Commission Documentation Mapping*.

D. The modeling organization shall maintain a table of all software components affecting loss costs and probable maximum loss levels, with the following table columns: (1) Component name, (2) Number of lines of code, minus blank and comment lines; and (3) Number of explanatory comment lines.

AIR maintains tables that identify each of the software components that affect loss costs and probable maximum loss levels. The tables contain the following column headings: Component name, Number of lines of code, Number of comment lines and blank lines. This documentation is hyperlinked from the FCHLPM User Help system and is available for review by the Professional Team: This *Line Counts* document is available for review by the Professional Team.

E. Each component shall be sufficiently and consistently commented so that a software engineer unfamiliar with the code shall be able to comprehend the component logic at a reasonable level of abstraction.

AIR documentation can be used by new software engineers to gain an understanding of the software being reviewed. AIR coding procedures ensure that software code is clearly commented for easy comprehension of content. Model and software development custodians shall be available to demonstrate commenting within the code.

F. The modeling organization shall maintain the following documentation for all components or data modified by items identified in Standard G-1, Scope of the Computer Model and Its Implementation, Disclosure 5 and Audit 5:

1. A list of all equations and formulas used in documentation of the model with definitions of all terms and variables.

The *Model 21 Equations/Formulas, Variable Mapping, and Crosschecking* document discusses the implementation of equations.

Changes to the model for each revision are documented in the release notes for each version at the time of release. The Enhancements and Florida Commission Documentation Mapping spreadsheet provides a list of all changes since the last release approved by the Florida Commission and the rationale for each change.

AIR's TFS server version control system provides for comments to be added by the developer each time a change is made.

AIR's Clear Quest software provides the means to track all issues and their resolutions.

2. A cross-referenced list of implementation source code terms and variable names corresponding to items within F.1 above.

The *Model 21 Equations/Formulas, Variable Mapping, and Crosschecking* document discusses the implementation of the equation used to calculate wind speed, including the FORTRAN subroutines, mapping to C++ functions, and crosscheck verification.

Model and software development custodians shall be available to illustrate the implementation of the equation and crosscheck verification.

Relevant Form: G-6, Computer/Information Standards Expert Certification

Disclosure

1. Specify the hardware, operating system, other software, and all computer languages required to use the model.

The following requirements are specified for the Touchstone software application. AIR's Technical Software group works directly with clients to ensure successful installation.

Supported Platforms

The following platforms are supported.

Operating Systems (U.S. English only)

- All operating systems are 64-bit
- Windows 7 and 8.1 on client machine only (UI)
- Windows Server 2012 R2

Microsoft SQL Servers

- SQL Server 2012 SP2+
- SQL Server 2014

SQL Server Collation

- Set SQL Server to the following collation setting: SQL_Latin1_General_CP1_CI_AS. This is the default installation for U.S. English SQL Server.

Microsoft HPC Services

- HPC Pack 2012 R2 w/ KB2956330 for head node

Processor

- AIR builds, tests, and deploys all AIR software on machines with Intel-based processors. AIR does not recommend or support non-Intel processors

Minimum Resource Requirements

Table 24 defines the minimum core, RAM, and disk space requirements for the Touchstone components.

Table 24. Minimum Resource Requirements

Touchstone Component	Cores	RAM	Disk Space	Scalability/Redundancy
Databases	8	32 GB	1 TB	▪ Exposure and Results databases can be proliferated. ▪ Multiple SQL server instances are allowed.
GIS Databases	8	32 GB	1 TB	▪ Single node. ▪ Optionally, can scale up with licenses at additional cost.
Property Exposure DB's	8	32 GB	1 TB	▪ Can install on the same SQL server as the Touchstone database.
Analysis Management	4	8 GB	250 GB	▪ Single node. ▪ Failover is supported by Windows Server 2012 R2 HPC Enterprise.
Analysis Server	4	16 GB	250 GB[1]	▪ 1/None ▪ Optionally, can be scaled out and load-balanced with HPC Scheduler.
Application Server	4	8 GB	250 GB	▪ 1/None ▪ Optionally, can be scaled out and load-balanced with network appliance.
Client Machine	2	4 GB	50 GB	▪ 1/None
Model Data[2]	4	8 GB	1.5 TB[3]	▪ Currently catalogs are installed on the compute node.

[1] The Model Data can also reside on the Analysis Server component, increasing data fetch speeds, but the Model Data disk requirements need to be added to the existing 250 GB requirement.

[2] Starting with Version 2.0, AIR now supports a centralized model data share.

[3] This value of 1.5TB is an estimate, and may increase as Catalogs and Hazard Data footprint grows.

Physical Memory Limits by OS Version

Table 25 defines the physical memory limits as defined by the OS version.

Table 25. Physical Memory Limits

Operating System	Max Supported Memory
Windows 7	192 GB
Windows Server 2008 R2 Standard	32 GB
Windows Server 2008 R2 Enterprise	2 TB
Windows 8/8.1	128 GB
Windows 8 Pro/8.1 Pro	512 GB
Windows Server 2012 R2	4 TB

Certified Platforms & Configuration

Table 26 below identifies the platforms certified by AIR.

Table 26. Certified Platforms

Touchstone V2.0.0	Operating System			SQL Server		HPC Pack
	Win 7	Win 8.1	Win Server 2012 R2	SQL Server 2012 SP2	SQL Server 2014	HPC 2012 R2 KB
Databases			✓	✓	✓	
GIS Databases			✓	✓	✓	
Analysis Management			✓			✓
Analysis Server			✓			✓
Application Server			✓			✓
Client Machine	✓	✓	✓			

Important ⚠ The HPC Pack 2012 R2 KB2956330 is required for the components indicated in the table.

Table 27 defines the certified OS or software that is required for the components.

Table 27. Certified Configuration

Component	Certified Configuration
Database Servers	▪ Windows Server 2012 R2, Standard/Enterprise Editions ▪ SQL Server 2012 SP2+ or SQL Server 2014 SP1, Standard/Enterprise Editions
GIS Server	▪ Windows Server 2012 R2, Standard/Enterprise Editions ▪ SQL Server 2012 SP2+ or SQL Server 2014 SP1, Standard/Enterprise Editions
Analysis Management Servers (HN)	▪ Windows Server 2012 R2, Standard/Enterprise Editions ▪ HPC Pack 2012 R2 KB2956330 (Head Node Components)
Analysis Servers (CN)	▪ Windows Server 2012 R2, Standard/Enterprise Editions ▪ HPC Pack 2012 R2 (Compute Node Components)
Application Server (IIS)	▪ Windows Server 2012 R2, Standard/Enterprise Editions ▪ HPC Pack 2012 R2 (Client Utilities)
Client machines (UI)	▪ Windows Server 2012 R2, Standard/Enterprise Editions ▪ Windows 8.1 Enterprise Edition, Windows 7

Upgrade Paths

For clients with Touchstone Version 3.0, who want the **least amount of environment reconfiguration**, use the upgrade guidelines summarized in Table 28 below. Note that *this path will not ensure complete future Touchstone compatibility*.

Table 28. Least Impact Upgrade Path

Touchstone Component	Operating System Version	HPC Pack Version	SQL Server Version
Databases	Windows Server 2012 R2	N/A	SQL Server 2012 SP2+ or SQL Server 2014
GIS Databases	Windows Server 2012 R2	N/A	SQL Server 2012 SP2+ or SQL Server 2014
Analysis Management	Windows Server 2012 R2	HPC Pack 2012 R2 KB2956330 Head Node	N/A
Analysis Server	Windows Server 2012 R2	HPC Pack 2012 R2 Compute Node	N/A
Application Server	Windows Server 2012R2	HPC Pack 2012 R2 Client Utilities	N/A
Client	Windows 7/8.1/2012 R2	N/A	N/A

For new clients without a pre-existing Touchstone installation, and for clients who wish to **ensure maximum future compatibility with Touchstone**, use the upgrade guidelines summarized in Table 29 below.

Table 29. Maximum Impact Upgrade Path

Touchstone Component	Operating System Version	HPC Pack Version	SQL Server Version
Databases	Windows Server 2012 R2	N/A	SQL Server 2012 SP2+ or SQL Server 2014
GIS Databases	Windows Server 2012 R2	N/A	SQL Server 2012 SP2+ or SQL Server 2014
Analysis Management	Windows Server 2012 R2	HPC Pack 2012 R2 KB2956330 Head Node	N/A
Analysis Server	Windows Server 2012 R2	HPC Pack 2012 R2 Compute Node	N/A
Application Server	Windows Server 2012 R2	HPC Pack 2012 R2 Client Utilities	N/A
Client	Windows 7/8.1/2012 R2	N/A	N/A

Migration to New Servers

Clients who are upgrading from an earlier version of Touchstone will most likely need to: migrate the existing Touchstone database to new servers, restore the AIR logins, and perform an in-place upgrade, to accommodate the transition to SQL 2014 and Windows 2012. This will not apply to new installations of Touchstone v4.0.

HPC Pack Breakdown

Table 30 below is a simple guide to which HPC component is required and what operating system is supported.

Table 30. HPC Pack Breakdown

Touchstone Component	Operating System	HPC Pack Component
Analysis Management Server	Windows Server 2012 R2	HPC Headnode 2012 KB2956330
Analysis Server	Windows Server 2012 R2	HPC Compute Node 2012
Application Server	Windows Server 2012 R2	HPC Client Utilities 2012
Analysis Management and Application Server	Windows Server 2012 R2	HPC Headnode 2012 KB2956330

Important

HPC 2012 R2 can only be installed to SQL Server 2012 instances, even express; the type of instance that can be installed through the HPC installer.

Model Data Disk Space Requirements

Touchstone 4.1 offers model data in two packages:

- 10K/50k/500k/Hazard Package
- 100K Package

Disk space requirements for these two packages are summarized in Table 31 below.

Table 31. Model Data Disk Space Requirements

Region of Data/Peril		Disk Space Required	
		10K/50K/500K (GB)	100K (GB)
Required files		1.2	0
Asia Pacific		196.38	579.29
	Earthquake	118.1430.2	306.09
	Bushfire	0.75	-
	Tropical Cyclone + Storm Surge	77.49	273.20
	Severe Thunderstorm	15.76	-
Central America		0.21	-
	Tropical Cyclone	0.77	
	Earthquake	0.21	-
Europe		13.08	-
	Earthquake	1.04	-
	Extratropical Cyclone	0.44	-
	Coastal Flood	0.08	-
	Inland Flood	11.52	-
Hazard		59.57	-
North America		470.44	133.94
	Earthquake	23.32	1.73
	Flood	146.87	-
	Tropical Cyclone	166.23	24.21
		-	
	Severe Thunderstorm	120.94	108.00
	Terrorism	1.18	-
	Wildfire	3.54	-
	Winter Storm	8.36	-
South America		19.86	-
	Earthquake	19.86	-
	Sum	**744.23**	**713.23**
	Total Sum	**1457.46**	

Development Tools and Dependencies

Table 32 defines the Touchstone development tools and dependencies.

Table 32. Touchstone Development Tools and Dependencies

Category	Item	Description	Version
Third Party	Industry Tool	Infragistics	15.1.0
Third Party	Industry Tool	ESRI	10.2.5.851
Third Party	Industry Tool	HPC	2012 R2 (4.2.440)
Third Party	Industry Tool	IIS	2008(7.5.7600)/ 2012(8.5.9600)
Third Party	Industry Tool	MDAC	2.8 SP1
Third Party	Industry Tool	Microsoft XML parser	3.0, 4.0
Third Party	Industry Tool	VB Runtime	6.0,SP6
Third Party	Industry Tool	VC++ Runtime	2013
Third Party	Industry Tool	Microsoft SQL Server (Workgroup; Standard; Enterprise)	2008 R2+ and 2014
Third Party	Industry Tool	Borland SilkTest	15.5
Third Party	Industry Tool	MathWorks, Inc. MATLAB	2014a
Third Party	Industry Tool	Scooter Software Beyond Compare	3.5, 4.1
Third Party	Industry Tool	IBM Rational Performance Tester	8.2
Third Party	Industry Tool	IBM Rational ClearQuest	8.0.1.4
Third Party	Industry Tool	Microsoft Visual SourceSafe	2005
Third Party	Industry Tool	Flexera Software InstallShield	2013
Third Party	Industry Tool	Microsoft Visual Studio	2013
Third Party	Industry Tool	Windows Server	Windows 7/8.1/2012
Third Party	Industry Tool	MSBuild	12
Third Party	Industry Tool	Red Gate Smart Assembly	6
Third Party	Industry Tool	MSDN ServiceModel Metadata Utility Tool (SvcUtil.exe)	for .NET Framework 4.5.2
Third Party	Industry Tool	VSoft Technologies Final Builder	7.0.0.898
Third Party	Industry Tool	Red Gate Sql Compare	10
Third Party	Industry Tool	Microsoft .NET Framework	4
Third Party	Industry Tool	CodePlex Trx2Html	0.7
Third Party	Industry Tool	ERSI ArcGIS for Desktop Basic	10.2.2
Third Party	Industry Tool	MathWorks, Inc. MATLAB	2014a
Third Party	Industry Tool	SharpGIS Shape2SQL	13
Third Party	Industry Tool	Eclipse	4.4

Category	Item	Description	Version
Third Party	Industry Tool	Microsoft Team Foundation Server	2010, 2015
Third Party	Industry Tool	Symantec Endpoint Protection Version	12.1.1101.401
Third Party	Industry Tool	Checkpoint Pointsec Full Disk Encryption	7.4.8
Third Party	Industry Tool	Websense Email Security	7.7
Third Party	Industry Tool	Shavlick Protect	9.1
Third Party	Industry Tool	EMC2 Avamar	7
Third Party	Industry Tool	Adobe Robohelp	10
Third Party	Industry Tool	Microsoft Word	2010
Third Party	Industry Tool	Microsoft Excel	2010
Third Party	Industry Tool	Microsoft Visio	2010
Third Party	Industry Tool	Microsoft Project	2010
Third Party	Industry Tool	Adobe Acrobat X Pro	10.1.10
Third Party	Industry Tool	Innovasys Document! X	2014.1.36.0
Third Party	Industry Tool	Production Ektron	8.5
Third Party	Industry Tool	TechSmith Snagit	11.2.1
Third Party	Industry Tool	Beyond Compare	3
Third Party	Industry Tool	SalesForce Enterprise	N/A
AIR-developed Tool	AIR Tool	ARMS—Scheduler	1.0.0
AIR-developed Tool	AIR Tool	ARMS—Website	1.0.0
AIR-developed Tool	AIR Tool	ARMS—Workerhost	1.0.0
AIR-developed Tool	AIR Tool	ARMS—Continuous Integration Agent	1.0.0
AIR-developed Tool	AIR Tool	Datafile Converter	15
Touchstone component	COM_Component	CATools Components	14.0.0.0
Touchstone component	COM_Component	Loss Engine	4.0.0
Touchstone component	COM_Component	CAT Engine	4.0.0
Touchstone component	COM_Component	Model_01: AIR Terrorism Loss Estimation Model	3.0.0
Touchstone component	COM_Component	Model_02: AIR U.S. Workers Comp	1.2.0
Touchstone component	COM_Component	Model_03: AIR Japan Personal Accident	1.0.1
Touchstone component	COM_Component	Model_05: AIR Wildfire Model for California	2.2.0
Touchstone component	COM_Component	Model_06: Australia Bushfire	2.1.0
Touchstone component	COM_Component	Model_08: AIR U.S. Flood	2.0.0
Touchstone component	COM_Component	Model_11: AIR Earthquake Model for the U.S.	9.0.1
Touchstone component	COM_Component	Model_12: AIR Earthquake Model for the U.S. and Canada	3.0.0

Category	Item	Description	Version
Touchstone component	COM_Component	Model_13: AIR Earthquake Model for Hawaii	1.7.1
Touchstone component	COM_Component	Model_14: AIR Earthquake Model for Alaska	1.8.0
Touchstone component	COM_Component	Model_15: AIR Earthquake Model for the Caribbean	2.0.0
Touchstone component	COM_Component	Model_21: AIR Hurricane Model for the U.S.	16.0.0
Touchstone component	COM_Component	Model_22: AIR Severe Thunderstorm Model for the U.S.	7.0.3
Touchstone component	COM_Component	Model_23: AIR Hurricane Model for Hawaii	3.9.0
Touchstone component	COM_Component	Model_24: AIR U.S. Hurricane Model for Offshore Assets	1.9.0
Touchstone component	COM_Component	Model_25: AIR Tropical Cyclone Model for the Caribbean	9.0.0
Touchstone component	COM_Component	Model_26: AIR Severe Thunderstorm Model for Canada	3.0.1
Touchstone component	COM_Component	Model_28: AIR Winter Storm Model for the U.S.	1.4.0
Touchstone component	COM_Component	Model_29: AIR Tropical Cyclone Model for Mexico	1.0.0
Touchstone component	COM_Component	Model_30: AIR Tropical Cyclone Model for Canada	1.0.0
Touchstone component	COM_Component	Model_31: AIR Earthquake Model for the Pan-European Region	3.0.0
Touchstone component	COM_Component	Model_41: AIR Extratropical Cyclone Model for Europe	5.0.0
Touchstone component	COM_Component	Model_42: AIR Winter Storm Model for Canada	1.0.0
Touchstone component	COM_Component	Model_51: AIR Earthquake Model for Australia	3.0.0
Touchstone component	COM_Component	Model_52: AIR Earthquake Model for Japan	6.3.0
Touchstone component	COM_Component	Model_53: AIR Earthquake Model for New Zealand	3.0.0
Touchstone component	COM_Component	Model_54: AIR Earthquake Model for Southeast Asia	4.0.0
Touchstone component	COM_Component	Model_55: AIR Earthquake Model for China	1.3.0
Touchtone component	COM_Component	Model_58: AIR Earthquake Model for India	1.0.0
Touchstone component	COM_Component	Model_61: AIR Cyclone Model for Australia	2.1.0
Touchstone component	COM_Component	Model_62: AIR Typhoon Model for Japan	4.0.0
Touchstone component	COM_Component	Model_64: AIR Typhoon Model for Southeast Asia	3.0.0
Touchstone component	COM_Component	Model_65: AIR Typhoon Model for China	12.5.0

Category	Item	Description	Version
Touchstone component	COM_Component	Model_66: AIR Typhoon Model for South Korea	2.1.0
Touchstone component	COM_Component	Model_67: AIR Tropical Cyclone Model for Central America	2.1.0
Touchstone component	COM_Component	Model_68: AIR India Tropical Cyclone	2.2.0
Touchstone component	COM_Component	Model_70: AIR Earthquake Model for South America	1.0.0
Touchstone component	COM_Component	Model_72: AIR Earthquake Model for Mexico	2.0.0
Touchstone component	COM_Component	Model_76: AIR Earthquake Model for Central America	1.0.0
Touchstone component	COM_Component	Model_91: AIR Flood Model for Great Britain	1.0.0
Touchstone component	COM_Component	Model_92: AIR Inland Flood Model for the UK	1.1.0
Touchstone component	COM_Component	Model_93: AIR Inland Flood Model for Germany	2.0.0
Touchstone component	COM_Component	Model_95: AIR Inland Flood Model for Austria, Czechoslovakia, and Switzerland	1.0.0
Touchstone component	COM_Component	Model _230: ERN Earthquake model for Mexico	1.0.0
Touchstone component	COM_Component	Model_231: ERN Tropical Cyclone Model for Mexico	1.0.0
Touchstone component	Touchstone Component	Touchstone User Interface	4.0.0
Touchstone component	Touchstone Component	Bulk Geocoding Service	4.0.0
Touchstone component	Touchstone Component	Bulk Data Service	3.0.0
Touchstone component	Touchstone Component	Address Service	6.1.0.12
Touchstone component	Touchstone Component	Loss Application Service	4.0.0
Touchstone component	Touchstone Component	Bulk Loss Analysis Service	4.0.0
Touchstone component	Touchstone Component	AIRDBAdmin database	4.1.0.4
Touchstone component	Touchstone Component	AIRDQIndustry database	4.1.0.4
Touchstone component	Touchstone Component	AIRExposure database	4.1.0.4
Touchstone component	Touchstone Component	AIRExposureSummary database	4.1.0.4
Touchstone component	Touchstone Component	AIRGeography database	4.1.0.4
Touchstone component	Touchstone Component	AIRIndustry database	4.1.0.4
Touchstone component	Touchstone Component	AIRLossCost database	4.1.0.4
Touchstone component	Touchstone Component	AIRMap database	4.1.0.4
Touchstone component	Touchstone Component	AIRMapBoundary database	4.1.0.4
Touchstone component	Touchstone Component	AIRProject database	4.1.0.4
Touchstone component	Touchstone Component	AIRReference database	4.1.0.4
Touchstone component	Touchstone Component	AIRReinsurance database	4.1.0.4
Touchstone component	Touchstone Component	AIRResult database	4.1.0.4

Category	Item	Description	Version
Touchstone component	Touchstone Component	AIRSecurity database	4.1.0.4
Touchstone component	Touchstone Component	AIRSpatial database	4.1.0.4
Touchstone component	Touchstone Component	AIRSpatialWork database	4.1.0.4
Touchstone component	Touchstone Component	AIRUserMap database	4.1.0.4
Touchstone component	Touchstone Component	AIRUserSetting database	4.1.0.4
Touchstone component	Touchstone Component	AIRUserSpatial database	4.1.0.4
Touchstone component	Touchstone Component	AIRUserSpatialWork database	4.1.0.4
Touchstone component	Touchstone Component	AIRWork database	4.1.0.4

Computer Languages

The computer languages employed at AIR include:

- FORTRAN
- C++
- Microsoft C#
- Visual Basic
- Java
- SQL
- WPF/WCF/XAML

CI-5 Verification

A. General

For each component, the modeling organization shall maintain procedures for verification, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness. Verification procedures shall include tests performed by modeling organization personnel other than the original component developers.

AIR software engineers employ a variety of verification procedures to check code correctness. These procedures include code-level debugging, component-level unit testing, verifying newly developed code against a stable reference version, and running diagnostic software tools to detect runtime problems.

In addition, other verification mechanisms are used to test the correctness of key variables that might be subject to modification. These mechanisms include code tracing, intermediate output printing and error logging. Examples of these verification procedures, including code inspections, reviews, calculation crosschecks, walk-through and the use of logical assertions and exception-handling mechanisms in the code, are described within the documentation and shall be available to the Professional Team.

Verification processes for all model and software components are defined as part of the workflows in the FCHLPM User Help system. Additional detailed information regarding the verification/testing process for the model components is provided within each component-specific document.

Crosschecking procedures and results for verifying equations are discussed in the document *Model 21 Equations/Formulas, Variable Mapping and Crosschecking*. Model and software development custodians shall be available to illustrate the equation crosscheck verification.

B. Component Testing

1. The modeling organization shall use testing software to assist in documenting and analyzing all components.

Tools used during the testing process include:

- SilkTest: Build and execute automated test cases.
- Beyond Compare: Compare and validate test output and results.
- ClearQuest: Bug tracking and process management.
- ArcGIS: Geo-spatial validation

2. Unit tests shall be performed and documented for each component.

Unit testing is done to ensure that the individual units (procedures/functions, functional units, etc.) are working as per the expected behavior. Unit testing is done by the developer for new development of a unit or an update to an existing unit. During testing, any deviation observed from the expected behavior would be fixed by the developer. The important test results are preserved in a folder for future reference.

3. Regression tests shall be performed and documented on incremental builds.

To ensure the quality of an incremental build, regression tests are executed at various levels including during Smoke testing and Acceptance testing (an extensive and thorough test) to ensure that only the expected changes are observed. When discrepancies are observed, QA refers the case to the appropriate stakeholder such as Research or Product Management for guidance. At the point of test plan execution, both the test plan and the test result are cataloged (documented) in a repository with version control.

4. ***Aggregation tests shall be performed and documented to ensure the correctness of all model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.***

Aggregation tests are performed and documented by various QA teams to ensure the correctness of all model components.

The process includes:

- gathering feature requirements to understand the objective and the details of the assignment
- creating test plans that detail the testing to be executed in addition to the regressions to be employed
- cross-functional review and acceptance of the test plan that ensures complete coverage of the test plan
- the execution of the test plan
- the archiving of the results
- the review of results by various stakeholders for correctness and completeness.

When applicable, issues that are found are entered into the tracking system.

C. Data Testing

1. ***The modeling organization shall use testing software to assist in documenting and analyzing all databases and data files accessed by components.***
2. ***The modeling organization shall perform and document integrity, consistency, and correctness checks on all databases and data files accessed by the components.***

AIR has a Verification Utility program, the Data File Converter, which checks the existence, consistency, and correctness of all data files. This program verifies that each data file matches a known version of the data file by performing checksum verification. Checksum is a count of the number of bits in a transmission unit so that the receiver can verify the number of bits received against the original number of bits. When the count matches, it is assumed that the complete transmission was received. For databases, AIR performs data validation on every step of the process and the entire process. This includes validating the source counts and ensuring that the changes are affected on the same number of records. Examples of the verification, including counts on the ZIP changed records, county change records, and ZIP centroid updates, are described within the documentation and shall be available to the Professional Team.

Relevant Form: G-6, Computer/Information Standards Expert Certification

Disclosures

1. *State whether any two executions of the model with no changes in input data, parameters, code, and seeds of random number generators produce the same loss costs and probable maximum loss levels.*

All model runs including random number generator codes are performed during the Model development process by our Research & Modeling Group. One of these iterations is selected and released in Touchstone as the event catalog. In this sense, the software as a separate application does not contain a random number generator component but, rather, it is contained within the event catalog (Model), which is an integrated part of the application.

AIR has multiple test cases that are run at every internal software build, and at least twice on the final release software build to ensure that Touchstone produces identical results, including loss costs and probable maximum loss levels.

These results are validated against past releases to ensure that there are no changes to the loss costs and probable maximum loss levels.

2. *Provide an overview of the component testing procedures.*

Model component testing procedures are divided into three broad sections. These include procedures to 1) ensure that the event generation, local intensity, and damage estimation modules are functioning correctly in each component and as a whole, 2) perform reasonability checks on the loss results, hazard pattern analysis, and document and quantify model changes, and 3) check various other model functionalities.

Verification processes for all model and software components are defined as part of the workflows in the FCHLPM User Help system. Addition detailed information regarding the verification/testing process for the model components is provided within each component-specific document.

3. *Provide a description of verification approaches used for externally acquired data, software, and models.*

AIR verifies all externally sourced data; it is an integral part of the development process, especially for those model components that rely heavily on scientific data. Explanation of the validation methods for these data sources is provided in the Table 33 below.

Table 33. Validation Methods Data Sources

Source Title	Description	Validation Methods
National Hurricane Center Tropical Cyclone Reports	Provides comprehensive information on each hurricane. Data for hurricanes that occurred between 1958 and 1994 are available at http://www.nhc.noaa.gov/archive/storm_wallets/atlantic/. Data for hurricanes that occurred between 1995 and 2010 are available at http://www.nhc.noaa.gov/pastall.shtml.	Downloaded data is compared to original versions. No additional validation is done.
HURDAT2 Chronological List of All Hurricanes which Affected the Continental United States: 1851-2014	Provides a chronological list of all hurricanes which affected the continental U.S. from 1851-2014. Revised in February 2015 to include the 2014 season and reflects official HURDAT reanalysis changes through 1955. Available online at http://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html	Downloaded data is compared to original versions. No additional validation is done.
The revised Atlantic hurricane database (HURDAT2)	Provides storm track data for all hurricanes from 1851 to 2014. Storm parameters are provided at 6-hour intervals for the life of the storm, including direction, speed, wind, pressure, and storm rating. Data are also provided at additional points of interest (such as time of landfall). Available online at http://www.aoml.noaa.gov/hrd/hurdat/hurdat2.html.	Downloaded data is compared to original versions. No additional validation is done.
HURDAT2 Continental U.S. Hurricanes: 1851 to 1930	Provides historic data for hurricanes that occurred from 1851 to 1930. This data was revised in December 2010 to include updates for the U.S. hurricanes through 1930. Available online at http://www.aoml.noaa.gov/hrd/hurdat/usland1851-1930&1983-2010-Mar2011.html.	Downloaded data is compared to original versions. No additional validation is done.
Monthly Weather Review Articles from 1872-2008	Contains weather review articles for each hurricane season from 1872 to 2008. These articles are available online at the HURDAT website, http://www.aoml.noaa.gov/general/lib/lib1/nhclib/mwreviews/.	Downloaded data is compared to original versions. No additional validation is done.

Source Title	Description	Validation Methods
National Hurricane Center Reconnaissance Data	Provides real-time hurricane data obtained from aircraft reconnaissance missions performed by the 53rd Weather Reconnaissance Squadron and the NOAA Aircraft Operations Center. Available online at http://www.nhc.noaa.gov/archive/recon/.	Downloaded data is compared to original versions. No additional validation is done.
USGS National Land Cover Database (NLCD)	Provides digital and satellite-derived land use/land cover data dating from 2001. This database encompasses all 50 states and includes land cover at 30m resolution, which was derived from Landsat Thematic Mapper satellite data imagery. This data is used to generate the physical properties component of Model 21. Available online at http://www.mrlc.gov/index.php.	USGS LULC data are overlaid over satellite imagery to ensure proper data projection has been applied. Additional checking is applied over bodies of water as identified by GIS boundary files. The U.S.G.S. incorrectly designates some of these areas as having land properties, and in these cases the data are corrected to water.
NIELSEN	Provides the population-weighted ZIP Code centroids that are used as part of the annual U.S. exposure update process. NIELSEN creates a population weighted centroid for each ZIP Code contained within the update files it provides. The process of creating these centroids relies upon mapping the centroids of census blocks to the ZIP Codes by allocating all Census Blocks whose centroid falls within the boundary of a given ZIP Code, to that ZIP Code. For each ZIP Code a population weighted centroid is calculated based on this mapping. The data received from NIELSEN is on average a year out of date.	The calculation of the population weighted centroids is checked by the Exposures group using the NIELSEN census block centroids and population. A secondary check is done using the block centroids and population from the most recent census. Centroid movements greater than .1 miles are plotted on maps and visually inspected. Any changes that can't be justified are referred to NIELSEN for further explanation.
Topologically Integrated Geographic Encoding and Referencing (TIGER) Database	Provides street information (name, address numbers, city, latitude and longitude coordinates for streets) that is used by the AIR Geocoder and Address Service to uniquely identify various geographic areas. Also provides various landmarks (parks, airports, etc.) data that is used by the Map Server. This data is from the Aug. 2014 U.S. Census TIGER shape file release.	Implemented as part of the AIRAddressServer database. Various fields counts in the integrated database are compared to the prior year's integrated database. In addition, address service batch processes are run to compare batch geocoding and address validation match results to the prior versions results.
United States Postal Service	Provides the official ZIP Codes, ZIP-9 codes, and related street segments for the U.S. This data, which is received monthly, is also included in the annual ZIPAll update by the Research group.	Implemented as part of the AIRAddressServer database. Various fields counts in the integrated database are compared to the prior year's integrated database. In addition, address service batch processes are run to compare batch geocoding and address validation match results to the prior versions results.
Department of Energy (DOE) Exposure Data	Residential Energy Consumption Survey (RECS) http://www.eia.gov/consumption/residential/data/2009/	The distributions of risk counts in various regions were compared against distributions of risk counts across the same regions in the AIR Industry Exposure.
U.S. Census: American Community Survey	Data regarding housing age counts (year of construction) extracted from: http://www.census.gov/acs/www/data_documentation/data_main/. Downloaded May 29, 2014	The distributions of risks compared against the AIR Industry Exposure, and with previous releases of the ACS to ensure consistency.

Source Title	Description	Validation Methods
	(ACS_12_5YR_DP04_with_ann.csv)	
ZIPList5Max by ZIPInfo	ZIPList5 Max is a 5-digit ZIP Code data file which includes latitude and longitude, MSA/PMSA, and market area. The file is available in comma-delimited ASCII format, as well as MS Access, dBase, and Paradox database formats. The file contains about 71,500 records (42,700 "preferred" records plus 28,800 "alias" records), covering all valid ZIP Codes to which the U.S. Postal Service delivers mail. Each ZIPList5 Max record contains the following data: 5-digit ZIP Code, City name (and abbreviation, if over 13 characters), State abbreviation, County name (for that ZIP code), County FIPS code, Area code, Time zone, Daylight Saving Time flag, Latitude and longitude in degrees, MSA/PMSA code, Market Area, Preferred name or alias name, lag (refers to city name), and ZIP Code type.	The GIS specialist in the product management group takes the latest commercial release from ZIPInfo, which matches the same timeline as the versions of the U.S. Postal Service ZIP+4 national and U.S. Census TIGER shapefile data releases, and conflate these separate data sources into the AIRAddressServer database. Various field counts in the integrated database are compared to the prior year's integrated database. In addition, address service batch processes are run to compare batch geocoding and address validation match results to the prior versions results. It is important to note that AIR receives receive quarterly update of the ZIPInfo data, however only the version that is closes to the U.S. Postal and U.S. census TIGER release dates is used. In some cases, the source release dates may differ by a month, but it is outside our control as to when a given sources release their data updates.
Rural-Urban Continuum Codes	The 2013 Rural-Urban Continuum Codes form a classification scheme that distinguishes metropolitan counties by the population size of their metro area, and nonmetropolitan counties by degree of urbanization and adjacency to a metro area. This scheme allows researchers to break county data into finer residential groups, beyond metro and nonmetro, particularly for the analysis of trends in nonmetro areas that are related to population density and metro influence.	This data/codes are used to identify which counties where "Rural" or "Urban" based on population density. Population counts were compared against exposure counts in the AIR Industry Exposure for validation.

Detailed discussion regarding the verification of the data is discussed in detail within each component-specific document. Model and Software development custodians shall be available to further explain the validation methods for each data source.

The QA test plans are designed to 1) evaluate the functionality of the software to ensure that it behaves as intended and 2) to ensure that the results are as expected. As such, all Touchstone dependencies (i.e. model .dlls and databases) are inherently validated via the testing process. Any inappropriate behavior or deviation from the expected results are further investigated by the various stakeholders, including QA, Product Management, Research, Software Development, and Client Consulting. When appropriate, ClearQuest tickets are opened to ensure that the source of the error is corrected and re-tested.

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CI-6 Model Maintenance and Revision

A. The modeling organization shall maintain a clearly written policy for model review, maintenance, and revision, including verification and validation of revised components, databases, and data files.

AIR maintains a clearly documented policy for model review, maintenance, and revision with respect to methodology and data. AIR employs a verification mechanism consisting of manual comparisons of its data files and databases used in the modeling process and a computer verification process that consists of comparing program, configuration, data file and database cryptographic service values against their known valid values.

B. A revision to any portion of the model that results in a change in any Florida residential hurricane loss cost or probable maximum loss level shall result in a new model version identification.

AIR has a clearly documented policy for model revision with respect to methodology and data. Any enhancement to the model that results in a change in hurricane loss costs or probable maximum loss levels also results in a new model version number. At least once a year, the ZIP Code information is updated to take into account the most recent data. Specifically, the ZIP Code Centroids are updated, and using this new information, the ZIP Code site characteristics are updated. These characteristics include elevation, surface roughness, and distance from the coastline. The historical meteorological information is periodically updated to reflect new events (or lack thereof).

Other enhancements may be made to the model based on ongoing research undertaken by AIR scientists and engineers. For example, post disaster damage surveys and collected loss data from actual events may improve our understanding of the effectiveness of building codes in specific areas.

C. The modeling organization shall use tracking software to identify and describe all errors, as well as modifications to code, data, and documentation.

AIR uses Salesforce CRM and ClearQuest to track issues/bugs, as well as modifications to code, data, and documentation. Revisions and versioning are managed using the build in versioning capability of Microsoft's Team Foundation Server via Microsoft Visual Studio, as well as Visual SourceSafe (VSS).AIR custodians shall be available to demonstrate issue management via Salesforce and ClearQuest.

Salesforce CRM

Client Services uses Salesforce CRM to track defects, bugs, enhancement and recommendations submitted by clients and customers. Salesforce CRM is an enterprise level customer relationship management (CRM) that allows AIR to manage client reported cases of technical support issues, including web-based reporting, tracking, documentation, management and resolution of all levels of client technical support.

Issues identified by Client Services using Salesforce CRM are escalated to ClearQuest tickets for further development when the case require extensive requirements gathering, analysis and/or technical, code or model changes.

ClearQuest Tickets

AIR uses ClearQuest to log and manage product enhancements, change requests, and issues management. Any issues/bugs/unexpected results that are identified via the testing process are also tracked using ClearQuest.

Issue/Bug Submission Process

Clients submit bugs or suspect model data errors using the Salesforce CRM. The Salesforce case is assigned to the appropriate group (i.e. Client Consulting, Research, Software Development), which reviews the circumstances and determines if a solution exists that does not require modifications to the application. If so, these solutions are documented in the Salesforce CRM system and provided to the client. When changes to Touchstone or the model are required to fix the issue, AIR follows the standard software development process.

Internal AIR users submit change requests electronically via ClearQuest. There are no restrictions to limit individuals who may submit a request. The workflows in Figure 62 and Figure 63 below illustrate the change management processes for the model and Touchstone software.

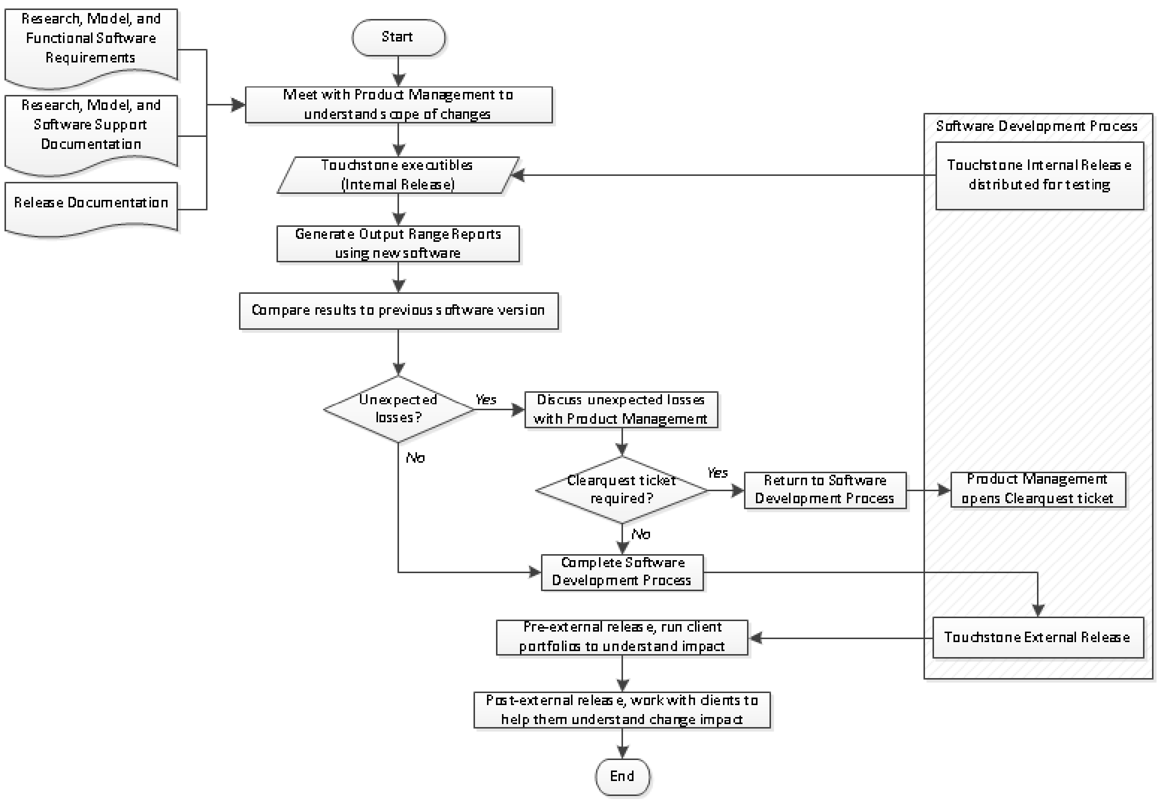


Figure 62. Version Change Management Process

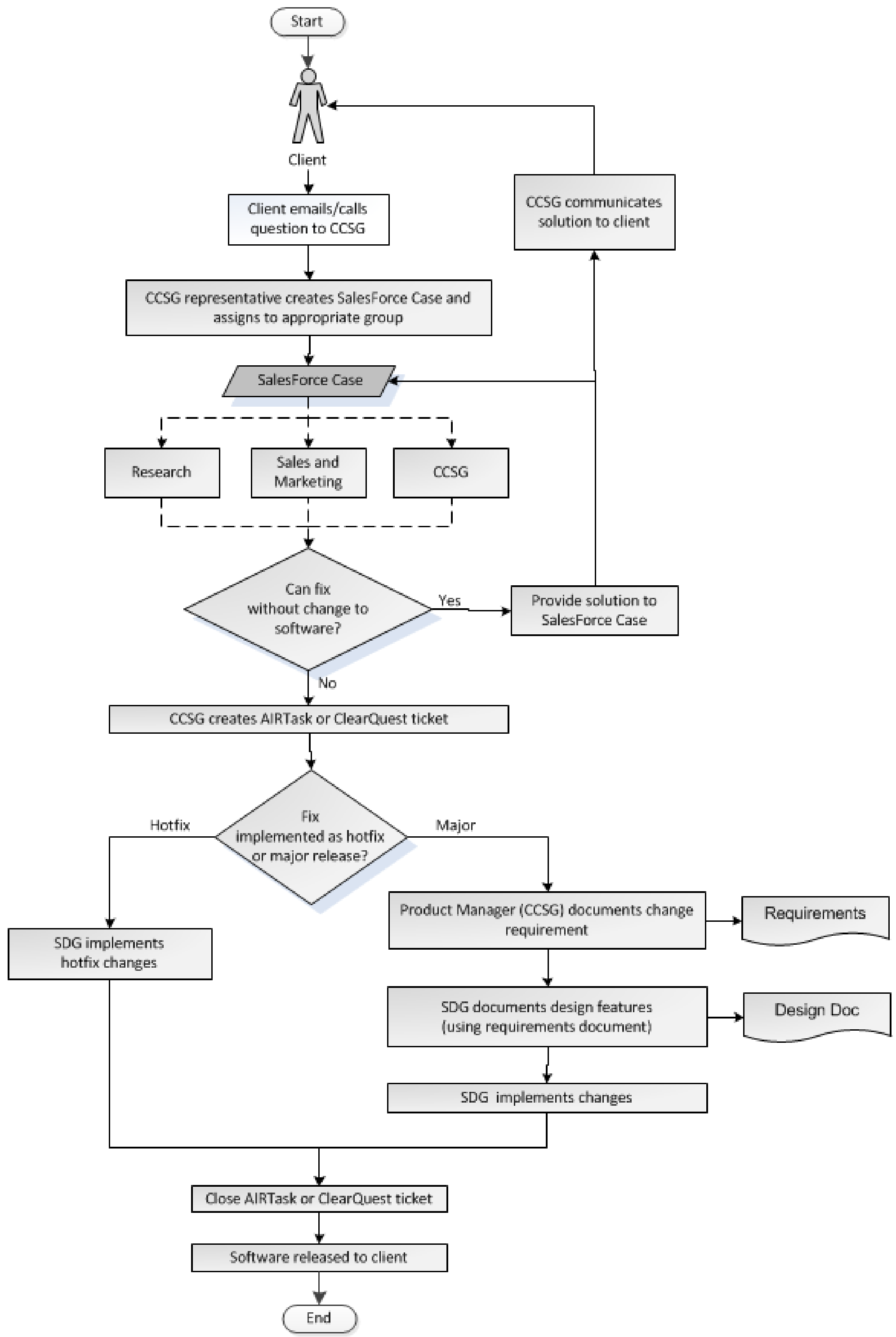


Figure 63. Software Change Management Process

D. The modeling organization shall maintain a list of all model versions since the initial submission for this year. Each model description shall have a unique version identification and a list of additions, deletions, and changes that define that version.

The document *Enhancements and Florida Commission Documentation Mapping* identifies the updates specific to the AIR Hurricane Model for the U.S. version 16.0.0 and Touchstone application version 4.1.0. The document *Version Change History* defines the source code additions, deletions, and changes for the model components and software since the last submission. These documents shall be available to the Professional Team.

Relevant Form: G-6, Computer/Information Standards Expert Certification

Disclosures

1. Identify procedures used to review and maintain code, data, and documentation.

AIR employs consistent and documented methods for data and documentation control for all software product development and test scripts. The current version number and date of most recent changes are documented for the individual components in the system decomposition.

AIR uses Team Foundation Server (TFS) for version control of the model components' source code. Due to the large size of the model's data files, they are not stored within TFS. They are stored on data servers, for which the AIR Data Control Workbook is used to log these model data that is ready for transfer from the Research and Model group to the Software Development team. This workbook tracking includes date, file name, data type, description, changes relative to previous year and the name of the person(s) who send and receive the data.

Version control for the Touchstone components' source code (including the C++ model code and databases) is maintained using Microsoft's Team Foundation Server (TFS) via Microsoft Visual Studio.

AIR uses Microsoft Office SharePoint Server (internally referred to as AIRPort) to manage project, archive and monitor requirements, store and share client-based or internal documentation or PDF files. Like TFS and VSS, AIRPort tracks installation date, date of most recent changes and version history.

2. Describe the rules underlying the model and code revision identification systems.

AIR maintains a clearly documented policy for model revision. The research models and the software applications have four components to the version number. For each new version a build date is assigned and the version numbers are tracked in source control. A detailed explanation of the revision number system is as follows.

The AIR Hurricane Model for the U.S. version definitions are predefined and follow typical versioning methodology, including:

- **Major Version** (two digit)—Incremented when model components, such as the catalog, hazard, intensity, or vulnerability modules, are updated. A single major version increment is sufficient in cases when multiple components are updated during a release cycle.
- **Minor Version** (two digit)—Incremented when data files, such as the physical properties or industry exposures, are updated but the model components remain unchanged. If data files are changing simultaneously with a major version update, the minor version number does not need to be incremented.
- **Update to Minor Version** (one digit)**—**Incremented when data file or model component bugs have been identified *after* the release of our client software products.
- **Build Version** (two digit)**—**Incremented when bug fixes are required for data files or model components and these changes have been identified *prior* to a release of our client software.

- **Build Date** (six digit—yymmdd)—Incremented every time significant changes are made to the data files and a new version of the model is compiled. The build date changes most frequently. A new build date is introduced every time the version number changes.

The software version definitions are predefined and follow typical software versioning methodology, including:

- **Major Version** (two digit)—Incremented when new or revised models are implemented into the software application. Also introduces database, engine, and other significant changes to the software.
- **Minor Version** (two digit)—Incremented when new or revised models, functionality enhancements, and other various software upgrades are introduced. Most often, this service pack is released in the fall.
- **Update to Minor Version** (one digit)—Incremented in cases when bug fixes are necessary and have been identified *after* the release of our client software. The need to increment this version number is most often identified externally by a client and incrementing this digit indicates that a service pack or Hot Fix was released.
- **Build Version** (two digit)—Incremented in cases when bug fixes are necessary and these changes have been identified *prior* to a release of our client software.
- **Build Date** (Eight digit—yyyymmdd)—Incremented each time significant changes are made to the source code and the software is compiled. The build date will change most frequently. A new build date is introduced every time the version number changes.

CI-7 Security

The modeling organization shall have implemented and fully documented security procedures for: (1) secure access to individual computers where the software components or data can be created or modified, (2) secure operation of the model by clients, if relevant, to ensure that the correct software operation cannot be compromised, (3) anti-virus software installation for all machines where all components and data are being accessed, and (4) secure access to documentation, software, and data in the event of a catastrophe.

AIR employs a number of physical and electronic security measures to protect all code, data, and documentation against both internal and external potential sources of damage, and against deliberate and inadvertent, unauthorized changes.

Electronic Security

The AIR network is made up of shared Windows and Linux servers along with a variety of desktop workstations and laptops used by individual employees. Within each department there may also be some workstations that contain applications or resources that are shared within the department. These machines may also be used to execute long running jobs.

Microsoft Windows servers are the foundation of the network. There are file, print, and Exchange mail servers. The network is connected with 1000/10,000 Gbps Ethernet switches for fast throughput. AIR also has Linux servers, which are primarily used for research and development of AIR models. They are also used for running these models for client services. Email is centralized through the Boston office. The AIR network also has a separate sub-network that contains classroom workstations. Students in classes see only what is available to that sub-network, not the servers and workstations of AIR employees.

As a directive from Verisk (AIR's parent company), every employee at AIR is required to complete the online Information Security Awareness with Privacy Principles program during the month of January. The program discusses key security elements that all employees must understand. To successfully complete the course, employees must review and accept the policies stated and score 80 percent or better on the assessment provided at the end of the course. Compliance with certain regulations, including security rules within the Health Insurance Portability and Accountability Act (HIPAA), mandate that all employees be fully trained in security awareness. Failure to complete and pass the course could result in suspension of the employee's LAN access.

Network Access Management

Access to the network is managed using:

- Firewall—The first stage of network protection is the use of firewalls. AIR policy is to maintain the minimum number of open ports necessary.
- Network logon (internal)—Access to the network via workstations at AIR's main office is restricted to AIR-approved Windows®-authenticated accounts with a valid user name and password. Passwords must be a minimum of eight characters in length and must contain a combination of alphabetic and numeric characters, including upper case letters. The Windows' login account password expires every 60 days. Use of personal computers is restricted without AIR network access approval. IS ensures that personal computers have functional anti-virus software, as well as relevant Microsoft patches.
- Network logon (external)—Access to the network from a workstation outside AIR's main office is subject to the internal network logon restrictions mentioned above, as well as access via the VPN gateway. VPN accounts are granted with management approval only.

- Branch offices and remote users—Access to the network from AIR's branch offices is subject to the internal network logon restrictions mentioned above, and can only be accessed via a virtual private network (VPN).

Data Servers Management

Access to the files and folders on AIR's data servers is regulated by permissions (read-only, read/write, etc.) assigned by management. In general, a member of one department has read/write access to that department's files and folders, and read-only access to the files and folders of other departments. Access to and permissions for specific folders are determined by the senior team leader and incorporated into each user's account profile.

The data servers are located in a secure server room. Access to the server room is granted by electronic badge verification and is limited to essential personnel only.

All model and software development is done within AIR's secure network. In general, developers have read-only access to the entire database, and read/write access to the product on which they are working.

Access to the contents of AIR's TFS and VSS databases is limited to authorized accounts approved and created by the senior team leader. The ability to delete code from the source control database is limited to the senior team leader.

Access to AIRPort—All AIR employees have access to AIRPort. Access is granted using the employee's Windows®-authenticated user name and password. When a site is created, the administrator determines who has access to the site and each member receives an invitation to join the site. The site administrator also assigns rights to team members.

FTP Server Management

The AIR Worldwide FTP Servers are contained within the DMZ zone and are accessed in a secure manner. In computer networks, a DMZ (demilitarized zone) is a computer host or small network inserted as a "neutral zone" between a company's private network and the outside public network. It prevents outside users from getting direct access to a server that has company data. A DMZ is an optional and more secure approach to a firewall and effectively acts as a proxy server as well.

In a typical DMZ configuration for a small company, a separate computer (or host in network terms) receives requests from users within the private network for access to websites or other companies accessible on the public network. The DMZ host then initiates sessions for these requests on the public network. However, the DMZ host is not able to initiate a session back into the private network. It can only forward packets that have already been requested. Users of the public network outside the company can access only the DMZ host. However, the DMZ provides access to no other company data.

Remote Access

AIR provides Virtual Private Network (VPN) service to give users access to the internal network while they are traveling or working at home. A VPN connection to AIR network enables employees to work remotely. Users can connect to a server to share files, to share their desktop via Remote Desktop protocol, and use X windows/SSH to connect to Linux resources. Since the home PC is not part of the AIR Worldwide domain, the user cannot see all of the workstations and servers in the Network Neighborhood. However, the can search for a particular server or workstation. Once the user finds the appropriate system, the user will be asked to enter their AIR Windows user name and password.

Using the VPN gateway to access the workstation at AIR Worldwide requires manager's approval, as well as the following computer pre-requisites:

- Symantec Anti-virus provided by AIR installed or equivalent anti-virus software on an employee's PC. The signature files should be updated daily or weekly. (Windows 7/8)
- The built-in Windows firewall (Windows 7/8) must also be installed and configured.

Access for Remote Offices

AIR Worldwide has several offices outside the Boston headquarters. Our branch offices have their own networks and servers, and each office has the ability to access the Boston servers and our Intranet via the VPN gateway.

File Back-up

To provide a safety net to AIR's network, AIR maintains a thorough back-up policy covering all files stored on the network, including all document, source and data files related to Touchstone and the AIR Atlantic Tropical Cyclone Model.

During the workweek, all critical servers are backed up in full to an Avamar/Datadomain grid.

Every thirty days a tape-out action is performed to LTO-6 with AES-256. Tapes are stored offsite at a commercial storage facility for seven years.

Virus Protection

Virus protection software is installed on the AIR servers, desktops, and notebooks. The virus protection maintenance policy is set up to automatically download virus signature pattern files every morning. These files are then automatically sent to all servers and workstations within the network. This protection scans not only incoming email and email attachments, but also any files introduced through external media, such as USB drives.

The virus scanning software, Symantec is always scanning files on our Windows desktops and servers. IS-installed Symantec always scans files as they are opened to ensure that no viruses have infected working files. Symantec is updated for new virus protection immediately upon release of an updated virus signature file.

AIR blocks spam using the third party application Websense Email Security. All email is filtered through the spam servers before being passed to the mail server.

Symantec is also installed on the FTP server. All files that are uploaded and downloaded are scanned automatically.

Microsoft® Patches

Patches to Microsoft products (including security patches) are provided and deployed using Shavlick. As Microsoft releases patches; the patch is deployed and installed automatically.

Laptops

In addition to the security software outlined in this document, all laptops are required to have the Checkpoint Pointsec Full Disk Encryption software installed. Check Point Full Disk Encryption provides the highest level of data security with multi-factor pre-boot authentication and the strongest encryption algorithms. The entire hard drive contents—including the operating system and even temporary files—are automatically encrypted for a completely transparent end-user experience.

Third Party Software

To maintain consistency among departments, any software that transfers data and is used within or between departments must be approved by IS. Wherever possible, functions within the Microsoft Office suite should be used. Only software that has been approved by both the department manager and IS can be installed on any AIR system. Individuals who load software that is not on the following list do so at their own risk. They are responsible for any consequences and will not be given IS support time for that software. Individual departments may have software that is required to perform the department's specific tasks. It is up to the department manager to select appropriate software. But all these products must coexist with the approved and supported software on a persons' desktop, as well as with the network environment. It is therefore a requirement that IS installs all software that is used on AIR equipment.

Disaster Recovery

The Disaster Recovery (DR) Procedure should be executed when any automated or human-sourced information determines there is a service outage at AIR. The goal is to determine if an authorized entity from AIR can determine if DR failover should or should not take place.

An incident response consists of three distinct phases, Emergency Response, Recovery and Restoration, each with its own set of objectives. The duration of each phase will depend on the nature of the event and its effect on AIR's critical business processes.

Emergency Response:—Once an incident is discovered and as it continues to unfold, the Emergency Response Team (ERT) is mobilized to determine the severity and extent of the incident. The ERT identifies what the situation is, how severe it is, what operations will be impacted if any, and what is the extent of the damage from the incident. This team reports all this information along with recommendations on how we should react to the Recovery Management Team (RMT). The RMT, headed by the company's president, decides whether the incident warrants a large scale response by the company. Depending on the severity and impact of the incident, the RMT may activate all or a portion of the Business Continuity Plan.

Recovery:—If the Business Continuity Plan is activated, it means that AIR's headquarters is not operational (fully or partially) and may not be accessible resulting in a focus shift to the recovery phase. The recovery phase involves activating and mobilizing the BCP teams and expanding the level of communications to internal and external parties. Employees will support operations from their designated recovery locations as defined in the BCP.

Restoration:—The restoration phase assumes that some or all of AIR's headquarters was damaged, continuity plans were activated, and employees and operations were relocated. During the restoration phase, the ERT stays at the AIR Headquarters to assess the extent, impact, and damage of any incident. They communicate with the RMT who will decide whether/when AIR can re-occupy its headquarters. When that decision is made, the teams involved in the re-location back from the disaster site will be activated and involved.

Information Security Incident Response Plan

All Suspected Data Breaches should be immediately reported to Verisk Help Desk, whose employees have been trained in managing incident response. They review what is reported and, if they deem it necessary, they invoke the Security Response Team.

Members of the Security Response Team are immediately notified simultaneously until one of the senior staff responds to the help desk. Confidentiality is extremely important and everyone is on a need-to-know basis. The decision-making around who gets notified and what happens next is wholly the Security Response Team's responsibility. The Response team will reach out to the person reporting the incident, get their business leaders involved, and start invoking.

Physical Security

AIR is located in a multi-story office building that contains multiple businesses. The building lobby is staffed by security guards 24 hours a day who verify the security badge of everyone who enters the building. Upon entering the building, the employee is required to swipe their badge by the elevator bank.

Employee Badges

Access to AIR's floor is restricted to current AIR employees and guests. All AIR Employees are issued an electronic security badge on the first day of their employment. All AIR employees (including employees visiting from other offices) should have their AIR security badges on their person at all times.

Employees who forget their badge must stop at the security desk and wait for clearance. In the event that a badge is lost, staff must notify the Office Manager *immediately* so that it can be deactivated and a new one can be issued.

The main entrances to the AIR offices are locked between 5:30 p.m. and 8:30 a.m. The use of the security badge is required to enter either of the doors on the north side of the building during those hours.

The data servers are located in a secure server room. Access to the server room is granted by electronic badge verification and is limited to essential personnel only.

Visitors

All visitors must be reported *in advance* to the Front Desk where they will be pre-cleared through our Visitor Clearance Program. Staff report the visitor's first and last name (spelled correctly), date(s) and time(s) of visit(s), and with whom they are meeting. Upon arrival, all guests must show photo ID at the security desk in the lobby to receive a 24-hour, self-invalidating badge indicating what floor and company they have clearance to visit. This badge cannot access any areas that require electronic badge verification. A new badge will be issued for each day of a guest's visit. All guests that are not pre-cleared will be announced via phone for approval before being given a badge.

During business hours, all guests must check in with the AIR receptionist and must be escorted by an AIR employee.

Emergency Evacuation Team

In the event of an emergency, announcements are made over the loud speaker instructing employees to remain or evacuate. Members of the AIR staff have been trained (Emergency Evacuation Team) to inform and guide employees in the event of an evacuation.

Relevant Form: G-6, Computer/Information Standards Expert Certification

Disclosure

1. *Describe methods used to ensure the security and integrity of the code, data, and documentation.*

AIR employs a number of physical and electronic security measures to protect all code, data and documentation against both internal and external potential sources of damage, and against deliberate and inadvertent, unauthorized changes.

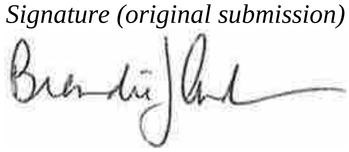
AIR's security policies, which are outlined above, are discussed in the FCHLPM User Help System. An AIR custodian shall be available to further discuss with the Professional Team the AIR security policies and procedures.

Appendix 1: General Standards

Form G-1: General Standards Expert Certification

I hereby certify that I have reviewed the current submission of AIR Hurricane Model for the U.S. *for compliance with the 2015 Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that*:

1) *The model meets the General Standards (G1 – G5),*
2) *The disclosures and forms related to the General Standards section are editorially and technically accurate, reliable, unbiased, and complete,*
3) *My review was completed in accordance with the professional standards and code of ethical conduct for my profession,*
4) *My review involved ensuring the consistency of the content in all sections of the submission; and*
5) *In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.*

Brandie Andrews	B.S., Mathematics
Name	*Professional Credentials (Area of Expertise)*
	October 25, 2016
Signature (original submission)	*Date*
	January 3, 2017
Signature (response to Deficiencies, if any)	*Date*
Signature (revisions to submission, if any)	*Date*
Signature (final submission)	*Date*

An updated signature and form is required following any modification of the model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	*Date*

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form G-1, General Standards Expert Certification, in a submission appendix.

<ins>Standard G-2, Disclosure 4</ins>

Form G-2: Meteorological Standards Expert Certification

I hereby certify that I have reviewed the current submission of AIR Hurricane Model for the U.S. *for compliance with the 2015 Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that*:

1) *The model meets the Meteorological Standards (M1 – M6),*
2) *The disclosures and forms related to the Meteorological Standards section are editorially and technically accurate, reliable, unbiased, and complete,*
3) *My review was completed in accordance with the professional standards and code of ethical conduct for my profession, and*
4) *In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.*

Eric Uhlhorn

Name

Ph.D., Meteorology and Physical Oceanogrpahy

Professional Credentials (Area of Expertise)

Signature (original submission)

October 25, 2016

Date

Signature (response to Deficiencies, if any)

January 3, 2017

Date

Signature (revisions to submission, if any)

Date

Date

Signature (final submission)

Date

An updated signature and form is required following any modification of the model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)

Date

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form G-2, Meteorological Standards Expert Certification, in a submission appendix.

Standard G-2, Disclosure 5

Form G-3: Statistical Standards Expert Certification

I hereby certify that I have reviewed the current submission of AIR Hurricane Model for the U.S. *for compliance with the 2015 Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that*:

1) *The model meets the Statistical Standards (S1 – S6),*
2) *The disclosures and forms related to the Statistical Standards section are editorially and technically accurate, reliable, unbiased, and complete,*
3) *My review was completed in accordance with the professional standards and code of ethical conduct for my profession, and*
4) *In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.*

Suilou Huang	M.S. in Statistics, Ph.D., Oceanography
Name	*Professional Credentials (Area of Expertise)*
[signature]	October 25, 2016
Signature (original submission)	*Date*
[signature]	January 3, 2017
Signature (response to Deficiencies, if any)	*Date*
Signature (revisions to submission, if any)	*Date*
Signature (final submission)	*Date*

An updated signature and form is required following any modification of the model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	*Date*

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

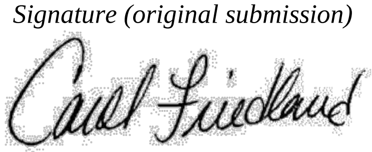
Include Form G-3, Statistical Standards Expert Certification, in a submission appendix.

Standard G-2, Disclosure 6

Form G-4: Vulnerability Standards Expert Certification

I hereby certify that I have reviewed the current submission of AIR Hurricane Model for the U.S. *for compliance with the 2015 Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:*

1) *The model meets the Vulnerability Standards (V1 – V3),*
2) *The disclosures and forms related to the Vulnerability Standards section are editorially and technically accurate, reliable, unbiased, and complete,*
3) *My review was completed in accordance with the professional standards and code of ethical conduct for my profession, and*
4) *In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.*

Carol Friedland	P.E., Ph.D., Civil Engineering
Name	*Professional Credentials (Area of Expertise)*
	October 21, 2016
Signature (original submission)	*Date*
	January 3, 2017
Signature (response to Deficiencies, if any)	*Date*
Signature (revisions to submission, if any)	*Date*
Signature (final submission)	*Date*

An updated signature and form is required following any modification of the model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	*Date*

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

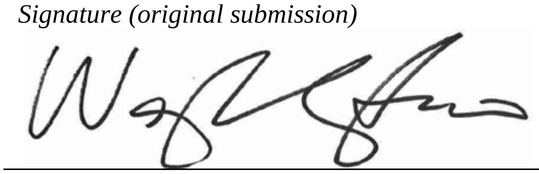
Include Form G-4, Vulnerability Standards Expert Certification, in a submission appendix.

<u>Standard G-2, Disclosure 7</u>

Form G-5: Actuarial Standards Expert Certification

I hereby certify that I have reviewed the current submission of AIR Hurricane Model for the U.S. *for compliance with the 2015 Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:*

1) *The model meets the Actuarial Standards (A1 – A6),*
2) *The disclosures and forms related to the Actuarial Standards section are editorially and technically accurate, reliable, unbiased, and complete,*
3) *My review was completed in accordance with the Actuarial Standards of Practice and Code of Conduct; and*
4) *In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.*

Heidi Wang	FCAS, M.S., Actuarial Science
Name	*Professional Credentials (Area of Expertise)*
	October 25, 2016
Signature (original submission)	*Date*
	January 3, 2017
Signature (response to Deficiencies, if any)	*Date*
Signature (revisions to submission, if any)	*Date*
Signature (final submission)	*Date*

An updated signature and form is required following any modification of the model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	*Date*

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

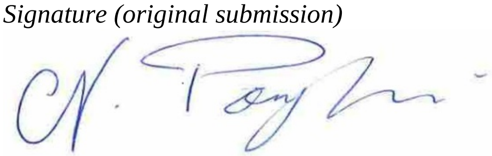
Include Form G-5, Actuarial Standards Expert Certification, in a submission appendix.

Standard G-2, Disclosure 8

Form G-6: Computer/Information Standards Expert Certification

I hereby certify that I have reviewed the current submission of AIR Hurricane Model for the U.S. *for compliance with the 2015 Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:*

1) *The model meets the Computer/Information Standards (C1 – C7),*
2) *The disclosures and forms related to the Computer/Information Standards section are editorially and technically accurate, reliable, unbiased, and complete,*
3) *My review was completed in accordance with the professional standards and code of ethical conduct for my profession, and*
4) *In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.*

Narges Pourghasemi	M.S. Computer Science
Name	*Professional Credentials (Area of Expertise)*
	September 28, 2016
Signature (original submission)	*Date*
	January 3, 2017
Signature (response to Deficiencies, if any)	*Date*
Signature (revisions to submission, if any)	*Date*
Signature (final submission)	*Date*

An updated signature and form is required following any modification of the model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	*Date*

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form G-6, Computer/Information Standards Expert Certification, in a submission appendix.

Standard G-2, Disclosure 9

Form G-7: Editorial Review Expert Certification

I/We hereby certify that I/we have reviewed the current submission of AIR Hurricane Model for the U.S. *for compliance with the "Process for Determining the Acceptability of a Computer Simulation Model" adopted by the Florida Commission on Hurricane Loss Projection Methodology in its Report of Activities as of November 1, 2015, and hereby certify that:*

1) *The model submission is in compliance with the Commission's Notification Requirements and General Standard G-5 Editorial Compliance;*
2) *The disclosures and forms related to each standards section are editorially accurate and contain complete information and any changes that have been made to the submission during the review process have been reviewed for completeness, grammatical correctness, and typographical errors;*
3) *There are no incomplete responses, inaccurate citations, charts or graphs, or extraneous text or references;*
4) *The current version of the model submission has been reviewed for grammatical correctness, typographical errors, completeness, the exclusion of extraneous data/information and is otherwise acceptable for publication; and*
5) *In expressing my/our opinion I/we have not been influenced by any other party in order to bias or prejudice my/our opinion.*

Jonathan Kinghorn	B.A., Arts Combination
Name	*Professional Credentials (Area of Expertise)*
Jonathan Kinghorn	October 25, 2016
Signature (original submission)	*Date*
Jonathan Kinghorn	January 3, 2017
Signature (response to Deficiencies, if any)	*Date*
Signature (revisions to submission, if any)	*Date*
Signature (final submission)	*Date*

An updated signature and form is required following any modification of the model and any revision of the original submission. If a signatory differs from the original signatory, provide the printed name and professional credentials for any new signatories. Additional signature lines shall be added as necessary with the following format:

Signature (revisions to submission)	*Date*

Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

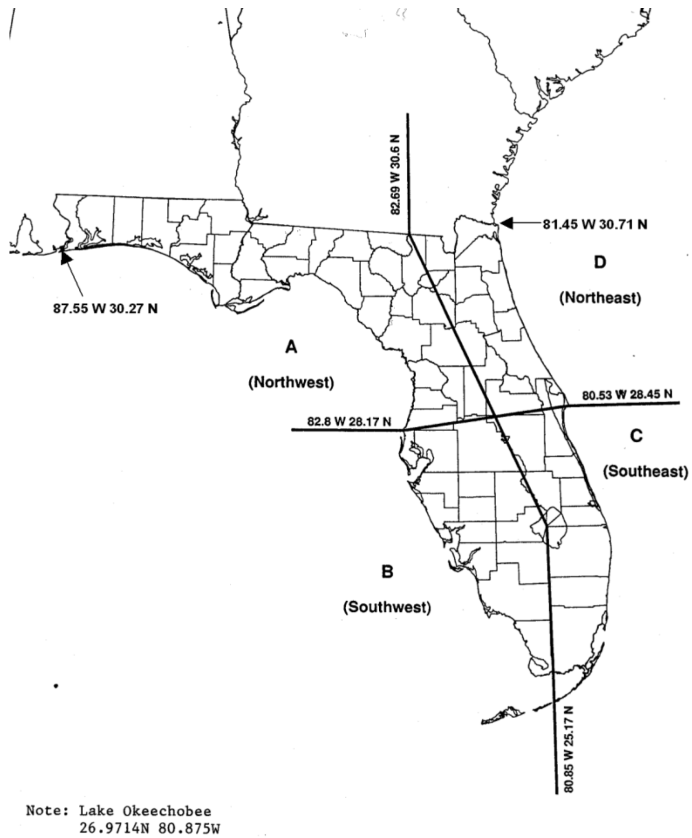
Include Form G-7, Editorial Review Expert Certification, in a submission appendix.

Standard G-5, Disclosure 3

Appendix 2: Meteorological Standards

Form M-1: Annual Occurrence Rates

A. *Provide a table of annual occurrence rates for landfall from the data set defined by marine exposure that the model generates by hurricane category (defined by maximum windspeed at landfall in the Saffir-Simpson scale) for the entire state of Florida and additional regions as defined in* Figure 3*. List the annual occurrence rate per hurricane category. Annual occurrence rates shall be rounded to two decimal places. The historical frequencies below have been derived from the Base Hurricane Storm Set as defined in Standard M-1, Base Hurricane Storm Set. If the modeling organization Base Hurricane Storm Set differs from that defined in Standard M-1 (for example, using a different historical period), the historical rates in the table shall be edited to reflect this difference (see below).*



State of Florida and Neighboring States by Region

Table 34. Modeled Annual Occurrence Rates

	Entire State				Region A – NW Florida			
	Historical		Modeled		Historical		Modeled	
Category	Number	Rate	Number	Rate	Number	Rate	Number	Rate
1	24	0.21	11415	0.23	14	0.12	4744	0.09
2	13	0.11	6986	0.14	4	0.03	2486	0.05
3	15	0.13	6383	0.13	6	0.05	1975	0.04
4	9	0.08	3394	0.07	0	0.00	891	0.02
5	2	0.02	513	0.01	0	0.00	103	0.00

	Region B – SW Florida				Region C – SE Florida			
	Historical		Modeled		Historical		Modeled	
Category	Number	Rate	Number	Rate	Number	Rate	Number	Rate
1	5	0.04	3104	0.06	9	0.08	4135	0.08
2	2	0.02	2087	0.04	7	0.06	2475	0.05
3	6	0.05	2005	0.04	3	0.03	2373	0.05
4	3	0.03	1151	0.02	6	0.05	1300	0.03
5	0	0.00	192	0.00	2	0.02	213	0.00

	Region D – NE Florida				Florida Bypassing Hurricanes			
	Historical		Modeled		Historical		Modeled	
Category	Number	Rate	Number	Rate	Number	Rate	Number	Rate
1	1	0.01	532	0.01	5	0.04	3700	0.07
2	1	0.01	242	0.00	0	0.00	1211	0.02
3	1	0.01	203	0.00	2	0.02	783	0.02
4	0	0.00	93	0.00	1	0.01	258	0.01
5	0	0.00	7	0.00	0	0.00	64	0.00

	Region E – Georgia				Region F – Alabama/Mississippi			
	Historical		Modeled		Historical		Modeled	
Category	Number	Rate	Number	Rate	Number	Rate	Number	Rate
1	1	0.01	710	0.01	11	0.10	3499	0.07
2	1	0.01	321	0.01	3	0.03	1899	0.04
3	0	0.00	247	0.00	4	0.03	1560	0.03
4	0	0.00	89	0.00	0	0.00	706	0.01
5	0	0.00	13	0.00	1	0.01	74	0.00

Note: Except where specified, number of hurricanes does not include by-passing hurricanes. Each time a hurricane goes from water to land (once per region) it is counted as a landfall in that region. However, each hurricane is counted only once in the entire state totals. Hurricanes recorded for adjacent states need not have reported damaging winds in Florida.

Note that there are 17 additional events from AIR's Base Hurricane Storm Set in Form A-2 not included here (UNNAMED01_1900, UNNAMED03_1919, UNNAMED04_1925, UNNAMED02_1930, UNNAMED08_1933, UNNAMED03_1934, UNNAMED02_1940, UNNAMED03_1947, HOW_1951, HILDA_1964, JUAN_1985, GORDON_1994, CINDY_2005, OPHELIA_2005, RITA_2005, IKE_2008, ISAAC_2012). These events bypass Florida at a great distance or cause low loss in the state, which is why from a meteorological perspective, AIR justifies not including them in Form M-1. However, these events are included in Form A-2 because they may have triggered a hurricane watch or warning in the state of Florida, and as per AIR's interpretation of Standard A-2, the losses from these events should be counted, as typical hurricane policies would cover their losses.

B. Describe model variations from the historical frequencies.

The modeled frequencies are consistent with the historical frequencies for the period 1900–2014. There are no variations from these frequencies.

*C. Provide vertical bar graphs depicting distributions of hurricane frequencies by category by region of Florida (*Figure 3*) for the neighboring states of Alabama/Mississippi and Georgia, and for by-passing hurricanes. For the neighboring states, statistics based on the closest coastal segment to the state boundaries used in the model are adequate.*

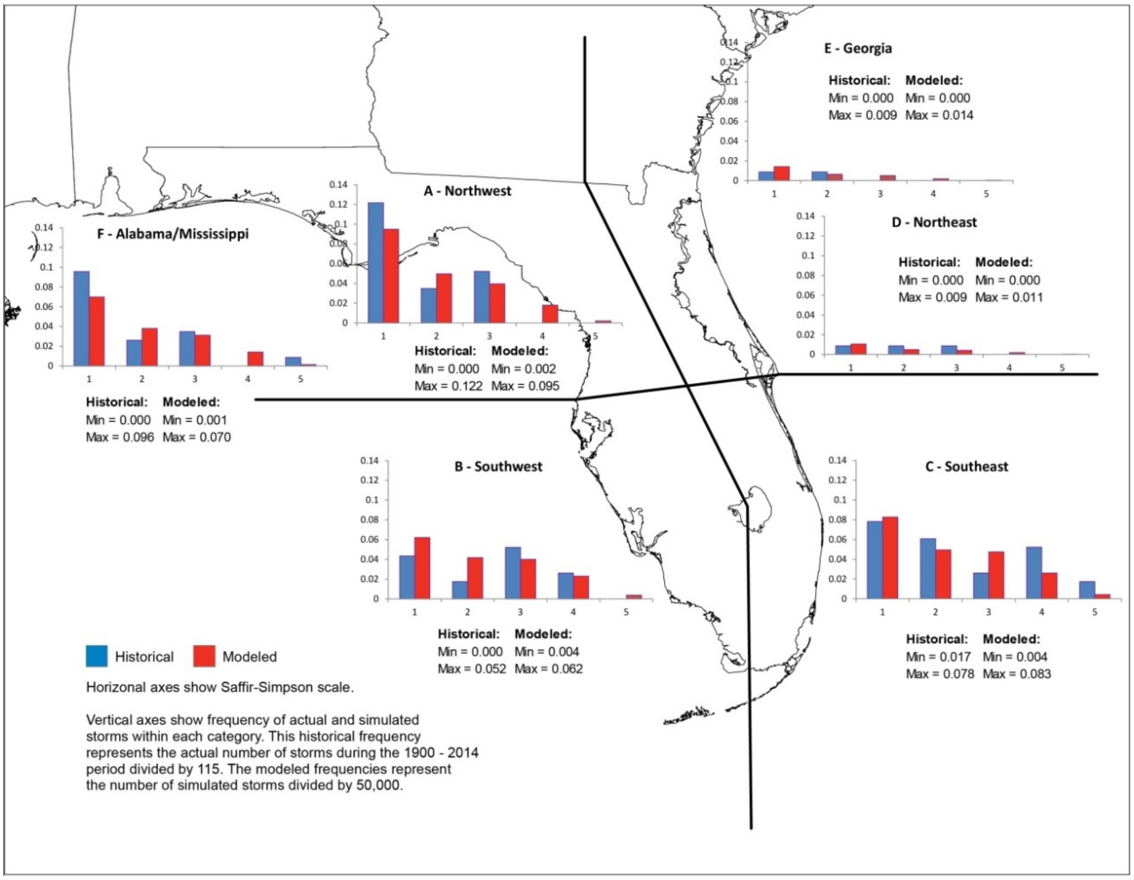


Figure 64. Historical and Modeled Hurricane Frequency for Florida and Neighboring States by Region

D. If the data are partitioned or modified, provide the historical annual occurrence rates for the applicable partition (and its complement) or modification as well as the modeled annual occurrence rates in additional copies of Form M-1 (Annual Occurrence Rates).

The data has not been temporally partitioned or modified.

E. List all hurricanes added, removed, or modified from the previously accepted model version of the Base Hurricane Storm Set.

One new storm (Hurricane Hazel, 1953) was added to the base hurricane storm set. Nineteen storms were modified according the recent update to HURDAT2.

The complete list of changes with impact on Florida is as follows:

Storms added: HAZEL_1953

Storms modified:

UNNAMED01_1928, UNNAMED06_1946, UNNAMED04_1947, UNNAMED09_1947, UNNAMED08_1948, UNNAMED09_1948, UNNAMED02_1949, BAKER_1950, EASY_1950,

KING_1950, FOX_1952, FLORENCE_1953, CAMILLE_1969, KATE_1985, FLOYD_1987, DANNY_1997, IRENE_1999, GORDON_2000, FRANCES_2004

F. *Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include Form M-1 Annual Occurrence Rates in a submission appendix.*

This Form is included in this submission appendix item and is additionally provided in Excel format.

Note: Except where specified, Number of Hurricanes does not include By-Passing Hurricanes. Each time a hurricane goes from water to land (once per region) it is counted as a landfall in that region. However, each hurricane is counted only once in the Entire State totals. Hurricanes recorded for neighboring states need not have reported damaging winds in Florida.

Form M-1, Annual Occurrence Rates, Form A-2, Base Hurricane Storm Set Statewide Losses, and Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, are based on the 115 year period 1900–2014 (consistent with Standard M-1, Base Hurricane Storm Set). It is intended that the storm set underlying Forms M-1, Annual Occurrence Rates, A-2, Base Hurricane Storm Set Statewide Losses, and S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, will be the same.
As specified in Standard M-1, Base Hurricane Storm Set, the modeling organization may exclude hurricanes that caused zero modeled damage, or include additional complete hurricane seasons, or may modify data for historical storms based on evidence in the peer-reviewed scientific literature. This may result in the modeling organization including additional landfalls in Florida and neighboring states to those listed in Form A-2, Base Hurricane Storm Set Statewide Losses, for Florida or counted in Form M-1, Annual Occurrence Rates, in the case of neighboring states. In this situation, the historical numbers in Form M-1, Annual Occurrence Rates, should be updated to agree with the modeling organization Base Hurricane Storm Set.

Any additional Florida hurricanes should be included in Form A-2, Base Hurricane Storm Set Statewide Losses, as instructed there, and the historical landfall counts in Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, should be updated.

In some circumstances, the modeling organization windfield reconstruction of a historical storm may indicate that it is a by-passing hurricane (the modeling organization windfield results in damaging winds somewhere in the state). In this situation, the historical numbers in Form M-1, Annual Occurrence Rates, should be updated to agree with the modeling organization Base Hurricane Storm Set, but no changes are required for Form A-2, Base Hurricane Storm Set Statewide Losses, or Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year.

Standard M-1, Disclosure 4

Form M-2: Maps of Maximum Winds

A. Provide color contour plots on maps with ZIP Code boundaries of the maximum winds for the modeled version of the Base Hurricane Storm Set for land use set for open terrain and for land use set for actual terrain. Plot the position and values of the maximum windspeeds on each contour map.

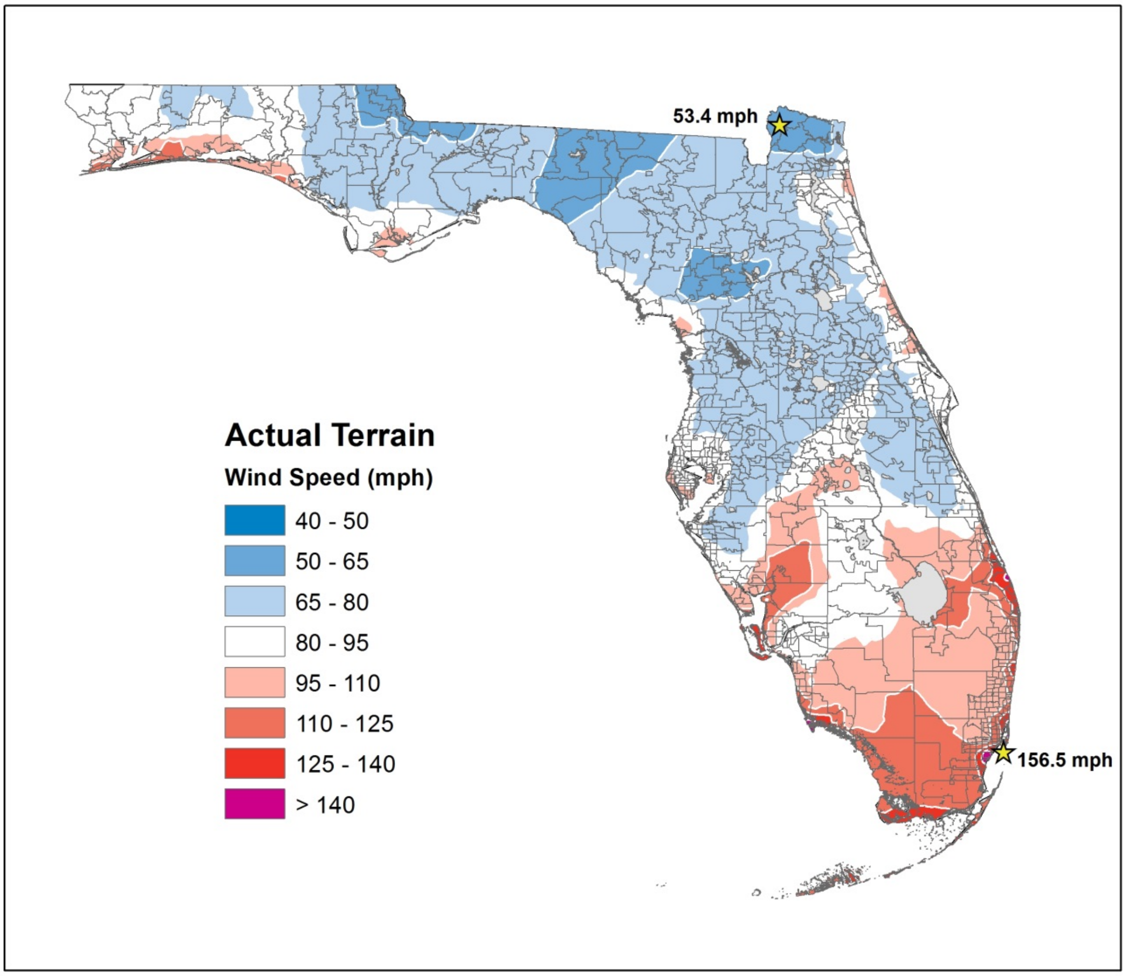


Figure 65. Maximum Winds for the Modeled Version of the Base Hurricane Storm Set for Actual Terrain

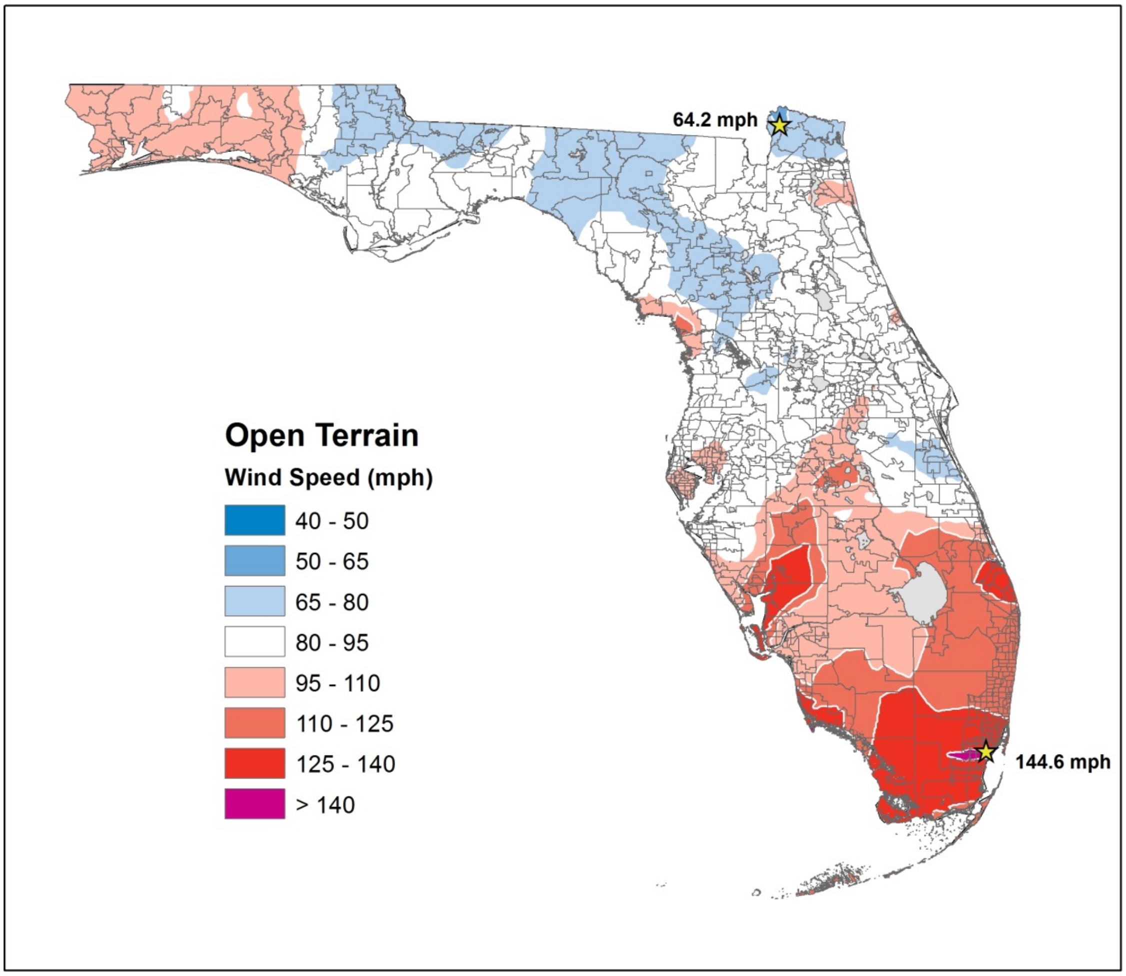


Figure 66. Maximum Winds for the Modeled Version of the Base Hurricane Storm Set for Open Terrain

B. Provide color contour plots on maps with ZIP Code boundaries of the maximum winds for a 100-year and a 250-year return period from the stochastic storm set for land use set for open terrain and for land use set for actual terrain. Plot the position and values of the maximum windspeeds on each contour map.

Actual terrain is the roughness distribution used in the standard version of the model as defined by the modeling organization. Open terrain uses the same roughness length of 0.03 meters at all land points.

Maximum winds in these maps are defined as the maximum one-minute sustained winds over the terrain as modeled and recorded at each location.

The same color scheme and increments shall be used for all maps.

Use the following eight isotach values and interval color coding:

(1)	*Minimum damaging*	*Blue*
(2)	*50 mph*	*Medium Blue*
(3)	*65 mph*	*Light Blue*
(4)	*80 mph*	*White*
(5)	*95 mph*	*Light Red*
(6)	*110 mph*	*Medium Red*
(7)	*125 mph*	*Red*
(8)	*140 mph*	*Magenta*

Contouring in addition to these isotach values may be included.

C. Include Form M-2, Maps of Maximum Winds, in a submission appendix.

Form M-2, Maps of Maximum Winds, are included below in Appendix 2.

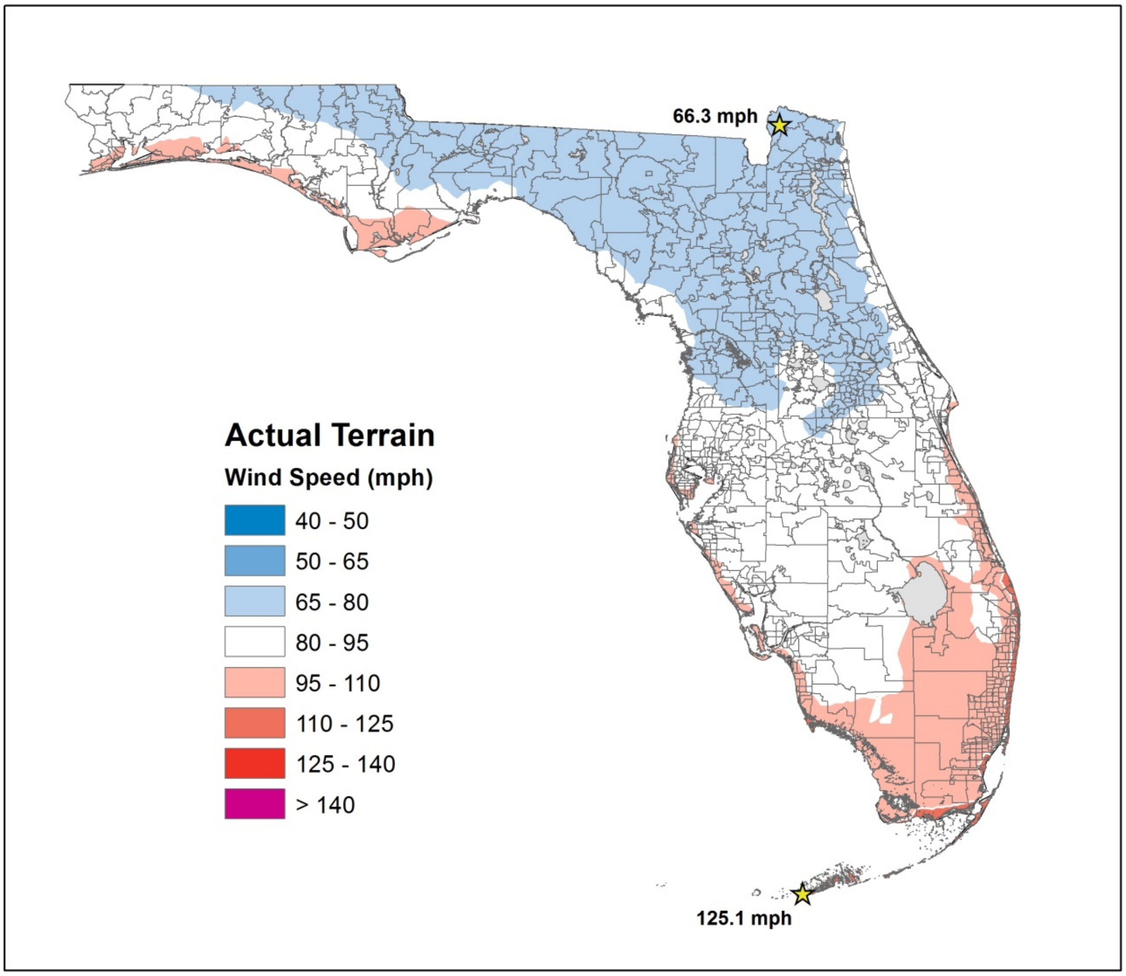


Figure 67. 100-Year Return Period Maximum Winds for Actual Terrain

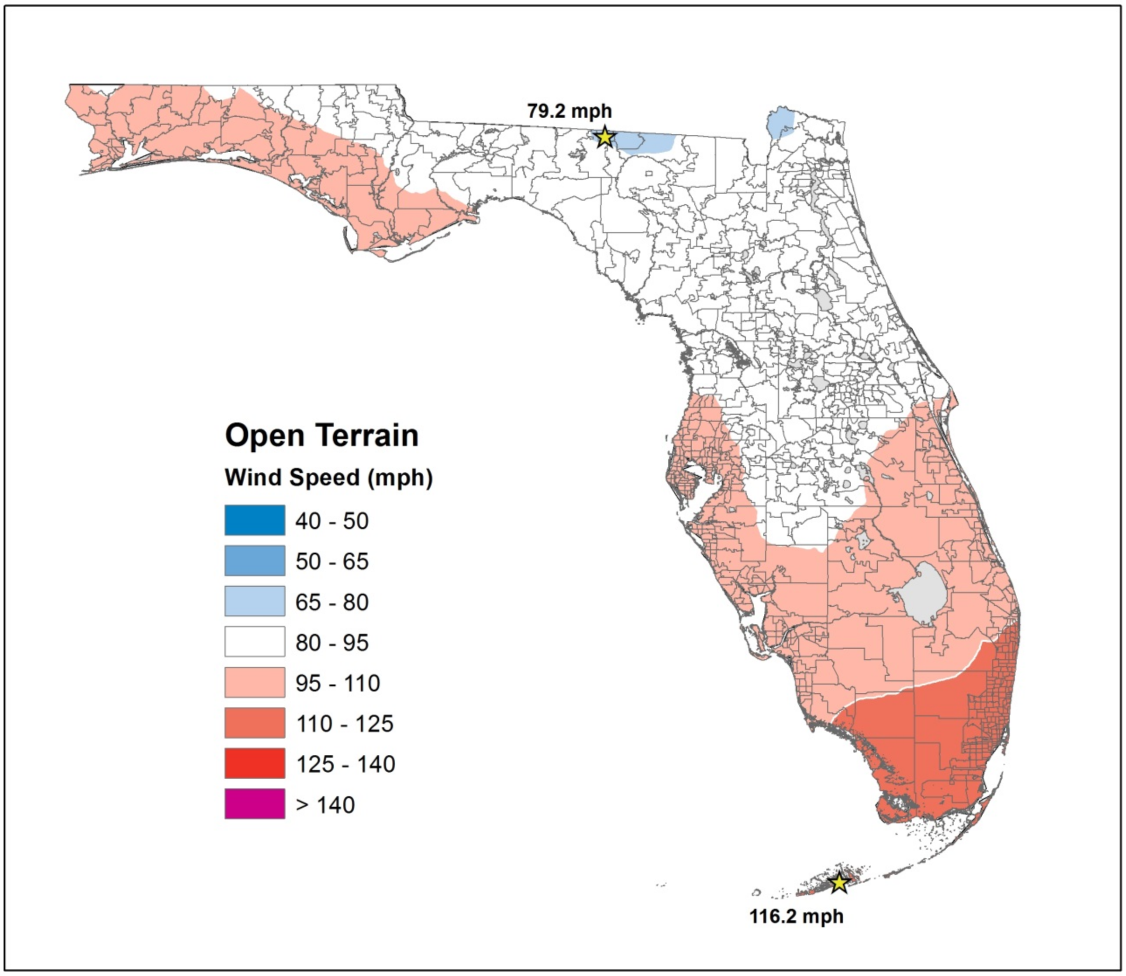


Figure 68. 100-Year Return Period Maximum Winds for Open Terrain

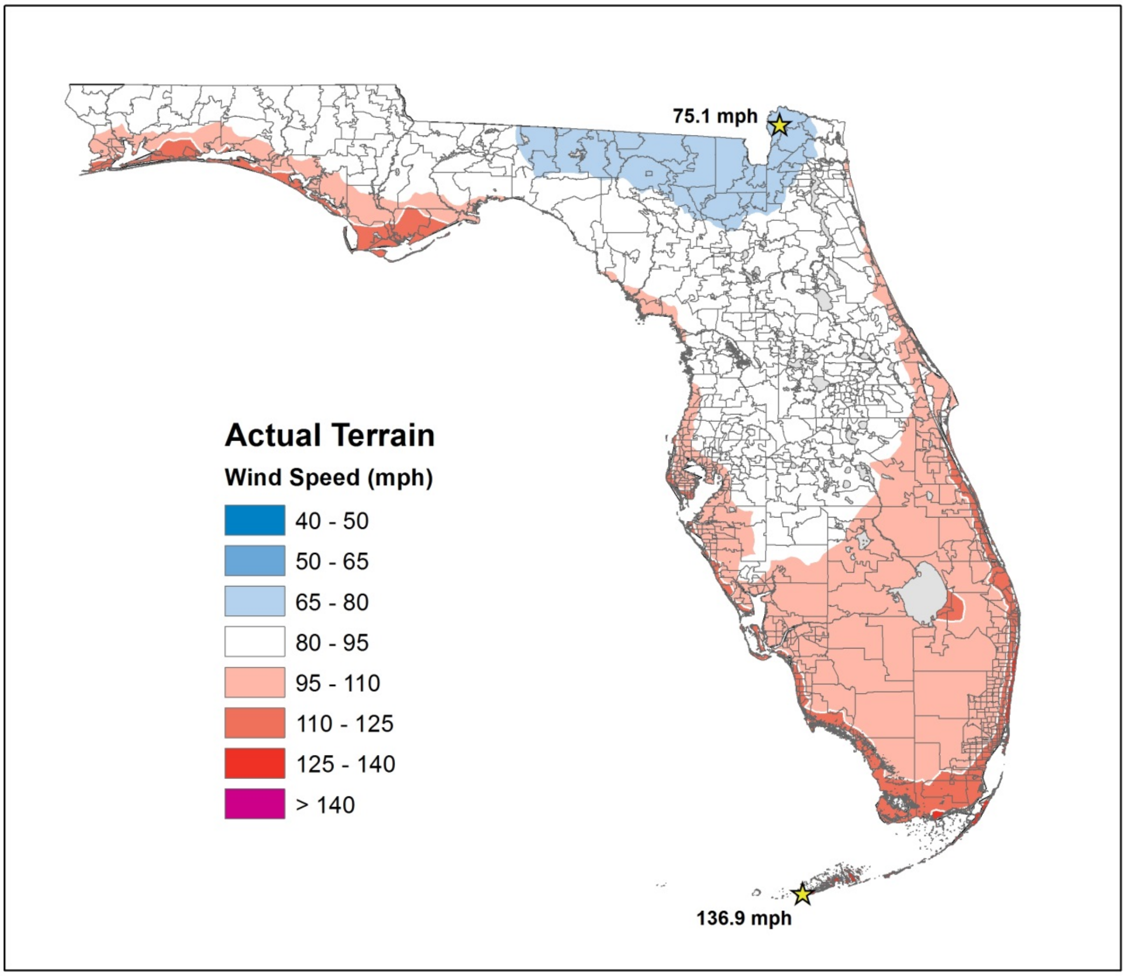


Figure 69. 250-Year Return Period Maximum Winds for Actual Terrain

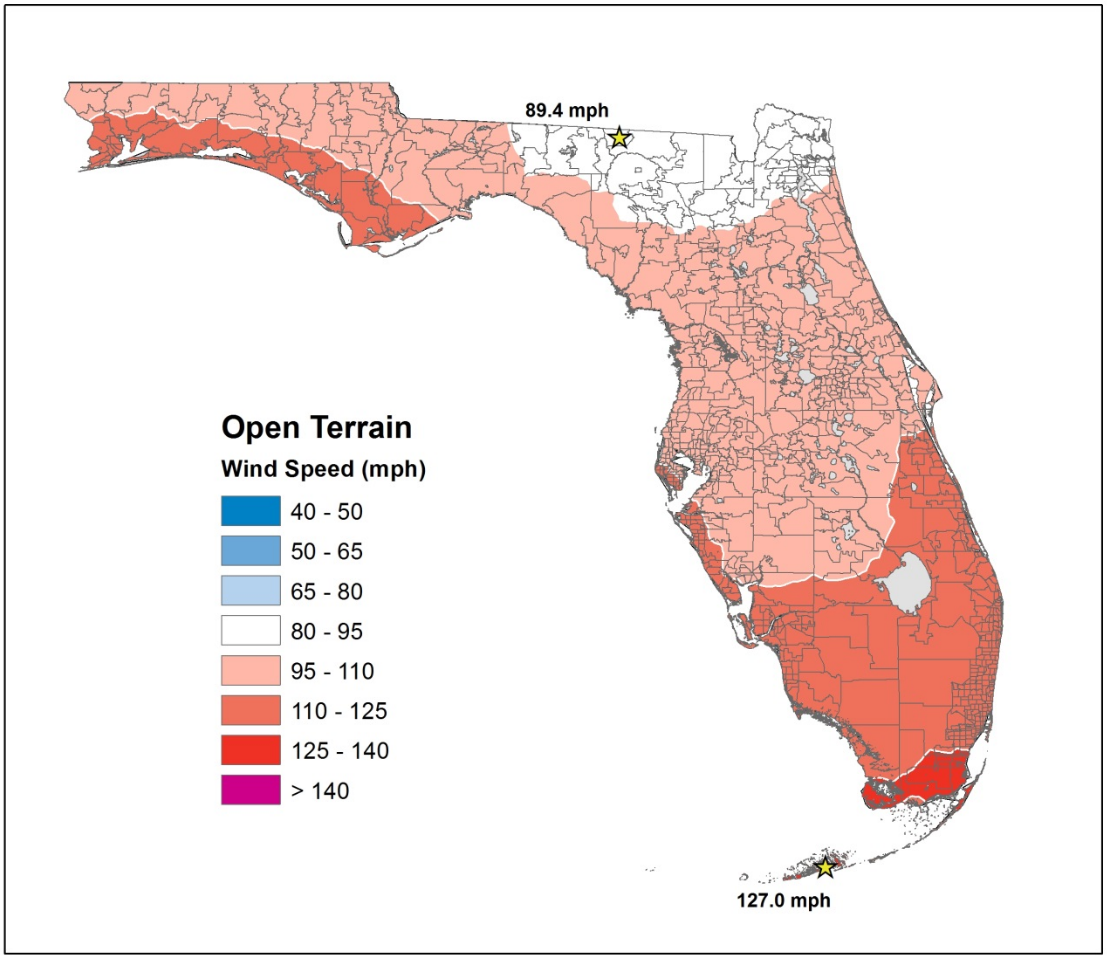


Figure 70. 250-Year Return Period Maximum Winds Open Terrain

Standard M-4, Disclosure 12

Form M-3: Radius of Maximum Winds and Radii of Standard Wind Thresholds

A. For the central pressures in the table below, provide the first quartile (1Q), median (2Q), and third quartile (3Q) values for (1) the radius of maximum winds (Rmax) used by the model to create the stochastic storm set, and the first quartile (1Q), median (2Q), and third quartile (3Q) values for the outer radii of (2) Category 3 winds (>110 mph), (3) Category 1 winds (>73 mph), and (4) gale force winds (>40 mph).

Table 35. Radius of Maximum Winds and Radii of Standard Wind Thresholds

Central Pressure (mb)	Rmax (mi)			Outer Radii (>110 mph) (mi)			Outer Radii (>73 mph) (mi)			Outer Radii (>40 mph) (mi)		
	1Q	2Q	3Q	1Q	2Q	3Q	1Q	2Q	3Q	1Q	2Q	3Q
990	18	27	38				20	28	40	72	93	111
980	20	25	35				28	35	47	102	114	135
970	17	23	31				30	39	52	110	127	145
960	17	25	31				34	48	58	122	144	157
950	17	25	29	18	25	29	37	52	60	131	153	162
940	14	23	27	17	27	32	34	52	60	127	155	165
930	14	23	27	20	31	55	38	55	63	132	160	170
920	14	25	28	21	36	40	42	64	70	137	169	176
910	14	15	20	23	24	31	45	47	58	140	144	160
900	7	12	17	13	21	29	30	43	55	112	134	152

B. Describe the procedure used to complete this form

For computing Rmax quartiles, cumulative distributions of Rmax in the historical catalog are calculated for central pressure bins centered on the values. Using the corresponding Rmax quartile values and the given central pressure, the model is used to compute quartiles of the significant wind radii. Representative values for other necessary parameters were assumed as follows: latitude (28°N), forward speed (28 mph), and gradient wind reduction factor (0.88). The model generates the radial wind profile for the given storm parameters, and then identifies the distance where this the profile equals the requested wind speed thresholds (110 mph, 73 mph and 40 mph). Where winds never exceed the 110 mph threshold (in weaker storms), the table cell is left blank.

C. Identify other variables that influence Rmax.

The value of Rmax is a function of central pressure, latitude and time after landfall.

D. Specify any truncations applied to Rmax distributions in the model, and if and how these truncations vary with other variables.

Upper and lower bounds are applied to the Rmax distribution in the model. Both truncations are based on central pressure. The lower Rmax limits are between 5 miles (for low central pressure) and 7 miles (for high central pressure). The upper limits are between 17.5 miles (for low central pressure) and 65 miles (for high central pressure).

E. Provide a box plot and histogram of Central Pressure (x-axis) versus Rmax (y-axis) to demonstrate relative populations and continuity of sampled hurricanes in the stochastic storm set.

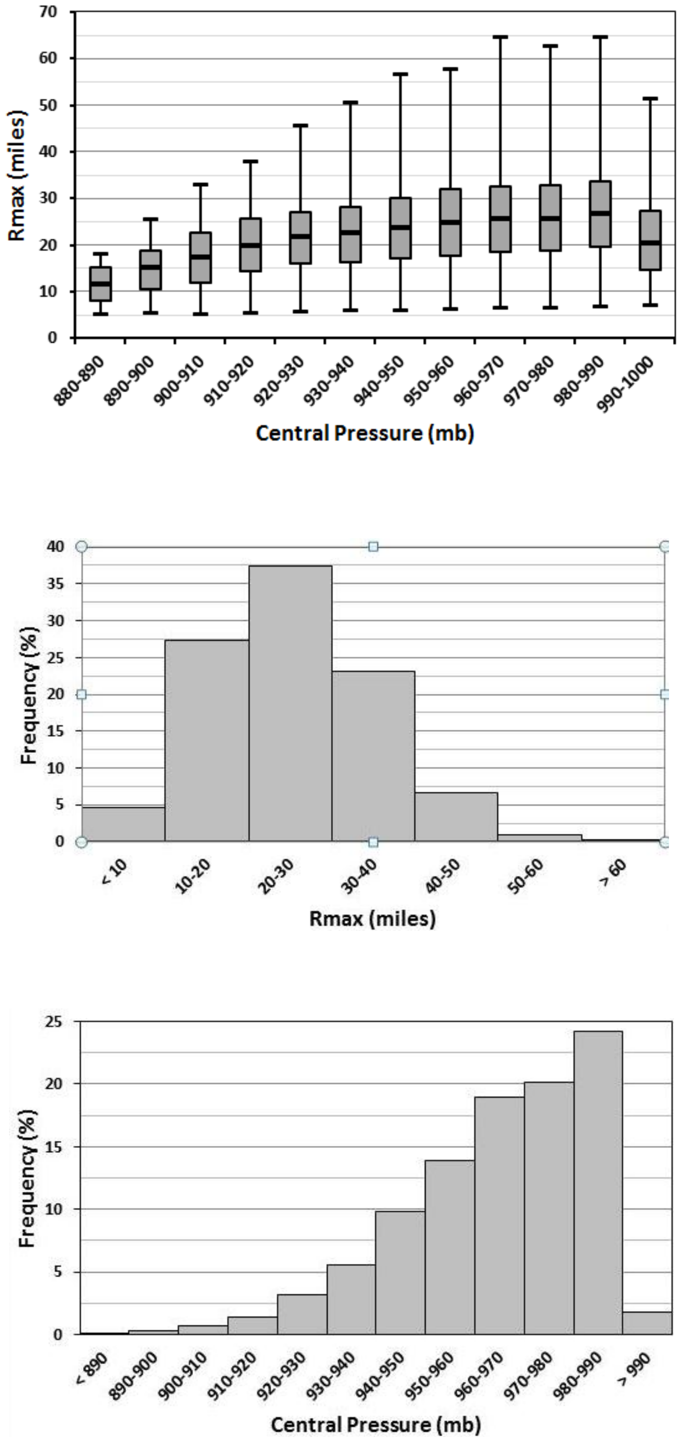


Figure 71. Box Plot and Histogram of Central Pressure vs. Rmax, Florida and Neighboring States

F. *Provide this form in Excel using the format given in the file named* "2015FormM3.xlsx." *The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include Form M-3, (Radius of Maximum Winds and Radii of Standard Wind Thresholds, in a submission appendix.*

Hard copy of Form M-3 is included here in this submission appendix and is additionally provided in Excel format

Standard M-6, Disclosure 2

Appendix 3: Statistical Standards

Form S-1: Probability and Frequency of Florida Landfalling Hurricanes per Year

Complete the table below showing the probability and modeled frequency of landfalling Florida hurricanes per year. Modeled probability shall be rounded to four decimal places. The historical probabilities and frequencies below have been derived from the Base Hurricane Storm Set for the 115 year period 1900–2014 (as given in Form A-2, Base Hurricane Storm Set Statewide Losses). Exclusion of hurricanes that caused zero modeled Florida damage or additional Florida landfalls included in the modeling organization Base Hurricane Storm Set as identified in their response to Standard M-1, Base Hurricane Storm Set, should be used to adjust the historical probabilities and frequencies provided here.

If the data are partitioned or modified, provide the historical probabilities and frequencies for the applicable partition (and its complement) or modification as well as the modeled probabilities and frequencies in additional copies of Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year.

Include Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, in a submission appendix.

Table 36. Model Results: Probability and Frequency of Florida Landfalling Hurricanes per Year

Hurricanes Per Year	Historical Probabilities	Modeled Probabilities	Historical Frequencies	Modeled Frequencies
0	0.6261	0.5606	72	28031
1	0.2261	0.3303	26	16515
2	0.1217	0.0874	14	4368
3	0.0261	0.0185	3	926
4	0	0.0028	0	140
5	0	0.0004	0	18
6	0	0	0	2
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10 or more	0	0	0	0

Standard S-1, Disclosure 7

Form S-2: Examples of Loss Exceedance Estimates

*Provide estimates of the aggregate personal and commercial insured losses for various probability levels using the notional risk data set specified in Form A-1, Zero Deductible Personal Residential Loss Costs by ZIP Code, and using the 2012 Florida Hurricane Catastrophe Fund aggregate personal and commercial residential zero deductibleexposure data provided in the file named “*hlpm2012c.exe.*” Provide the total average annual loss for the loss exceedance distribution. If the modeling methodology does not allow the model to produce a viable answer, please state so and why.*

Include Form S-2, Examples of Loss Exceedance Estimates, in a submission appendix.

Table 37. Examples of Loss Exceedance Estimates. Part A

Return Period (years)	Probability of Exceedance	Estimated Loss Notional Risk Data Set	Estimated Personal & Commercial Residential Loss FHCF Dataset
Top Event	N/A	88,623,270	341,540,808,268
10,000	0.01%	71,331,730	281,766,392,070
5,000	0.02%	60,219,750	222,020,434,487
2,000	0.05%	45,768,970	176,653,563,946
1,000	0.10%	40,239,160	150,697,328,776
500	0.20%	35,032,230	120,232,144,608
250	0.40%	28,592,990	97,022,230,596
100	1.00%	20,404,860	64,717,548,965
50	2.00%	14,738,730	44,076,076,242
20	5.00%	8,205,975	22,338,780,214
10	10.00%	4,416,937	11,212,306,547
5	20.00%	1,729,057	4,027,998,143

Table 38. Examples of Loss Exceedance Estimates. Part B

	Estimated Loss Notional Risk Data Set	Estimated Personal & Commercial Residential Loss FHCF Dataset
Mean (Total Average Annual Loss)	1,551,822	4,330,755,811
Median	53,610	99,336,593
Standard Deviation	4,082,314	13,239,993,675
Interquartile Range	1,124,481	2,544,174,818
Sample Size	50,000 Years of Simulated Events	50,000 Years of Simulated Events

Standard S-1, Disclosure 8

Form S-3: Distributions of Stochastic Hurricane Parameters

Provide the probability distribution functional form used for each stochastic hurricane parameter in the model. Provide a summary of the justification for each functional form selected for each general classification.

Include Form S-3, Distributions of Stochastic Hurricane Parameters, in a submission appendix.

Table 39. Distributions of Stochastic Hurricane Parameters

Stochastic Hurricane Parameter (Function or Variable)	Functional Form of Distribution	Data Source	Year Range Used	Justification for Functional Form
Annual Frequency	Negative Binomial(s,p) s>0 0<p<1	HURDAT2	1900–2014	Appropriate for count data when the variance exceeds the mean. The Negative Binomial is also known as a gamma-Poisson mixture, since it can be derived from a Poisson where the annual rate follows a gamma distribution. These considerations, combined with goodness-of-fit results, justify the use of the Negative Binomial distribution for annual landfall frequency.
Landfall Location	Cumulative distribution function (CDF) derived by smoothing historical landfall frequencies grouped by 50-mile coastal segments	HURDAT2	1900–2014	Due to the relative scarcity of historical data at this spatial resolution, smoothing is used to arrive at credible landfall probabilities. The smoothing is based on a formula available in NWS-38, p. 75. Graphical comparisons and goodness-of-fit tests indicate that the resulting landfall distribution is reasonable.

Stochastic Hurricane Parameter (Function or Variable)	Functional Form of Distribution	Data Source	Year Range Used	Justification for Functional Form
Central Pressure	Weibull(k, λ) where k>0 is the shape parameter, and λ>0 is the scale parameter.	HURDAT	1900–2008	The distribution of the historical central pressures is a skewed distribution since very intense hurricanes are less frequent than weak hurricanes. The two-parameter Weibull distribution has a very flexible shape and is able to capture the skewness present in the historical data. Goodness-of-fit tests support the use of this distribution. A comparison to the Log-normal distribution was reported by Clark (1986).
Radius of Maximum Winds	Regression model of the form: R_{max} = f(CP, latitude) + ε	HURDAT	1900–2008	The model captures the correlation between Rmax, central pressure, and latitude. The model is similar to a regression model proposed earlier by (Vickery et. al., 2001). The noise ε is bounded to capture the fact that intense hurricanes tend to have a smaller Rmax than weaker hurricanes.
Forward Speed	Log-normal(μ, σ) where μ is the mean and σ is the standard deviation	HURDAT	1900–2008	This distribution is well-suited to represent forward speed which has a skewed distribution. Graphical comparisons between historical and modeled forward speeds combined with goodness-of-fit tests support the use of the Log-normal distribution.
Gradient Wind Reduction Factor	Normal distribution	Dropsonde data analysis; Research by Franklin, et al. (2005) and Powell et al. (2009)	2002–2005 for dropsonde data	An analysis of the historical data shows a symmetrical distribution well approximated by a Normal distribution

Stochastic Hurricane Parameter (Function or Variable)	Functional Form of Distribution	Data Source	Year Range Used	Justification for Functional Form
Peak Weighting Factor	Skewed distribution modeled as a Normal Distribution after variable transformation	Dropsonde data analysis; Research by Powell et al. (2009)	2002–2005 for dropsonde data	The distribution of the historical data is skewed. However, the distribution becomes Normal after an inverse power transformation of the data. Correlation between GWRF and PWF is modeled using a bivariate normal distribution fitted to GWRF and the transformed PWF.
Storm Heading at Landfall	Mixture of normal distributions with constraints imposed on the drawings	HURDAT	1900–-2008	Modeled as combined Normal distributions, and bounded based on the historical record and orientation of the coast-line. Comparisons of historical and simulated tracks provide support for this procedure.
Storm Tracks	Multi-step procedure involving the use of Markov chains and Autoregressive models to describe the evolution of storm parameters across time and space	HURDAT	1900–2007	Time series models are appropriate since the storm parameters are typically correlated across time. Appropriate models were selected by calculating autocorrelation and partial auto-correlation functions for different model parameters. The models selected include a random walk with drift for track direction, a first-order autoregressive model for forward speed, and a second-order autoregressive model for central pressure. The resulting model is similar to a track model used by AIR for the Northwest Pacific basin; see Pawale, et. al. (2003).

Standard S-1, Disclosure 1

Form S-4: Validation Comparisons

A. *Provide five validation comparisons of actual personal residential exposures and loss to modeled exposures and loss. Provide these comparisons by line of insurance, construction type, policy coverage, county or other level of similar detail in addition to total losses. Include loss as a percent of total exposure. Total exposure represents the total amount of insured values (all coverages combined) in the area affected by the hurricane. This would include exposures for policies that did not have a loss. If this is not available, use exposures for only those policies that had a loss. Specify which was used. Also, specify the name of the hurricane event compared.*

Table 40. Validation Comparisons

Comparison #1
Hurricane = Erin
Exposure = total (Personal Residential)

Company C	**Actual**			**Modeled**		
	Exposure	**Loss**	**Loss/Exposure**	**Exposure**	**Loss**	**Loss/Exposure**
Frame	9,003,772,462	6,881,690	0.000764	9,003,772,462	11,792,698	0.001310
Masonry	7,729,395,776	2,987,052	0.000386	7,729,395,776	4,610,227	0.000596
Manufactured Home	464,017,336	663,292	0.001430	464,017,336	3,270,215	0.007048
Total	**17,197,185,574**	**10,532,034**	**0.000612**	**17,197,185,574**	**19,673,140**	**0.001144**

Note: All the exposures and losses have been multiplied by a single constant to disguise the identity of the client.

Comparison #2
Hurricane = Andrew
Exposure = total (Personal Residential)

Company A	**Actual**			**Modeled**		
	Exposure	**Loss**	**Loss/Exposure**	**Exposure**	**Loss**	**Loss/Exposure**
Frame	2,360,887,194	49,465,744	0.020952	2,360,887,194	19,535,873	0.008275
Masonry	17,572,031,076	650,233,285	0.037004	17,572,031,076	573,544,307	0.032640
Total	**19,932,918,270**	**699,699,029**	**0.035103**	**19,932,918,270**	**593,080,180**	**0.029754**

Note: All the exposures and losses have been multiplied by a single constant to disguise the identity of the client.

Comparison #3
Hurricane = Wilma
Exposure = total (Personal Residential)

Company M	Actual			Modeled		
	Exposure	Loss	Loss/Exposure	Exposure	Loss	Loss/Exposure
Frame	140,684,876	1,078,031	0.007663	140,684,876	879,713	0.006253
Masonry	2,951,013,573	12,859,659	0.004358	2,951,013,573	12,996,601	0.004404
Total	**3,091,698,449**	**13,937,690**	**0.004508**	**3,091,698,449**	**13,876,314**	**0.004488**

Note: All the exposures and losses have been multiplied by a single constant to disguise the identity of the client.

Comparison #4
Hurricane = Charley
Exposure = total
(Personal Residential)

Company J	Actual			Modeled		
	Exposure	Loss	Loss/Exposure	Exposure	Loss	Loss/Exposure
Coverage A	6,093,742,480	62,338,151	0.010230	6,093,742,480	48,972,525	0.008037
Coverage C	2,160,691,981	4,087,662	0.001892	2,160,691,981	4,601,785	0.002130
Coverage D	582,010,740	1,449,072	0.002490	582,010,740	1,622,721	0.002788
Total	**8,836,445,201**	**67,874,885**	**0.007681**	**8,836,445,201**	**55,197,031**	**0.006247**

Note: All the exposures and losses have been multiplied by a single constant to disguise the identity of the client.

Comparison #5
Hurricane = Frances
Exposure = total (Personal Residential)

Company G	Actual			Modeled		
	Exposure	Loss	Loss/Exposure	Exposure	Loss	Loss/Exposure
Coverage A	1,821,376,361	9,755,813	0.005356	1,821,376,361	6,622,444	0.003636
Coverage C	1,024,510,046	772,325	0.000754	1,024,510,046	737,023	0.000719
Coverage D	165,341,800	239,072	0.001446	165,341,800	132,854	0.000804
Total	**3,011,228,207**	**10,767,210**	**0.003576**	**3,011,228,207**	**7,492,321**	**0.002488**

Note: All the exposures and losses have been multiplied by a single constant to disguise the identity of the client.

Comparison #6
Hurricane = Wilma
Exposure = total (Personal Residential)

Company N	Actual			Modeled		
	Exposure	Loss	Loss/Exposure	Exposure	Loss	Loss/Exposure
Coverage A	2,336,868,242	51,124,993	0.021878	2,336,868,242	40,810,582	0.017464
Coverage C	786,969,185	1,813,070	0.002304	786,969,185	3,253,607	0.004134
Coverage D	214,939,504	369,507	0.001719	214,939,504	195,478	0.000909
Total	**3,338,776,931**	**53,307,570**	**0.015966**	**3,338,776,931**	**44,259,667**	**0.013256**

Note: All the exposures and losses have been multiplied by a single constant to disguise the identity of the client.

Comparison #7
Hurricane = Bonnie
Exposure = total (Personal Residential)

Company D	Actual			Modeled		
	Exposure	Loss	Loss/Exposure	Exposure	Loss	Loss/Exposure
Brunswick	185,761,296	902,555	0.004859	185,761,296	1,424,756	0.007670
Duplin	9,712,367	10,593	0.001091	9,712,367	62,015	0.006385
Lenoir	60,723,614	5,396	0.000089	60,723,614	315,672	0.005199
Onslow	673,111,082	881,104	0.001309	673,111,082	4,640,068	0.006894
Pender	34,660,493	88,708	0.002559	34,660,493	389,455	0.011236
Total	**963,968,852**	**1,888,356**	**0.001959**	**963,968,852**	**6,831,966**	**0.007087**

Note: All the exposures and losses have been multiplied by a single constant to disguise the identity of the client.

Comparison #8
Hurricane = Wilma
Exposure = total (Commercial Residential)

Company N	Actual			Modeled		
	Exposure	**Loss**	**Loss/Exposure**	**Exposure**	**Loss**	**Loss/Exposure**
Masonry	3,523,834,122	57,537,128	0.016328	3,523,834,122	49,689,434	0.014101
Concrete	4,913,776,098	60,983,157	0.012411	4,913,776,098	35,840,947	0.007294
Total	**8,437,610,220**	**118,520,285**	**0.014047**	**8,437,610,220**	**85,530,381**	**0.010137**

Note: All the exposures and losses have been multiplied by a single constant to disguise the identity of the client.

Standard S-5, Disclosure 2

B. *Provide a validation comparison of actual commercial residential exposures and loss to modeled exposures and loss. Use and provide a definition of the model's relevant commercial residential classifications.*

The table below contains a comparison of actual commercial residential exposures and loss to modeled exposures and loss. The exposure data used is AIR occupancy code 306—commercial residential and includes reinforced concrete, masonry and wood frame constructions as defined in Table 16 on page 122. The data also contains height information. The description of AIR height bands is given in Table 17 on page 123.

Table 41. Comparison of Actual Commercial Residential Exposures and Loss to Modeled Exposures and Loss

Hurricane	Exposure	Actual Loss	Modeled Loss
Charley	9,744,212,955	65,465,443	104,109,663
Frances	5,953,182,495	60,324,157	32,512,811
Ivan	769,935,738	22,407,198	23,344,872
Jeanne	6,270,282,204	11,708,119	24,062,641
Wilma	15,004,104,155	140,144,282	133,946,150
Katrina	8,098,990,923	7,139,327	12,571,697
Total	**45,840,708,470**	**307,188,525**	**330,547,834**

Note: All the exposures and losses have been multiplied by a single constant to disguise the identity of clients.

C. *Provide scatter plot(s) of modeled vs. historical losses for each of the required validation comparisons. (Plot the historical losses on the x-axis and the modeled losses on the y-axis.)*

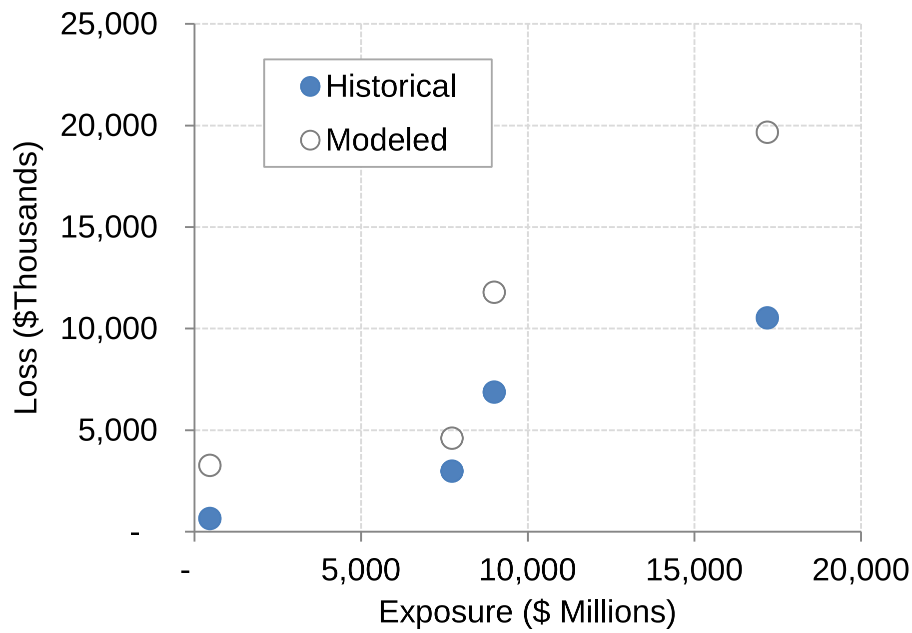


Figure 72. Scatter Plot of Comparison #1

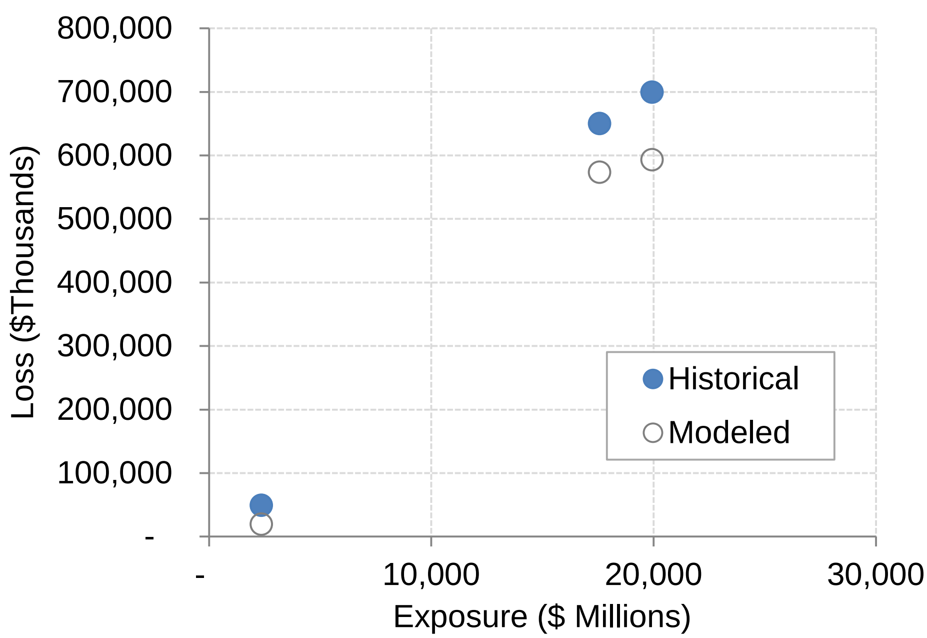


Figure 73. Scatter Plot of Comparison #2

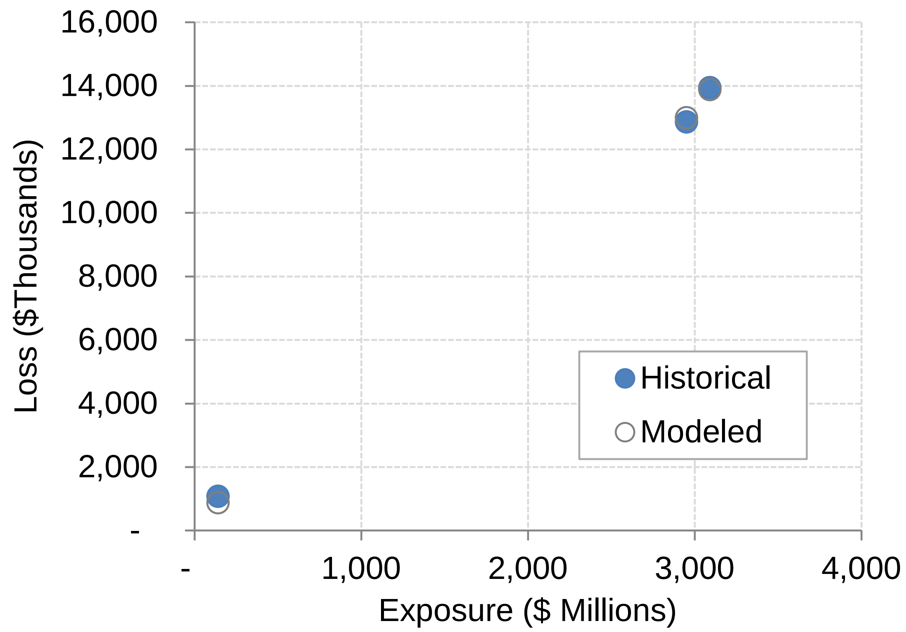


Figure 74. Scatter Plot of Comparison #3

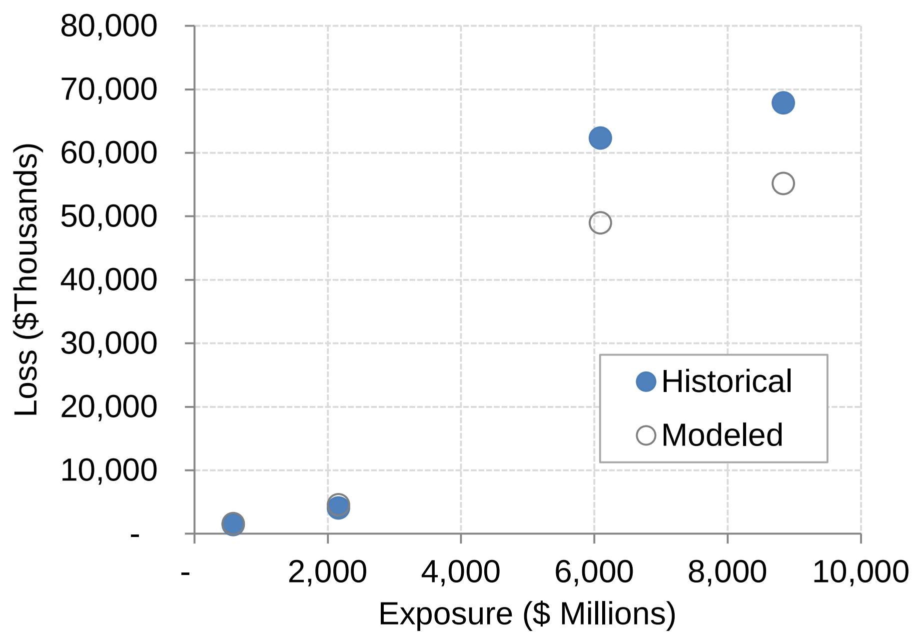


Figure 75. Scatter Plot of Comparison #4

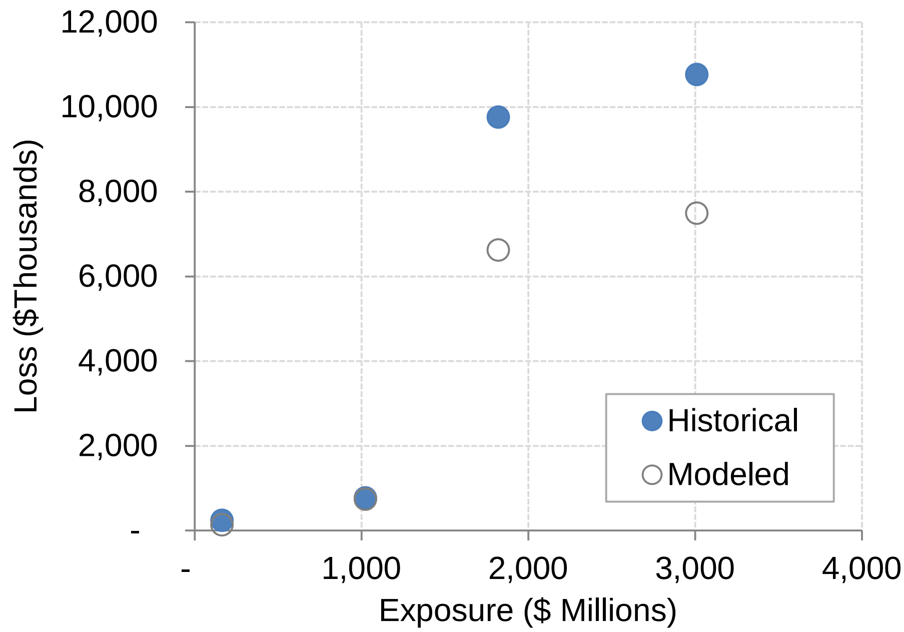


Figure 76. Scatter Plot of Comparison #5

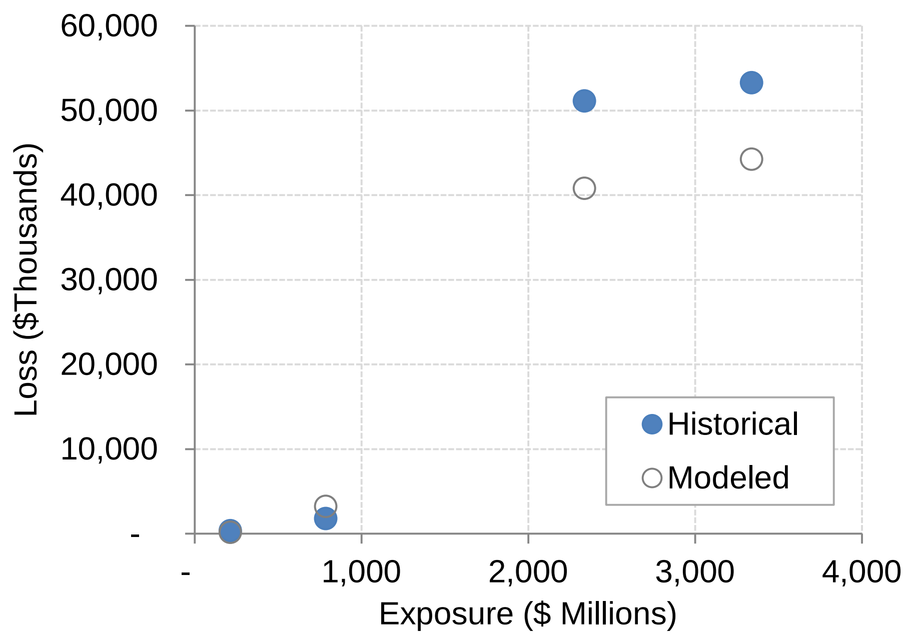


Figure 77. Scatter Plot of Comparison #6

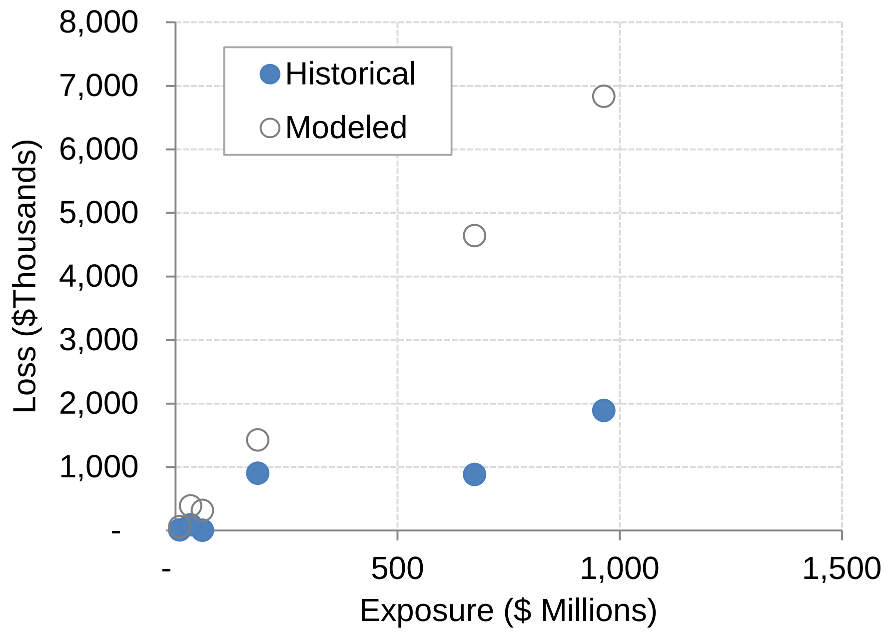


Figure 78. Scatter Plot of Comparison #7

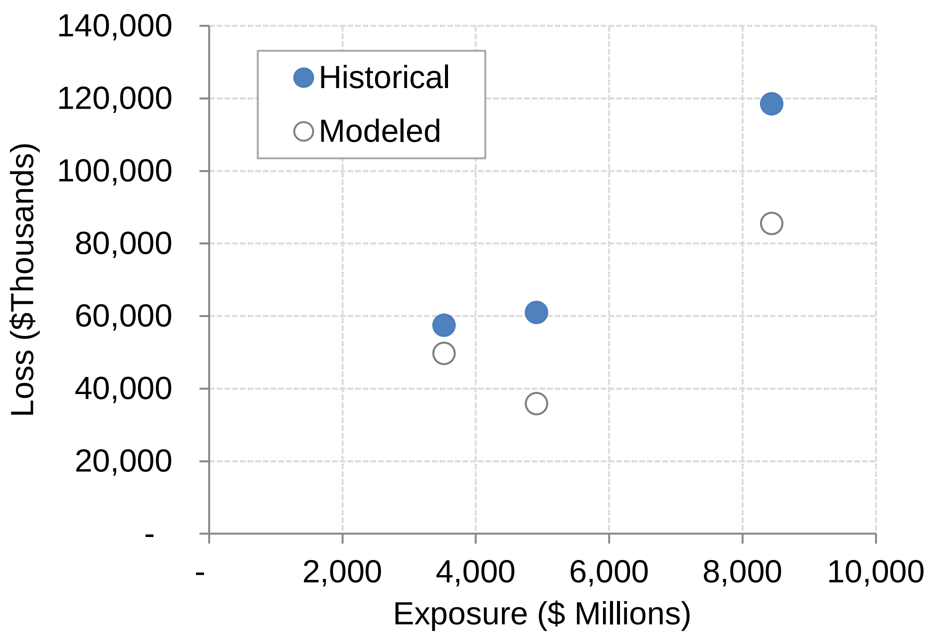


Figure 79. Scatter Plot of Comparison #8

D. Include Form S-4, Validation Comparisons, in a submission appendix.

Rather than using a specific published hurricane windfield directly, the winds underlying the modeled loss cost calculations must be produced by the model being evaluated and should be the same hurricane parameters as used in completing Form A-2, Base Hurricane Storm Set Statewide Losses.

Form S-5: Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled

A. *Provide the average annual zero deductible statewide personal and commercial residential loss costs produced using the list of hurricanes in the Base Hurricane Storm Set as defined in Standard M-1, Base Hurricane Storm Set, based on the 2012 Florida Hurricane Catastrophe Fund's aggregate personal and commercial zero deductible residential exposure data found in the file named "*hlpm2012c.exe.*"*

The average annual zero deductible statewide personal and commercial residential loss costs produced using the list of hurricanes in M-1 based on the 2012 FHCF aggregate data has been provided in Table 42.

Table 42. Average Annual Zero Deductible Statewide Personal and Commercial Residential Loss Costs

Time Period	Historical Hurricanes	Produced by Model
Current Submission	3.505 billion	4.331 billion
Previously Accepted Model* (2013 Standards)	3.536 billion	4.337 billion
Percentage Change Current Submission/Previously Accepted Model	-0.90%	-0.15%

**NA if no previously accepted model*

B. *Provide a comparison with the statewide personal and commercial residential loss costs produced by the model on an average industry basis.*

The average annual zero deductible statewide loss cost produced using the list of hurricanes in the Base Hurricane Storm Set and the 2012 FHCF aggregate personal and commercial residential exposure data is \$3.505 billion (μ_H). The statewide loss cost produced on an average industry basis is \$4.331 billion (μ_S).

C. *Provide the 95% confidence interval on the differences between the mean of the historical and modeled personal and commercial residential loss.*

The 95% confidence interval on the difference between the mean historical and modeled losses is (-2.495 billion <= (μ_H - μ_S) <= +0.843 billion).

D. *If the data are partitioned or modified, provide the average annual zero deductible statewide personal and commercial residential loss costs for the applicable partition (and its complement) or modification, as well as the modeled average annual zero deductible statewide personal and commercial residential loss costs in additional copies of Form S-5, Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled.*

The data has not been partitioned or modified in any way.

E. Include Form S-5, Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled, in a submission appendix.

Standard S-6, Disclosure 3

Form S-6: Hypothetical Events for Sensitivity and Uncertainty Analysis

Form S-6 was submitted as a requirement under the 2009 Standards. The results are unchanged.

Appendix 4: Vulnerability Standards

Form V-1: One Hypothetical Event

A. *Windspeeds for 96 ZIP Codes and sample personal and commercial residential exposure data are provided in the file named* "FormV1Input15.xlsx." *The windspeeds and ZIP Codes represent a hypothetical hurricane track. Model the sample personal and commercial residential exposure data provided in the file against these windspeeds at the specified ZIP Codes and provide the damage ratios summarized by windspeed (mph) and construction type.*

The windspeeds provided are one-minute sustained 10-meter windspeeds. The sample personal and commercial residential exposure data provided consists of four structures (one of each construction type – wood frame, masonry, manufactured home, and concrete) individually placed at the population centroid of each of the ZIP Codes provided. Each ZIP Code is subjected to a specific windspeed. For completing Part A, Estimated Damage for each individual windspeed range is the sum of ground up loss to all structures in the ZIP Codes subjected to that individual windspeed range, excluding demand surge and storm surge. Subject Exposure is all exposures in the ZIP Codes subjected to that individual windspeed range. For completing Part B, Estimated Damage is the sum of the ground up loss to all structures of a specific type (wood frame, masonry, manufactured home, or concrete) in all of the windspeed ranges, excluding demand surge and storm surge. Subject Exposure is all exposures of that specific type in all of the ZIP Codes.

One reference structure for each of the construction types shall be placed at the population centroid of the ZIP Codes. Do not include contents, appurtenant structure, or time element coverages.

Reference Frame Structure:	**Reference Masonry Structure**:
One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Toe nail truss to wall anchor Wood framed exterior walls 5/8" diameter anchors at 48" centers for wall/floor/foundation connections No shutters Standard glass windows No door covers No skylight covers Constructed in 1995	One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Weak truss to wall connection Masonry exterior walls No vertical wall reinforcing No shutters Standard glass windows No door covers No skylight covers Constructed in 1995
Reference Manufactured Home Structure: Tie downs Single unit Manufactured in 1980	**Reference Concrete Structure**: Twenty story Eight apartment units per story No shutters Standard glass windows Constructed in 1980

Table 43. Damage Ratios Summarized by Windspeed (mph) and Construction Type

Part A	
Windspeed* (mph)	**Estimated Damage/Subject Exposure**
41 – 50	0.271%
51 – 60	1.937%
61 – 70	5.042%
71 – 80	9.770%
81 – 90	16.637%
91 – 100	23.301%
101 – 110	33.865%
111 – 120	43.896%
121 – 130	53.312%
131 – 140	67.492%
141 – 150	75.568%
151 – 160	81.538%
161 – 170	83.711%
Part B	
Construction Type	**Estimated Damage/Subject Exposure**
Wood Frame	37.130%
Masonry	34.832%
Manufactured Home	58.813%
Concrete Structure	15.716%

** Windspeeds are one-minute sustained, measured at ten-meter height*

B. Confirm that the structures used in completing the form are identical to those in the above table for the reference structures. If additional assumptions are necessary to complete this form (for example, regarding structural characteristics, duration, or surface roughness), provide the reasons why the assumptions were necessary as well as a detailed description of how they were included.

The structures used in completing this Form are identical to those in the above table. The AIR vulnerability model requires a complete time profile of one minute sustained wind speeds to calculate the damage for a particular risk. Therefore using just the peak wind speed is not sufficient to calculate damage ratios. To provide information for Form V-1, AIR chose a hypothetical storm that produces the range of wind speeds given in Form V-1. The AIR Hurricane Model for the U.S. additionally considers actual terrain surface roughness to calculate the wind speeds used in Form V-1.

C. Provide a plot of the Form V-1, One Hypothetical Event, Part A data.

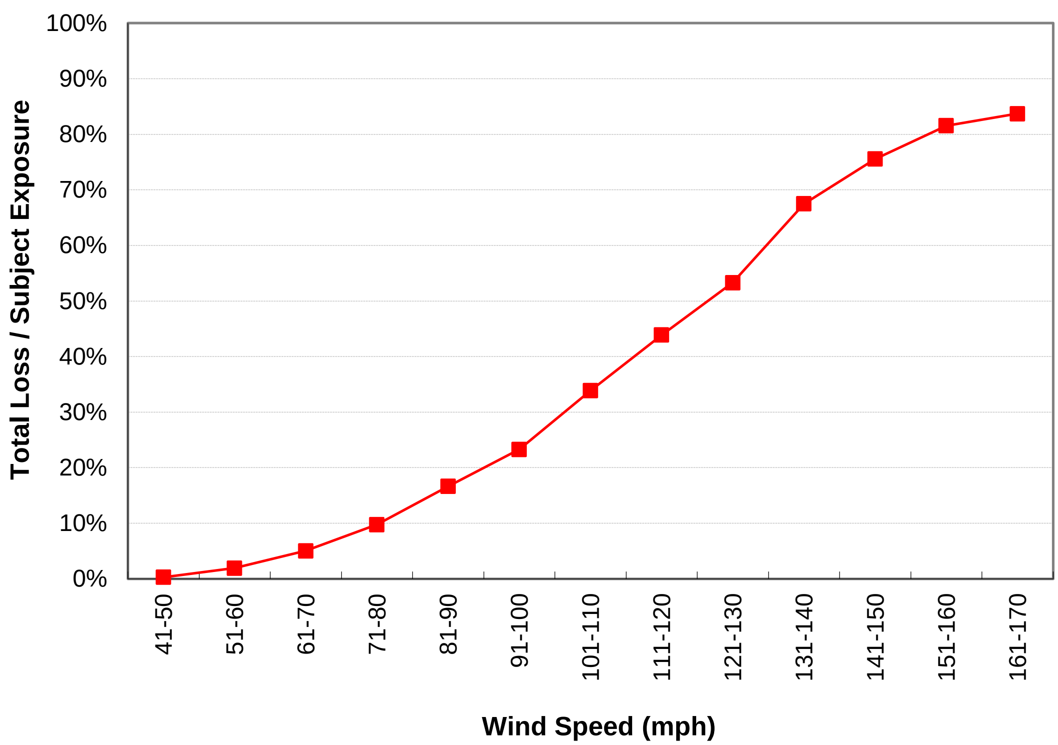


Figure 80. Total Loss Percentages by Wind Speed

D. Include Form V-1, One Hypothetical Event, in a submission appendix.

<u>Standard V-1, Disclosure 14</u>

Form V-2: Mitigation Measures – Range of Changes in Damage

A. *Provide the change in the zero deductible personal residential reference building damage rate (not loss cost) for each individual mitigation measure listed in Form V-2, Mitigation Measures – Range of Changes in Damage, as well as for the combination of the four mitigation measures provided for the Mitigated Frame Building and the Mitigated Masonry Building below.*

A completed Form V-2 is provided in this submission appendix in Excel format.

B. *If additional assumptions are necessary to complete this form (for example, regarding duration or surface roughness), provide the rationale for the assumptions as well as a detailed description of how they are included.*

The AIR vulnerability model requires a complete time profile of one minute sustained wind speeds in order to calculate damage for a particular risk. For the purpose of completion of Form V-2, the effect of duration is not accounted for. The instructions for Form V-2 require a wind speed input. Wind speed is not an explicit input to the AIR Hurricane Model for the U.S. To populate Form V-2, we create a set of events, which approximate the requested wind speeds at the specified locations.

C. *Provide this form in Excel format without truncation. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include Form V-2, Mitigation Measures – Range of Changes in Damage, in a submission appendix.*

A hard copy of Form V-2 is included in this submission appendix item and is additionally provided in Excel format without truncation.

Reference Frame Building:	**Reference Masonry Building**:
One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Toe nail truss to wall anchor Wood framed exterior walls 5/8" diameter anchors at 48" centers for wall/floor/foundation connections No shutters Standard glass windows No door covers No skylight covers Constructed in 1995	One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Weak truss to wall connection Masonry exterior walls No vertical wall reinforcing No shutters Standard glass windows No door covers No skylight covers Constructed in 1995

Mitigated Frame Building:	Mitigated Masonry Building:
ASTM D7158 Class H (150 mph) shingles 8d nails, deck to roof members Truss straps at roof Plywood Shutters	ASTM D7158 Class H (150 mph) shingles 8d nails, deck to roof members Truss straps at roof Plywood Shutters

Reference and mitigated buildings are fully insured building structures with a zero deductible building only policy.

Place the reference building at the population centroid for ZIP Code 33921.

Windspeeds used in the form are one-minute sustained 10-meter windspeeds.

Table 44. Mitigation Measures—Range of Changes in Damage

INDIVIDUAL MITIGATION MEASURES			PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATE - MITIGATED DAMAGE RATE) / REFERENCE DAMAGE RATE) * 100									
			FRAME BUILDING					MASONRY BUILDING				
			WINDSPEED (MPH)					WINDSPEED (MPH)				
			60	85	110	135	160	60	85	110	135	160
	REFERENCE BUILDING		-	-	-	-	-	-	-	-	-	-
ROOF CONFIGURATION	BRACED GABLE ENDS		10.1	13.6	13.2	9.9	6.3	9.7	13.5	13.2	9.8	6.1
	HIP ROOF		14.0	17.5	16.7	12.8	9.0	13.4	17.2	16.5	13.1	8.8
ROOF COVERING	METAL		-4.5	-2.6	-1.2	-0.5	-0.5	-4.3	-2.5	-1.1	-0.5	-0.5
	ASTM D7158 CLASS H SHINGLES (150 MPH)		0.6	0.5	0.3	0.1	0.1	0.6	0.5	0.3	0.2	0.1
	MEMBRANE		0.0	7.6	8.2	0.0	0.0	0.0	8.1	8.4	0.0	0.0
	NAILING OF DECK	8d	12.8	22.8	24.2	17.8	10.2	12.3	22.2	23.7	18.1	10.0
ROOF-WALL STRENGTH	CLIPS		1.7	5.1	10.7	11.6	7.6	1.7	5.4	10.8	11.8	7.4
	STRAPS		2.2	6.5	13.1	14.1	9.8	2.2	6.7	13.2	14.5	9.6
WALL-FLOOR STRENGTH	TIES OR CLIPS		0.0	0.4	0.6	2.6	7.0	0.0	0.4	0.5	2.6	6.8
	STRAPS		0.0	0.8	2.2	6.1	12.7	0.0	0.9	2.1	6.1	12.3
WALL-FOUNDATION STRENGTH	LARGER ANCHORS OR CLOSER SPACING		0.0	0.4	0.6	2.6	7.0	-	-	-	-	-
	STRAPS		0.0	0.8	2.2	6.1	12.7	-	-	-	-	-
	VERTICAL REINFORCING		-	-	-	-	-	0.0	1.1	2.2	6.9	15.0
OPENING PROTECTION	WINDOW SHUTTERS	STRUCTURAL WOOD PANEL	9.4	13.2	12.5	10.0	8.2	8.8	12.9	12.2	9.7	7.9
		METAL	9.4	13.2	12.5	10.0	8.2	8.8	12.9	12.2	9.7	7.9
	DOOR AND SKYLIGHT COVERS		1.7	3.7	5.2	5.0	4.4	1.5	4.0	4.9	4.9	4.3
WINDOW, DOOR, SKYLIGHT STRENGTH	WINDOWS	IMPACT RATED	13.6	19.8	19.3	16.1	13.9	12.7	18.9	18.6	16.1	13.5
	ENTRY DOORS	MEETS WINDBORNE DEBRIS REQUIREMENTS	1.7	3.7	5.2	5.0	4.4	1.5	4.0	4.9	4.9	4.3
	GARAGE DOORS	MEETS WINDBORNE DEBRIS REQUIREMENTS	2.6	4.0	3.7	2.1	1.4	2.8	4.7	3.9	2.3	1.4
	SLIDING GLASS DOORS	MEETS WINDBORNE DEBRIS REQUIREMENTS	-0.3	-0.6	-0.8	-0.7	-0.6	-0.3	-0.7	-0.8	-0.7	-0.6
	SKYLIGHT	IMPACT RATED	1.7	1.8	1.6	1.0	0.6	1.5	2.0	1.5	1.0	0.6

MITIGATION MEASURES IN COMBINATION		PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATE - MITIGATED DAMAGE RATE)/ REFERENCE DAMAGE RATE)*100									
		FRAME BUILDING					MASONRY BUILDING				
		WINDSPEED (MPH)					WINDSPEED (MPH)				
		60	85	110	135	160	60	85	110	135	160
BUILDING	MITIGATED BUILDING	26.1	45.0	50.5	41.5	26.5	24.7	42.9	48.4	40.6	26.1

The following modification factors to the vulnerability functions are based on structural characteristics. A positive value implies a mitigation credit, while a negative value implies a debit or increase in damage. All the modification factors in the following table have been calculated with respect to frame and masonry reference structures, respectively, as defined in the V-2 standards.

Table 45. Modification Factors to Vulnerability Functions

Individual Mitigation Measures		Percentage Changes In Damage ((Reference Damage Rate - Mitigated Damage Rate) / Reference Damage Rate) * 100									
		Frame Building					Masonry Building				
		Windspeed (MPH)					Windspeed (MPH)				
		60	85	110	135	160	60	85	110	135	160
Building	Reference Building	-	-	-	-	-	-	-	-	-	-
Building Condition	Average	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Good	0.8	0.9	0.9	0.6	0.3	0.8	1.0	0.9	0.6	0.3
	Poor	-4.6	-6.0	-5.7	-4.4	-2.9	-4.6	-6.0	-5.6	-4.4	-3.5
Tree Exposure	No	0.0	0.2	0.3	0.4	0.5	0.0	0.2	0.3	0.4	0.5
	Yes	-0.6	-2.0	-2.6	-2.8	-3.1	-0.6	-2.0	-2.6	-2.8	-3.8
Small Debris Source	No	3.5	5.9	7.9	7.7	7.1	3.5	6.4	8.0	7.9	7.1
	Yes	-1.0	-1.3	-1.2	-0.9	-0.9	-1.1	-1.4	-1.2	-1.0	-0.9
Large Missile Source	No	2.6	5.8	10.0	11.1	10.0	2.5	6.2	10.3	11.5	9.9
	Yes	-0.8	-1.0	-1.0	-0.8	-0.7	-0.8	-1.1	-1.0	-0.8	-0.7
Roof Geometry	Flat	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.1
	Gable Without Bracing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Hip	14.0	17.5	16.7	12.8	9.0	13.4	17.2	16.5	13.1	8.8
	Complex	3.3	4.5	4.8	3.6	2.7	3.2	4.8	4.6	3.6	2.6

Individual Mitigation Measures		Percentage Changes In Damage ((Reference Damage Rate - Mitigated Damage Rate) / Reference Damage Rate) * 100									
		Frame Building					Masonry Building				
		Windspeed (MPH)					Windspeed (MPH)				
		60	85	110	135	160	60	85	110	135	160
	Stepped	8.3	10.9	11.0	8.5	5.8	8.0	11.0	11.1	8.4	5.7
	Shed	-1.7	-2.5	-2.3	-1.6	-1.1	-1.5	-2.4	-2.2	-1.5	-1.1
	Mansard	10.8	13.8	13.4	10.4	7.0	10.4	13.7	13.4	10.4	6.9
	Gable With Bracing	10.1	13.6	13.2	9.9	6.3	9.7	13.5	13.2	9.8	6.1
	Pyramid	10.8	13.7	13.3	10.6	7.9	10.3	13.6	13.3	10.6	7.7
	Gambrel	7.8	10.1	10.3	8.1	5.6	7.5	10.3	10.4	8.0	5.5
Roof Pitch	Low	-3.6	-5.4	-5.1	-3.6	-2.2	-3.4	-5.2	-4.8	-3.5	-2.4
	Medium	-0.4	-0.7	-0.7	-0.5	-0.3	-0.3	-0.7	-0.7	-0.5	-0.3
	High	3.7	5.1	5.3	3.4	2.0	3.5	5.5	5.1	3.4	1.9
Roof Covering	Asphalt Shingles	-28.9	-18.4	-12.1	-8.5	-4.9	-28.6	-17.8	-11.8	-8.6	-7.1
	Wooden Shingles	-20.8	-12.8	-7.3	-4.3	-2.4	-20.4	-12.2	-7.0	-4.1	-2.6
	clay/Concrete Tiles	-6.7	-2.1	-0.6	-0.5	-0.4	-6.3	-2.0	-0.5	-0.5	-0.4
	Light Metal Panels	-38.1	-26.3	-17.7	-11.5	-5.5	-37.5	-25.3	-17.1	-11.7	-8.4
	Slate	-4.5	-2.6	-1.2	-0.5	-0.5	-4.3	-2.5	-1.1	-0.5	-0.5
	built-Up Roof With Gravel	-4.5	-2.6	-1.2	-0.5	-0.5	-4.3	-2.5	-1.1	-0.5	-0.5
	Single Ply Membrane	-4.5	-2.6	-1.2	-0.5	-0.5	-4.3	-2.5	-1.1	-0.5	-0.5
	Standing Seam Metal Roofs	-4.5	-2.6	-1.2	-0.5	-0.5	-4.3	-2.5	-1.1	-0.5	-0.5
	built-Up Roof Without Gravel	-4.5	-2.6	-1.2	-0.5	-0.5	-4.3	-2.5	-1.1	-0.5	-0.5
	Single Ply Membrane Ballasted	-4.5	-2.6	-1.2	-0.5	-0.5	-4.3	-2.5	-1.1	-0.5	-0.5
	hurricane Wind-Rated Roof Coverings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Roof Deck	Plywood	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Wood Planks	4.9	5.2	5.0	3.7	3.0	4.6	5.5	4.8	3.7	2.9
	Particle Board/Osb	4.0	4.4	4.2	3.0	2.4	3.8	4.7	4.0	3.0	2.3
	Metal Deck With Insulation Board	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Metal Deck With Concrete	3.3	3.9	3.8	2.8	2.2	3.2	4.3	3.6	2.8	2.2
	Pre-Cast Concrete Slabs	3.3	3.9	3.7	2.6	2.1	3.2	4.2	3.5	2.6	2.0
	Reinforced Concrete Slabs	3.3	3.9	3.7	2.6	2.1	3.2	4.2	3.5	2.6	2.0
	Light Metal	-3.0	-4.0	-1.8	-0.1	0.0	-2.8	-3.9	-1.8	-0.1	0.0
Roof Covering Attachment	Screws	0.6	0.5	0.3	0.1	0.1	0.6	0.5	0.3	0.2	0.1
	Nails/Staples	-5.8	-4.3	-2.5	-1.3	-0.6	-5.5	-4.1	-2.4	-1.3	-0.6
	Adhesive/Epoxy	-11.2	-8.0	-4.5	-2.2	-1.1	-10.9	-7.6	-4.3	-2.2	-1.1

Individual Mitigation Measures		Percentage Changes In Damage ((Reference Damage Rate - Mitigated Damage Rate) / Reference Damage Rate) * 100									
		Frame Building					Masonry Building				
		Windspeed (MPH)					Windspeed (MPH)				
		60	85	110	135	160	60	85	110	135	160
	Mortar	-5.8	-4.3	-2.5	-1.3	-0.6	-5.5	-4.1	-2.4	-1.3	-0.6
Roof Deck Attachment	Screws/Bolts	12.8	22.8	24.2	17.8	10.2	12.3	22.2	23.7	18.1	10.0
	Nails/Staples	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adhesive/Epoxy	-8.7	-14.7	-15.2	-11.0	-4.6	-8.4	-14.0	-14.5	-11.1	-6.4
	Structurally Connected	22.6	27.6	27.0	21.5	15.8	21.7	26.8	26.4	21.6	15.8
	6d Nails @ 6" Spacing, 12" On Center	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	8d Nails @ 6" Spacing, 12" On Center	12.8	22.8	24.2	17.8	10.2	12.3	22.2	23.7	18.1	10.0
	8d Nails @ 8" Spacing, 6" On Center	21.3	27.2	26.8	20.8	14.4	20.4	26.4	26.2	21.0	14.3
Roof Anchorage	Hurricane Ties	2.2	6.5	13.1	14.1	9.8	2.2	6.7	13.2	14.5	9.6
	Nails/Screws	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Anchor Bolts	1.7	5.1	10.7	11.6	7.6	1.7	5.4	10.8	11.8	7.4
	Gravity/Friction	-0.9	-3.2	-6.8	-7.0	-3.5	-0.9	-3.1	-6.5	-6.9	-4.5
	Adhesive/Epoxy	0.3	-0.5	-2.6	-2.9	-1.7	0.2	-0.5	-2.4	-2.8	-1.7
	Structurally Connected	1.9	6.2	13.1	14.2	9.9	1.8	6.5	13.1	14.5	9.7
	Clips	1.7	5.1	10.7	11.6	7.6	1.7	5.4	10.8	11.8	7.4
Wall Type	Brick/Unreinforced Masonry	-3.6	-4.1	-3.6	-2.7	-2.0	0.0	0.0	0.0	0.0	0.0
	Reinforced Masonry	3.6	4.0	4.4	3.6	2.6	6.8	7.8	7.8	6.4	4.6
	Plywood	0.0	0.0	0.0	0.0	0.0	3.4	4.0	3.5	2.8	2.0
	Wood Planks	3.6	3.9	4.1	3.1	2.2	6.8	7.7	7.4	5.9	4.1
	Particle Board/Osb	1.0	1.3	1.3	1.0	0.7	4.3	5.2	4.8	3.8	2.7
	Metal Panels	-5.4	-6.5	-5.8	-4.3	-2.6	-1.8	-2.3	-2.1	-1.6	-1.0
	Pre-Cast Concrete Elements	3.6	4.0	4.4	3.6	2.6	6.8	7.8	7.8	6.4	4.6
	Cast-In-Place Concrete	3.6	4.0	4.4	3.6	2.6	6.8	7.8	7.8	6.4	4.6
	Gypsum Board	-4.6	-5.4	-4.3	-2.9	-2.0	-1.1	-1.2	-0.7	-0.2	0.0
Wall Siding	Veneer Brick/Masonry	3.9	3.4	2.6	1.5	0.9	3.7	3.6	2.4	1.5	0.9
	Wood Shingles	0.8	0.5	0.4	0.2	0.1	0.8	0.6	0.3	0.2	0.1
	Clapboards	2.2	2.3	1.7	0.9	0.6	2.2	2.5	1.6	0.9	0.6
	Aluminum/Vinyl Siding	-7.2	-7.7	-5.1	-2.7	-1.6	-6.9	-7.3	-4.8	-2.6	-1.6
	Stone Panels	4.7	3.8	2.9	1.8	1.0	4.5	4.0	2.7	1.7	1.0
	Exterior Insulation Finishing System	-18.2	-16.2	-11.1	-6.6	-3.1	-17.8	-15.3	-10.4	-6.4	-3.8
	Stucco	-5.3	-5.3	-3.5	-1.8	-1.1	-4.9	-5.0	-3.3	-1.8	-1.0
Glass Type	Annealed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Individual Mitigation Measures		Percentage Changes In Damage ((Reference Damage Rate - Mitigated Damage Rate) / Reference Damage Rate) * 100									
		Frame Building					Masonry Building				
		Windspeed (MPH)					Windspeed (MPH)				
		60	85	110	135	160	60	85	110	135	160
	Tempered	4.5	5.7	5.0	3.3	2.7	4.1	5.9	4.7	3.2	2.6
	Heat Strengthened	3.6	4.3	3.7	2.4	2.2	3.4	4.6	3.5	2.4	2.1
	Laminated	5.6	7.7	7.3	5.1	4.0	5.4	7.8	6.9	5.0	3.8
	Insulating Glass Units	2.8	3.5	3.1	2.2	1.9	2.8	3.8	2.9	2.1	1.8
Glass Percentage	Less Than 5%	1.0	1.5	1.5	1.2	1.0	0.9	1.6	1.4	1.1	1.0
	Between 5% And 20%	0.3	0.5	0.4	0.3	0.2	0.3	0.5	0.4	0.3	0.2
	Between 20% And 60%	-3.5	-5.8	-5.1	-3.5	-2.4	-3.2	-5.5	-4.8	-3.4	-2.6
	Greater Than 60%	-4.9	-8.2	-6.9	-4.5	-2.8	-4.6	-7.8	-6.5	-4.4	-3.3
Window Protection	No Protection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Non-Engineered Shutters	9.4	13.2	12.5	10.0	8.2	8.8	12.9	12.2	9.7	7.9
	Engineered Shutters	13.6	19.8	19.3	16.1	13.9	12.7	18.9	18.6	16.1	13.5
Exterior Doors	Single Width Doors	0.3	0.6	0.8	0.7	0.6	0.2	0.7	0.8	0.7	0.6
	Double Width Doors	-1.9	-4.3	-4.9	-4.2	-3.0	-1.8	-4.1	-4.6	-4.0	-3.6
	Reinforced Single Width Doors	1.7	3.7	5.2	5.0	4.4	1.5	4.0	4.9	4.9	4.3
	Reinforced Double Width Doors	0.6	1.2	1.7	1.7	1.6	0.6	1.3	1.6	1.7	1.5
	Sliding Doors	-2.3	-5.5	-6.5	-5.7	-3.9	-2.2	-5.2	-6.1	-5.5	-5.1
	Reinforced Sliding Doors	-0.3	-0.6	-0.8	-0.7	-0.6	-0.3	-0.7	-0.8	-0.7	-0.6
Foundation Connection	Hurricane Ties	0.0	0.8	2.2	6.1	12.7	0.0	0.9	2.1	6.1	12.3
	Nails/Screws	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Anchor Bolts	0.0	0.4	0.6	2.6	7.0	0.0	0.4	0.5	2.6	6.8
	Gravity/Friction	0.0	-0.7	-1.7	-4.6	-6.1	0.0	-0.7	-1.6	-4.5	-9.5
	Adhesive/Epoxy	-0.1	-0.3	-0.6	-2.3	-4.1	0.0	-0.3	-0.6	-2.3	-5.5
	Structurally Connected	0.0	1.0	2.3	6.9	15.0	0.0	1.1	2.2	6.9	15.0
roof Attached Structures	Chimneys	-1.3	-1.4	-1.0	-0.6	-0.5	-1.2	-1.4	-0.9	-0.6	-0.5
	A/C Unit	-3.1	-4.1	-2.9	-1.6	-1.1	-2.9	-4.0	-2.8	-1.5	-1.1
	Skylights	-4.0	-5.3	-3.6	-1.8	-1.2	-3.8	-5.0	-3.5	-1.8	-1.2
	Parapet Walls	1.8	0.6	-0.6	-1.1	-1.0	1.8	0.7	-0.6	-1.0	-0.9
	Overhang/Rake (8 - 36 Inches)	-1.3	-1.4	-1.0	-0.6	-0.5	-1.2	-1.4	-0.9	-0.6	-0.5
	Dormers	-1.9	-2.0	-1.1	-0.5	-0.5	-1.8	-1.9	-1.0	-0.5	-0.5
	Other	-1.0	-1.3	-1.0	-0.6	-0.5	-0.9	-1.3	-0.9	-0.6	-0.5
	No Attached Structures	1.7	1.8	1.6	1.0	0.6	1.5	2.0	1.5	1.0	0.6
	Overhang/Rake (< 8 Inches)	1.3	1.5	1.2	0.8	0.6	1.2	1.6	1.2	0.8	0.6

Individual Mitigation Measures		Percentage Changes In Damage ((Reference Damage Rate - Mitigated Damage Rate) / Reference Damage Rate) * 100									
		Frame Building					Masonry Building				
		Windspeed (MPH)					Windspeed (MPH)				
		60	85	110	135	160	60	85	110	135	160
	Overhang/Rake (> 36 Inches)	-1.8	-2.0	-1.2	-0.5	-0.5	-1.7	-2.0	-1.1	-0.5	-0.5
	Waterproof Membrane/Fabric	1.8	2.0	1.7	1.1	0.9	1.7	2.2	1.6	1.1	0.8
	Secondary Water Resistance - Yes	0.0	7.6	8.2	0.0	0.0	0.0	8.1	8.4	0.0	0.0
	Secondary Water Resistance - No	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wall Attached Structures	Carports/Canopies/Porches	-2.7	-4.0	-3.6	-2.6	-2.0	-2.6	-4.1	-3.6	-2.7	-2.1
	Single Door Garage	0.5	0.8	0.8	0.5	0.3	0.6	1.0	0.8	0.5	0.4
	Double Door Garage	-4.2	-6.1	-5.6	-4.3	-3.0	-4.3	-6.3	-5.7	-4.4	-3.7
	Reinforced Single Door Garage	2.6	4.0	3.7	2.1	1.4	2.8	4.7	3.9	2.3	1.4
	Reinforced Double Door Garage	0.5	0.8	0.8	0.5	0.3	0.6	1.0	0.8	0.5	0.4
	Screened Porches/Glass Patio Doors	-3.2	-4.5	-4.1	-3.0	-2.2	-3.2	-4.6	-4.1	-3.1	-2.4
	Balcony	-2.4	-3.7	-3.3	-2.4	-1.9	-2.5	-3.8	-3.4	-2.5	-1.9
	No Attached Wall Structures	2.6	4.0	3.7	2.1	1.4	2.8	4.7	3.9	2.3	1.4
Appurtenant Structures	Detached Garage	-0.5	-1.0	-1.2	-1.0	-0.7	-0.5	-1.0	-1.2	-1.0	-0.7
	Pool Enclosures	-10.4	-18.9	-13.0	-3.6	0.0	-10.4	-18.6	-12.8	-3.6	0.0
	No Pool Enclosures	-0.5	-1.0	-1.2	-1.0	-0.7	-0.5	-1.0	-1.2	-1.0	-0.7
	Shed	-0.5	-1.0	-1.2	-1.0	-0.7	-0.5	-1.0	-1.2	-1.0	-0.7
	Masonry Boundary Wall	-0.5	-1.0	-1.2	-1.0	-0.7	-0.5	-1.0	-1.2	-1.0	-0.7
	Other Fence	2.7	3.5	3.5	2.3	1.7	2.8	4.0	3.4	2.4	1.7
	No Appurtenant Structures	1.5	2.1	2.0	1.4	1.0	1.5	2.4	2.0	1.4	1.0
Roof Built	0-10 Years Old	2.8	4.5	4.6	2.6	1.2	2.6	4.9	4.4	2.6	1.2
	11-20 Years Old	0.4	0.6	0.7	0.5	0.3	0.3	0.7	0.6	0.5	0.3
	21+ Years Old	-5.1	-7.0	-6.4	-4.7	-2.8	-4.9	-6.7	-6.2	-4.6	-3.3

Standard V-3, Disclosure 2

Form V-3: Mitigation Measures—Mean Damage Ratios and Loss Costs (Trade Secret Item)

A. Provide the mean damage ratio (prior to any insurance considerations) to the reference building for each individual mitigation measure listed in Form V-3, Mitigation Measures – Mean Damage Ratios and Loss Costs (Trade Secret item), as well as the percent damage for the combination of the four mitigation measures provided for the Mitigated Frame Building and the Mitigated Masonry Building below.

B. Provide the loss cost rounded to three decimal places, for the reference building and for each individual mitigation measure listed in Form V-3, Mitigation Measurers – Mean Damage Ratios and Loss Costs (Trade Secret item), as well as the loss cost for the combination of the four mitigation measures provided for the Mitigated Frame Building and the Mitigated Masonry Building below.

C. If additional assumptions are necessary to complete this form (for example, regarding duration or surface roughness), provide the rationale for the assumptions as well as a detailed description of how they are included.

D. Provide a graphical representation of the vulnerability curves for the reference and the fully mitigated building.

Reference Frame Building: One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Toe nail truss to wall anchor Wood framed exterior walls 5/8" diameter anchors at 48" centers for wall/floor/foundation connections No shutters Standard glass windows No door covers No skylight covers Constructed in 1995	**Reference Masonry Building**: One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Weak truss to wall connection Masonry exterior walls No vertical wall reinforcing No shutters Standard glass windows No door covers No skylight covers Constructed in 1995
Mitigated Frame Building: ASTM D7158 Class H (150 mph) shingles 8d nails, deck to roof members Truss straps at roof Plywood Shutters	**Mitigated Masonry Building**: ASTM D7158 Class H (150 mph) shingles 8d nails, deck to roof members Truss straps at roof Plywood Shutters

Reference and mitigated buildings are fully insured building structures with a zero deductible building only policy.

Place the reference building at the population centroid for ZIP Code 33921.

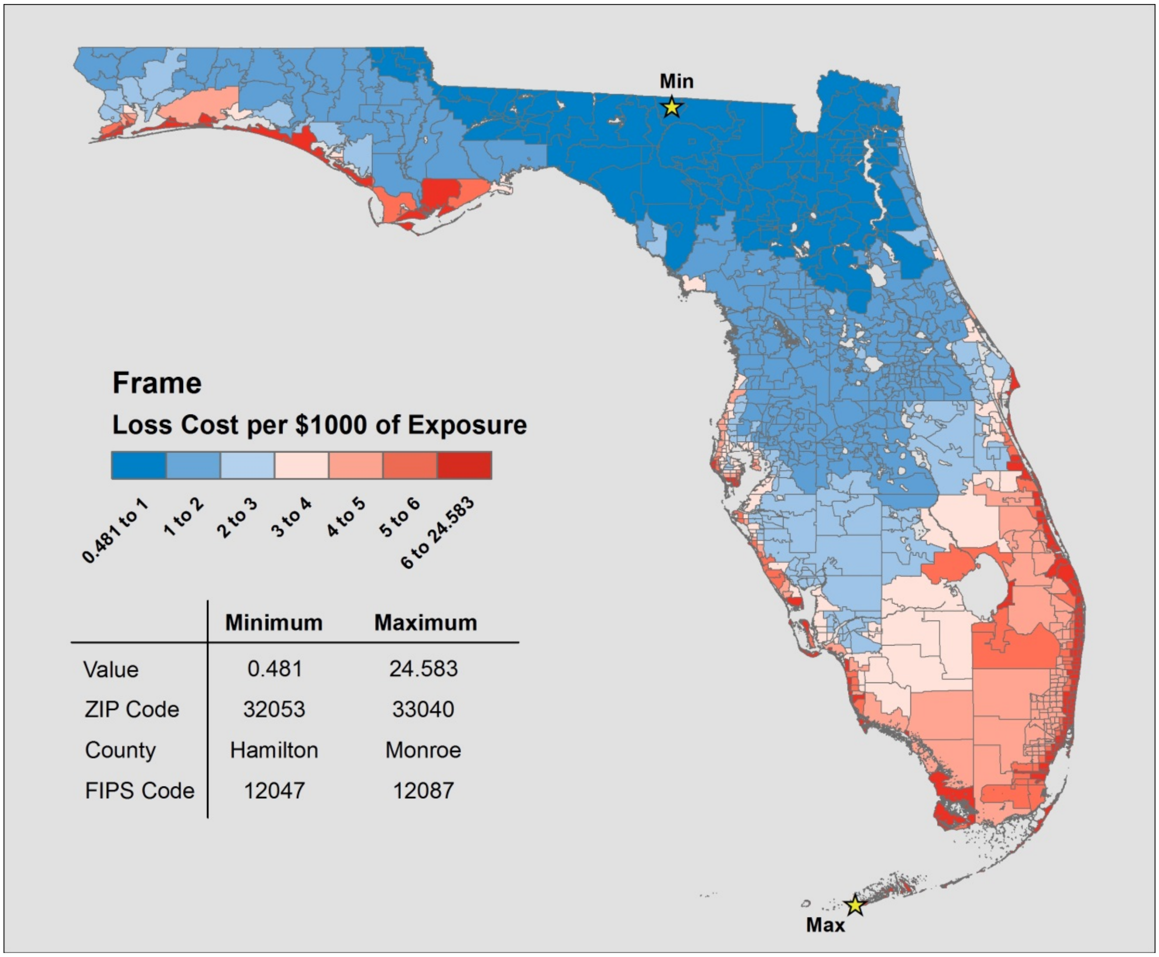
Windspeeds used in the form are one-minute sustained 10-meter windspeeds.

Form V-3 will be presented to the professional team and at the closed meeting of the Commission.

Appendix 5: Actuarial Standards

Form A-1: Zero Deductible Personal Residential Loss Costs by ZIP Code

A. Provide three maps, color-coded by ZIP Code (with a minimum of six value ranges), displaying zero deductible personal residential loss costs per $1,000 of exposure for frame, masonry, and manufactured home.



	Minimum	Maximum
Value	0.481	24.583
ZIP Code	32053	33040
County	Hamilton	Monroe
FIPS Code	12047	12087

Figure 81. Loss Costs by ZIP Code for Owners Wood Frame, Zero Deductible

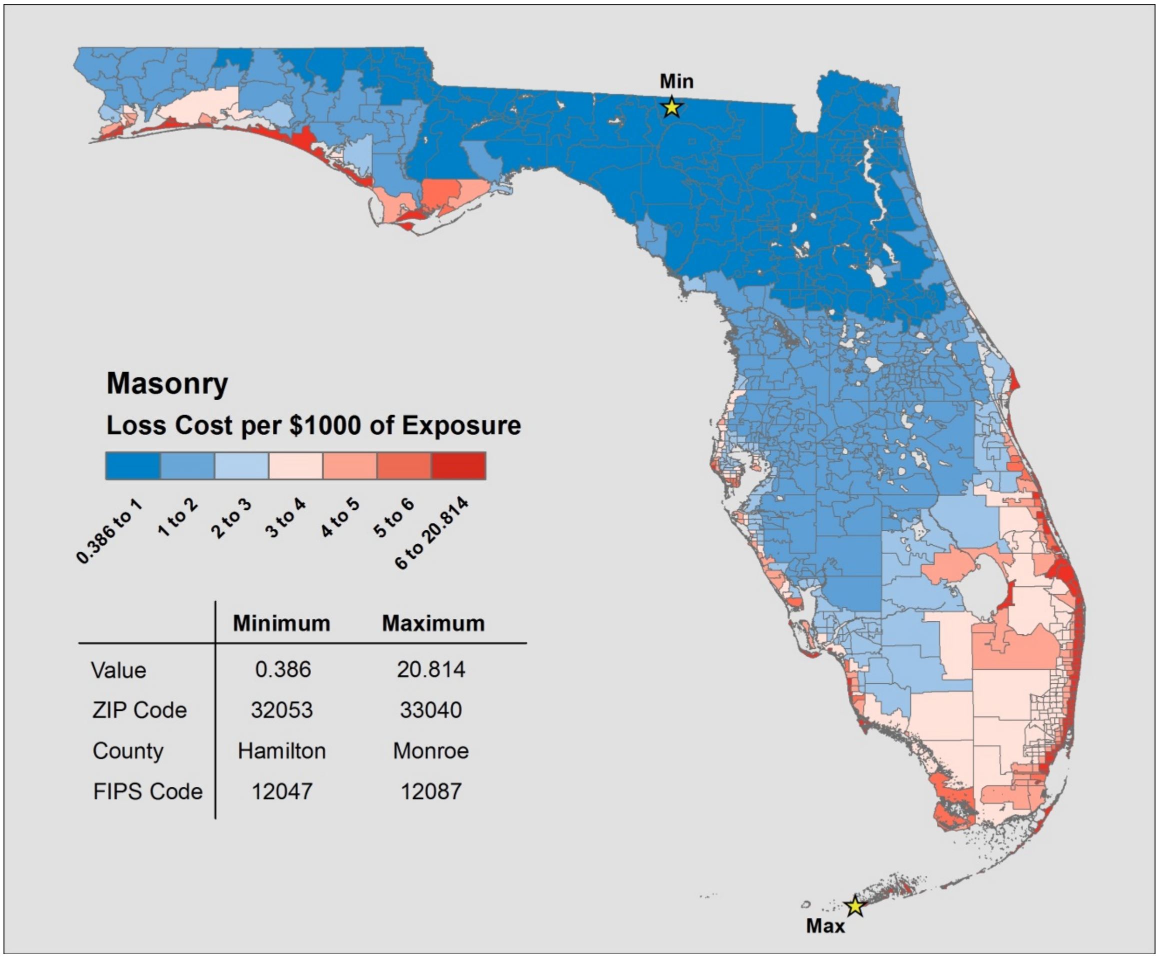


Figure 82. Loss Costs by ZIP Code for Owners Masonry, Zero Deductible

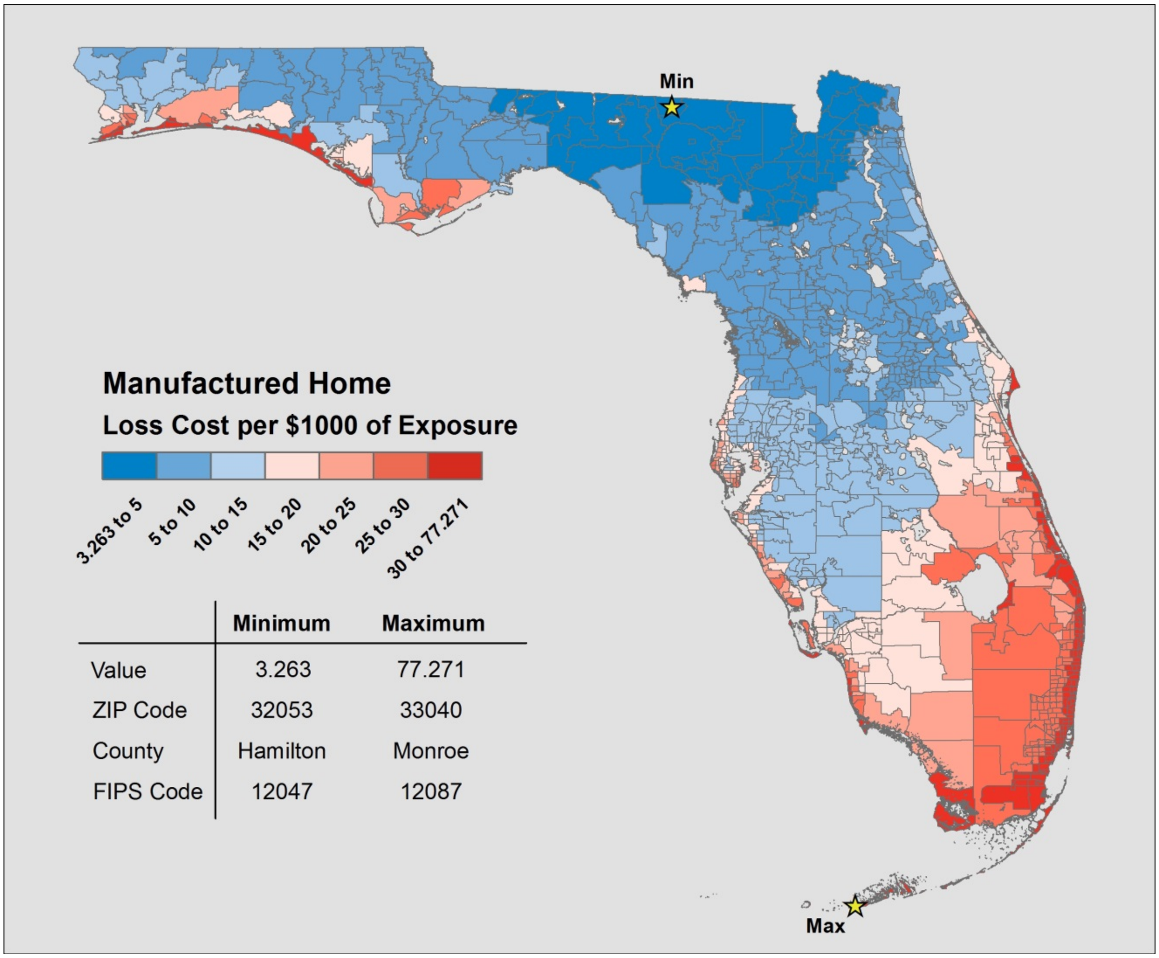


Figure 83. Loss Costs by ZIP Code for Manufactured Home, Zero Deductible

B. Create exposure sets for these exhibits by modeling all of the buildings from Notional Set 3 described in the file "NotionalInput15.xlsx" *geocoded to each ZIP Code centroid in the state, as provided in the model. Provide the predominant County name and the Federal Information Processing Standards (FIPS) code associated with each ZIP Code centroid. Refer to the Notional Policy Specification below for additional modeling information. Explain any assumptions, deviations, and differences from the prescribed exposure information.*

Exposure sets for these exhibits have been created as specified.

C. Provide, in the format given in the file named "2015FormA1.xlsx," *the underlying loss cost data rounded to three decimal places used for A. above in both Excel and PDF format. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name.*

A completed Form A-1 is provided in an Excel format.

Standard A-6, Disclosure 1

Form A-2: Base Hurricane Storm Set Statewide Losses

A. *Provide the total insured loss and the dollar contribution to the average annual loss assuming zero deductible policies for individual historical hurricanes using the Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named "*hlpm2012c.exe*." The list of hurricanes in this form shall include all Florida and by-passing hurricanes in the modeling organization Base Hurricane Storm Set, as defined in Standard M-1, Base Hurricane Storm Set.*

The FHCF aggregate exposure data has been modeled with a zero deductible assumption. The gross modeled loss from each specific hurricane in the Base Hurricane Storm Set is provided in Form A-2.

The table below contains the minimum number of hurricanes from HURDAT2 to be included in the Base Hurricane Storm Set, based on the 115-year period 1900-2014. Each hurricane has been assigned an ID number. As defined in Standard M-1, Base Hurricane Storm Set, the Base Hurricane Storm Set for the modeling organization may exclude hurricanes that had zero modeled impact, or it may include additional hurricanes when there is clear justification for the additions. For hurricanes in the table below resulting in zero loss, the table entry shall be left blank. Additional hurricanes included in the model's Base Hurricane Storm Set shall be added to the table below in order of year and assigned an intermediate ID number as the hurricane falls within the bounding ID numbers.

Table 46. Base Hurricane Storm Set Statewide Losses

ID	Landfall/ Closest Approach Date	Year	Name	Personal and Commercial Residential Insured Losses ($)	Dollar Contribution*
001	09/09/1900	1900	NoName01-1900	407,005	3,539
005	08/15/1901	1901	NoName04-1901	135,790,018	1,180,783
010	09/11/1903	1903	NoName03-1903	3,270,717,456	28,441,021
015	10/17/1904	1904	NoName04-1904	1,096,652,509	9,536,109
020	06/17/1906	1906	NoName02-1906	1,314,667,175	11,431,888
025	09/27/1906	1906	NoName06-1906	131,760,180	1,145,741
030	10/18/1906	1906	NoName08-1906	4,029,568,939	35,039,730
035	10/11/1909	1909	NoName11-1909	1,096,288,645	9,532,945
040	10/18/1910	1910	NoName05-1910	8,519,902,714	74,086,111
045	08/11/1911	1911	NoName02-1911	484,708,919	4,214,860
050	09/14/1912	1912	NoName04-1912	358,756,915	3,119,625
055	08/01/1915	1915	NoName01-1915	187,884,512	1,633,778
060	09/04/1915	1915	NoName04-1915	63,455,767	551,789
065	07/05/1916	1916	NoName02-1916	104,742,745	910,806
070	10/18/1916	1916	NoName14-1916	499,965,542	4,347,526
075	09/29/1917	1917	NoName04-1917	2,707,829,364	23,546,342
080	09/10/1919	1919	NoName02-1919	718,060,785	6,244,007
085	10/25/1921	1921	TampaBay06-1921	9,466,463,890	82,317,077
090	09/15/1924	1924	NoName05-1924	88,626,716	770,667
095	10/21/1924	1924	NoName10-1924	765,261,760	6,654,450
096	12/01/1925	1925	NoName04-1925	379,159,014	3,297,035
100	07/28/1926	1926	NoName01-1926	2,986,739,627	25,971,649
105	09/18/1926	1926	GreatMaimi07-1926	61,129,083,930	531,557,252
110	10/21/1926	1926	NoName10-1926	222,826,960	1,937,626
115	08/08/1928	1928	NoName01-1928	1,687,685,621	14,675,527
120	09/17/1928	1928	LakeOkeechobee04-1928	45,204,549,980	393,083,043
125	09/28/1929	1929	NoName02-1929	8,301,105,466	72,183,526
126	09/12/1930	1930	NoName02-1930	6,108,027	53,113
130	09/01/1932	1932	NoName03-1932	722,856,610	6,285,710
135	07/30/1933	1933	NoName05-1933	461,134,732	4,009,867
140	09/04/1933	1933	NoName11-1933	6,914,134,681	60,122,910

ID	Landfall/ Closest Approach Date	Year	Name	Personal and Commercial Residential Insured Losses ($)	Dollar Contribution*
141	09/05/1933	1933	NoName08-1933	3,223,851	28,033
142	10/05/1933	1933	NoName18-1933	81,923,990	712,383
143	07/25/1934	1934	NoName03-1934	25,348,672	220,423
145	09/03/1935	1935	LaborDay03-1935	13,139,176,235	114,253,706
146	09/29/1935	1935	NoName04-1935	1,125,620,764	9,788,007
150	11/04/1935	1935	NoName07-1935	2,339,659,569	20,344,866
155	07/31/1936	1936	NoName05-1936	1,169,296,729	10,167,798
160	08/11/1939	1939	NoName02-1939	922,083,021	8,018,113
161	08/07/1940	1940	NoName02-1940	809,209	7,037
165	10/06/1941	1941	NoName05-1941	2,071,943,795	18,016,903
170	10/19/1944	1944	NoName13-1944	11,034,110,221	95,948,785
175	06/24/1945	1945	NoName01-1945	1,509,975,191	13,130,219
180	09/15/1945	1945	NoName09-1945	12,008,425,935	104,421,095
185	10/08/1946	1946	NoName06-1946	1,653,172,818	14,375,416
186	08/24/1947	1947	NoName03-1947	4,207,390	36,586
190	09/17/1947	1947	NoName04-1947	29,092,483,618	252,978,118
195	10/12/1947	1947	NoName09-1947	1,159,795,867	10,085,181
200	09/22/1948	1948	NoName08-1948	17,150,619,303	149,135,820
205	10/05/1948	1948	NoName09-1948	917,970,025	7,982,348
210	08/26/1949	1949	NoName02-1949	14,689,354,121	127,733,514
215	08/31/1950	1950	Baker-1950	172,542,681	1,500,371
220	09/05/1950	1950	Easy-1950	5,524,929,301	48,042,863
225	10/18/1950	1950	King-1950	6,552,357,422	56,977,021
226	10/04/1951	1951	How-1951	360,808,962	3,137,469
230	09/26/1953	1953	Florence-1953	243,310,970	2,115,748
235	10/09/1953	1953	Hazel-1953	884,240,491	7,689,048
240	09/25/1956	1956	Flossy-1956	352,330,536	3,063,744
245	09/10/1960	1960	Donna-1960	18,881,196,860	164,184,321
250	08/27/1964	1964	Cleo-1964	5,493,730,934	47,771,573
255	09/10/1964	1964	Dora-1964	5,206,060,815	45,270,094
256	10/02/1964	1964	Hilda-1964	20,803,986	180,904
260	10/14/1964	1964	Isbell-1964	1,549,830,393	13,476,786
265	09/08/1965	1965	Betsy-1965	10,425,521,655	90,656,710
270	06/09/1966	1966	Alma-1966	220,579,804	1,918,085
275	10/04/1966	1966	Inez-1966	139,486,056	1,212,922

ID	Landfall/ Closest Approach Date	Year	Name	Personal and Commercial Residential Insured Losses ($)	Dollar Contribution*
276	06/04/1968	1968	Abby-1968	389,883,814	3,390,294
280	10/19/1968	1968	Gladys-1968	1,927,001,141	16,756,532
281	08/18/1969	1969	Camille-1969	22,785,632	198,136
285	06/19/1972	1972	Agnes-1972	57,788,318	502,507
290	09/23/1975	1975	Eloise-1975	714,456,564	6,212,666
295	09/04/1979	1979	David-1979	3,193,064,059	27,765,774
300	09/13/1979	1979	Frederic-1979	805,950,587	7,008,266
305	09/02/1985	1985	Elena-1985	741,569,800	6,448,433
306	10/29/1985	1985	Juan-1985	317,296,253	2,759,098
310	11/21/1985	1985	Kate-1985	423,968,682	3,686,684
315	10/12/1987	1987	Floyd-1987	37,293,881	324,295
320	08/24/1992	1992	Andrew-1992	27,252,404,540	236,977,431
321	11/18/1994	1994	Gordon-1994	239,206,398	2,080,056
325	08/03/1995	1995	Erin-1995	1,177,488,595	10,239,031
330	10/04/1995	1995	Opal-1995	2,175,594,248	18,918,211
335	07/19/1997	1997	Danny-1997	46,400,004	403,478
340	09/03/1998	1998	Earl-1998	57,561,401	500,534
345	09/25/1998	1998	Georges-1998	139,560,077	1,213,566
350	10/15/1999	1999	Irene-1999	283,261,014	2,463,139
351	09/17/2000	2000	Gordon-2000	169,410,464	1,473,134
355	08/13/2004	2004	Charley-2004	7,186,885,920	62,494,660
360	09/05/2004	2004	Frances-2004	6,512,314,902	56,628,825
365	09/16/2004	2004	Ivan-2004	2,314,278,792	20,124,163
370	09/26/2004	2004	Jeanne-2004	4,671,054,160	40,617,862
371	07/06/2005	2005	Cindy-2005	347,265	3,020
375	07/10/2005	2005	Dennis-2005	941,693,465	8,188,639
380	08/25/2005	2005	Katrina-2005	790,636,082	6,875,096
381	09/15/2005	2005	Ophelia-2005	1,168,416	10,160
382	09/21/2005	2005	Rita-2005	6,827,769	59,372
385	10/24/2005	2005	Wilma-2005	11,260,724,188	97,919,341
386	09/13/2008	2008	Ike-2008	386,540	3,361
387	29/08/2012	2012	Isaac-2012	1,463,456	12,726
			Total	**403,043,553,821**	**3,504,726,552**

*Dollar Contribution = (Insured Losses)/(Number of Years in Historical Record).

B. Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include Form A-2, Base Hurricane Storm Set Statewide Losses in a submission appendix.

A hard copy of Form A-2 is included in this submission appendix item and is also provided in an Excel format.

Note: Total dollar contributions should agree with the total average annual zero deductible statewide loss costs provided in Form S-5, Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled.

Total dollar contributions agree with the total average annual zero deductible statewide loss costs provided in Form S-5.

Standard A-6, Disclosure 2

Form A-3: 2004 Hurricane Season Losses

A. Provide the percentage of residential zero deductible losses, rounded to four decimal places, and the monetary contribution from Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), and Hurricane Jeanne (2004) for each affected ZIP Code, individually and in total. Include all ZIP Codes where losses are equal to or greater than $500,000.

Use the 2012 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named "hlpm2012c.exe."

Rather than using directly a specified published windfield, the winds underlying the loss cost calculations must be produced by the model being evaluated and should be the same hurricane parameters as used in completing Form A-2, Base Hurricane Storm Set Statewide Losses.

The 2012 FHCF aggregate exposure data has been modeled with a zero deductible assumption used. The percentage of personal and commercial residential losses from Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), and Hurricane Jeanne (2004) for each affected ZIP Code is provided in Table 47. Note that all ZIP Codes where the total (i.e. all four events) losses are equal to or greater than $500,000 have been included. Zero deductible, gross modeled losses have been used in the creation of this form.

Table 47. Percentage of Total Personal and Commercial Residential Losses from 2004 Storms

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32003	0	0.0000%	0	0.0000%	0	0.0000%	2,847,935	0.0610%	2,847,935	0.0138%
32008	0	0.0000%	249,795	0.0038%	0	0.0000%	707,119	0.0151%	956,914	0.0046%
32024	0	0.0000%	0	0.0000%	0	0.0000%	4,275,248	0.0915%	4,275,248	0.0207%
32025	0	0.0000%	0	0.0000%	0	0.0000%	3,127,325	0.0670%	3,127,325	0.0151%
32034	0	0.0000%	0	0.0000%	0	0.0000%	4,349,807	0.0931%	4,349,807	0.0210%
32038	0	0.0000%	40,578	0.0006%	0	0.0000%	1,789,869	0.0383%	1,830,447	0.0088%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32040	0	0.0000%	0	0.0000%	0	0.0000%	650,781	0.0139%	650,781	0.0031%
32043	0	0.0000%	0	0.0000%	0	0.0000%	1,774,306	0.0380%	1,774,306	0.0086%
32052	0	0.0000%	0	0.0000%	0	0.0000%	694,473	0.0149%	694,473	0.0034%
32053	0	0.0000%	58,287	0.0009%	0	0.0000%	477,984	0.0102%	536,271	0.0026%
32054	0	0.0000%	0	0.0000%	0	0.0000%	1,844,228	0.0395%	1,844,228	0.0089%
32055	0	0.0000%	0	0.0000%	0	0.0000%	2,406,596	0.0515%	2,406,596	0.0116%
32060	0	0.0000%	687,622	0.0106%	0	0.0000%	3,372,955	0.0722%	4,060,578	0.0196%
32062	0	0.0000%	113,258	0.0017%	0	0.0000%	399,574	0.0086%	512,832	0.0025%
32063	0	0.0000%	0	0.0000%	0	0.0000%	861,448	0.0184%	861,448	0.0042%
32064	0	0.0000%	78,231	0.0012%	0	0.0000%	547,824	0.0117%	626,055	0.0030%
32065	0	0.0000%	0	0.0000%	0	0.0000%	2,179,397	0.0467%	2,179,397	0.0105%
32066	0	0.0000%	615,814	0.0095%	0	0.0000%	393,042	0.0084%	1,008,856	0.0049%
32068	0	0.0000%	0	0.0000%	0	0.0000%	4,222,406	0.0904%	4,222,406	0.0204%
32071	0	0.0000%	148,330	0.0023%	0	0.0000%	584,480	0.0125%	732,810	0.0035%
32073	0	0.0000%	0	0.0000%	0	0.0000%	3,765,620	0.0806%	3,765,620	0.0182%
32080	2,412,317	0.0336%	4,426,956	0.0680%	0	0.0000%	6,993,391	0.1497%	13,832,664	0.0669%
32082	807,848	0.0112%	2,251,261	0.0346%	0	0.0000%	10,268,194	0.2198%	13,327,302	0.0644%
32084	704,669	0.0098%	1,126,811	0.0173%	0	0.0000%	2,183,633	0.0467%	4,015,113	0.0194%
32086	872,866	0.0121%	1,377,337	0.0211%	0	0.0000%	2,306,617	0.0494%	4,556,821	0.0220%
32091	0	0.0000%	0	0.0000%	0	0.0000%	1,957,615	0.0419%	1,957,615	0.0095%
32092	0	0.0000%	0	0.0000%	0	0.0000%	1,702,192	0.0364%	1,702,192	0.0082%
32094	0	0.0000%	14,514	0.0002%	0	0.0000%	624,249	0.0134%	638,764	0.0031%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32095	136,729	0.0019%	276,290	0.0042%	0	0.0000%	711,170	0.0152%	1,124,189	0.0054%
32102	303,160	0.0042%	462,777	0.0071%	0	0.0000%	721,358	0.0154%	1,487,295	0.0072%
32110	344,750	0.0048%	0	0.0000%	0	0.0000%	424,370	0.0091%	769,120	0.0037%
32112	119,954	0.0017%	477,437	0.0073%	0	0.0000%	1,103,223	0.0236%	1,700,614	0.0082%
32113	0	0.0000%	343,121	0.0053%	0	0.0000%	2,087,753	0.0447%	2,430,874	0.0118%
32114	8,312,758	0.1157%	2,481,337	0.0381%	0	0.0000%	1,469,567	0.0315%	12,263,662	0.0593%
32117	11,109,194	0.1546%	2,895,255	0.0445%	0	0.0000%	1,828,094	0.0391%	15,832,542	0.0765%
32118	24,149,566	0.3360%	5,538,782	0.0851%	0	0.0000%	3,528,254	0.0755%	33,216,602	0.1606%
32119	12,743,222	0.1773%	4,734,381	0.0727%	0	0.0000%	2,740,124	0.0587%	20,217,727	0.0977%
32124	828,826	0.0115%	178,387	0.0027%	0	0.0000%	197,515	0.0042%	1,204,729	0.0058%
32127	20,513,469	0.2854%	8,405,342	0.1291%	0	0.0000%	4,505,772	0.0965%	33,424,583	0.1616%
32128	9,577,259	0.1333%	2,060,650	0.0316%	0	0.0000%	1,531,677	0.0328%	13,169,586	0.0637%
32129	11,686,681	0.1626%	4,619,936	0.0709%	0	0.0000%	2,769,424	0.0593%	19,076,041	0.0922%
32130	641,101	0.0089%	354,109	0.0054%	0	0.0000%	482,630	0.0103%	1,477,840	0.0071%
32132	2,547,922	0.0355%	2,255,302	0.0346%	0	0.0000%	1,118,471	0.0239%	5,921,695	0.0286%
32134	0	0.0000%	409,271	0.0063%	0	0.0000%	1,820,327	0.0390%	2,229,598	0.0108%
32136	5,654,432	0.0787%	2,905,071	0.0446%	0	0.0000%	2,351,886	0.0504%	10,911,388	0.0528%
32137	9,296,778	0.1294%	4,735,799	0.0727%	0	0.0000%	4,463,445	0.0956%	18,496,021	0.0894%
32139	24,493	0.0003%	200,765	0.0031%	0	0.0000%	810,807	0.0174%	1,036,064	0.0050%
32141	7,480,799	0.1041%	8,182,107	0.1256%	0	0.0000%	4,074,221	0.0872%	19,737,127	0.0954%
32148	0	0.0000%	0	0.0000%	0	0.0000%	1,694,522	0.0363%	1,694,522	0.0082%
32159	530,590	0.0074%	22,394,177	0.3439%	0	0.0000%	37,206,649	0.7965%	60,131,416	0.2907%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32162	0	0.0000%	18,388,726	0.2824%	0	0.0000%	33,042,141	0.7074%	51,430,866	0.2486%
32163	0	0.0000%	505,406	0.0078%	0	0.0000%	815,317	0.0175%	1,320,723	0.0064%
32164	3,768,122	0.0524%	1,114,831	0.0171%	0	0.0000%	1,465,857	0.0314%	6,348,809	0.0307%
32168	12,739,842	0.1773%	3,761,481	0.0578%	0	0.0000%	2,132,478	0.0457%	18,633,801	0.0901%
32169	7,129,278	0.0992%	8,558,657	0.1314%	0	0.0000%	4,427,012	0.0948%	20,114,947	0.0972%
32174	39,422,861	0.5485%	8,244,038	0.1266%	0	0.0000%	5,953,058	0.1274%	53,619,957	0.2592%
32176	17,514,565	0.2437%	5,993,640	0.0920%	0	0.0000%	4,204,287	0.0900%	27,712,492	0.1340%
32177	0	0.0000%	0	0.0000%	0	0.0000%	2,252,528	0.0482%	2,252,528	0.0109%
32179	0	0.0000%	1,310,820	0.0201%	0	0.0000%	3,473,745	0.0744%	4,784,565	0.0231%
32180	158,597	0.0022%	195,731	0.0030%	0	0.0000%	320,853	0.0069%	675,181	0.0033%
32181	0	0.0000%	212,393	0.0033%	0	0.0000%	474,987	0.0102%	687,380	0.0033%
32189	0	0.0000%	220,136	0.0034%	0	0.0000%	1,217,197	0.0261%	1,437,333	0.0069%
32195	0	0.0000%	1,121,862	0.0172%	0	0.0000%	2,091,935	0.0448%	3,213,796	0.0155%
32205	0	0.0000%	0	0.0000%	0	0.0000%	2,068,900	0.0443%	2,068,900	0.0100%
32207	0	0.0000%	0	0.0000%	0	0.0000%	1,429,069	0.0306%	1,429,069	0.0069%
32208	0	0.0000%	0	0.0000%	0	0.0000%	752,869	0.0161%	752,869	0.0036%
32209	0	0.0000%	0	0.0000%	0	0.0000%	628,405	0.0135%	628,405	0.0030%
32210	0	0.0000%	0	0.0000%	0	0.0000%	4,005,670	0.0858%	4,005,670	0.0194%
32211	0	0.0000%	0	0.0000%	0	0.0000%	594,155	0.0127%	594,155	0.0029%
32216	0	0.0000%	0	0.0000%	0	0.0000%	882,414	0.0189%	882,414	0.0043%
32217	0	0.0000%	0	0.0000%	0	0.0000%	885,448	0.0190%	885,448	0.0043%
32218	0	0.0000%	0	0.0000%	0	0.0000%	1,556,161	0.0333%	1,556,161	0.0075%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32220	0	0.0000%	0	0.0000%	0	0.0000%	629,374	0.0135%	629,374	0.0030%
32221	0	0.0000%	0	0.0000%	0	0.0000%	1,356,311	0.0290%	1,356,311	0.0066%
32222	0	0.0000%	0	0.0000%	0	0.0000%	540,694	0.0116%	540,694	0.0026%
32223	0	0.0000%	0	0.0000%	0	0.0000%	1,830,934	0.0392%	1,830,934	0.0089%
32224	0	0.0000%	0	0.0000%	0	0.0000%	1,192,668	0.0255%	1,192,668	0.0058%
32225	0	0.0000%	0	0.0000%	0	0.0000%	1,644,820	0.0352%	1,644,820	0.0080%
32226	0	0.0000%	0	0.0000%	0	0.0000%	504,809	0.0108%	504,809	0.0024%
32233	0	0.0000%	0	0.0000%	0	0.0000%	2,681,462	0.0574%	2,681,462	0.0130%
32244	0	0.0000%	0	0.0000%	0	0.0000%	3,836,211	0.0821%	3,836,211	0.0185%
32246	0	0.0000%	0	0.0000%	0	0.0000%	1,017,285	0.0218%	1,017,285	0.0049%
32250	87,404	0.0012%	0	0.0000%	0	0.0000%	3,346,675	0.0716%	3,434,079	0.0166%
32256	0	0.0000%	0	0.0000%	0	0.0000%	1,123,255	0.0240%	1,123,255	0.0054%
32257	0	0.0000%	0	0.0000%	0	0.0000%	1,667,251	0.0357%	1,667,251	0.0081%
32258	0	0.0000%	0	0.0000%	0	0.0000%	1,118,953	0.0240%	1,118,953	0.0054%
32259	0	0.0000%	0	0.0000%	0	0.0000%	2,686,393	0.0575%	2,686,393	0.0130%
32266	0	0.0000%	122,915	0.0019%	0	0.0000%	1,336,628	0.0286%	1,459,543	0.0071%
32277	0	0.0000%	0	0.0000%	0	0.0000%	658,624	0.0141%	658,624	0.0032%
32301	0	0.0000%	2,711,668	0.0416%	0	0.0000%	0	0.0000%	2,711,668	0.0131%
32303	0	0.0000%	5,594,459	0.0859%	0	0.0000%	0	0.0000%	5,594,459	0.0270%
32304	0	0.0000%	1,696,149	0.0260%	0	0.0000%	0	0.0000%	1,696,149	0.0082%
32305	0	0.0000%	1,718,492	0.0264%	0	0.0000%	0	0.0000%	1,718,492	0.0083%
32308	0	0.0000%	4,302,733	0.0661%	0	0.0000%	0	0.0000%	4,302,733	0.0208%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32309	0	0.0000%	7,604,857	0.1168%	0	0.0000%	132,519	0.0028%	7,737,375	0.0374%
32310	0	0.0000%	1,323,132	0.0203%	0	0.0000%	0	0.0000%	1,323,132	0.0064%
32311	0	0.0000%	2,757,127	0.0423%	0	0.0000%	119,601	0.0026%	2,876,728	0.0139%
32312	0	0.0000%	8,248,084	0.1267%	0	0.0000%	0	0.0000%	8,248,084	0.0399%
32317	0	0.0000%	3,029,618	0.0465%	0	0.0000%	124,095	0.0027%	3,153,713	0.0152%
32327	0	0.0000%	2,450,796	0.0376%	0	0.0000%	0	0.0000%	2,450,796	0.0118%
32331	0	0.0000%	956,687	0.0147%	0	0.0000%	225,885	0.0048%	1,182,572	0.0057%
32333	0	0.0000%	1,645,446	0.0253%	0	0.0000%	0	0.0000%	1,645,446	0.0080%
32340	0	0.0000%	1,187,209	0.0182%	0	0.0000%	716,671	0.0153%	1,903,880	0.0092%
32344	0	0.0000%	3,237,093	0.0497%	0	0.0000%	501,721	0.0107%	3,738,814	0.0181%
32347	0	0.0000%	2,099,803	0.0322%	0	0.0000%	307,402	0.0066%	2,407,206	0.0116%
32348	0	0.0000%	1,772,214	0.0272%	0	0.0000%	270,441	0.0058%	2,042,655	0.0099%
32351	0	0.0000%	1,356,978	0.0208%	0	0.0000%	0	0.0000%	1,356,978	0.0066%
32352	0	0.0000%	532,900	0.0082%	0	0.0000%	0	0.0000%	532,900	0.0026%
32359	0	0.0000%	1,330,295	0.0204%	0	0.0000%	263,021	0.0056%	1,593,316	0.0077%
32401	0	0.0000%	0	0.0000%	856,587	0.0370%	0	0.0000%	856,587	0.0041%
32405	0	0.0000%	0	0.0000%	654,677	0.0283%	0	0.0000%	654,677	0.0032%
32407	0	0.0000%	0	0.0000%	2,261,693	0.0977%	0	0.0000%	2,261,693	0.0109%
32408	0	0.0000%	0	0.0000%	4,566,107	0.1973%	0	0.0000%	4,566,107	0.0221%
32413	0	0.0000%	0	0.0000%	7,489,570	0.3236%	0	0.0000%	7,489,570	0.0362%
32433	0	0.0000%	0	0.0000%	801,654	0.0346%	0	0.0000%	801,654	0.0039%
32439	0	0.0000%	0	0.0000%	1,100,380	0.0475%	0	0.0000%	1,100,380	0.0053%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32446	0	0.0000%	628,190	0.0096%	0	0.0000%	0	0.0000%	628,190	0.0030%
32459	0	0.0000%	0	0.0000%	15,058,310	0.6507%	0	0.0000%	15,058,310	0.0728%
32501	0	0.0000%	0	0.0000%	57,029,400	2.4642%	0	0.0000%	57,029,400	0.2757%
32502	0	0.0000%	0	0.0000%	15,017,041	0.6489%	0	0.0000%	15,017,041	0.0726%
32503	0	0.0000%	0	0.0000%	155,116,305	6.7026%	0	0.0000%	155,116,305	0.7499%
32504	0	0.0000%	0	0.0000%	107,320,570	4.6373%	0	0.0000%	107,320,570	0.5188%
32505	0	0.0000%	0	0.0000%	75,577,352	3.2657%	0	0.0000%	75,577,352	0.3654%
32506	0	0.0000%	0	0.0000%	223,844,518	9.6723%	0	0.0000%	223,844,518	1.0822%
32507	0	0.0000%	0	0.0000%	547,103,033	23.6403%	0	0.0000%	547,103,033	2.6450%
32508	0	0.0000%	0	0.0000%	1,309,454	0.0566%	0	0.0000%	1,309,454	0.0063%
32514	0	0.0000%	0	0.0000%	107,975,387	4.6656%	0	0.0000%	107,975,387	0.5220%
32526	0	0.0000%	0	0.0000%	138,021,529	5.9639%	0	0.0000%	138,021,529	0.6673%
32531	0	0.0000%	0	0.0000%	1,359,929	0.0588%	0	0.0000%	1,359,929	0.0066%
32533	0	0.0000%	0	0.0000%	97,819,724	4.2268%	0	0.0000%	97,819,724	0.4729%
32534	0	0.0000%	0	0.0000%	35,843,421	1.5488%	0	0.0000%	35,843,421	0.1733%
32535	0	0.0000%	0	0.0000%	7,290,728	0.3150%	0	0.0000%	7,290,728	0.0352%
32536	0	0.0000%	0	0.0000%	3,346,094	0.1446%	0	0.0000%	3,346,094	0.0162%
32539	0	0.0000%	0	0.0000%	3,223,189	0.1393%	0	0.0000%	3,223,189	0.0156%
32541	0	0.0000%	0	0.0000%	28,365,730	1.2257%	0	0.0000%	28,365,730	0.1371%
32547	0	0.0000%	0	0.0000%	23,925,468	1.0338%	0	0.0000%	23,925,468	0.1157%
32548	0	0.0000%	0	0.0000%	26,461,954	1.1434%	0	0.0000%	26,461,954	0.1279%
32550	0	0.0000%	0	0.0000%	14,024,437	0.6060%	0	0.0000%	14,024,437	0.0678%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32561	0	0.0000%	0	0.0000%	165,295,404	7.1424%	0	0.0000%	165,295,404	0.7991%
32563	0	0.0000%	0	0.0000%	130,156,486	5.6241%	0	0.0000%	130,156,486	0.6292%
32564	0	0.0000%	0	0.0000%	706,322	0.0305%	0	0.0000%	706,322	0.0034%
32565	0	0.0000%	0	0.0000%	9,358,222	0.4044%	0	0.0000%	9,358,222	0.0452%
32566	0	0.0000%	0	0.0000%	99,772,546	4.3112%	0	0.0000%	99,772,546	0.4824%
32568	0	0.0000%	0	0.0000%	5,959,528	0.2575%	0	0.0000%	5,959,528	0.0288%
32569	0	0.0000%	0	0.0000%	22,153,271	0.9572%	0	0.0000%	22,153,271	0.1071%
32570	0	0.0000%	0	0.0000%	31,580,516	1.3646%	0	0.0000%	31,580,516	0.1527%
32571	0	0.0000%	0	0.0000%	74,054,298	3.1999%	0	0.0000%	74,054,298	0.3580%
32577	0	0.0000%	0	0.0000%	15,411,766	0.6659%	0	0.0000%	15,411,766	0.0745%
32578	0	0.0000%	0	0.0000%	14,319,954	0.6188%	0	0.0000%	14,319,954	0.0692%
32579	0	0.0000%	0	0.0000%	11,064,716	0.4781%	0	0.0000%	11,064,716	0.0535%
32580	0	0.0000%	0	0.0000%	1,393,707	0.0602%	0	0.0000%	1,393,707	0.0067%
32583	0	0.0000%	0	0.0000%	29,035,800	1.2546%	0	0.0000%	29,035,800	0.1404%
32601	0	0.0000%	224,683	0.0035%	0	0.0000%	2,661,696	0.0570%	2,886,380	0.0140%
32603	0	0.0000%	41,961	0.0006%	0	0.0000%	560,019	0.0120%	601,981	0.0029%
32605	0	0.0000%	526,124	0.0081%	0	0.0000%	7,507,377	0.1607%	8,033,500	0.0388%
32606	0	0.0000%	454,812	0.0070%	0	0.0000%	5,744,560	0.1230%	6,199,371	0.0300%
32607	0	0.0000%	453,573	0.0070%	0	0.0000%	5,281,707	0.1131%	5,735,280	0.0277%
32608	0	0.0000%	876,936	0.0135%	0	0.0000%	8,154,552	0.1746%	9,031,488	0.0437%
32609	0	0.0000%	196,853	0.0030%	0	0.0000%	2,904,491	0.0622%	3,101,344	0.0150%
32615	0	0.0000%	113,653	0.0017%	0	0.0000%	3,819,385	0.0818%	3,933,038	0.0190%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32617	0	0.0000%	272,829	0.0042%	0	0.0000%	1,317,156	0.0282%	1,589,986	0.0077%
32618	0	0.0000%	262,088	0.0040%	0	0.0000%	1,570,535	0.0336%	1,832,624	0.0089%
32619	0	0.0000%	303,700	0.0047%	0	0.0000%	526,548	0.0113%	830,248	0.0040%
32621	0	0.0000%	440,833	0.0068%	0	0.0000%	690,279	0.0148%	1,131,112	0.0055%
32625	0	0.0000%	3,716,078	0.0571%	0	0.0000%	599,072	0.0128%	4,315,150	0.0209%
32626	0	0.0000%	1,454,067	0.0223%	0	0.0000%	963,882	0.0206%	2,417,949	0.0117%
32628	0	0.0000%	485,919	0.0075%	0	0.0000%	121,004	0.0026%	606,922	0.0029%
32640	0	0.0000%	253,089	0.0039%	0	0.0000%	2,478,723	0.0531%	2,731,812	0.0132%
32641	0	0.0000%	126,203	0.0019%	0	0.0000%	1,643,498	0.0352%	1,769,701	0.0086%
32643	0	0.0000%	100,302	0.0015%	0	0.0000%	2,552,494	0.0546%	2,652,796	0.0128%
32653	0	0.0000%	209,081	0.0032%	0	0.0000%	4,630,359	0.0991%	4,839,441	0.0234%
32656	0	0.0000%	0	0.0000%	0	0.0000%	2,433,648	0.0521%	2,433,648	0.0118%
32666	0	0.0000%	46,962	0.0007%	0	0.0000%	1,457,458	0.0312%	1,504,419	0.0073%
32667	0	0.0000%	278,831	0.0043%	0	0.0000%	1,890,919	0.0405%	2,169,750	0.0105%
32668	0	0.0000%	970,825	0.0149%	0	0.0000%	1,526,422	0.0327%	2,497,246	0.0121%
32669	0	0.0000%	371,520	0.0057%	0	0.0000%	2,870,774	0.0615%	3,242,295	0.0157%
32680	0	0.0000%	1,604,260	0.0246%	0	0.0000%	745,119	0.0160%	2,349,379	0.0114%
32686	0	0.0000%	484,468	0.0074%	0	0.0000%	1,964,535	0.0421%	2,449,003	0.0118%
32693	0	0.0000%	1,155,177	0.0177%	0	0.0000%	1,174,944	0.0252%	2,330,122	0.0113%
32696	0	0.0000%	778,254	0.0120%	0	0.0000%	2,430,440	0.0520%	3,208,694	0.0155%
32701	9,581,231	0.1333%	4,919,174	0.0755%	0	0.0000%	3,898,720	0.0835%	18,399,125	0.0890%
32702	90,834	0.0013%	500,266	0.0077%	0	0.0000%	848,897	0.0182%	1,439,998	0.0070%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32703	14,236,768	0.1981%	10,459,226	0.1606%	0	0.0000%	9,349,110	0.2001%	34,045,104	0.1646%
32707	21,249,978	0.2957%	9,020,753	0.1385%	0	0.0000%	6,763,317	0.1448%	37,034,049	0.1790%
32708	34,809,492	0.4843%	13,306,704	0.2043%	0	0.0000%	9,815,573	0.2101%	57,931,769	0.2801%
32709	787,097	0.0110%	782,049	0.0120%	0	0.0000%	458,347	0.0098%	2,027,492	0.0098%
32712	13,386,364	0.1863%	12,994,965	0.1995%	0	0.0000%	14,192,070	0.3038%	40,573,400	0.1962%
32713	10,137,819	0.1411%	4,967,795	0.0763%	0	0.0000%	4,737,576	0.1014%	19,843,190	0.0959%
32714	14,012,088	0.1950%	8,356,435	0.1283%	0	0.0000%	6,807,066	0.1457%	29,175,589	0.1411%
32720	5,789,727	0.0806%	2,834,301	0.0435%	0	0.0000%	3,103,492	0.0664%	11,727,520	0.0567%
32724	7,901,935	0.1099%	3,270,207	0.0502%	0	0.0000%	3,547,389	0.0759%	14,719,532	0.0712%
32725	20,007,863	0.2784%	5,926,870	0.0910%	0	0.0000%	6,324,362	0.1354%	32,259,095	0.1560%
32726	1,228,729	0.0171%	5,964,472	0.0916%	0	0.0000%	8,304,661	0.1778%	15,497,862	0.0749%
32730	2,599,549	0.0362%	1,183,351	0.0182%	0	0.0000%	899,744	0.0193%	4,682,644	0.0226%
32732	7,015,377	0.0976%	1,621,564	0.0249%	0	0.0000%	1,137,838	0.0244%	9,774,778	0.0473%
32735	190,614	0.0027%	1,956,145	0.0300%	0	0.0000%	3,136,641	0.0672%	5,283,399	0.0255%
32736	1,423,386	0.0198%	2,247,960	0.0345%	0	0.0000%	3,045,967	0.0652%	6,717,313	0.0325%
32738	22,362,527	0.3112%	4,529,208	0.0695%	0	0.0000%	4,215,685	0.0903%	31,107,420	0.1504%
32744	1,347,257	0.0187%	413,641	0.0064%	0	0.0000%	422,169	0.0090%	2,183,066	0.0106%
32746	24,642,283	0.3429%	13,327,212	0.2046%	0	0.0000%	10,865,546	0.2326%	48,835,042	0.2361%
32750	14,084,149	0.1960%	7,276,029	0.1117%	0	0.0000%	5,793,044	0.1240%	27,153,222	0.1313%
32751	19,954,895	0.2777%	9,247,025	0.1420%	0	0.0000%	7,011,956	0.1501%	36,213,876	0.1751%
32754	2,661,078	0.0370%	3,743,310	0.0575%	0	0.0000%	1,875,864	0.0402%	8,280,251	0.0400%
32757	2,442,416	0.0340%	8,259,207	0.1268%	0	0.0000%	10,303,071	0.2206%	21,004,695	0.1015%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32759	889,184	0.0124%	1,321,249	0.0203%	0	0.0000%	657,856	0.0141%	2,868,289	0.0139%
32763	6,749,469	0.0939%	2,548,868	0.0391%	0	0.0000%	2,704,051	0.0579%	12,002,388	0.0580%
32764	3,472,861	0.0483%	657,523	0.0101%	0	0.0000%	558,994	0.0120%	4,689,378	0.0227%
32765	54,973,565	0.7649%	16,951,132	0.2603%	0	0.0000%	11,364,121	0.2433%	83,288,818	0.4027%
32766	12,955,897	0.1803%	4,287,755	0.0658%	0	0.0000%	2,688,007	0.0575%	19,931,659	0.0964%
32767	249,767	0.0035%	396,066	0.0061%	0	0.0000%	544,512	0.0117%	1,190,345	0.0058%
32771	18,182,432	0.2530%	8,912,399	0.1369%	0	0.0000%	7,306,022	0.1564%	34,400,853	0.1663%
32773	10,748,085	0.1496%	4,636,006	0.0712%	0	0.0000%	3,602,799	0.0771%	18,986,891	0.0918%
32776	2,590,631	0.0360%	2,324,069	0.0357%	0	0.0000%	2,748,418	0.0588%	7,663,117	0.0370%
32778	1,981,673	0.0276%	11,413,971	0.1753%	0	0.0000%	15,373,216	0.3291%	28,768,861	0.1391%
32779	23,739,353	0.3303%	15,832,726	0.2431%	0	0.0000%	13,672,813	0.2927%	53,244,892	0.2574%
32780	5,493,400	0.0764%	12,442,405	0.1911%	0	0.0000%	5,755,696	0.1232%	23,691,501	0.1145%
32784	231,235	0.0032%	2,348,995	0.0361%	0	0.0000%	3,926,753	0.0841%	6,506,983	0.0315%
32789	43,210,214	0.6012%	17,157,244	0.2635%	0	0.0000%	12,741,562	0.2728%	73,109,021	0.3534%
32792	29,071,168	0.4045%	10,936,383	0.1679%	0	0.0000%	7,895,134	0.1690%	47,902,685	0.2316%
32796	3,572,745	0.0497%	6,279,338	0.0964%	0	0.0000%	3,148,403	0.0674%	13,000,486	0.0629%
32798	2,527,357	0.0352%	3,702,729	0.0569%	0	0.0000%	5,433,839	0.1163%	11,663,925	0.0564%
32801	9,803,790	0.1364%	4,017,417	0.0617%	0	0.0000%	2,908,599	0.0623%	16,729,806	0.0809%
32803	25,354,980	0.3528%	8,752,705	0.1344%	0	0.0000%	6,326,130	0.1354%	40,433,815	0.1955%
32804	24,851,815	0.3458%	9,568,457	0.1469%	0	0.0000%	7,196,175	0.1541%	41,616,447	0.2012%
32805	7,776,741	0.1082%	3,639,989	0.0559%	0	0.0000%	2,662,521	0.0570%	14,079,251	0.0681%
32806	30,393,960	0.4229%	12,425,344	0.1908%	0	0.0000%	8,733,068	0.1870%	51,552,371	0.2492%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32807	19,220,116	0.2674%	5,939,737	0.0912%	0	0.0000%	4,143,305	0.0887%	29,303,158	0.1417%
32808	17,346,797	0.2414%	8,148,359	0.1251%	0	0.0000%	6,478,109	0.1387%	31,973,266	0.1546%
32809	15,981,352	0.2224%	7,600,743	0.1167%	0	0.0000%	5,401,349	0.1156%	28,983,444	0.1401%
32810	13,809,018	0.1921%	7,063,261	0.1085%	0	0.0000%	5,643,582	0.1208%	26,515,861	0.1282%
32811	8,332,510	0.1159%	4,488,347	0.0689%	0	0.0000%	3,461,381	0.0741%	16,282,238	0.0787%
32812	31,722,655	0.4414%	12,091,140	0.1857%	0	0.0000%	8,389,258	0.1796%	52,203,052	0.2524%
32814	6,363,486	0.0885%	2,298,031	0.0353%	0	0.0000%	1,661,446	0.0356%	10,322,962	0.0499%
32816	1,467,502	0.0204%	403,026	0.0062%	0	0.0000%	256,494	0.0055%	2,127,021	0.0103%
32817	24,976,585	0.3475%	7,927,490	0.1217%	0	0.0000%	5,294,998	0.1134%	38,199,074	0.1847%
32818	21,338,815	0.2969%	11,028,266	0.1693%	0	0.0000%	9,279,905	0.1987%	41,646,986	0.2013%
32819	28,515,040	0.3968%	18,425,152	0.2829%	0	0.0000%	14,400,533	0.3083%	61,340,725	0.2966%
32820	3,325,934	0.0463%	2,173,187	0.0334%	0	0.0000%	1,359,543	0.0291%	6,858,663	0.0332%
32821	10,366,733	0.1442%	7,056,837	0.1084%	0	0.0000%	5,300,933	0.1135%	22,724,502	0.1099%
32822	39,962,956	0.5561%	12,854,609	0.1974%	0	0.0000%	8,867,137	0.1898%	61,684,702	0.2982%
32824	38,210,706	0.5317%	18,744,513	0.2878%	0	0.0000%	12,921,767	0.2766%	69,876,986	0.3378%
32825	36,514,698	0.5081%	14,081,493	0.2162%	0	0.0000%	9,435,122	0.2020%	60,031,314	0.2902%
32826	17,929,988	0.2495%	6,393,921	0.0982%	0	0.0000%	4,101,201	0.0878%	28,425,110	0.1374%
32827	13,612,141	0.1894%	4,908,054	0.0754%	0	0.0000%	3,376,153	0.0723%	21,896,347	0.1059%
32828	32,948,515	0.4585%	15,864,485	0.2436%	0	0.0000%	10,069,908	0.2156%	58,882,908	0.2847%
32829	14,776,483	0.2056%	5,427,745	0.0833%	0	0.0000%	3,676,240	0.0787%	23,880,468	0.1155%
32832	13,844,862	0.1926%	7,145,975	0.1097%	0	0.0000%	4,765,754	0.1020%	25,756,591	0.1245%
32833	3,374,080	0.0469%	2,918,252	0.0448%	0	0.0000%	1,787,676	0.0383%	8,080,008	0.0391%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32835	21,119,984	0.2939%	13,022,596	0.2000%	0	0.0000%	10,628,130	0.2275%	44,770,710	0.2164%
32836	21,339,079	0.2969%	16,114,410	0.2474%	0	0.0000%	12,515,634	0.2679%	49,969,123	0.2416%
32837	44,180,239	0.6147%	25,703,975	0.3947%	0	0.0000%	18,393,287	0.3938%	88,277,502	0.4268%
32839	13,060,156	0.1817%	6,469,137	0.0993%	0	0.0000%	4,713,133	0.1009%	24,242,426	0.1172%
32901	970,113	0.0135%	27,194,202	0.4176%	0	0.0000%	11,710,503	0.2507%	39,874,818	0.1928%
32903	1,337,076	0.0186%	44,717,047	0.6867%	0	0.0000%	18,202,300	0.3897%	64,256,423	0.3106%
32904	2,270,224	0.0316%	29,243,810	0.4491%	0	0.0000%	13,863,188	0.2968%	45,377,221	0.2194%
32905	1,100,993	0.0153%	37,808,870	0.5806%	0	0.0000%	16,291,517	0.3488%	55,201,380	0.2669%
32907	2,728,825	0.0380%	35,687,596	0.5480%	0	0.0000%	18,446,207	0.3949%	56,862,628	0.2749%
32908	587,766	0.0082%	7,994,437	0.1228%	0	0.0000%	4,529,377	0.0970%	13,111,579	0.0634%
32909	1,582,093	0.0220%	27,040,296	0.4152%	0	0.0000%	14,360,369	0.3074%	42,982,758	0.2078%
32920	1,857,086	0.0258%	12,300,625	0.1889%	0	0.0000%	5,403,085	0.1157%	19,560,796	0.0946%
32922	875,549	0.0122%	3,684,740	0.0566%	0	0.0000%	1,670,944	0.0358%	6,231,234	0.0301%
32926	3,324,616	0.0463%	9,911,917	0.1522%	0	0.0000%	4,692,572	0.1005%	17,929,105	0.0867%
32927	3,094,215	0.0431%	8,012,795	0.1230%	0	0.0000%	3,765,639	0.0806%	14,872,649	0.0719%
32931	3,517,748	0.0489%	30,488,062	0.4682%	0	0.0000%	12,769,150	0.2734%	46,774,959	0.2261%
32934	1,938,330	0.0270%	17,920,408	0.2752%	0	0.0000%	8,157,246	0.1746%	28,015,984	0.1354%
32935	2,294,979	0.0319%	35,522,077	0.5455%	0	0.0000%	14,806,030	0.3170%	52,623,086	0.2544%
32937	2,853,258	0.0397%	64,862,475	0.9960%	0	0.0000%	26,199,673	0.5609%	93,915,406	0.4540%
32940	4,037,876	0.0562%	33,884,150	0.5203%	0	0.0000%	14,642,458	0.3135%	52,564,484	0.2541%
32948	145,397	0.0020%	4,227,649	0.0649%	0	0.0000%	3,366,042	0.0721%	7,739,088	0.0374%
32949	118,865	0.0017%	8,227,203	0.1263%	0	0.0000%	3,577,008	0.0766%	11,923,075	0.0576%

	Hurricane Charley		**Hurricane Frances**		**Hurricane Ivan**		**Hurricane Jeanne**		**Total**	
ZIP Code	**Personal and Commercial Residential Monetary Contribution ($)**	**Percent of Losses (%)**	**Personal and Commercial Residential Monetary Contribution ($)**	**Percent of Losses (%)**	**Personal and Commercial Residential Monetary Contribution ($)**	**Percent of Losses (%)**	**Personal and Commercial Residential Monetary Contribution ($)**	**Percent of Losses (%)**	**Personal and Commercial Residential Monetary Contribution ($)**	**Percent of Losses (%)**
32950	283,873	0.0039%	12,670,817	0.1946%	0	0.0000%	5,363,599	0.1148%	18,318,289	0.0886%
32951	1,045,573	0.0145%	57,458,439	0.8823%	0	0.0000%	23,622,075	0.5057%	82,126,087	0.3970%
32952	3,153,434	0.0439%	22,351,921	0.3432%	0	0.0000%	9,732,414	0.2084%	35,237,769	0.1704%
32953	3,033,736	0.0422%	13,911,603	0.2136%	0	0.0000%	6,368,213	0.1363%	23,313,552	0.1127%
32955	4,177,389	0.0581%	26,235,719	0.4029%	0	0.0000%	11,576,734	0.2478%	41,989,842	0.2030%
32958	1,097,792	0.0153%	120,255,833	1.8466%	0	0.0000%	59,942,837	1.2833%	181,296,462	0.8765%
32960	548,823	0.0076%	82,590,969	1.2682%	0	0.0000%	74,483,134	1.5946%	157,622,925	0.7620%
32962	614,163	0.0085%	88,557,561	1.3598%	0	0.0000%	80,930,706	1.7326%	170,102,430	0.8224%
32963	1,520,733	0.0212%	319,673,966	4.9088%	0	0.0000%	223,357,557	4.7817%	544,552,256	2.6327%
32966	957,888	0.0133%	39,041,967	0.5995%	0	0.0000%	37,849,405	0.8103%	77,849,260	0.3764%
32967	549,160	0.0076%	47,458,502	0.7288%	0	0.0000%	34,531,317	0.7393%	82,538,979	0.3990%
32968	499,648	0.0070%	31,780,005	0.4880%	0	0.0000%	31,038,973	0.6645%	63,318,626	0.3061%
32976	2,099,396	0.0292%	126,378,096	1.9406%	0	0.0000%	64,118,211	1.3727%	192,595,703	0.9311%
33040	4,966,108	0.0691%	0	0.0000%	0	0.0000%	0	0.0000%	4,966,108	0.0240%
33042	929,686	0.0129%	0	0.0000%	0	0.0000%	0	0.0000%	929,686	0.0045%
33050	594,450	0.0083%	0	0.0000%	0	0.0000%	0	0.0000%	594,450	0.0029%
33062	0	0.0000%	1,107,082	0.0170%	0	0.0000%	0	0.0000%	1,107,082	0.0054%
33063	0	0.0000%	809,383	0.0124%	0	0.0000%	0	0.0000%	809,383	0.0039%
33064	0	0.0000%	2,164,085	0.0332%	0	0.0000%	0	0.0000%	2,164,085	0.0105%
33065	0	0.0000%	774,630	0.0119%	0	0.0000%	0	0.0000%	774,630	0.0037%
33066	0	0.0000%	505,142	0.0078%	0	0.0000%	0	0.0000%	505,142	0.0024%
33067	0	0.0000%	1,766,258	0.0271%	0	0.0000%	0	0.0000%	1,766,258	0.0085%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33073	0	0.0000%	1,222,789	0.0188%	0	0.0000%	0	0.0000%	1,222,789	0.0059%
33076	0	0.0000%	1,445,721	0.0222%	0	0.0000%	0	0.0000%	1,445,721	0.0070%
33308	0	0.0000%	594,043	0.0091%	0	0.0000%	0	0.0000%	594,043	0.0029%
33401	0	0.0000%	19,585,734	0.3007%	0	0.0000%	3,994,676	0.0855%	23,580,411	0.1140%
33403	0	0.0000%	10,603,189	0.1628%	0	0.0000%	3,302,159	0.0707%	13,905,348	0.0672%
33404	0	0.0000%	29,441,746	0.4521%	0	0.0000%	8,200,313	0.1756%	37,642,058	0.1820%
33405	0	0.0000%	14,587,809	0.2240%	0	0.0000%	2,393,596	0.0512%	16,981,405	0.0821%
33406	0	0.0000%	14,205,857	0.2181%	0	0.0000%	2,254,505	0.0483%	16,460,362	0.0796%
33407	0	0.0000%	21,129,573	0.3245%	0	0.0000%	5,052,887	0.1082%	26,182,460	0.1266%
33408	0	0.0000%	52,947,650	0.8130%	0	0.0000%	18,339,100	0.3926%	71,286,750	0.3446%
33409	0	0.0000%	18,475,797	0.2837%	0	0.0000%	3,864,890	0.0827%	22,340,688	0.1080%
33410	0	0.0000%	62,394,895	0.9581%	0	0.0000%	25,618,883	0.5485%	88,013,778	0.4255%
33411	0	0.0000%	64,265,130	0.9868%	0	0.0000%	13,015,287	0.2786%	77,280,417	0.3736%
33412	0	0.0000%	27,802,143	0.4269%	0	0.0000%	8,333,201	0.1784%	36,135,345	0.1747%
33413	0	0.0000%	8,754,534	0.1344%	0	0.0000%	1,470,127	0.0315%	10,224,661	0.0494%
33414	0	0.0000%	58,203,872	0.8938%	0	0.0000%	9,184,064	0.1966%	67,387,936	0.3258%
33415	0	0.0000%	19,982,760	0.3068%	0	0.0000%	3,159,193	0.0676%	23,141,953	0.1119%
33417	0	0.0000%	24,981,223	0.3836%	0	0.0000%	5,050,967	0.1081%	30,032,190	0.1452%
33418	0	0.0000%	95,421,762	1.4653%	0	0.0000%	39,943,231	0.8551%	135,364,993	0.6544%
33426	0	0.0000%	7,529,809	0.1156%	0	0.0000%	575,656	0.0123%	8,105,465	0.0392%
33428	0	0.0000%	3,905,591	0.0600%	0	0.0000%	0	0.0000%	3,905,591	0.0189%
33430	139,689	0.0019%	3,230,890	0.0496%	0	0.0000%	684,566	0.0147%	4,055,145	0.0196%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33431	0	0.0000%	3,503,235	0.0538%	0	0.0000%	0	0.0000%	3,503,235	0.0169%
33432	0	0.0000%	3,865,155	0.0594%	0	0.0000%	0	0.0000%	3,865,155	0.0187%
33433	0	0.0000%	5,961,478	0.0915%	0	0.0000%	0	0.0000%	5,961,478	0.0288%
33434	0	0.0000%	5,427,768	0.0833%	0	0.0000%	103,377	0.0022%	5,531,145	0.0267%
33435	0	0.0000%	12,635,768	0.1940%	0	0.0000%	887,728	0.0190%	13,523,495	0.0654%
33436	0	0.0000%	25,661,786	0.3941%	0	0.0000%	2,222,891	0.0476%	27,884,677	0.1348%
33437	0	0.0000%	21,060,638	0.3234%	0	0.0000%	1,588,095	0.0340%	22,648,733	0.1095%
33438	19,600	0.0003%	1,656,474	0.0254%	0	0.0000%	697,781	0.0149%	2,373,855	0.0115%
33440	872,847	0.0121%	3,064,695	0.0471%	0	0.0000%	1,086,940	0.0233%	5,024,483	0.0243%
33441	0	0.0000%	1,515,990	0.0233%	0	0.0000%	0	0.0000%	1,515,990	0.0073%
33442	0	0.0000%	2,121,374	0.0326%	0	0.0000%	0	0.0000%	2,121,374	0.0103%
33444	0	0.0000%	4,189,779	0.0643%	0	0.0000%	233,317	0.0050%	4,423,096	0.0214%
33445	0	0.0000%	9,644,051	0.1481%	0	0.0000%	531,380	0.0114%	10,175,432	0.0492%
33446	0	0.0000%	10,020,081	0.1539%	0	0.0000%	437,984	0.0094%	10,458,065	0.0506%
33449	0	0.0000%	7,099,454	0.1090%	0	0.0000%	923,814	0.0198%	8,023,268	0.0388%
33455	0	0.0000%	68,378,175	1.0500%	0	0.0000%	46,995,348	1.0061%	115,373,523	0.5578%
33458	0	0.0000%	62,620,434	0.9616%	0	0.0000%	41,868,881	0.8963%	104,489,315	0.5052%
33460	0	0.0000%	11,863,229	0.1822%	0	0.0000%	1,567,933	0.0336%	13,431,162	0.0649%
33461	0	0.0000%	14,706,119	0.2258%	0	0.0000%	2,025,648	0.0434%	16,731,766	0.0809%
33462	0	0.0000%	16,824,447	0.2583%	0	0.0000%	1,922,347	0.0412%	18,746,794	0.0906%
33463	0	0.0000%	23,211,449	0.3564%	0	0.0000%	2,897,065	0.0620%	26,108,514	0.1262%
33467	0	0.0000%	35,299,987	0.5420%	0	0.0000%	4,231,499	0.0906%	39,531,487	0.1911%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33469	0	0.0000%	41,238,110	0.6332%	0	0.0000%	22,043,679	0.4719%	63,281,789	0.3059%
33470	0	0.0000%	33,080,116	0.5080%	0	0.0000%	7,888,244	0.1689%	40,968,360	0.1981%
33471	914,301	0.0127%	1,975,974	0.0303%	0	0.0000%	1,189,885	0.0255%	4,080,159	0.0197%
33472	0	0.0000%	9,040,318	0.1388%	0	0.0000%	835,485	0.0179%	9,875,803	0.0477%
33473	0	0.0000%	2,019,736	0.0310%	0	0.0000%	172,974	0.0037%	2,192,710	0.0106%
33476	75,228	0.0010%	5,827,265	0.0895%	0	0.0000%	1,885,520	0.0404%	7,788,014	0.0377%
33477	0	0.0000%	63,434,130	0.9741%	0	0.0000%	27,972,284	0.5988%	91,406,414	0.4419%
33478	0	0.0000%	18,927,164	0.2906%	0	0.0000%	13,760,348	0.2946%	32,687,512	0.1580%
33480	0	0.0000%	70,509,821	1.0827%	0	0.0000%	11,386,556	0.2438%	81,896,376	0.3959%
33483	0	0.0000%	6,975,752	0.1071%	0	0.0000%	393,004	0.0084%	7,368,756	0.0356%
33484	0	0.0000%	8,826,553	0.1355%	0	0.0000%	391,835	0.0084%	9,218,388	0.0446%
33486	0	0.0000%	3,232,922	0.0496%	0	0.0000%	0	0.0000%	3,232,922	0.0156%
33487	0	0.0000%	6,063,235	0.0931%	0	0.0000%	118,042	0.0025%	6,181,277	0.0299%
33493	26,060	0.0004%	416,692	0.0064%	0	0.0000%	79,031	0.0017%	521,784	0.0025%
33496	0	0.0000%	9,848,972	0.1512%	0	0.0000%	235,470	0.0050%	10,084,442	0.0488%
33498	0	0.0000%	3,382,393	0.0519%	0	0.0000%	81,508	0.0017%	3,463,901	0.0167%
33510	138,381	0.0019%	6,435,434	0.0988%	0	0.0000%	6,862,881	0.1469%	13,436,695	0.0650%
33511	290,155	0.0040%	11,336,554	0.1741%	0	0.0000%	13,593,275	0.2910%	25,219,984	0.1219%
33513	0	0.0000%	6,322,978	0.0971%	0	0.0000%	4,966,719	0.1063%	11,289,696	0.0546%
33514	10,718	0.0001%	714,369	0.0110%	0	0.0000%	825,781	0.0177%	1,550,868	0.0075%
33523	0	0.0000%	8,161,283	0.1253%	0	0.0000%	4,975,911	0.1065%	13,137,194	0.0635%
33525	0	0.0000%	11,087,966	0.1703%	0	0.0000%	7,957,203	0.1704%	19,045,169	0.0921%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33527	179,039	0.0025%	3,335,379	0.0512%	0	0.0000%	3,748,708	0.0803%	7,263,126	0.0351%
33534	46,769	0.0007%	2,565,323	0.0394%	0	0.0000%	2,993,923	0.0641%	5,606,015	0.0271%
33538	0	0.0000%	2,181,147	0.0335%	0	0.0000%	2,548,756	0.0546%	4,729,904	0.0229%
33540	133,885	0.0019%	6,850,634	0.1052%	0	0.0000%	6,178,845	0.1323%	13,163,364	0.0636%
33541	260,015	0.0036%	15,813,608	0.2428%	0	0.0000%	14,225,204	0.3045%	30,298,828	0.1465%
33542	263,448	0.0037%	14,438,402	0.2217%	0	0.0000%	13,287,115	0.2845%	27,988,965	0.1353%
33543	0	0.0000%	9,926,095	0.1524%	0	0.0000%	8,022,568	0.1718%	17,948,663	0.0868%
33544	0	0.0000%	8,154,430	0.1252%	0	0.0000%	5,775,999	0.1237%	13,930,429	0.0673%
33545	0	0.0000%	4,003,095	0.0615%	0	0.0000%	2,794,615	0.0598%	6,797,709	0.0329%
33547	771,699	0.0107%	5,849,857	0.0898%	0	0.0000%	8,207,260	0.1757%	14,828,815	0.0717%
33548	0	0.0000%	2,818,444	0.0433%	0	0.0000%	2,274,748	0.0487%	5,093,193	0.0246%
33549	0	0.0000%	5,814,049	0.0893%	0	0.0000%	4,789,756	0.1025%	10,603,806	0.0513%
33556	0	0.0000%	11,050,212	0.1697%	0	0.0000%	7,575,039	0.1622%	18,625,251	0.0900%
33558	0	0.0000%	7,426,634	0.1140%	0	0.0000%	5,495,776	0.1177%	12,922,410	0.0625%
33559	0	0.0000%	3,591,761	0.0552%	0	0.0000%	2,877,576	0.0616%	6,469,337	0.0313%
33563	370,399	0.0052%	4,294,240	0.0659%	0	0.0000%	5,248,295	0.1124%	9,912,935	0.0479%
33565	413,347	0.0058%	7,183,384	0.1103%	0	0.0000%	7,981,881	0.1709%	15,578,612	0.0753%
33566	512,696	0.0071%	5,414,330	0.0831%	0	0.0000%	6,827,324	0.1462%	12,754,350	0.0617%
33567	289,387	0.0040%	2,245,760	0.0345%	0	0.0000%	3,037,640	0.0650%	5,572,786	0.0269%
33569	403,505	0.0056%	8,268,111	0.1270%	0	0.0000%	11,383,255	0.2437%	20,054,871	0.0970%
33570	598,308	0.0083%	15,739,609	0.2417%	0	0.0000%	8,939,978	0.1914%	25,277,895	0.1222%
33572	458,454	0.0064%	13,531,917	0.2078%	0	0.0000%	11,744,414	0.2514%	25,734,786	0.1244%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33573	644,972	0.0090%	9,984,623	0.1533%	0	0.0000%	6,967,452	0.1492%	17,597,046	0.0851%
33576	0	0.0000%	2,187,025	0.0336%	0	0.0000%	1,333,440	0.0285%	3,520,465	0.0170%
33578	81,821	0.0011%	7,496,276	0.1151%	0	0.0000%	9,744,775	0.2086%	17,322,872	0.0837%
33579	278,806	0.0039%	3,987,151	0.0612%	0	0.0000%	4,712,296	0.1009%	8,978,253	0.0434%
33584	127,592	0.0018%	5,781,241	0.0888%	0	0.0000%	6,160,661	0.1319%	12,069,494	0.0584%
33585	0	0.0000%	653,701	0.0100%	0	0.0000%	833,876	0.0179%	1,487,577	0.0072%
33592	0	0.0000%	2,794,036	0.0429%	0	0.0000%	2,828,988	0.0606%	5,623,025	0.0272%
33594	630,688	0.0088%	11,175,815	0.1716%	0	0.0000%	13,697,014	0.2932%	25,503,516	0.1233%
33596	666,586	0.0093%	8,815,491	0.1354%	0	0.0000%	11,616,843	0.2487%	21,098,920	0.1020%
33597	0	0.0000%	4,493,972	0.0690%	0	0.0000%	3,856,238	0.0826%	8,350,210	0.0404%
33598	221,923	0.0031%	2,346,167	0.0360%	0	0.0000%	1,674,250	0.0358%	4,242,340	0.0205%
33602	0	0.0000%	3,972,836	0.0610%	0	0.0000%	3,441,045	0.0737%	7,413,880	0.0358%
33603	0	0.0000%	4,357,225	0.0669%	0	0.0000%	3,108,066	0.0665%	7,465,291	0.0361%
33604	0	0.0000%	6,144,668	0.0944%	0	0.0000%	4,794,511	0.1026%	10,939,178	0.0529%
33605	0	0.0000%	2,115,142	0.0325%	0	0.0000%	1,646,423	0.0352%	3,761,565	0.0182%
33606	0	0.0000%	7,727,612	0.1187%	0	0.0000%	7,901,999	0.1692%	15,629,611	0.0756%
33607	0	0.0000%	4,422,772	0.0679%	0	0.0000%	3,494,724	0.0748%	7,917,496	0.0383%
33609	0	0.0000%	9,852,260	0.1513%	0	0.0000%	9,022,648	0.1932%	18,874,908	0.0913%
33610	0	0.0000%	4,264,285	0.0655%	0	0.0000%	3,652,126	0.0782%	7,916,411	0.0383%
33611	0	0.0000%	14,045,166	0.2157%	0	0.0000%	12,433,852	0.2662%	26,479,018	0.1280%
33612	0	0.0000%	5,466,240	0.0839%	0	0.0000%	4,593,971	0.0983%	10,060,211	0.0486%
33613	0	0.0000%	6,001,901	0.0922%	0	0.0000%	5,075,156	0.1087%	11,077,057	0.0536%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33614	0	0.0000%	7,973,204	0.1224%	0	0.0000%	4,499,007	0.0963%	12,472,211	0.0603%
33615	0	0.0000%	13,653,015	0.2096%	0	0.0000%	6,549,212	0.1402%	20,202,228	0.0977%
33616	0	0.0000%	4,077,730	0.0626%	0	0.0000%	2,974,370	0.0637%	7,052,100	0.0341%
33617	0	0.0000%	7,307,929	0.1122%	0	0.0000%	6,336,878	0.1357%	13,644,807	0.0660%
33618	0	0.0000%	9,156,361	0.1406%	0	0.0000%	7,025,985	0.1504%	16,182,346	0.0782%
33619	0	0.0000%	4,953,726	0.0761%	0	0.0000%	3,856,697	0.0826%	8,810,423	0.0426%
33624	0	0.0000%	12,181,362	0.1871%	0	0.0000%	8,815,758	0.1887%	20,997,119	0.1015%
33625	0	0.0000%	6,885,917	0.1057%	0	0.0000%	4,189,405	0.0897%	11,075,323	0.0535%
33626	0	0.0000%	10,148,788	0.1558%	0	0.0000%	5,173,519	0.1108%	15,322,307	0.0741%
33629	0	0.0000%	18,179,341	0.2792%	0	0.0000%	17,906,486	0.3833%	36,085,826	0.1745%
33634	0	0.0000%	6,426,945	0.0987%	0	0.0000%	3,261,510	0.0698%	9,688,456	0.0468%
33635	0	0.0000%	5,065,285	0.0778%	0	0.0000%	2,265,909	0.0485%	7,331,195	0.0354%
33637	0	0.0000%	2,229,914	0.0342%	0	0.0000%	2,046,709	0.0438%	4,276,623	0.0207%
33647	0	0.0000%	18,199,896	0.2795%	0	0.0000%	15,131,497	0.3239%	33,331,393	0.1611%
33701	0	0.0000%	3,115,816	0.0478%	0	0.0000%	1,017,698	0.0218%	4,133,514	0.0200%
33702	0	0.0000%	11,739,661	0.1803%	0	0.0000%	4,018,225	0.0860%	15,757,886	0.0762%
33703	0	0.0000%	10,783,489	0.1656%	0	0.0000%	3,678,909	0.0788%	14,462,398	0.0699%
33704	0	0.0000%	6,995,824	0.1074%	0	0.0000%	2,341,211	0.0501%	9,337,035	0.0451%
33705	0	0.0000%	5,887,581	0.0904%	0	0.0000%	1,975,882	0.0423%	7,863,463	0.0380%
33706	0	0.0000%	17,528,157	0.2692%	0	0.0000%	7,167,314	0.1534%	24,695,471	0.1194%
33707	0	0.0000%	13,732,471	0.2109%	0	0.0000%	5,231,389	0.1120%	18,963,860	0.0917%
33708	0	0.0000%	14,714,422	0.2259%	0	0.0000%	5,515,706	0.1181%	20,230,128	0.0978%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33709	0	0.0000%	7,488,628	0.1150%	0	0.0000%	2,307,945	0.0494%	9,796,573	0.0474%
33710	0	0.0000%	12,847,900	0.1973%	0	0.0000%	4,402,513	0.0943%	17,250,413	0.0834%
33711	0	0.0000%	5,150,397	0.0791%	0	0.0000%	1,961,851	0.0420%	7,112,248	0.0344%
33712	0	0.0000%	4,709,642	0.0723%	0	0.0000%	1,696,057	0.0363%	6,405,699	0.0310%
33713	0	0.0000%	7,053,960	0.1083%	0	0.0000%	2,329,914	0.0499%	9,383,874	0.0454%
33714	0	0.0000%	3,172,959	0.0487%	0	0.0000%	1,017,822	0.0218%	4,190,781	0.0203%
33715	0	0.0000%	11,122,068	0.1708%	0	0.0000%	4,828,313	0.1034%	15,950,381	0.0771%
33716	0	0.0000%	2,159,274	0.0332%	0	0.0000%	810,634	0.0174%	2,969,908	0.0144%
33755	0	0.0000%	11,649,577	0.1789%	0	0.0000%	7,267,451	0.1556%	18,917,028	0.0915%
33756	0	0.0000%	18,821,185	0.2890%	0	0.0000%	10,652,339	0.2281%	29,473,525	0.1425%
33759	0	0.0000%	4,155,906	0.0638%	0	0.0000%	2,756,806	0.0590%	6,912,713	0.0334%
33760	0	0.0000%	2,698,877	0.0414%	0	0.0000%	1,067,820	0.0229%	3,766,697	0.0182%
33761	0	0.0000%	8,775,842	0.1348%	0	0.0000%	6,730,366	0.1441%	15,506,208	0.0750%
33762	0	0.0000%	3,369,766	0.0517%	0	0.0000%	1,157,791	0.0248%	4,527,558	0.0219%
33763	0	0.0000%	5,310,892	0.0816%	0	0.0000%	3,884,422	0.0832%	9,195,314	0.0445%
33764	0	0.0000%	9,494,769	0.1458%	0	0.0000%	5,250,606	0.1124%	14,745,376	0.0713%
33765	0	0.0000%	3,507,956	0.0539%	0	0.0000%	2,350,758	0.0503%	5,858,714	0.0283%
33767	0	0.0000%	14,500,739	0.2227%	0	0.0000%	6,951,741	0.1488%	21,452,479	0.1037%
33770	0	0.0000%	18,694,314	0.2871%	0	0.0000%	9,183,926	0.1966%	27,878,240	0.1348%
33771	0	0.0000%	12,403,272	0.1905%	0	0.0000%	6,012,733	0.1287%	18,416,005	0.0890%
33772	0	0.0000%	17,142,020	0.2632%	0	0.0000%	6,429,405	0.1376%	23,571,425	0.1140%
33773	0	0.0000%	6,900,161	0.1060%	0	0.0000%	2,786,658	0.0597%	9,686,819	0.0468%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33774	0	0.0000%	21,533,785	0.3307%	0	0.0000%	8,827,893	0.1890%	30,361,678	0.1468%
33776	0	0.0000%	16,441,545	0.2525%	0	0.0000%	6,494,621	0.1390%	22,936,166	0.1109%
33777	0	0.0000%	7,795,956	0.1197%	0	0.0000%	2,702,139	0.0578%	10,498,095	0.0508%
33778	0	0.0000%	11,606,861	0.1782%	0	0.0000%	5,054,733	0.1082%	16,661,594	0.0806%
33781	0	0.0000%	5,169,330	0.0794%	0	0.0000%	1,605,842	0.0344%	6,775,171	0.0328%
33782	0	0.0000%	5,915,753	0.0908%	0	0.0000%	1,948,010	0.0417%	7,863,763	0.0380%
33785	0	0.0000%	12,178,175	0.1870%	0	0.0000%	4,759,455	0.1019%	16,937,631	0.0819%
33786	0	0.0000%	4,981,277	0.0765%	0	0.0000%	2,097,000	0.0449%	7,078,276	0.0342%
33801	4,484,718	0.0624%	13,500,604	0.2073%	0	0.0000%	17,020,069	0.3644%	35,005,391	0.1692%
33803	4,096,154	0.0570%	14,339,963	0.2202%	0	0.0000%	18,357,640	0.3930%	36,793,757	0.1779%
33805	1,329,701	0.0185%	6,650,271	0.1021%	0	0.0000%	8,533,105	0.1827%	16,513,078	0.0798%
33809	2,252,695	0.0313%	14,678,129	0.2254%	0	0.0000%	17,753,384	0.3801%	34,684,208	0.1677%
33810	2,743,150	0.0382%	22,665,734	0.3480%	0	0.0000%	27,697,585	0.5930%	53,106,469	0.2567%
33811	1,751,675	0.0244%	7,554,594	0.1160%	0	0.0000%	9,527,658	0.2040%	18,833,927	0.0911%
33812	2,990,662	0.0416%	5,025,651	0.0772%	0	0.0000%	6,870,695	0.1471%	14,887,008	0.0720%
33813	7,089,020	0.0986%	17,460,288	0.2681%	0	0.0000%	23,060,080	0.4937%	47,609,388	0.2302%
33815	658,160	0.0092%	3,473,234	0.0533%	0	0.0000%	4,505,913	0.0965%	8,637,307	0.0418%
33823	20,036,594	0.2788%	17,174,393	0.2637%	0	0.0000%	22,157,968	0.4744%	59,368,954	0.2870%
33825	23,470,091	0.3266%	12,189,143	0.1872%	0	0.0000%	14,775,071	0.3163%	50,434,304	0.2438%
33827	9,045,736	0.1259%	2,018,276	0.0310%	0	0.0000%	2,856,820	0.0612%	13,920,833	0.0673%
33830	23,696,130	0.3297%	11,426,065	0.1755%	0	0.0000%	16,498,617	0.3532%	51,620,812	0.2496%
33834	8,119,000	0.1130%	1,340,072	0.0206%	0	0.0000%	1,726,668	0.0370%	11,185,740	0.0541%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33837	25,490,942	0.3547%	20,006,522	0.3072%	0	0.0000%	24,589,022	0.5264%	70,086,486	0.3388%
33838	4,780,620	0.0665%	2,011,439	0.0309%	0	0.0000%	3,065,659	0.0656%	9,857,718	0.0477%
33839	2,729,810	0.0380%	1,165,931	0.0179%	0	0.0000%	1,645,849	0.0352%	5,541,591	0.0268%
33841	14,823,343	0.2063%	2,992,461	0.0460%	0	0.0000%	4,056,381	0.0868%	21,872,184	0.1057%
33843	17,299,163	0.2407%	6,884,356	0.1057%	0	0.0000%	9,049,114	0.1937%	33,232,634	0.1607%
33844	51,140,073	0.7116%	31,577,842	0.4849%	0	0.0000%	45,505,517	0.9742%	128,223,433	0.6199%
33849	18,772	0.0003%	406,537	0.0062%	0	0.0000%	429,527	0.0092%	854,836	0.0041%
33850	8,632,768	0.1201%	6,166,190	0.0947%	0	0.0000%	8,302,401	0.1777%	23,101,359	0.1117%
33852	9,103,774	0.1267%	15,066,005	0.2313%	0	0.0000%	16,641,251	0.3563%	40,811,031	0.1973%
33853	23,644,127	0.3290%	6,121,980	0.0940%	0	0.0000%	9,122,154	0.1953%	38,888,261	0.1880%
33857	696,453	0.0097%	2,438,941	0.0375%	0	0.0000%	2,355,266	0.0504%	5,490,660	0.0265%
33859	26,250,955	0.3653%	8,170,840	0.1255%	0	0.0000%	11,883,453	0.2544%	46,305,248	0.2239%
33860	2,258,422	0.0314%	7,122,322	0.1094%	0	0.0000%	9,330,018	0.1997%	18,710,762	0.0905%
33865	1,967,693	0.0274%	252,631	0.0039%	0	0.0000%	221,908	0.0048%	2,442,232	0.0118%
33868	2,488,439	0.0346%	9,567,992	0.1469%	0	0.0000%	11,782,044	0.2522%	23,838,475	0.1152%
33870	11,051,467	0.1538%	10,587,244	0.1626%	0	0.0000%	12,653,076	0.2709%	34,291,787	0.1658%
33872	16,954,535	0.2359%	10,993,609	0.1688%	0	0.0000%	13,029,335	0.2789%	40,977,479	0.1981%
33873	33,253,268	0.4627%	3,490,028	0.0536%	0	0.0000%	4,608,321	0.0987%	41,351,618	0.1999%
33875	7,609,943	0.1059%	7,237,535	0.1111%	0	0.0000%	7,902,494	0.1692%	22,749,972	0.1100%
33876	3,230,685	0.0450%	4,749,691	0.0729%	0	0.0000%	5,340,498	0.1143%	13,320,874	0.0644%
33880	35,633,030	0.4958%	18,609,536	0.2858%	0	0.0000%	24,582,162	0.5263%	78,824,728	0.3811%
33881	41,521,904	0.5777%	24,565,392	0.3772%	0	0.0000%	33,760,446	0.7228%	99,847,742	0.4827%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33884	64,712,202	0.9004%	24,955,432	0.3832%	0	0.0000%	36,888,851	0.7897%	126,556,485	0.6118%
33890	15,567,696	0.2166%	1,753,948	0.0269%	0	0.0000%	2,131,162	0.0456%	19,452,807	0.0940%
33896	9,871,941	0.1374%	7,069,206	0.1086%	0	0.0000%	7,120,737	0.1524%	24,061,884	0.1163%
33897	11,501,330	0.1600%	18,994,619	0.2917%	0	0.0000%	18,310,153	0.3920%	48,806,103	0.2360%
33898	54,111,801	0.7529%	15,486,263	0.2378%	0	0.0000%	23,802,859	0.5096%	93,400,924	0.4515%
33901	12,437,651	0.1731%	233,908	0.0036%	0	0.0000%	0	0.0000%	12,671,559	0.0613%
33903	61,933,349	0.8618%	1,463,635	0.0225%	0	0.0000%	0	0.0000%	63,396,984	0.3065%
33904	86,960,358	1.2100%	444,478	0.0068%	0	0.0000%	0	0.0000%	87,404,836	0.4226%
33905	13,882,113	0.1932%	788,880	0.0121%	0	0.0000%	0	0.0000%	14,670,993	0.0709%
33907	13,158,827	0.1831%	198,611	0.0030%	0	0.0000%	0	0.0000%	13,357,438	0.0646%
33908	120,033,582	1.6702%	2,074,574	0.0319%	0	0.0000%	0	0.0000%	122,108,156	0.5903%
33909	31,284,324	0.4353%	453,275	0.0070%	0	0.0000%	0	0.0000%	31,737,599	0.1534%
33912	19,442,779	0.2705%	321,574	0.0049%	0	0.0000%	0	0.0000%	19,764,353	0.0956%
33913	8,440,092	0.1174%	247,472	0.0038%	0	0.0000%	0	0.0000%	8,687,564	0.0420%
33914	172,160,837	2.3955%	1,120,969	0.0172%	0	0.0000%	0	0.0000%	173,281,805	0.8377%
33916	4,563,974	0.0635%	137,713	0.0021%	0	0.0000%	0	0.0000%	4,701,687	0.0227%
33917	45,593,264	0.6344%	1,456,845	0.0224%	0	0.0000%	0	0.0000%	47,050,109	0.2275%
33919	43,495,701	0.6052%	447,026	0.0069%	0	0.0000%	0	0.0000%	43,942,726	0.2124%
33920	2,423,136	0.0337%	312,548	0.0048%	0	0.0000%	71,729	0.0015%	2,807,412	0.0136%
33921	325,606,216	4.5306%	2,848,270	0.0437%	0	0.0000%	1,185,971	0.0254%	329,640,457	1.5937%
33922	194,739,140	2.7096%	569,867	0.0088%	0	0.0000%	155,959	0.0033%	195,464,966	0.9450%
33924	188,104,561	2.6173%	762,990	0.0117%	0	0.0000%	273,248	0.0058%	189,140,799	0.9144%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33928	17,219,047	0.2396%	653,426	0.0100%	0	0.0000%	0	0.0000%	17,872,473	0.0864%
33931	74,548,059	1.0373%	947,485	0.0145%	0	0.0000%	75,665	0.0016%	75,571,209	0.3654%
33935	3,345,688	0.0466%	1,172,504	0.0180%	0	0.0000%	544,526	0.0117%	5,062,717	0.0245%
33936	5,268,332	0.0733%	446,149	0.0069%	0	0.0000%	0	0.0000%	5,714,482	0.0276%
33946	12,217,439	0.1700%	1,489,324	0.0229%	0	0.0000%	634,394	0.0136%	14,341,158	0.0693%
33947	13,105,105	0.1823%	1,527,110	0.0234%	0	0.0000%	616,782	0.0132%	15,248,997	0.0737%
33948	101,068,320	1.4063%	1,295,465	0.0199%	0	0.0000%	329,261	0.0070%	102,693,047	0.4965%
33950	645,516,482	8.9819%	5,467,162	0.0840%	0	0.0000%	2,347,027	0.0502%	653,330,672	3.1585%
33952	209,275,774	2.9119%	2,317,739	0.0356%	0	0.0000%	632,953	0.0136%	212,226,467	1.0260%
33953	24,058,315	0.3348%	523,420	0.0080%	0	0.0000%	95,586	0.0020%	24,677,321	0.1193%
33954	57,927,211	0.8060%	791,077	0.0121%	0	0.0000%	217,265	0.0047%	58,935,552	0.2849%
33955	172,882,824	2.4055%	2,340,092	0.0359%	0	0.0000%	1,000,077	0.0214%	176,222,992	0.8520%
33956	109,425,273	1.5226%	700,215	0.0108%	0	0.0000%	171,815	0.0037%	110,297,302	0.5332%
33957	498,818,844	6.9407%	1,593,137	0.0245%	0	0.0000%	214,159	0.0046%	500,626,140	2.4203%
33960	249,660	0.0035%	371,304	0.0057%	0	0.0000%	357,178	0.0076%	978,142	0.0047%
33966	5,431,574	0.0756%	162,573	0.0025%	0	0.0000%	0	0.0000%	5,594,147	0.0270%
33967	11,894,681	0.1655%	59,573	0.0009%	0	0.0000%	0	0.0000%	11,954,255	0.0578%
33971	5,081,402	0.0707%	334,474	0.0051%	0	0.0000%	0	0.0000%	5,415,876	0.0262%
33972	2,559,900	0.0356%	272,349	0.0042%	0	0.0000%	26,646	0.0006%	2,858,894	0.0138%
33973	1,243,004	0.0173%	58,203	0.0009%	0	0.0000%	0	0.0000%	1,301,207	0.0063%
33974	1,743,036	0.0243%	137,793	0.0021%	0	0.0000%	0	0.0000%	1,880,829	0.0091%
33976	1,822,903	0.0254%	101,212	0.0016%	0	0.0000%	0	0.0000%	1,924,115	0.0093%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33980	112,598,577	1.5667%	1,483,202	0.0228%	0	0.0000%	448,668	0.0096%	114,530,447	0.5537%
33981	36,460,342	0.5073%	663,175	0.0102%	0	0.0000%	50,462	0.0011%	37,173,978	0.1797%
33982	138,940,373	1.9332%	1,161,338	0.0178%	0	0.0000%	436,326	0.0093%	140,538,037	0.6794%
33983	161,431,488	2.2462%	1,537,082	0.0236%	0	0.0000%	608,471	0.0130%	163,577,042	0.7908%
33990	56,451,846	0.7855%	599,094	0.0092%	0	0.0000%	0	0.0000%	57,050,940	0.2758%
33991	58,157,142	0.8092%	538,625	0.0083%	0	0.0000%	0	0.0000%	58,695,767	0.2838%
33993	91,435,234	1.2723%	934,474	0.0143%	0	0.0000%	206,888	0.0044%	92,576,596	0.4476%
34102	27,545,036	0.3833%	1,558,254	0.0239%	0	0.0000%	224,576	0.0048%	29,327,867	0.1418%
34103	26,036,286	0.3623%	1,559,112	0.0239%	0	0.0000%	239,907	0.0051%	27,835,305	0.1346%
34104	8,269,129	0.1151%	0	0.0000%	0	0.0000%	0	0.0000%	8,269,129	0.0400%
34105	13,348,070	0.1857%	892,980	0.0137%	0	0.0000%	0	0.0000%	14,241,050	0.0688%
34108	40,828,124	0.5681%	2,788,591	0.0428%	0	0.0000%	449,590	0.0096%	44,066,305	0.2130%
34109	13,985,762	0.1946%	978,339	0.0150%	0	0.0000%	0	0.0000%	14,964,101	0.0723%
34110	26,366,643	0.3669%	2,030,134	0.0312%	0	0.0000%	337,127	0.0072%	28,733,903	0.1389%
34112	15,684,186	0.2182%	665,926	0.0102%	0	0.0000%	0	0.0000%	16,350,112	0.0790%
34113	7,666,799	0.1067%	0	0.0000%	0	0.0000%	0	0.0000%	7,666,799	0.0371%
34114	4,862,510	0.0677%	0	0.0000%	0	0.0000%	0	0.0000%	4,862,510	0.0235%
34116	3,434,078	0.0478%	0	0.0000%	0	0.0000%	0	0.0000%	3,434,078	0.0166%
34117	1,720,263	0.0239%	0	0.0000%	0	0.0000%	0	0.0000%	1,720,263	0.0083%
34119	9,639,122	0.1341%	0	0.0000%	0	0.0000%	0	0.0000%	9,639,122	0.0466%
34120	3,996,788	0.0556%	0	0.0000%	0	0.0000%	0	0.0000%	3,996,788	0.0193%
34134	47,622,543	0.6626%	3,069,387	0.0471%	0	0.0000%	675,232	0.0145%	51,367,163	0.2483%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34135	25,805,365	0.3591%	1,663,067	0.0255%	0	0.0000%	0	0.0000%	27,468,432	0.1328%
34142	558,970	0.0078%	28,934	0.0004%	0	0.0000%	0	0.0000%	587,903	0.0028%
34145	24,888,289	0.3463%	580,121	0.0089%	0	0.0000%	0	0.0000%	25,468,410	0.1231%
34201	240,907	0.0034%	1,123,391	0.0173%	0	0.0000%	422,144	0.0090%	1,786,442	0.0086%
34202	1,243,408	0.0173%	4,658,060	0.0715%	0	0.0000%	1,787,915	0.0383%	7,689,384	0.0372%
34203	534,277	0.0074%	6,642,380	0.1020%	0	0.0000%	2,508,518	0.0537%	9,685,175	0.0468%
34205	359,807	0.0050%	7,241,263	0.1112%	0	0.0000%	2,847,034	0.0610%	10,448,105	0.0505%
34207	364,741	0.0051%	6,968,524	0.1070%	0	0.0000%	2,836,894	0.0607%	10,170,159	0.0492%
34208	325,993	0.0045%	4,908,329	0.0754%	0	0.0000%	1,855,309	0.0397%	7,089,631	0.0343%
34209	972,408	0.0135%	21,800,028	0.3348%	0	0.0000%	9,022,856	0.1932%	31,795,292	0.1537%
34210	334,325	0.0047%	7,025,544	0.1079%	0	0.0000%	2,932,833	0.0628%	10,292,703	0.0498%
34211	197,703	0.0028%	868,335	0.0133%	0	0.0000%	347,405	0.0074%	1,413,443	0.0068%
34212	522,820	0.0073%	3,578,647	0.0550%	0	0.0000%	1,438,787	0.0308%	5,540,254	0.0268%
34215	33,932	0.0005%	825,914	0.0127%	0	0.0000%	349,662	0.0075%	1,209,509	0.0058%
34217	446,143	0.0062%	11,979,035	0.1839%	0	0.0000%	4,999,455	0.1070%	17,424,633	0.0842%
34219	503,829	0.0070%	5,506,796	0.0846%	0	0.0000%	2,281,558	0.0488%	8,292,183	0.0401%
34221	878,063	0.0122%	23,400,347	0.3593%	0	0.0000%	10,510,580	0.2250%	34,788,991	0.1682%
34222	329,460	0.0046%	6,273,245	0.0963%	0	0.0000%	2,717,331	0.0582%	9,320,036	0.0451%
34223	10,171,432	0.1415%	6,671,229	0.1024%	0	0.0000%	3,048,330	0.0653%	19,890,992	0.0962%
34224	18,581,622	0.2585%	3,865,374	0.0594%	0	0.0000%	1,679,818	0.0360%	24,126,814	0.1166%
34228	510,503	0.0071%	12,902,603	0.1981%	0	0.0000%	5,776,456	0.1237%	19,189,561	0.0928%
34229	989,635	0.0138%	4,838,846	0.0743%	0	0.0000%	2,275,818	0.0487%	8,104,299	0.0392%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34231	1,453,918	0.0202%	13,261,533	0.2036%	0	0.0000%	5,986,685	0.1282%	20,702,137	0.1001%
34232	1,093,774	0.0152%	5,383,207	0.0827%	0	0.0000%	2,232,930	0.0478%	8,709,912	0.0421%
34233	867,434	0.0121%	3,728,760	0.0573%	0	0.0000%	1,534,044	0.0328%	6,130,238	0.0296%
34234	289,435	0.0040%	4,293,369	0.0659%	0	0.0000%	1,948,433	0.0417%	6,531,237	0.0316%
34235	511,451	0.0071%	3,076,510	0.0472%	0	0.0000%	1,323,160	0.0283%	4,911,121	0.0237%
34236	442,820	0.0062%	6,197,822	0.0952%	0	0.0000%	2,838,484	0.0608%	9,479,126	0.0458%
34237	283,550	0.0039%	2,816,477	0.0432%	0	0.0000%	1,250,440	0.0268%	4,350,467	0.0210%
34238	1,434,825	0.0200%	6,823,393	0.1048%	0	0.0000%	2,922,828	0.0626%	11,181,047	0.0541%
34239	542,661	0.0076%	5,736,937	0.0881%	0	0.0000%	2,596,406	0.0556%	8,876,004	0.0429%
34240	1,268,882	0.0177%	2,338,371	0.0359%	0	0.0000%	861,649	0.0184%	4,468,902	0.0216%
34241	1,502,268	0.0209%	2,501,191	0.0384%	0	0.0000%	873,241	0.0187%	4,876,701	0.0236%
34242	1,081,216	0.0150%	11,636,765	0.1787%	0	0.0000%	5,267,992	0.1128%	17,985,972	0.0870%
34243	634,873	0.0088%	6,296,605	0.0967%	0	0.0000%	2,682,810	0.0574%	9,614,288	0.0465%
34251	1,417,335	0.0197%	1,673,959	0.0257%	0	0.0000%	843,354	0.0181%	3,934,648	0.0190%
34266	177,678,359	2.4723%	6,482,601	0.0995%	0	0.0000%	4,708,678	0.1008%	188,869,638	0.9131%
34269	49,395,527	0.6873%	694,866	0.0107%	0	0.0000%	352,562	0.0075%	50,442,955	0.2439%
34275	3,013,268	0.0419%	8,668,294	0.1331%	0	0.0000%	3,947,919	0.0845%	15,629,481	0.0756%
34285	3,934,407	0.0547%	9,147,113	0.1405%	0	0.0000%	4,071,639	0.0872%	17,153,160	0.0829%
34286	44,121,820	0.6139%	1,029,857	0.0158%	0	0.0000%	266,223	0.0057%	45,417,899	0.2196%
34287	40,118,529	0.5582%	2,740,598	0.0421%	0	0.0000%	646,954	0.0139%	43,506,081	0.2103%
34288	31,182,276	0.4339%	632,143	0.0097%	0	0.0000%	223,278	0.0048%	32,037,697	0.1549%
34289	4,337,016	0.0603%	114,663	0.0018%	0	0.0000%	41,551	0.0009%	4,493,229	0.0217%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34291	3,110,286	0.0433%	269,030	0.0041%	0	0.0000%	66,184	0.0014%	3,445,500	0.0167%
34292	2,988,412	0.0416%	2,864,026	0.0440%	0	0.0000%	1,106,186	0.0237%	6,958,624	0.0336%
34293	7,070,819	0.0984%	8,657,759	0.1329%	0	0.0000%	3,893,253	0.0833%	19,621,830	0.0949%
34420	0	0.0000%	3,192,084	0.0490%	0	0.0000%	7,132,146	0.1527%	10,324,231	0.0499%
34428	0	0.0000%	3,299,139	0.0507%	0	0.0000%	2,252,961	0.0482%	5,552,100	0.0268%
34429	0	0.0000%	4,296,692	0.0660%	0	0.0000%	2,453,502	0.0525%	6,750,194	0.0326%
34431	0	0.0000%	1,972,254	0.0303%	0	0.0000%	1,973,721	0.0423%	3,945,975	0.0191%
34432	0	0.0000%	3,242,198	0.0498%	0	0.0000%	4,176,544	0.0894%	7,418,742	0.0359%
34433	0	0.0000%	2,091,043	0.0321%	0	0.0000%	1,514,991	0.0324%	3,606,033	0.0174%
34434	0	0.0000%	1,900,279	0.0292%	0	0.0000%	1,566,096	0.0335%	3,466,375	0.0168%
34436	0	0.0000%	4,371,621	0.0671%	0	0.0000%	2,817,601	0.0603%	7,189,222	0.0348%
34442	0	0.0000%	6,336,529	0.0973%	0	0.0000%	4,719,817	0.1010%	11,056,346	0.0535%
34446	0	0.0000%	9,976,570	0.1532%	0	0.0000%	4,217,710	0.0903%	14,194,280	0.0686%
34448	0	0.0000%	6,151,699	0.0945%	0	0.0000%	3,116,421	0.0667%	9,268,120	0.0448%
34449	0	0.0000%	926,691	0.0142%	0	0.0000%	589,282	0.0126%	1,515,973	0.0073%
34450	0	0.0000%	4,858,700	0.0746%	0	0.0000%	3,731,385	0.0799%	8,590,085	0.0415%
34452	0	0.0000%	4,799,463	0.0737%	0	0.0000%	2,836,063	0.0607%	7,635,526	0.0369%
34453	0	0.0000%	3,503,708	0.0538%	0	0.0000%	2,524,847	0.0541%	6,028,555	0.0291%
34461	0	0.0000%	4,331,771	0.0665%	0	0.0000%	2,749,354	0.0589%	7,081,124	0.0342%
34465	0	0.0000%	5,356,968	0.0823%	0	0.0000%	3,630,416	0.0777%	8,987,384	0.0434%
34470	0	0.0000%	1,521,200	0.0234%	0	0.0000%	5,342,971	0.1144%	6,864,172	0.0332%
34471	0	0.0000%	3,395,355	0.0521%	0	0.0000%	9,833,494	0.2105%	13,228,849	0.0640%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34472	0	0.0000%	2,963,139	0.0455%	0	0.0000%	8,781,072	0.1880%	11,744,212	0.0568%
34473	0	0.0000%	2,949,336	0.0453%	0	0.0000%	4,792,458	0.1026%	7,741,793	0.0374%
34474	0	0.0000%	1,905,346	0.0293%	0	0.0000%	4,681,503	0.1002%	6,586,849	0.0318%
34475	0	0.0000%	591,670	0.0091%	0	0.0000%	1,765,454	0.0378%	2,357,125	0.0114%
34476	0	0.0000%	4,620,459	0.0709%	0	0.0000%	8,244,098	0.1765%	12,864,557	0.0622%
34479	0	0.0000%	934,418	0.0143%	0	0.0000%	3,510,956	0.0752%	4,445,374	0.0215%
34480	0	0.0000%	2,737,161	0.0420%	0	0.0000%	7,468,542	0.1599%	10,205,703	0.0493%
34481	0	0.0000%	3,415,405	0.0524%	0	0.0000%	5,523,399	0.1182%	8,938,804	0.0432%
34482	0	0.0000%	2,309,406	0.0355%	0	0.0000%	6,736,551	0.1442%	9,045,957	0.0437%
34484	0	0.0000%	1,023,955	0.0157%	0	0.0000%	1,827,649	0.0391%	2,851,604	0.0138%
34488	0	0.0000%	1,081,001	0.0166%	0	0.0000%	3,086,290	0.0661%	4,167,291	0.0201%
34491	0	0.0000%	8,302,236	0.1275%	0	0.0000%	16,347,671	0.3500%	24,649,907	0.1192%
34498	0	0.0000%	352,992	0.0054%	0	0.0000%	334,895	0.0072%	687,887	0.0033%
34601	0	0.0000%	11,646,978	0.1788%	0	0.0000%	5,760,978	0.1233%	17,407,956	0.0842%
34602	0	0.0000%	4,659,629	0.0716%	0	0.0000%	2,237,347	0.0479%	6,896,975	0.0333%
34604	0	0.0000%	3,906,642	0.0600%	0	0.0000%	1,993,170	0.0427%	5,899,812	0.0285%
34606	0	0.0000%	11,392,026	0.1749%	0	0.0000%	10,110,808	0.2165%	21,502,834	0.1040%
34607	0	0.0000%	5,644,865	0.0867%	0	0.0000%	7,110,493	0.1522%	12,755,358	0.0617%
34608	0	0.0000%	12,450,168	0.1912%	0	0.0000%	6,610,624	0.1415%	19,060,791	0.0921%
34609	0	0.0000%	15,676,981	0.2407%	0	0.0000%	7,867,312	0.1684%	23,544,293	0.1138%
34610	0	0.0000%	5,303,886	0.0814%	0	0.0000%	2,948,730	0.0631%	8,252,616	0.0399%
34613	0	0.0000%	19,565,069	0.3004%	0	0.0000%	8,985,671	0.1924%	28,550,740	0.1380%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
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34614	0	0.0000%	2,995,132	0.0460%	0	0.0000%	1,289,977	0.0276%	4,285,110	0.0207%
34637	0	0.0000%	2,099,151	0.0322%	0	0.0000%	1,209,416	0.0259%	3,308,568	0.0160%
34638	0	0.0000%	6,373,151	0.0979%	0	0.0000%	3,837,943	0.0822%	10,211,094	0.0494%
34639	0	0.0000%	8,843,718	0.1358%	0	0.0000%	6,621,074	0.1417%	15,464,792	0.0748%
34652	0	0.0000%	10,962,212	0.1683%	0	0.0000%	15,921,682	0.3409%	26,883,894	0.1300%
34653	0	0.0000%	9,019,774	0.1385%	0	0.0000%	13,791,042	0.2952%	22,810,816	0.1103%
34654	0	0.0000%	7,366,508	0.1131%	0	0.0000%	5,508,769	0.1179%	12,875,277	0.0622%
34655	0	0.0000%	12,848,620	0.1973%	0	0.0000%	10,374,081	0.2221%	23,222,701	0.1123%
34667	0	0.0000%	16,227,651	0.2492%	0	0.0000%	23,472,184	0.5025%	39,699,836	0.1919%
34668	0	0.0000%	14,414,239	0.2213%	0	0.0000%	22,473,125	0.4811%	36,887,365	0.1783%
34669	0	0.0000%	4,540,878	0.0697%	0	0.0000%	3,675,692	0.0787%	8,216,570	0.0397%
34677	0	0.0000%	7,760,281	0.1192%	0	0.0000%	4,691,650	0.1004%	12,451,931	0.0602%
34681	0	0.0000%	1,023,188	0.0157%	0	0.0000%	786,190	0.0168%	1,809,378	0.0087%
34683	0	0.0000%	22,792,057	0.3500%	0	0.0000%	19,914,683	0.4263%	42,706,740	0.2065%
34684	0	0.0000%	11,614,815	0.1784%	0	0.0000%	10,128,626	0.2168%	21,743,441	0.1051%
34685	0	0.0000%	6,933,709	0.1065%	0	0.0000%	5,373,583	0.1150%	12,307,292	0.0595%
34688	0	0.0000%	4,068,480	0.0625%	0	0.0000%	3,084,350	0.0660%	7,152,829	0.0346%
34689	0	0.0000%	18,636,019	0.2862%	0	0.0000%	15,387,771	0.3294%	34,023,790	0.1645%
34690	0	0.0000%	5,037,377	0.0774%	0	0.0000%	5,865,523	0.1256%	10,902,900	0.0527%
34691	0	0.0000%	11,730,186	0.1801%	0	0.0000%	10,950,061	0.2344%	22,680,246	0.1096%
34695	0	0.0000%	6,870,718	0.1055%	0	0.0000%	4,356,823	0.0933%	11,227,541	0.0543%
34698	0	0.0000%	26,817,530	0.4118%	0	0.0000%	19,135,314	0.4097%	45,952,845	0.2222%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
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34705	334,667	0.0047%	2,395,834	0.0368%	0	0.0000%	2,505,085	0.0536%	5,235,586	0.0253%
34711	6,885,066	0.0958%	42,125,554	0.6469%	0	0.0000%	38,568,537	0.8257%	87,579,157	0.4234%
34714	6,350,111	0.0884%	10,669,960	0.1638%	0	0.0000%	9,269,438	0.1984%	26,289,509	0.1271%
34715	1,227,211	0.0171%	11,034,403	0.1694%	0	0.0000%	9,609,493	0.2057%	21,871,107	0.1057%
34731	191,827	0.0027%	6,897,430	0.1059%	0	0.0000%	9,534,164	0.2041%	16,623,421	0.0804%
34734	3,585,337	0.0499%	1,953,470	0.0300%	0	0.0000%	1,710,035	0.0366%	7,248,842	0.0350%
34736	537,769	0.0075%	8,879,869	0.1364%	0	0.0000%	9,401,026	0.2013%	18,818,663	0.0910%
34737	273,263	0.0038%	2,072,270	0.0318%	0	0.0000%	2,352,397	0.0504%	4,697,930	0.0227%
34739	365,227	0.0051%	1,944,943	0.0299%	0	0.0000%	2,329,305	0.0499%	4,639,475	0.0224%
34741	28,646,207	0.3986%	19,430,284	0.2984%	0	0.0000%	14,150,498	0.3029%	62,226,988	0.3008%
34743	43,787,878	0.6093%	22,789,758	0.3499%	0	0.0000%	15,685,078	0.3358%	82,262,714	0.3977%
34744	70,108,611	0.9755%	34,825,872	0.5348%	0	0.0000%	25,094,144	0.5372%	130,028,627	0.6286%
34746	73,035,464	1.0162%	49,433,862	0.7591%	0	0.0000%	36,016,596	0.7711%	158,485,921	0.7662%
34747	26,913,330	0.3745%	25,429,038	0.3905%	0	0.0000%	21,163,929	0.4531%	73,506,298	0.3554%
34748	1,174,626	0.0163%	30,110,008	0.4624%	0	0.0000%	34,966,593	0.7486%	66,251,226	0.3203%
34753	85,834	0.0012%	1,749,418	0.0269%	0	0.0000%	1,900,072	0.0407%	3,735,324	0.0181%
34756	1,123,863	0.0156%	3,844,975	0.0590%	0	0.0000%	3,260,172	0.0698%	8,229,010	0.0398%
34758	45,596,876	0.6344%	28,389,854	0.4359%	0	0.0000%	26,058,208	0.5579%	100,044,939	0.4837%
34759	44,645,553	0.6212%	19,056,386	0.2926%	0	0.0000%	24,632,112	0.5273%	88,334,052	0.4271%
34760	600,405	0.0084%	464,133	0.0071%	0	0.0000%	442,064	0.0095%	1,506,602	0.0073%
34761	28,472,938	0.3962%	12,832,889	0.1971%	0	0.0000%	11,530,731	0.2469%	52,836,558	0.2554%
34762	17,263	0.0002%	445,939	0.0068%	0	0.0000%	509,085	0.0109%	972,287	0.0047%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal and Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34769	23,562,512	0.3279%	17,239,384	0.2647%	0	0.0000%	12,284,191	0.2630%	53,086,087	0.2566%
34771	10,209,333	0.1421%	12,447,737	0.1911%	0	0.0000%	8,340,985	0.1786%	30,998,054	0.1499%
34772	18,017,548	0.2507%	20,694,089	0.3178%	0	0.0000%	14,832,105	0.3175%	53,543,742	0.2589%
34773	700,433	0.0097%	2,525,946	0.0388%	0	0.0000%	1,720,475	0.0368%	4,946,853	0.0239%
34785	0	0.0000%	6,937,787	0.1065%	0	0.0000%	10,419,684	0.2231%	17,357,471	0.0839%
34786	37,779,285	0.5257%	32,970,806	0.5063%	0	0.0000%	27,874,922	0.5968%	98,625,013	0.4768%
34787	29,925,683	0.4164%	23,986,969	0.3683%	0	0.0000%	21,962,718	0.4702%	75,875,369	0.3668%
34788	1,066,597	0.0148%	13,003,368	0.1997%	0	0.0000%	19,367,980	0.4146%	33,437,945	0.1617%
34797	80,796	0.0011%	985,404	0.0151%	0	0.0000%	1,155,389	0.0247%	2,221,589	0.0107%
34945	180,287	0.0025%	6,759,699	0.1038%	0	0.0000%	6,570,549	0.1407%	13,510,535	0.0653%
34946	74,767	0.0010%	11,769,954	0.1807%	0	0.0000%	11,814,559	0.2529%	23,659,279	0.1144%
34947	63,424	0.0009%	7,442,670	0.1143%	0	0.0000%	7,711,041	0.1651%	15,217,135	0.0736%
34949	239,815	0.0033%	49,676,815	0.7628%	0	0.0000%	54,046,350	1.1570%	103,962,980	0.5026%
34950	87,266	0.0012%	15,477,426	0.2377%	0	0.0000%	15,978,907	0.3421%	31,543,599	0.1525%
34951	680,239	0.0095%	54,407,179	0.8355%	0	0.0000%	46,570,102	0.9970%	101,657,519	0.4915%
34952	528,145	0.0073%	78,949,988	1.2123%	0	0.0000%	83,258,654	1.7824%	162,736,787	0.7868%
34953	929,809	0.0129%	39,973,609	0.6138%	0	0.0000%	44,339,497	0.9492%	85,242,915	0.4121%
34956	118,217	0.0016%	5,535,864	0.0850%	0	0.0000%	4,343,264	0.0930%	9,997,345	0.0483%
34957	0	0.0000%	56,347,578	0.8652%	0	0.0000%	49,379,665	1.0571%	105,727,243	0.5111%
34972	947,024	0.0132%	13,705,202	0.2105%	0	0.0000%	11,462,112	0.2454%	26,114,338	0.1263%
34974	5,730,502	0.0797%	43,059,669	0.6612%	0	0.0000%	34,796,846	0.7449%	83,587,017	0.4041%
34981	43,599	0.0006%	4,399,155	0.0676%	0	0.0000%	4,471,129	0.0957%	8,913,883	0.0431%

	Hurricane Charley		**Hurricane Frances**		**Hurricane Ivan**		**Hurricane Jeanne**		**Total**	
ZIP Code	**Personal and Commercial Residential Monetary Contribution ($)**	**Percent of Losses (%)**	**Personal and Commercial Residential Monetary Contribution ($)**	**Percent of Losses (%)**	**Personal and Commercial Residential Monetary Contribution ($)**	**Percent of Losses (%)**	**Personal and Commercial Residential Monetary Contribution ($)**	**Percent of Losses (%)**	**Personal and Commercial Residential Monetary Contribution ($)**	**Percent of Losses (%)**
34982	245,467	0.0034%	41,215,796	0.6329%	0	0.0000%	41,799,090	0.8949%	83,260,353	0.4025%
34983	564,184	0.0079%	35,454,428	0.5444%	0	0.0000%	39,869,333	0.8535%	75,887,945	0.3669%
34984	208,701	0.0029%	13,483,100	0.2070%	0	0.0000%	16,020,406	0.3430%	29,712,207	0.1436%
34986	578,566	0.0081%	24,547,265	0.3769%	0	0.0000%	25,406,280	0.5439%	50,532,111	0.2443%
34987	167,990	0.0023%	5,307,318	0.0815%	0	0.0000%	5,318,609	0.1139%	10,793,917	0.0522%
34990	429,791	0.0060%	42,613,664	0.6544%	0	0.0000%	44,099,646	0.9441%	87,143,100	0.4213%
34994	0	0.0000%	20,160,609	0.3096%	0	0.0000%	17,945,520	0.3842%	38,106,129	0.1842%
34996	0	0.0000%	44,184,169	0.6785%	0	0.0000%	35,610,957	0.7624%	79,795,126	0.3858%
34997	0	0.0000%	70,293,325	1.0794%	0	0.0000%	60,088,997	1.2864%	130,382,322	0.6303%

Note: ZIP Codes where total losses are equal to or greater than $500,000 are shown.

B. *Provide maps color-coded by ZIP Code depicting the percentage of total residential losses from each hurricane, Hurricane Charley (2004), Hurricane Frances (2004), Hurricane Ivan (2004), and Hurricane Jeanne (2004) and for the cumulative losses using the following interval coding:*

Red	*5%*
Light Red	*2% to 5%*
Pink	*1% to 2%*
Light Pink	*0.5% to 1%*
Light Blue	*0.2% to 0.5%*
Medium Blue	*0.1% to 0.2%*
Blue	*0.1%*

Plot the relevant storm track on each map.

The maps in Figure 84 to Figure 88 depict the percentage of gross, zero deductible losses from each specified event and in total for all events.

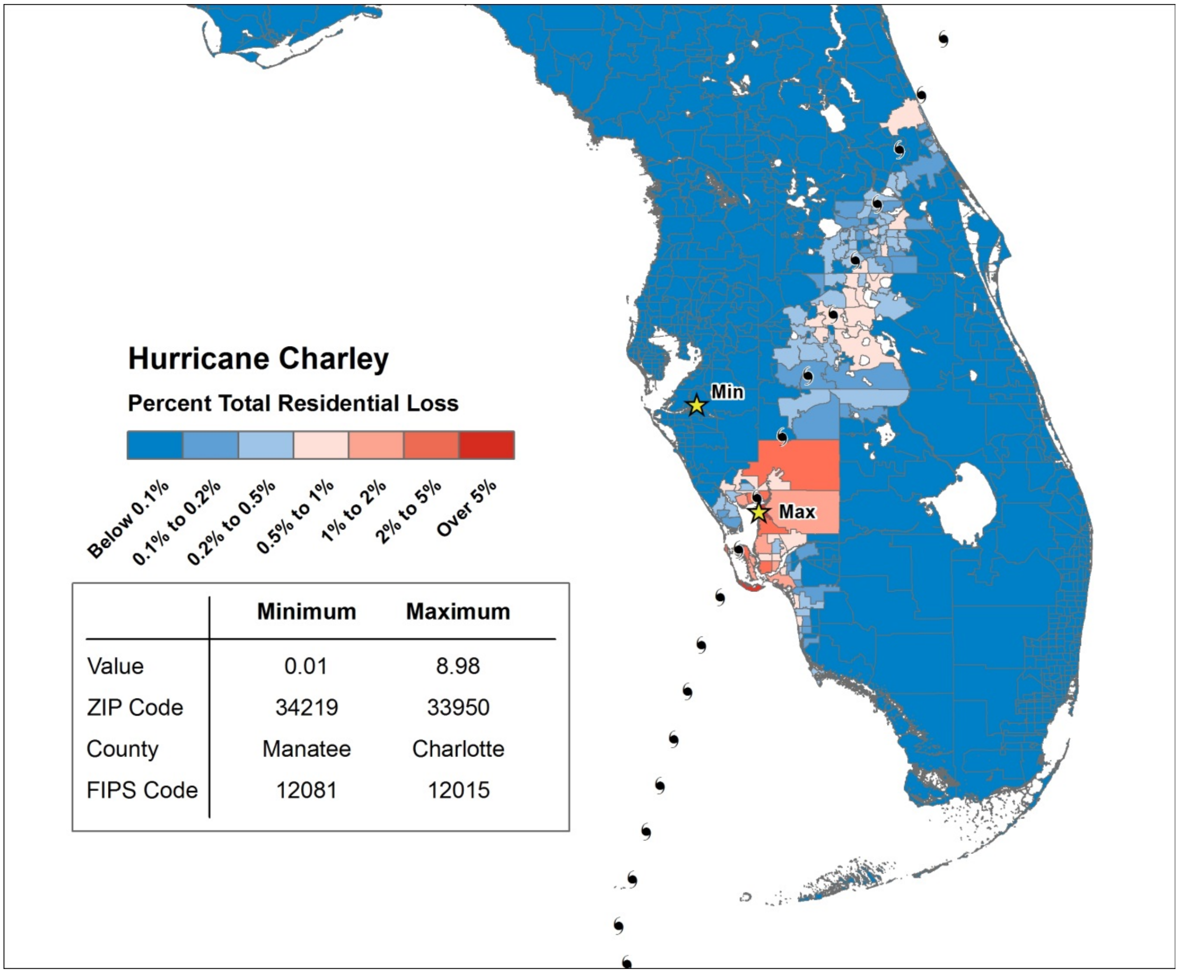
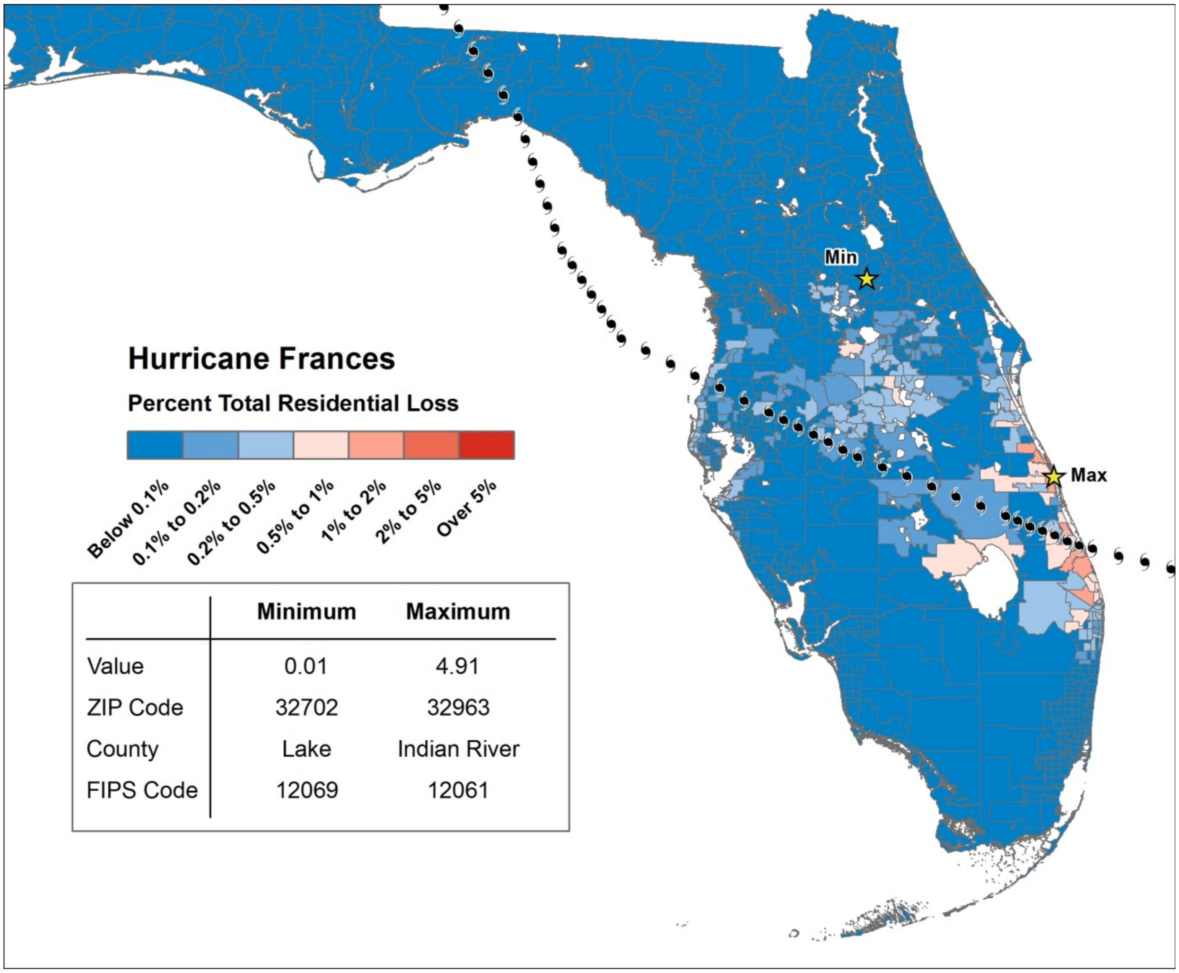
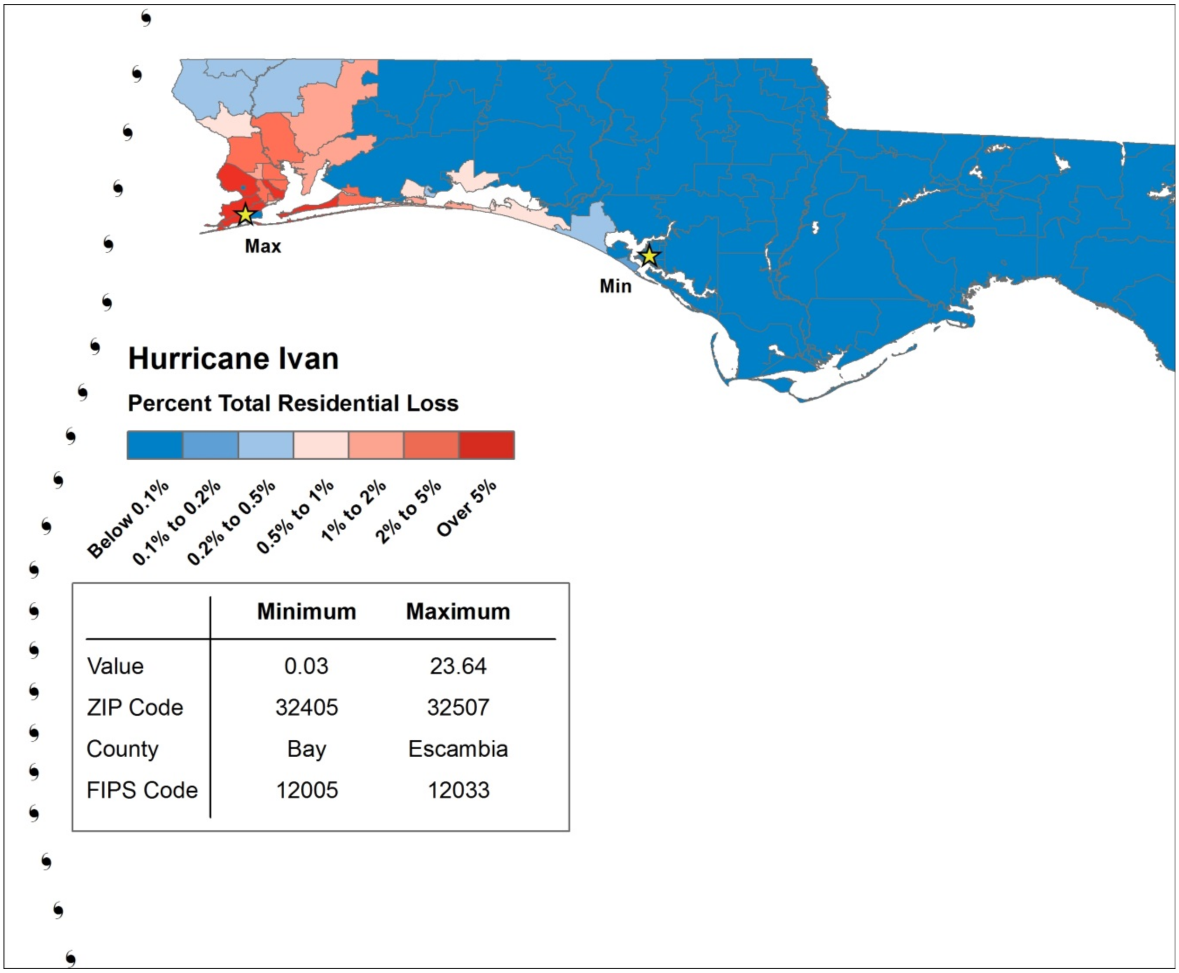


Figure 84. Percentage of Total Residential Loss from Hurricane Charley (2004)



	Minimum	Maximum
Value	0.01	4.91
ZIP Code	32702	32963
County	Lake	Indian River
FIPS Code	12069	12061

Figure 85. Percentage of Total Residential Loss from Hurricane Frances (2004)



	Minimum	Maximum
Value	0.03	23.64
ZIP Code	32405	32507
County	Bay	Escambia
FIPS Code	12005	12033

Figure 86. Percentage of Total Residential Loss from Hurricane Ivan (2004)

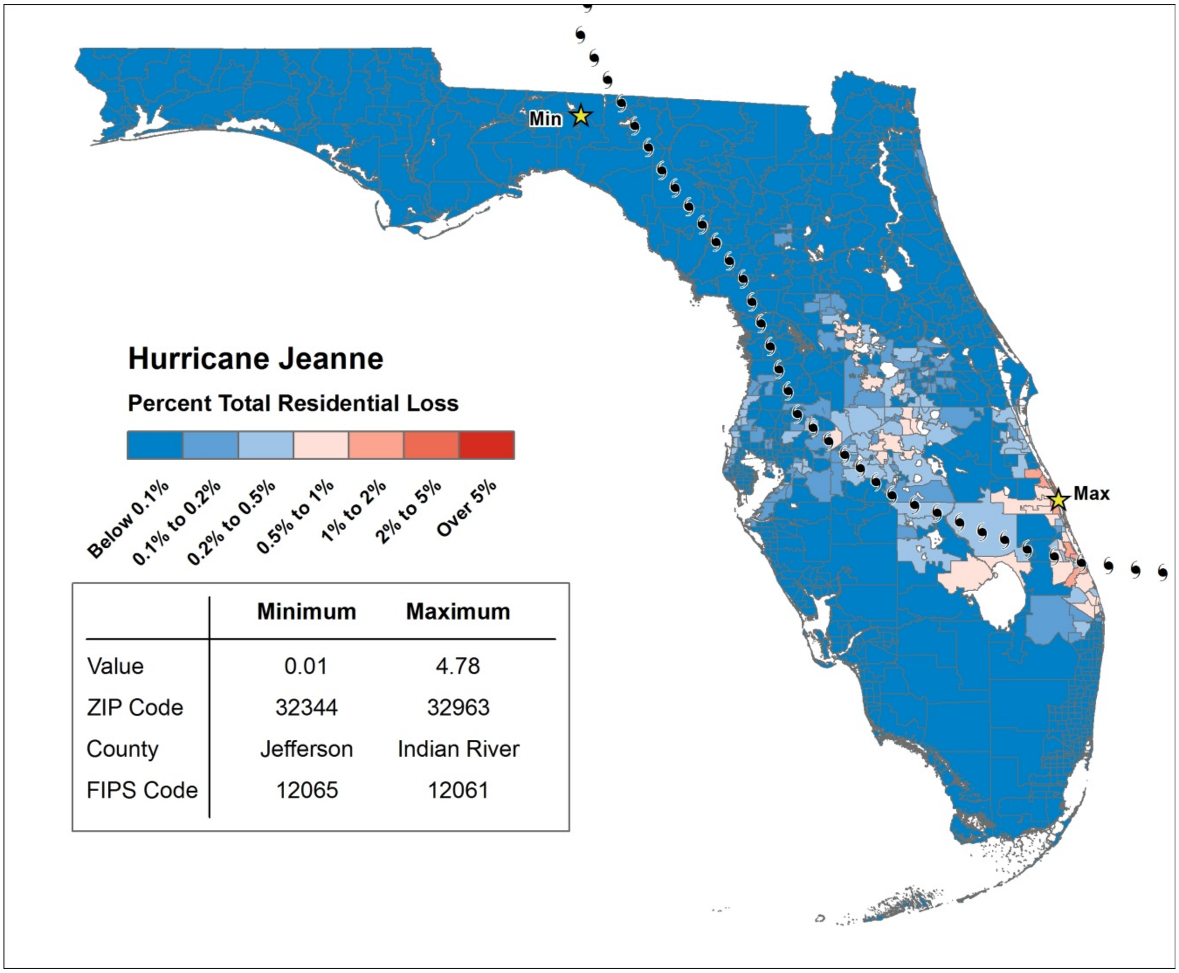
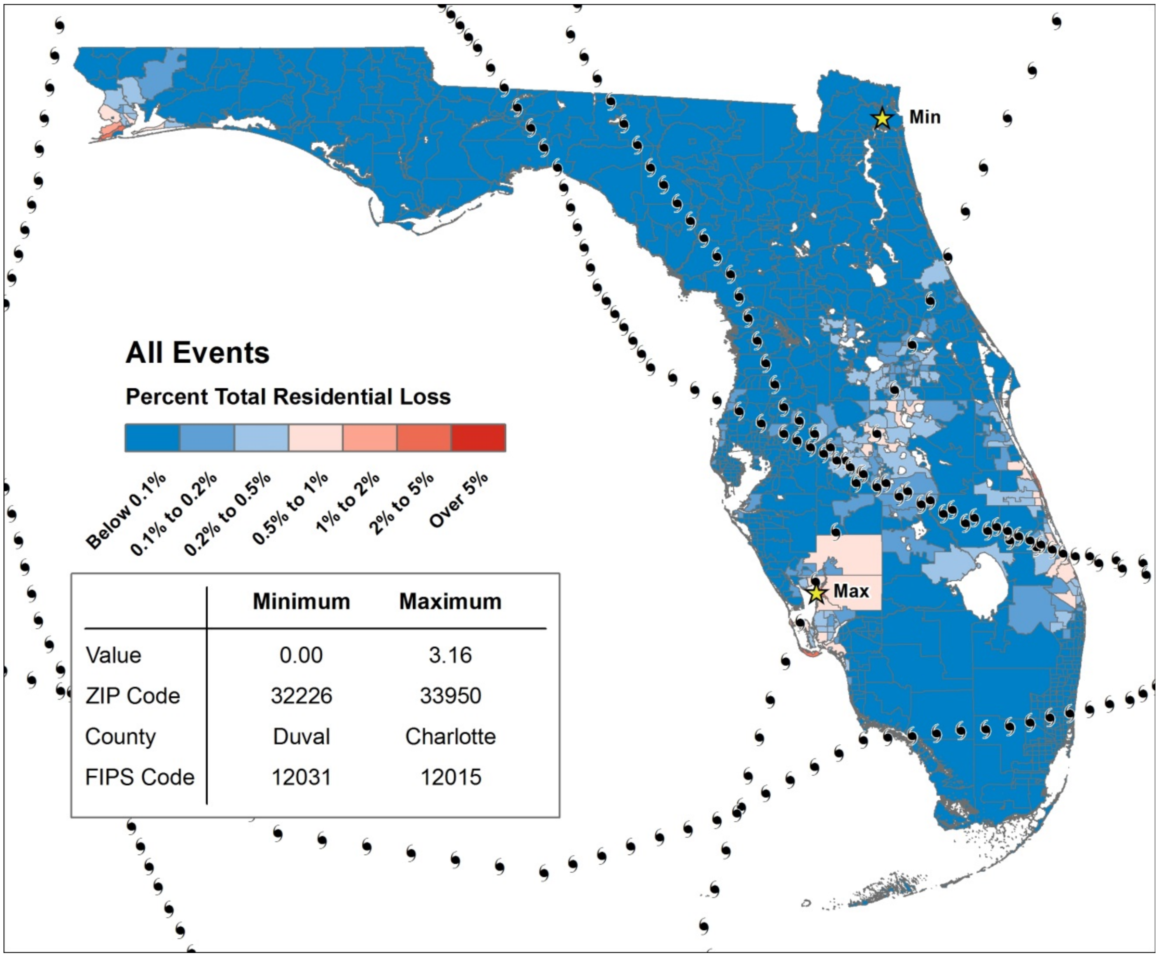


Figure 87. Percentage of Total Residential Loss from Hurricane Jeanne (2004)



	Minimum	Maximum
Value	0.00	3.16
ZIP Code	32226	33950
County	Duval	Charlotte
FIPS Code	12031	12015

Figure 88. Percentage of Total Residential Loss from All Events (2004)

C. *Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include Form A-3, 2004 Hurricane Season Losses, in a submission appendix.*

A hard copy of Form A-3 is included in this submission appendix and is also provided in Excel format.

Standard A-6, Disclosure 3

Form A-4: Output Ranges

A. *Provide personal and commercial residential output ranges in the format shown in the file named "*2015FormA4A.xlsx*" by using an automated program or script. Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include Form A-4, Output Ranges, in a submission appendix.*

A hard copy of Form A-4 is included in this submission appendix and is also provided in Excel format.

B. *Provide loss costs rounded to three decimal places by county. Within each county, loss costs shall be shown separately per $1,000 of exposure for frame owners, masonry owners, frame renters, masonry renters, frame condo unit owners, masonry condo unit owners, manufactured home, and commercial residential. For each of these categories using ZIP Code centroids, the output range shall show the highest loss cost, the lowest loss cost, and the weighted average loss cost. The aggregate residential exposure data for this form shall be developed from the information in the file named "*hlpm2012c.exe*," except for insured value and deductibles information. Insured values shall be based on the output range specifications given below. Deductible amounts of 0% and as specified in the output range specifications given below shall be assumed to be uniformly applied to all risks. When calculating the weighted average loss costs, weight the loss costs by the total insured value calculated above. Include the statewide range of loss costs (i.e., low, high, and weighted average).*

All requested loss costs are provided in Form A-4, calculated using gross modeled losses based on the 2012 FHCF aggregate exposure data prepared as specified.

There are several county and type of business combinations for which there are no exposures in the "hlpm2012c.exe" file. In these cases, a loss cost is not generated by the software costs. "NA" has been used to signify no exposure.

C. *If a modeling organization has loss costs for a ZIP Code for which there is no exposure, give the loss costs zero weight (i.e., assume the exposure in that ZIP Code is zero). Provide a list in the submission document of those ZIP Codes where this occurs.*

A loss cost is not produced in any case where there is no exposure.

D. *If a modeling organization does not have loss costs for a ZIP Code for which there is some exposure, do not assume such loss costs are zero, but use only the exposures for which there are loss costs in calculating the weighted average loss costs. Provide a list in the submission document of the ZIP Codes where this occurs.*

There are no ZIP Codes in the FHCF data for which AIR does not produce loss costs. FHCF ZIP Codes are remapped to current ZIP Codes by AIR.

E. *NA shall be used in cells to signify no exposure.*

NA has been used in cells to signify no exposure.

F. All anomalies in loss costs that are not consistent with the requirements of Standard A-6, Loss Outputs and Logical Relationships to Risk, and have been explained in Disclosure A-6.12 shall be shaded.

All such anomalies are shaded in orange below in

Table 48 and Table 49.

G. Indicate if per diem is used in producing loss costs for Coverage D (Time Element) in the personal residential output ranges. If a per diem rate is used, a rate of $150.00 per day per policy shall be used.

A $150 per diem per policy is used in producing loss costs for Coverage D.

Standard A-6, Disclosure 5

Table 48. Output Ranges—Loss Costs per $1000 for 0% Deductible

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Alachua	LOW	0.325	0.266	2.511	0.304	0.189	0.295	0.207	0.244
	AVERAGE	0.795	0.723	4.910	0.654	0.449	0.686	0.455	0.588
	HIGH	1.176	0.945	8.534	0.978	0.627	0.940	0.643	0.818
Baker	LOW	0.229	0.194	1.707	0.208	0.164	NA	NA	NA
	AVERAGE	0.514	0.449	3.022	0.463	0.335	NA	NA	NA
	HIGH	0.680	0.546	5.265	0.554	0.365	NA	NA	NA
Bay	LOW	0.708	0.718	5.534	0.844	0.731	1.341	0.753	1.032
	AVERAGE	5.095	3.966	17.918	4.087	2.856	7.984	4.517	5.827
	HIGH	10.976	9.081	47.954	10.265	6.879	9.898	6.714	8.178
Bradford	LOW	0.319	0.276	2.205	0.313	0.207	NA	NA	NA
	AVERAGE	0.765	0.669	4.173	0.685	0.438	NA	NA	NA
	HIGH	0.908	0.729	6.880	0.743	0.480	NA	NA	NA
Brevard	LOW	0.809	0.683	7.244	0.859	0.473	1.044	0.473	0.326
	AVERAGE	4.055	3.303	27.607	3.771	2.628	4.056	3.682	3.682
	HIGH	11.883	9.887	51.358	10.738	7.239	10.374	7.095	8.905

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Broward	LOW	1.062	0.894	11.459	0.899	0.510	0.874	0.535	0.496
	AVERAGE	7.506	5.429	40.101	4.930	4.321	5.718	4.579	5.112
	HIGH	20.212	16.984	73.995	18.355	12.497	16.990	12.303	14.944
Calhoun	LOW	0.709	0.451	4.139	0.593	0.670	NA	NA	NA
	AVERAGE	1.455	1.222	6.817	1.315	0.851	NA	NA	NA
	HIGH	2.117	1.704	13.990	1.839	0.900	NA	NA	NA
Charlotte	LOW	0.855	0.721	5.919	0.979	0.469	0.737	0.491	0.490
	AVERAGE	3.617	2.468	16.442	2.774	1.668	4.023	1.738	2.004
	HIGH	8.708	7.260	38.116	7.740	5.211	7.463	5.137	6.635
Citrus	LOW	0.516	0.415	3.989	0.551	0.297	0.572	0.419	0.514
	AVERAGE	1.532	1.079	8.601	1.240	0.742	1.373	0.921	1.144
	HIGH	1.946	1.570	12.324	1.648	1.051	1.594	1.056	1.512
Clay	LOW	0.312	0.250	2.360	0.265	0.215	0.275	0.200	0.254
	AVERAGE	0.751	0.704	4.451	0.663	0.477	0.578	0.391	0.594
	HIGH	1.134	0.912	8.148	0.940	0.606	0.933	0.624	0.907
Collier	LOW	1.169	0.986	8.213	1.024	0.645	0.940	0.594	0.516
	AVERAGE	5.476	3.972	27.751	4.648	3.165	5.591	3.622	3.791
	HIGH	14.774	12.394	57.013	13.419	9.176	12.944	8.977	11.064

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Columbia	LOW	0.262	0.210	1.985	0.247	0.179	0.524	0.327	0.294
	AVERAGE	0.649	0.553	3.804	0.531	0.360	0.586	0.402	0.315
	HIGH	0.918	0.740	6.818	0.759	0.482	0.743	0.414	0.416
DeSoto	LOW	0.956	0.764	7.118	1.001	0.678	1.133	0.705	1.030
	AVERAGE	2.594	1.958	13.007	2.285	1.324	1.754	1.161	1.274
	HIGH	3.001	2.415	19.896	2.519	1.589	2.193	1.601	1.669
Dixie	LOW	0.504	0.358	2.855	0.415	0.448	0.451	0.253	0.338
	AVERAGE	1.116	0.802	5.356	0.903	0.593	0.860	0.539	0.732
	HIGH	2.857	2.350	15.389	1.008	0.654	1.127	0.752	0.959
Duval	LOW	0.264	0.231	2.045	0.262	0.181	0.300	0.186	0.134
	AVERAGE	0.966	0.834	4.974	0.795	0.544	0.711	0.544	0.702
	HIGH	2.917	2.524	16.901	2.530	1.772	2.477	1.573	2.389
Escambia	LOW	0.553	0.468	5.013	0.616	0.691	1.163	0.835	0.879
	AVERAGE	4.858	4.500	18.306	4.453	3.272	6.257	4.537	4.961
	HIGH	11.301	9.363	49.190	12.537	8.397	10.022	6.826	8.525
Flagler	LOW	0.439	0.352	3.468	0.441	0.234	0.669	0.265	0.339
	AVERAGE	2.001	1.212	10.471	1.470	0.777	2.315	1.018	1.294
	HIGH	4.254	3.458	23.829	3.758	2.439	3.633	2.400	3.295

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Franklin	LOW	2.186	1.776	11.634	3.065	2.526	2.657	1.884	4.142
	AVERAGE	6.612	6.231	22.400	7.143	4.811	4.549	4.472	5.254
	HIGH	9.298	7.701	39.875	8.691	5.857	8.396	5.701	6.760
Gadsden	LOW	0.332	0.302	2.457	0.267	0.285	NA	0.555	0.609
	AVERAGE	0.860	0.765	4.872	0.830	0.558	NA	0.555	0.870
	HIGH	1.096	0.881	8.188	0.919	0.591	NA	0.555	0.887
Gilchrist	LOW	0.483	0.312	2.839	0.438	0.340	NA	0.617	NA
	AVERAGE	0.990	0.837	5.167	0.986	0.643	NA	0.617	NA
	HIGH	1.283	1.038	8.792	1.079	0.697	NA	0.617	NA
Glades	LOW	1.273	1.018	9.532	2.951	1.543	NA	NA	NA
	AVERAGE	3.480	2.405	17.670	3.242	1.944	NA	NA	NA
	HIGH	3.941	3.166	25.882	3.315	2.078	NA	NA	NA
Gulf	LOW	0.746	0.600	4.942	0.941	0.604	1.385	0.984	0.840
	AVERAGE	4.542	4.452	15.294	5.234	3.286	3.112	1.564	3.294
	HIGH	7.261	5.956	34.311	6.723	4.420	6.433	4.302	5.481
Hamilton	LOW	0.264	0.189	1.679	0.233	0.259	NA	NA	NA
	AVERAGE	0.521	0.449	2.951	0.463	0.316	NA	NA	NA
	HIGH	0.668	0.536	5.306	0.542	0.355	NA	NA	NA

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Hardee	LOW	0.855	0.684	6.484	0.882	0.611	NA	1.392	0.689
	AVERAGE	2.335	1.806	12.084	2.002	1.244	NA	1.392	1.008
	HIGH	2.663	2.136	18.205	2.222	1.399	NA	1.392	1.327
Hendry	LOW	1.295	1.037	7.504	1.127	0.982	3.001	0.883	1.261
	AVERAGE	3.917	2.918	18.737	3.311	2.105	3.743	2.087	2.052
	HIGH	5.115	4.107	32.286	4.355	2.706	4.164	2.711	2.833
Hernando	LOW	0.668	0.486	4.541	0.638	0.330	1.230	0.585	0.480
	AVERAGE	2.257	1.584	11.268	1.592	1.039	2.314	1.440	1.129
	HIGH	4.395	3.619	21.116	3.881	2.568	3.743	2.526	2.451
Highlands	LOW	0.838	0.662	6.374	0.885	0.437	0.848	0.599	0.652
	AVERAGE	2.442	1.895	15.808	2.004	1.207	2.055	1.390	1.503
	HIGH	4.024	3.232	26.626	3.385	2.122	2.852	1.868	2.835
Hillsborough	LOW	0.719	0.575	5.575	0.646	0.386	0.621	0.417	0.513
	AVERAGE	2.578	1.985	13.002	2.031	1.387	2.107	1.484	1.614
	HIGH	6.344	5.241	27.917	5.585	3.711	5.387	3.654	4.863
Holmes	LOW	0.476	0.403	3.756	0.562	0.773	1.194	NA	0.806
	AVERAGE	1.236	1.089	6.355	1.085	0.773	1.194	NA	0.926
	HIGH	1.449	1.164	10.581	1.210	0.773	1.194	NA	1.167

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Indian River	LOW	1.252	1.002	10.557	1.488	0.782	1.318	0.815	0.894
	AVERAGE	7.233	4.299	28.888	6.275	3.465	6.658	5.332	5.571
	HIGH	14.470	12.075	59.352	13.144	8.913	12.696	8.716	10.824
Jackson	LOW	0.398	0.365	2.835	0.431	0.453	NA	0.642	0.327
	AVERAGE	1.093	0.948	5.746	0.958	0.656	NA	0.678	0.698
	HIGH	1.668	1.342	11.775	1.270	0.738	NA	0.722	1.052
Jefferson	LOW	0.265	0.225	2.145	0.280	0.194	0.527	NA	NA
	AVERAGE	0.649	0.540	3.709	0.615	0.391	0.527	NA	NA
	HIGH	0.844	0.678	6.399	0.706	0.456	0.527	NA	NA
Lafayette	LOW	0.423	0.358	2.405	0.548	0.435	0.751	NA	NA
	AVERAGE	0.817	0.700	4.259	0.772	0.507	0.751	NA	NA
	HIGH	0.968	0.780	6.894	0.814	0.530	0.751	NA	NA
Lake	LOW	0.517	0.380	3.670	0.432	0.368	0.608	0.400	0.515
	AVERAGE	1.606	1.214	12.048	1.223	0.798	1.607	1.022	1.327
	HIGH	2.587	2.075	18.016	2.142	1.358	1.959	1.298	1.955
Lee	LOW	0.888	0.749	6.384	0.792	0.458	0.754	0.467	0.389
	AVERAGE	5.001	2.315	22.566	2.967	1.718	4.307	2.160	2.497
	HIGH	12.945	10.862	50.316	11.664	7.980	11.251	7.814	9.734

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Leon	LOW	0.312	0.264	2.409	0.244	0.185	0.307	0.207	0.141
	AVERAGE	0.858	0.739	5.151	0.694	0.471	0.553	0.430	0.502
	HIGH	1.107	0.891	7.890	0.938	0.603	0.877	0.619	0.890
Levy	LOW	0.441	0.360	3.386	0.505	0.313	1.685	1.185	0.734
	AVERAGE	1.537	1.035	6.385	1.289	0.697	3.008	2.047	2.229
	HIGH	4.444	3.674	21.232	4.009	2.680	3.855	2.634	3.410
Liberty	LOW	0.650	0.551	3.773	0.560	0.849	NA	NA	NA
	AVERAGE	1.279	1.113	6.372	1.248	0.849	NA	NA	NA
	HIGH	1.556	1.253	10.800	1.329	0.849	NA	NA	NA
Madison	LOW	0.267	0.235	1.753	0.256	0.184	NA	NA	NA
	AVERAGE	0.621	0.523	3.416	0.555	0.370	NA	NA	NA
	HIGH	0.740	0.595	5.653	0.612	0.400	NA	NA	NA
Manatee	LOW	0.758	0.639	5.405	0.587	0.416	0.653	0.415	0.448
	AVERAGE	4.150	2.656	19.979	3.569	1.883	4.576	2.909	3.109
	HIGH	10.856	9.075	45.360	9.671	6.589	9.373	6.466	8.140
Marion	LOW	0.351	0.281	2.713	0.364	0.254	0.458	0.290	0.297
	AVERAGE	1.226	0.853	7.411	0.911	0.582	1.002	0.681	0.763
	HIGH	1.578	1.267	11.446	1.299	0.827	1.271	0.849	1.274

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Martin	LOW	1.626	1.302	10.837	2.101	1.026	2.122	0.936	1.009
	AVERAGE	8.816	5.946	47.946	8.255	4.676	10.279	5.834	5.760
	HIGH	14.736	12.170	64.025	13.464	8.926	12.961	8.719	11.087
Miami-Dade	LOW	1.091	0.910	11.724	1.023	0.614	0.965	0.546	0.526
	AVERAGE	8.212	5.971	30.466	8.088	5.693	7.856	5.873	5.244
	HIGH	27.188	22.954	65.607	24.778	17.164	24.094	16.790	19.857
Monroe	LOW	6.292	5.145	34.856	8.722	4.001	7.259	3.493	3.255
	AVERAGE	21.824	18.669	83.664	24.674	16.672	23.359	15.316	13.783
	HIGH	30.849	26.287	99.307	28.590	20.253	27.787	19.763	22.202
Nassau	LOW	0.220	0.187	1.709	0.215	0.155	0.583	0.251	0.256
	AVERAGE	1.162	0.860	4.214	1.202	0.751	1.363	1.021	1.063
	HIGH	2.121	1.735	12.989	1.824	1.205	1.782	1.216	1.664
Okaloosa	LOW	0.540	0.509	4.020	0.610	0.439	0.774	0.407	0.726
	AVERAGE	5.499	5.022	13.539	5.093	3.904	7.640	5.813	5.596
	HIGH	12.606	10.438	53.739	11.801	7.915	11.389	7.718	9.359
Okeechobee	LOW	1.384	1.169	10.799	2.548	1.058	2.434	0.860	1.892
	AVERAGE	4.952	3.586	28.709	4.359	2.683	3.607	3.301	2.912
	HIGH	6.655	5.372	38.670	5.786	3.637	5.525	3.607	3.652

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Orange	LOW	0.565	0.465	4.503	0.456	0.297	0.488	0.316	0.223
	AVERAGE	1.497	1.251	11.584	1.169	0.753	1.143	0.775	0.992
	HIGH	2.451	1.966	16.947	2.027	1.289	1.946	1.291	1.941
Osceola	LOW	0.594	0.502	4.855	0.558	0.354	0.541	0.352	0.239
	AVERAGE	1.718	1.451	13.430	1.354	0.859	1.237	0.755	0.969
	HIGH	3.183	2.552	21.740	2.666	1.544	2.275	1.568	2.257
Palm Beach	LOW	1.551	1.309	10.905	1.329	0.860	1.252	0.797	0.916
	AVERAGE	8.839	6.034	40.136	7.927	5.203	8.228	5.336	5.584
	HIGH	19.179	16.026	72.847	17.481	11.839	17.013	11.643	14.236
Pasco	LOW	0.697	0.522	4.916	0.715	0.439	0.618	0.439	0.431
	AVERAGE	2.213	2.357	13.446	1.738	1.409	2.083	2.181	2.126
	HIGH	6.141	5.098	28.616	5.420	3.619	5.242	3.581	4.663
Pinellas	LOW	0.884	0.715	5.612	1.026	0.494	1.073	0.510	0.659
	AVERAGE	5.594	4.309	22.978	3.992	2.952	4.515	3.295	3.196
	HIGH	9.982	8.377	37.583	8.942	6.145	8.654	6.025	7.511
Polk	LOW	0.601	0.507	4.890	0.527	0.350	0.525	0.329	0.478
	AVERAGE	1.769	1.358	12.151	1.338	0.931	1.212	0.943	1.022
	HIGH	2.523	2.022	17.741	2.079	1.317	1.974	1.309	1.985

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Putnam	LOW	0.369	0.285	2.637	0.385	0.266	0.401	0.277	0.577
	AVERAGE	0.990	0.825	6.235	0.863	0.554	0.806	0.454	0.742
	HIGH	1.583	1.269	11.583	1.229	0.782	1.212	0.807	0.887
St. Johns	LOW	0.386	0.327	3.029	0.342	0.258	0.339	0.247	0.283
	AVERAGE	1.463	1.453	8.478	1.487	1.006	1.929	1.469	1.607
	HIGH	3.868	3.144	21.895	3.396	2.227	3.302	2.199	2.998
St. Lucie	LOW	1.475	1.246	13.020	1.716	0.818	1.342	0.854	0.876
	AVERAGE	6.421	3.468	36.771	5.764	2.890	6.901	4.715	4.553
	HIGH	15.581	12.952	65.605	14.217	9.533	13.702	9.320	11.659
Santa Rosa	LOW	0.577	0.645	5.207	0.619	0.602	2.265	1.679	0.715
	AVERAGE	5.014	4.452	18.011	5.461	3.583	10.911	6.151	5.652
	HIGH	15.099	12.586	61.899	13.989	9.516	13.450	9.285	11.237
Sarasota	LOW	0.743	0.627	5.457	0.883	0.586	0.681	0.451	0.462
	AVERAGE	4.516	3.137	24.203	3.579	2.460	4.948	3.183	3.181
	HIGH	9.192	7.721	37.066	8.226	5.645	7.968	5.552	6.930
Seminole	LOW	0.556	0.445	4.412	0.439	0.295	0.486	0.336	0.218
	AVERAGE	1.508	1.226	11.314	1.187	0.767	1.192	0.804	0.998
	HIGH	1.985	1.591	14.299	1.639	1.041	1.602	1.015	1.525

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Sumter	LOW	0.522	0.441	4.168	0.556	0.294	0.580	0.399	0.429
	AVERAGE	0.903	0.756	9.678	0.833	0.594	1.174	0.556	0.699
	HIGH	1.900	1.524	13.435	1.531	0.997	1.427	0.928	1.399
Suwannee	LOW	0.289	0.232	2.119	0.278	0.201	0.521	0.275	0.501
	AVERAGE	0.714	0.595	3.951	0.612	0.417	0.521	0.275	0.670
	HIGH	1.007	0.812	7.301	0.838	0.544	0.521	0.275	0.767
Taylor	LOW	0.363	0.329	2.592	0.607	0.393	0.445	0.474	0.725
	AVERAGE	1.022	0.836	5.208	0.857	0.565	0.874	0.658	0.725
	HIGH	2.018	1.642	11.992	1.768	1.162	1.728	0.879	0.725
Union	LOW	0.321	0.242	2.125	0.301	0.161	0.313	0.228	0.676
	AVERAGE	0.678	0.579	3.810	0.606	0.415	0.313	0.228	0.676
	HIGH	0.840	0.674	6.423	0.689	0.449	0.313	0.228	0.676
Volusia	LOW	0.468	0.381	3.780	0.438	0.263	0.454	0.310	0.334
	AVERAGE	2.344	1.690	13.855	1.780	1.200	2.730	2.144	1.978
	HIGH	5.614	4.582	29.814	5.011	3.247	4.856	3.214	4.307
Wakulla	LOW	0.454	0.385	3.516	0.395	0.368	0.975	1.821	0.377
	AVERAGE	1.317	1.248	6.813	1.011	0.676	1.972	2.565	1.970
	HIGH	4.491	3.705	19.261	3.476	2.760	3.965	2.687	2.878

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
Walton	LOW	0.620	0.497	4.727	0.592	0.464	1.387	1.008	0.489
	AVERAGE	4.720	3.355	12.172	4.599	3.303	7.985	4.268	6.010
	HIGH	11.446	9.492	49.407	10.594	7.127	10.181	6.946	8.536
Washington	LOW	0.623	0.501	4.444	0.657	0.469	0.967	NA	0.716
	AVERAGE	1.542	1.389	7.408	1.475	0.984	0.967	NA	0.841
	HIGH	2.635	2.125	16.752	2.293	1.457	0.967	NA	1.025
Statewide	LOW	0.220	0.187	1.679	0.208	0.155	0.275	0.186	0.134
	AVERAGE	3.130	3.266	15.778	2.345	2.444	3.448	3.754	3.903
	HIGH	30.849	26.287	99.307	28.590	20.253	27.787	19.763	22.202

Table 49. Loss Costs per $1000 with Specified Deductibles

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
ALACHUA	LOW	0.240	0.197	1.912	0.237	0.143	0.222	0.152	0.164
	AVERAGE	0.591	0.535	4.044	0.504	0.346	0.510	0.336	0.391
	HIGH	0.889	0.707	7.314	0.763	0.488	0.708	0.480	0.540
BAKER	LOW	0.171	0.145	1.263	0.161	0.124	NA	NA	NA
	AVERAGE	0.382	0.333	2.392	0.358	0.257	NA	NA	NA
	HIGH	0.506	0.406	4.339	0.429	0.281	NA	NA	NA
BAY	LOW	0.513	0.524	4.507	0.625	0.559	0.992	0.552	0.710
	AVERAGE	4.281	3.261	16.130	3.440	2.417	6.916	3.842	4.555
	HIGH	9.654	7.894	44.825	9.098	6.104	8.674	5.835	6.500
BRADFORD	LOW	0.237	0.205	1.663	0.242	0.157	NA	NA	NA
	AVERAGE	0.569	0.496	3.382	0.529	0.338	NA	NA	NA
	HIGH	0.676	0.539	5.776	0.573	0.371	NA	NA	NA
BREVARD	LOW	0.599	0.507	5.867	0.660	0.361	0.784	0.349	0.216
	AVERAGE	3.281	2.661	24.982	3.128	2.204	3.307	3.051	2.793
	HIGH	10.389	8.559	47.704	9.451	6.396	9.006	6.123	7.039
BROWARD	LOW	0.779	0.657	9.482	0.686	0.392	0.650	0.397	0.324
	AVERAGE	6.293	4.455	36.806	4.092	3.683	4.666	3.782	3.973
	HIGH	18.142	15.115	69.571	16.499	11.267	15.074	10.899	12.294

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
CALHOUN	LOW	0.509	0.328	3.289	0.435	0.511	NA	NA	NA
	AVERAGE	1.092	0.906	5.758	1.009	0.658	NA	NA	NA
	HIGH	1.635	1.291	12.464	1.446	0.698	NA	NA	NA
CHARLOTTE	LOW	0.628	0.530	4.740	0.758	0.358	0.553	0.362	0.328
	AVERAGE	2.932	1.947	14.562	2.269	1.358	3.310	1.364	1.456
	HIGH	7.522	6.211	35.097	6.740	4.561	6.387	4.380	5.164
CITRUS	LOW	0.381	0.305	3.177	0.421	0.228	0.428	0.309	0.350
	AVERAGE	1.187	0.822	7.376	0.984	0.587	1.057	0.704	0.794
	HIGH	1.531	1.218	10.793	1.326	0.845	1.239	0.813	1.046
CLAY	LOW	0.231	0.186	1.793	0.208	0.163	0.209	0.147	0.171
	AVERAGE	0.561	0.525	3.630	0.514	0.369	0.433	0.290	0.399
	HIGH	0.860	0.686	6.930	0.735	0.473	0.705	0.468	0.608
COLLIER	LOW	0.854	0.721	6.725	0.789	0.492	0.687	0.436	0.344
	AVERAGE	4.565	3.259	25.191	3.908	2.690	4.689	3.012	2.924
	HIGH	13.077	10.866	53.219	11.926	8.189	11.370	7.844	8.900
COLUMBIA	LOW	0.194	0.156	1.486	0.189	0.134	0.388	0.239	0.199
	AVERAGE	0.482	0.409	3.068	0.407	0.276	0.433	0.296	0.214
	HIGH	0.690	0.552	5.752	0.590	0.372	0.555	0.306	0.282

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
DESOTO	LOW	0.693	0.556	5.774	0.749	0.514	0.833	0.515	0.704
	AVERAGE	1.988	1.476	11.222	1.795	1.039	1.313	0.870	0.882
	HIGH	2.343	1.856	17.642	2.005	1.267	1.639	1.220	1.177
DIXIE	LOW	0.374	0.265	2.246	0.317	0.350	0.334	0.186	0.230
	AVERAGE	0.864	0.609	4.491	0.711	0.469	0.668	0.413	0.510
	HIGH	2.358	1.919	13.752	0.794	0.517	0.887	0.588	0.650
DUVAL	LOW	0.197	0.173	1.543	0.203	0.138	0.227	0.137	0.088
	AVERAGE	0.744	0.637	4.117	0.631	0.431	0.545	0.418	0.487
	HIGH	2.379	2.044	15.007	2.105	1.482	2.010	1.266	1.734
ESCAMBIA	LOW	0.405	0.345	3.923	0.455	0.519	0.842	0.609	0.589
	AVERAGE	3.992	3.670	16.288	3.696	2.751	5.232	3.792	3.745
	HIGH	9.834	8.050	45.745	11.100	7.445	8.661	5.855	6.681
FLAGLER	LOW	0.319	0.257	2.674	0.339	0.176	0.501	0.192	0.224
	AVERAGE	1.590	0.936	9.028	1.191	0.621	1.859	0.794	0.927
	HIGH	3.510	2.820	21.437	3.159	2.052	2.983	1.951	2.419
FRANKLIN	LOW	1.751	1.412	10.195	2.565	2.139	2.169	1.536	3.260
	AVERAGE	5.713	5.367	20.420	6.285	4.250	3.869	3.853	4.157
	HIGH	8.171	6.693	37.193	7.709	5.201	7.358	4.957	5.332

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
GADSDEN	LOW	0.243	0.221	1.882	0.206	0.213	NA	0.405	0.408
	AVERAGE	0.634	0.560	4.034	0.630	0.426	NA	0.405	0.559
	HIGH	0.815	0.648	7.011	0.705	0.455	NA	0.405	0.571
GILCHRIST	LOW	0.359	0.232	2.210	0.338	0.263	NA	0.467	NA
	AVERAGE	0.757	0.636	4.304	0.779	0.508	NA	0.467	NA
	HIGH	0.993	0.795	7.593	0.855	0.553	NA	0.467	NA
GLADES	LOW	0.920	0.739	7.789	2.275	1.198	NA	NA	NA
	AVERAGE	2.679	1.806	15.458	2.543	1.530	NA	NA	NA
	HIGH	3.058	2.411	23.199	2.610	1.641	NA	NA	NA
GULF	LOW	0.536	0.432	3.999	0.704	0.455	1.057	0.752	0.588
	AVERAGE	3.818	3.726	13.736	4.510	2.829	2.554	1.239	2.487
	HIGH	6.262	5.067	31.808	5.855	3.851	5.517	3.652	4.234
HAMILTON	LOW	0.193	0.140	1.237	0.179	0.196	NA	NA	NA
	AVERAGE	0.382	0.329	2.330	0.353	0.240	NA	NA	NA
	HIGH	0.491	0.392	4.376	0.413	0.270	NA	NA	NA
HARDEE	LOW	0.625	0.503	5.160	0.666	0.465	NA	1.041	0.462
	AVERAGE	1.775	1.353	10.329	1.564	0.972	NA	1.041	0.688
	HIGH	2.058	1.628	15.998	1.759	1.107	NA	1.041	0.915

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
HENDRY	LOW	0.942	0.756	6.041	0.859	0.750	2.280	0.639	0.838
	AVERAGE	3.058	2.221	16.520	2.612	1.664	2.864	1.572	1.416
	HIGH	4.029	3.169	29.272	3.469	2.155	3.203	2.066	1.999
HERNANDO	LOW	0.497	0.362	3.652	0.494	0.254	0.948	0.442	0.329
	AVERAGE	1.821	1.253	9.849	1.294	0.848	1.878	1.152	0.809
	HIGH	3.706	3.021	19.039	3.322	2.204	3.133	2.101	1.793
HIGHLANDS	LOW	0.607	0.485	5.012	0.657	0.332	0.611	0.435	0.433
	AVERAGE	1.841	1.406	13.724	1.543	0.931	1.520	1.029	1.023
	HIGH	3.121	2.463	23.847	2.667	1.675	2.159	1.405	1.905
HILLSBOROUGH	LOW	0.528	0.424	4.461	0.512	0.297	0.472	0.312	0.361
	AVERAGE	2.083	1.576	11.373	1.668	1.144	1.690	1.181	1.168
	HIGH	5.426	4.438	25.503	4.830	3.218	4.565	3.079	3.745
HOLMES	LOW	0.345	0.294	2.929	0.419	0.591	0.876	NA	0.541
	AVERAGE	0.914	0.799	5.294	0.820	0.591	0.876	NA	0.613
	HIGH	1.075	0.852	9.141	0.921	0.591	0.876	NA	0.757
INDIAN RIVER	LOW	0.915	0.734	8.767	1.151	0.598	0.973	0.598	0.605
	AVERAGE	6.079	3.517	26.104	5.345	2.932	5.583	4.496	4.356
	HIGH	12.738	10.524	55.358	11.635	7.917	11.095	7.573	8.635

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
JACKSON	LOW	0.291	0.266	2.147	0.317	0.338	NA	0.467	0.216
	AVERAGE	0.804	0.691	4.762	0.720	0.497	NA	0.494	0.459
	HIGH	1.255	0.993	10.297	0.953	0.560	NA	0.528	0.679
JEFFERSON	LOW	0.196	0.166	1.631	0.211	0.145	0.388	NA	NA
	AVERAGE	0.480	0.397	3.012	0.470	0.298	0.388	NA	NA
	HIGH	0.630	0.501	5.429	0.543	0.350	0.388	NA	NA
LAFAYETTE	LOW	0.313	0.265	1.853	0.425	0.339	0.564	NA	NA
	AVERAGE	0.618	0.526	3.499	0.603	0.397	0.564	NA	NA
	HIGH	0.737	0.588	5.864	0.638	0.416	0.564	NA	NA
LAKE	LOW	0.378	0.280	2.803	0.335	0.280	0.441	0.290	0.343
	AVERAGE	1.202	0.896	10.389	0.938	0.614	1.197	0.757	0.884
	HIGH	1.973	1.560	15.847	1.670	1.061	1.466	0.968	1.296
LEE	LOW	0.647	0.546	5.138	0.609	0.351	0.556	0.342	0.257
	AVERAGE	4.166	1.808	20.318	2.427	1.400	3.542	1.731	1.854
	HIGH	11.435	9.506	46.793	10.349	7.111	9.852	6.809	7.818
LEON	LOW	0.227	0.194	1.850	0.186	0.139	0.225	0.150	0.092
	AVERAGE	0.638	0.545	4.319	0.529	0.361	0.405	0.316	0.329
	HIGH	0.836	0.663	6.805	0.729	0.469	0.651	0.459	0.584

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
LEVY	LOW	0.329	0.263	2.669	0.385	0.236	1.352	0.946	0.503
	AVERAGE	1.213	0.790	5.381	1.035	0.548	2.500	1.692	1.657
	HIGH	3.750	3.071	19.125	3.436	2.305	3.237	2.201	2.577
LIBERTY	LOW	0.469	0.396	3.002	0.412	0.658	NA	NA	NA
	AVERAGE	0.958	0.825	5.384	0.960	0.658	NA	NA	NA
	HIGH	1.176	0.932	9.467	1.025	0.658	NA	NA	NA
MADISON	LOW	0.197	0.172	1.297	0.196	0.138	NA	NA	NA
	AVERAGE	0.459	0.385	2.744	0.425	0.282	NA	NA	NA
	HIGH	0.550	0.439	4.724	0.470	0.306	NA	NA	NA
MANATEE	LOW	0.558	0.471	4.351	0.451	0.318	0.487	0.305	0.303
	AVERAGE	3.469	2.166	17.982	3.029	1.585	3.875	2.433	2.406
	HIGH	9.560	7.922	42.163	8.574	5.864	8.186	5.618	6.520
MARION	LOW	0.257	0.207	2.053	0.275	0.193	0.343	0.213	0.197
	AVERAGE	0.925	0.635	6.243	0.707	0.452	0.750	0.510	0.513
	HIGH	1.200	0.951	9.883	1.025	0.652	0.967	0.633	0.847
MARTIN	LOW	1.183	0.949	8.897	1.601	0.786	1.568	0.689	0.684
	AVERAGE	7.473	4.927	44.360	7.088	3.996	8.837	4.914	4.473
	HIGH	12.955	10.578	59.861	11.893	7.897	11.312	7.545	8.842

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
MIAMI-DADE	LOW	0.798	0.668	9.728	0.784	0.469	0.710	0.404	0.343
	AVERAGE	6.912	4.918	27.584	6.961	4.930	6.643	4.978	4.102
	HIGH	24.731	20.713	61.459	22.521	15.641	21.755	15.068	16.668
MONROE	LOW	5.290	4.283	31.852	7.566	3.456	6.179	2.927	2.526
	AVERAGE	19.785	16.807	79.372	22.583	15.273	21.212	13.799	11.567
	HIGH	28.365	23.990	94.785	26.285	18.646	25.413	17.973	18.899
NASSAU	LOW	0.163	0.138	1.282	0.165	0.117	0.454	0.188	0.179
	AVERAGE	0.914	0.669	3.466	0.974	0.610	1.076	0.807	0.756
	HIGH	1.699	1.377	11.387	1.492	0.990	1.417	0.966	1.181
OKALOOSA	LOW	0.392	0.372	3.134	0.447	0.326	0.557	0.293	0.468
	AVERAGE	4.656	4.232	11.948	4.355	3.373	6.589	5.004	4.364
	HIGH	11.148	9.130	50.278	10.507	7.052	10.040	6.744	7.513
OKEECHOBEE	LOW	1.006	0.851	8.891	1.947	0.805	1.820	0.626	1.306
	AVERAGE	3.936	2.783	25.837	3.508	2.164	2.795	2.595	2.037
	HIGH	5.406	4.286	35.342	4.750	2.987	4.409	2.848	2.667
ORANGE	LOW	0.412	0.342	3.470	0.351	0.227	0.366	0.233	0.144
	AVERAGE	1.108	0.918	9.910	0.890	0.575	0.838	0.566	0.654
	HIGH	1.868	1.477	14.844	1.581	1.008	1.459	0.964	1.290

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
OSCEOLA	LOW	0.435	0.370	3.752	0.433	0.270	0.404	0.259	0.156
	AVERAGE	1.283	1.072	11.560	1.037	0.660	0.908	0.553	0.640
	HIGH	2.445	1.927	19.275	2.087	1.210	1.715	1.175	1.508
PALM BEACH	LOW	1.130	0.954	8.973	1.010	0.652	0.909	0.585	0.614
	AVERAGE	7.486	5.000	36.789	6.788	4.472	6.936	4.447	4.338
	HIGH	17.137	14.188	68.369	15.663	10.638	15.103	10.272	11.635
PASCO	LOW	0.518	0.389	3.934	0.559	0.344	0.469	0.330	0.298
	AVERAGE	1.784	1.928	11.830	1.430	1.178	1.678	1.804	1.619
	HIGH	5.289	4.350	26.215	4.723	3.160	4.478	3.043	3.623
PINELLAS	LOW	0.675	0.542	4.613	0.810	0.389	0.822	0.386	0.467
	AVERAGE	4.784	3.634	20.871	3.413	2.549	3.820	2.784	2.488
	HIGH	8.790	7.314	34.851	7.927	5.474	7.558	5.241	6.016
POLK	LOW	0.440	0.374	3.786	0.411	0.268	0.395	0.244	0.319
	AVERAGE	1.322	1.002	10.412	1.027	0.718	0.896	0.695	0.683
	HIGH	1.918	1.516	15.549	1.619	1.027	1.466	0.970	1.299
PUTNAM	LOW	0.273	0.211	2.005	0.295	0.202	0.291	0.200	0.390
	AVERAGE	0.732	0.605	5.185	0.659	0.423	0.590	0.331	0.488
	HIGH	1.189	0.939	10.017	0.943	0.600	0.893	0.593	0.572

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
ST. JOHNS	LOW	0.289	0.245	2.348	0.270	0.200	0.257	0.183	0.196
	AVERAGE	1.156	1.145	7.250	1.215	0.822	1.548	1.176	1.158
	HIGH	3.180	2.557	19.656	2.843	1.871	2.700	1.785	2.192
ST. LUCIE	LOW	1.080	0.913	10.977	1.298	0.623	0.984	0.625	0.592
	AVERAGE	5.279	2.758	33.590	4.823	2.401	5.757	3.937	3.489
	HIGH	13.747	11.307	61.447	12.605	8.479	12.001	8.105	9.334
SANTA ROSA	LOW	0.422	0.468	4.101	0.458	0.448	1.703	1.311	0.463
	AVERAGE	4.181	3.688	16.030	4.648	3.060	9.492	5.266	4.387
	HIGH	13.350	11.010	57.997	12.412	8.467	11.817	8.106	9.012
SARASOTA	LOW	0.544	0.460	4.364	0.677	0.448	0.505	0.334	0.314
	AVERAGE	3.791	2.582	21.966	3.030	2.100	4.190	2.674	2.462
	HIGH	8.057	6.715	34.175	7.267	5.012	6.932	4.814	5.519
SEMINOLE	LOW	0.406	0.327	3.395	0.342	0.224	0.364	0.246	0.141
	AVERAGE	1.120	0.901	9.663	0.906	0.587	0.874	0.588	0.656
	HIGH	1.499	1.186	12.409	1.270	0.806	1.193	0.750	1.001
SUMTER	LOW	0.383	0.324	3.261	0.420	0.223	0.424	0.292	0.287
	AVERAGE	0.665	0.556	8.269	0.642	0.458	0.876	0.410	0.467
	HIGH	1.445	1.145	11.680	1.206	0.784	1.082	0.691	0.929

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
SUWANNEE	LOW	0.213	0.172	1.596	0.210	0.151	0.384	0.202	0.341
	AVERAGE	0.530	0.440	3.203	0.469	0.319	0.384	0.202	0.446
	HIGH	0.762	0.608	6.204	0.654	0.424	0.384	0.202	0.510
TAYLOR	LOW	0.267	0.243	2.017	0.464	0.303	0.331	0.359	0.496
	AVERAGE	0.785	0.634	4.374	0.674	0.444	0.677	0.509	0.496
	HIGH	1.624	1.306	10.581	1.453	0.958	1.384	0.690	0.496
UNION	LOW	0.237	0.180	1.597	0.234	0.122	0.232	0.166	0.447
	AVERAGE	0.503	0.428	3.064	0.466	0.319	0.232	0.166	0.447
	HIGH	0.626	0.499	5.369	0.532	0.345	0.232	0.166	0.447
VOLUSIA	LOW	0.341	0.278	2.906	0.339	0.199	0.339	0.226	0.219
	AVERAGE	1.849	1.313	12.083	1.434	0.969	2.198	1.731	1.435
	HIGH	4.700	3.794	27.041	4.266	2.766	4.048	2.656	3.218
WAKULLA	LOW	0.334	0.283	2.831	0.302	0.281	0.739	1.481	0.253
	AVERAGE	1.036	0.979	5.861	0.798	0.541	1.593	2.144	1.475
	HIGH	3.813	3.105	17.435	2.960	2.382	3.350	2.252	2.140
WALTON	LOW	0.449	0.363	3.761	0.445	0.347	1.022	0.748	0.324
	AVERAGE	3.952	2.743	10.680	3.910	2.825	6.891	3.605	4.694
	HIGH	10.057	8.248	46.082	9.369	6.311	8.897	6.021	6.783

COUNTY	LOSS COSTS	FRAME OWNERS	MASONRY OWNERS	MANUFACTURED HOMES	FRAME RENTERS	MASONRY RENTERS	FRAME CONDO UNIT	MASONRY CONDO UNIT	COMMERCIAL RESIDENTIAL
WASHINGTON	LOW	0.450	0.364	3.526	0.483	0.351	0.702	NA	0.459
	AVERAGE	1.164	1.040	6.261	1.140	0.766	0.702	NA	0.558
	HIGH	2.063	1.634	14.984	1.822	1.161	0.702	NA	0.701
STATEWIDE	LOW	0.163	0.138	1.237	0.161	0.117	0.209	0.137	0.088
	AVERAGE	2.574	2.654	14.005	1.940	2.064	2.864	3.122	3.014
	HIGH	28.365	23.990	94.785	26.285	18.646	25.413	17.973	18.899

Form A-5: Percentage Change in Output Ranges

A. *Provide summaries of the percentage change in average loss cost output range data compiled in Form A-4A, Output Ranges, relative to the equivalent data compiled from the previously accepted model in the format shown in the file named "*2015FormA5.xlsx.*"*

For the change in output range exhibit, provide the summary by:

- *Statewide (overall percentage change),*
- *By region, as defined in Figure 14 – North, Central and South,*
- *By county, as defined in Figure 15 – Coastal and Inland.*

The percentage change in the average loss costs relative to the equivalent data compiled from the previously accepted model is provided in Form A-5.

B. *Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include all tables in Form A-5, Percentage Change in Output Ranges, in a submission appendix.*

A hard copy of the tables in Form A-5 is included in this appendix and provided in an Excel format.

Table 50. Percentage Change in $0 Deductible Output Ranges

Region	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Coastal	-0.5%	-0.1%	-0.7%	-0.5%	-0.3%	-0.9%	-0.5%	-0.1%
Inland	-0.1%	-0.5%	-0.3%	-0.6%	-0.8%	-0.6%	-0.8%	-0.3%
North	-0.4%	-0.3%	-0.4%	-0.5%	-0.4%	-1.3%	-0.7%	-0.8%
Central	-0.7%	-0.5%	-0.7%	-0.7%	-0.7%	-1.0%	-0.9%	-0.6%
South	-0.1%	0.1%	-0.4%	-0.3%	-0.2%	-0.5%	-0.3%	0.0%
Statewide	-0.4%	-0.2%	-0.6%	-0.5%	-0.4%	-0.9%	-0.5%	-0.1%

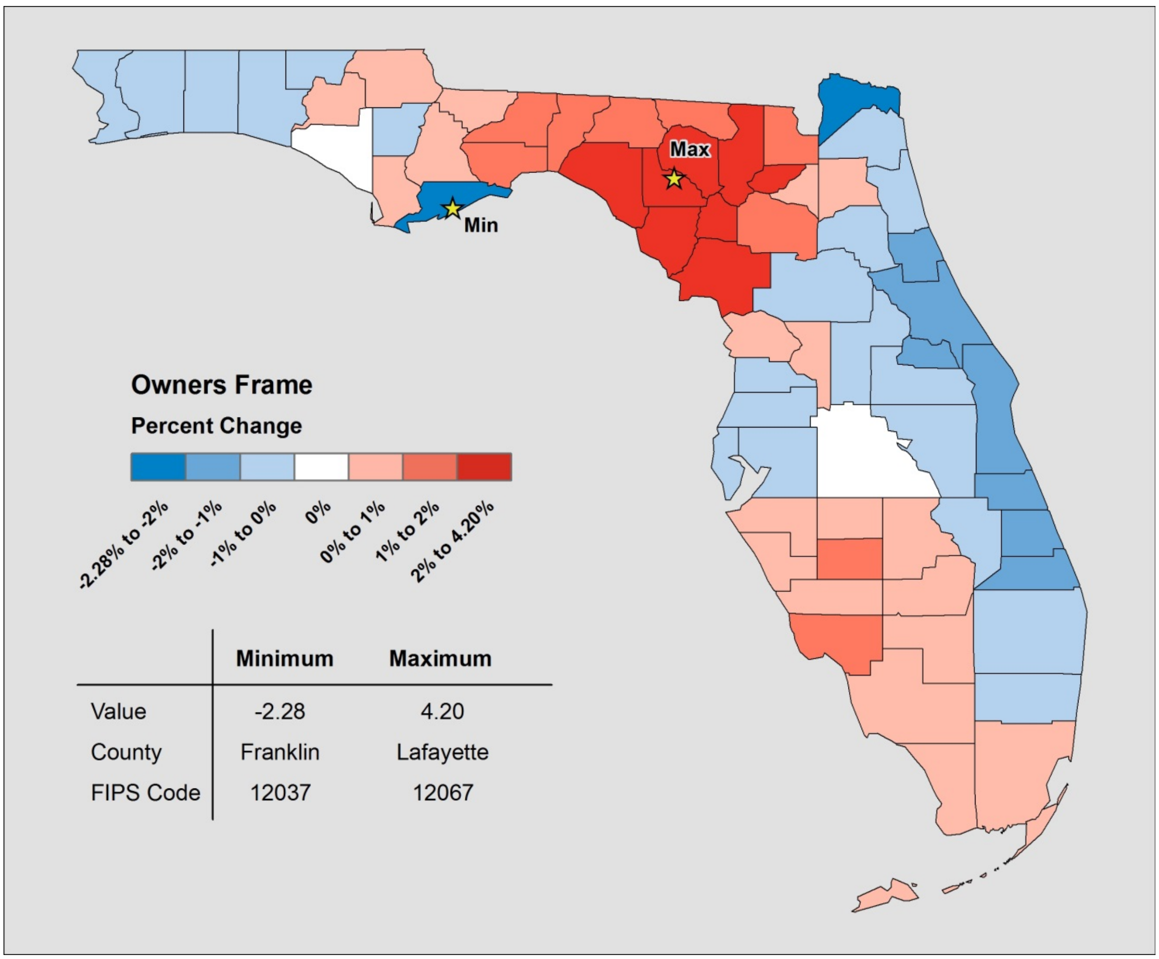
Table 51. Percentage Change in Specified Deductible Output Ranges

Region	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Coastal	-0.5%	-0.1%	-0.8%	-0.5%	-0.3%	-1.0%	-0.5%	-0.1%
Inland	0.0%	-0.5%	-0.2%	-0.5%	-0.7%	-0.6%	-0.7%	-0.3%
North	-0.4%	-0.3%	-0.5%	-0.5%	-0.4%	-1.4%	-0.7%	-0.8%
Central	-0.7%	-0.5%	-0.7%	-0.6%	-0.7%	-1.0%	-0.9%	-0.6%
South	-0.1%	0.1%	-0.5%	-0.4%	-0.2%	-0.5%	-0.4%	0.0%
Statewide	-0.4%	-0.1%	-0.6%	-0.5%	-0.4%	-0.9%	-0.5%	-0.1%

C. *Provide color-coded maps by county reflecting the percentage changes in the average loss costs with specified deductibles for frame owners, masonry owners, frame renters, masonry renters, frame condo unit owners, masonry condo unit owners, manufactured home, and commercial residential from the output ranges from the previously accepted model.*

Counties with a negative percentage change (reduction in loss costs) shall be indicated with shades of blue; counties with a positive percentage change (increase in loss costs) shall be indicated with shades of red; and counties with no percentage change shall be white. The larger the percentage change in the county, the more intense the color-shade.

Figure 89 to Figure 96 show the percentage change in loss costs by county for the specified deductibles from the output ranges from the previously accepted model.



	Minimum	Maximum
Value	-2.28	4.20
County	Franklin	Lafayette
FIPS Code	12037	12067

Figure 89. Percentage Change for Owners Frame

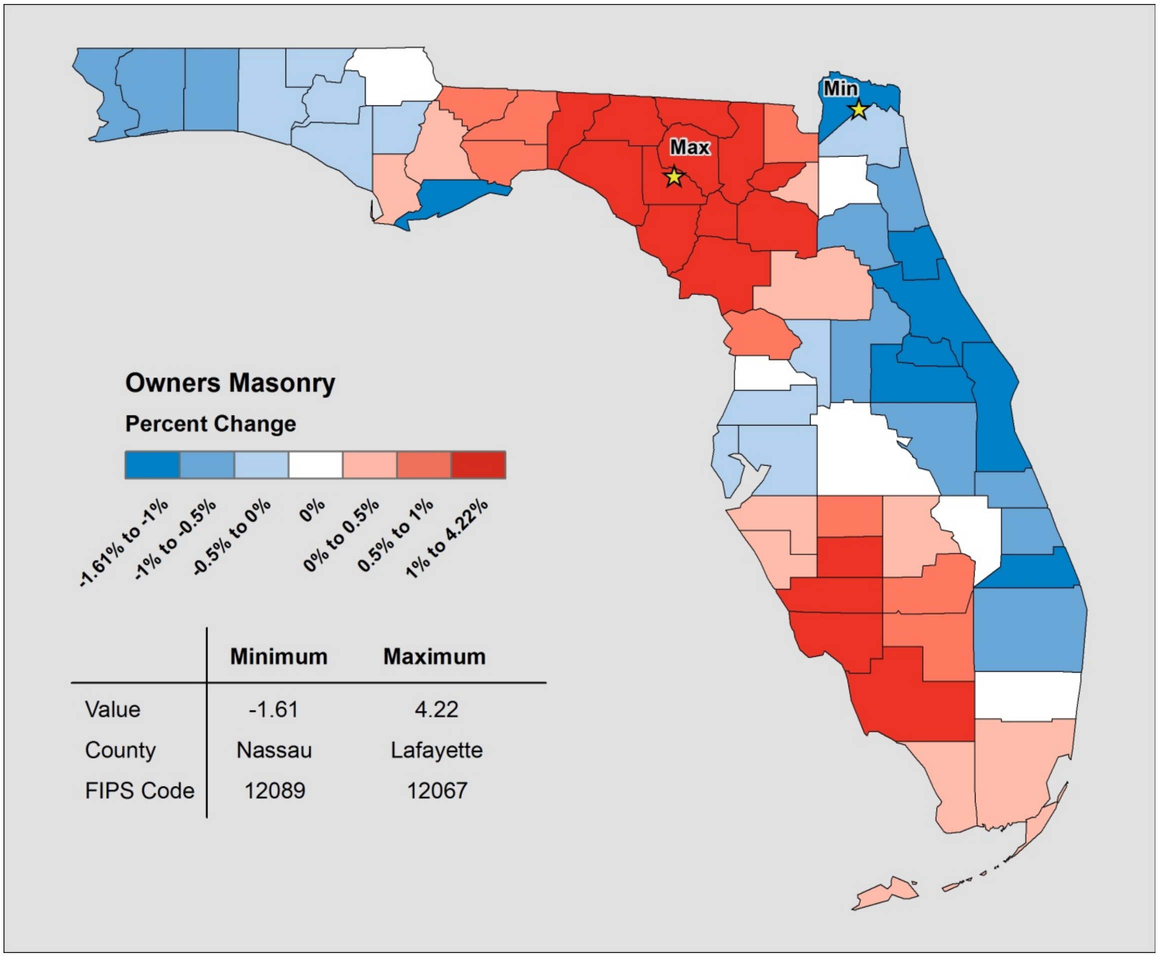


Figure 90. Percentage Change for Owners Masonry

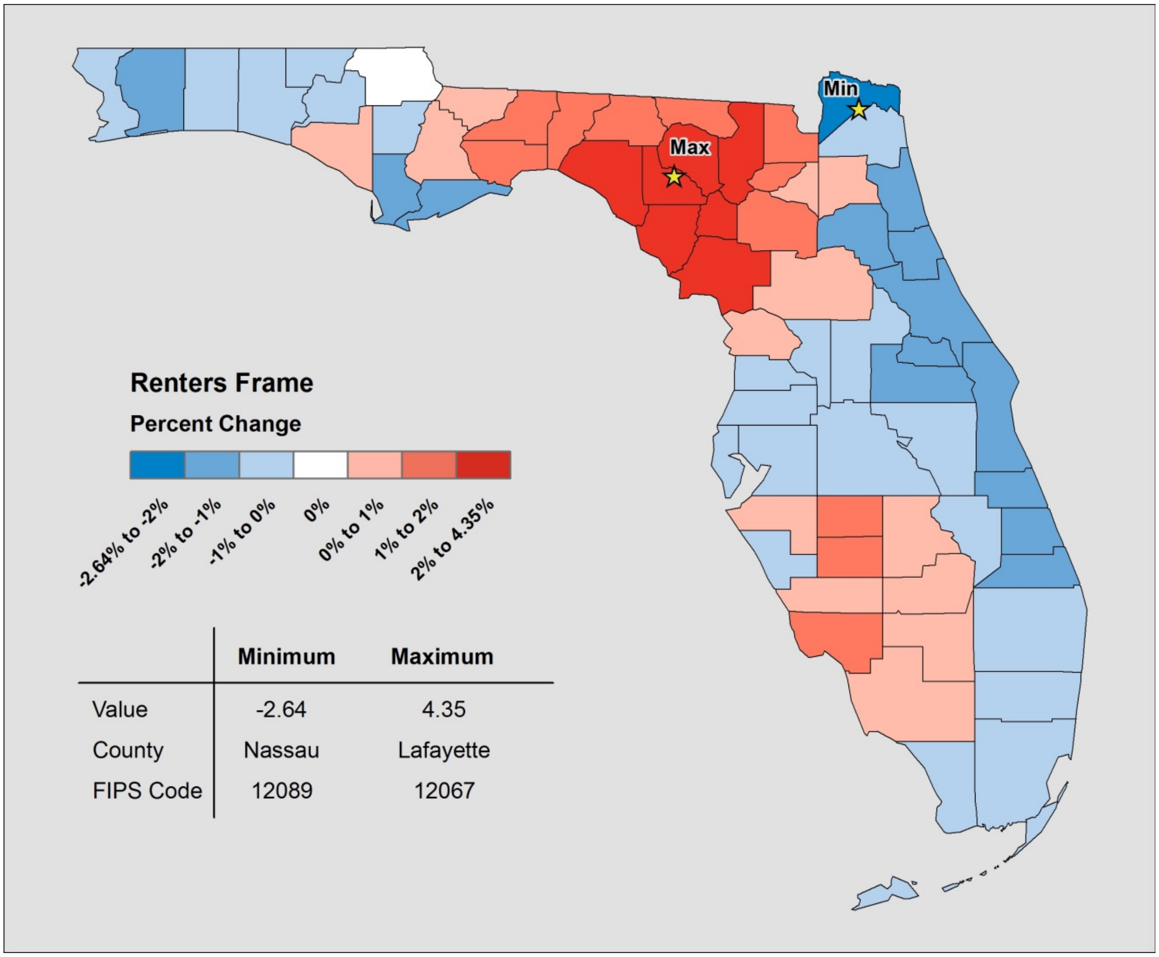
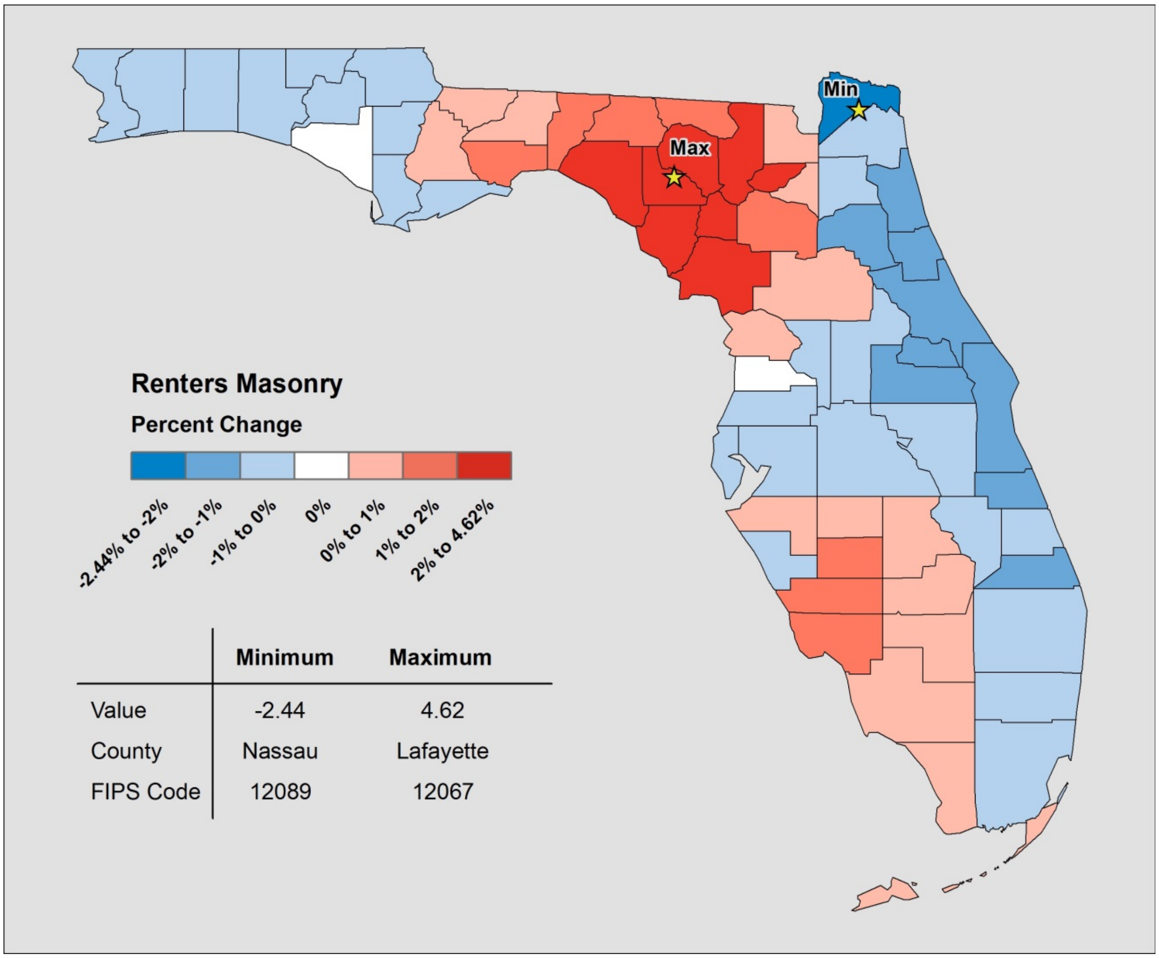


Figure 91. Percentage Change for Renters Frame



	Minimum	Maximum
Value	-2.44	4.62
County	Nassau	Lafayette
FIPS Code	12089	12067

Figure 92. Percentage Change for Renters Masonry

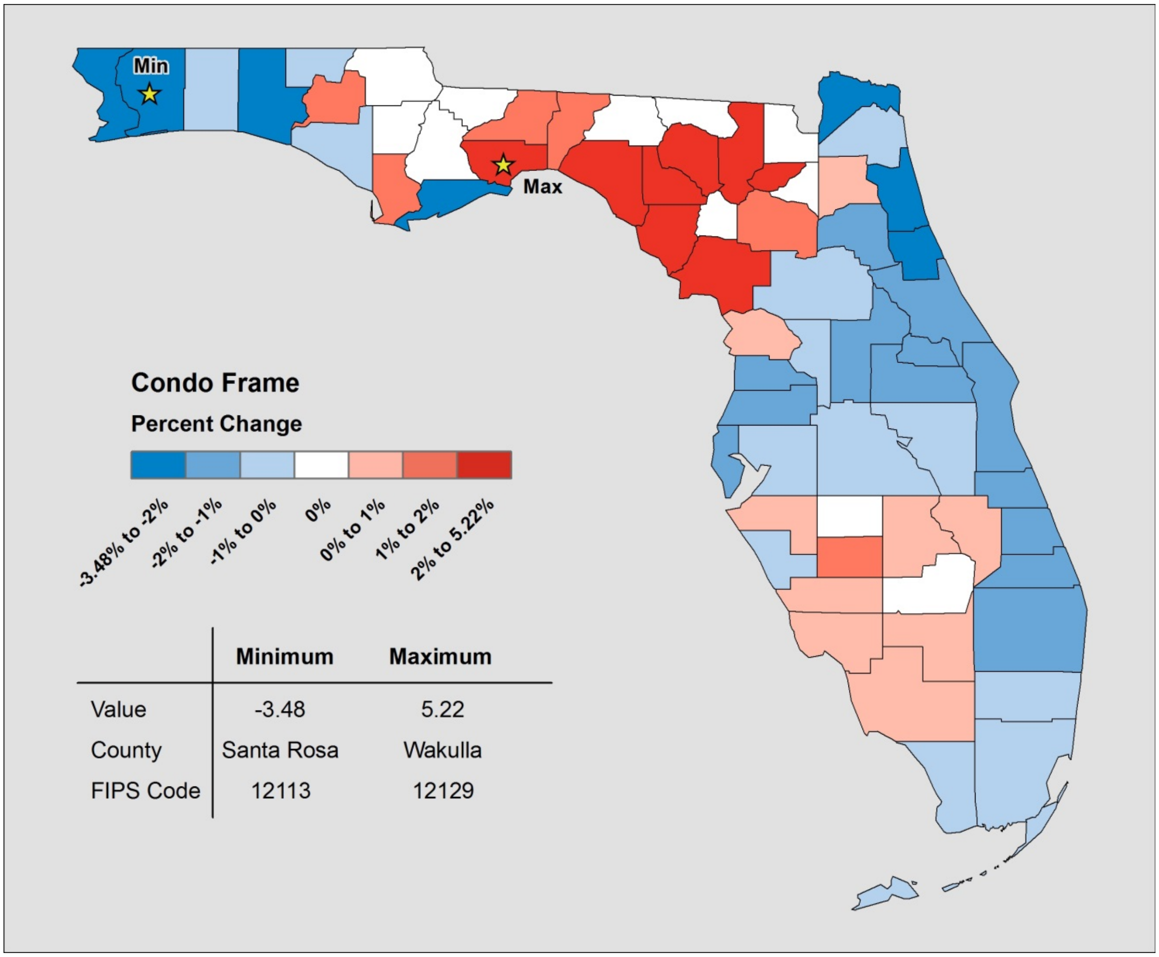


Figure 93. Percentage Change for Frame Condo Unit Owners

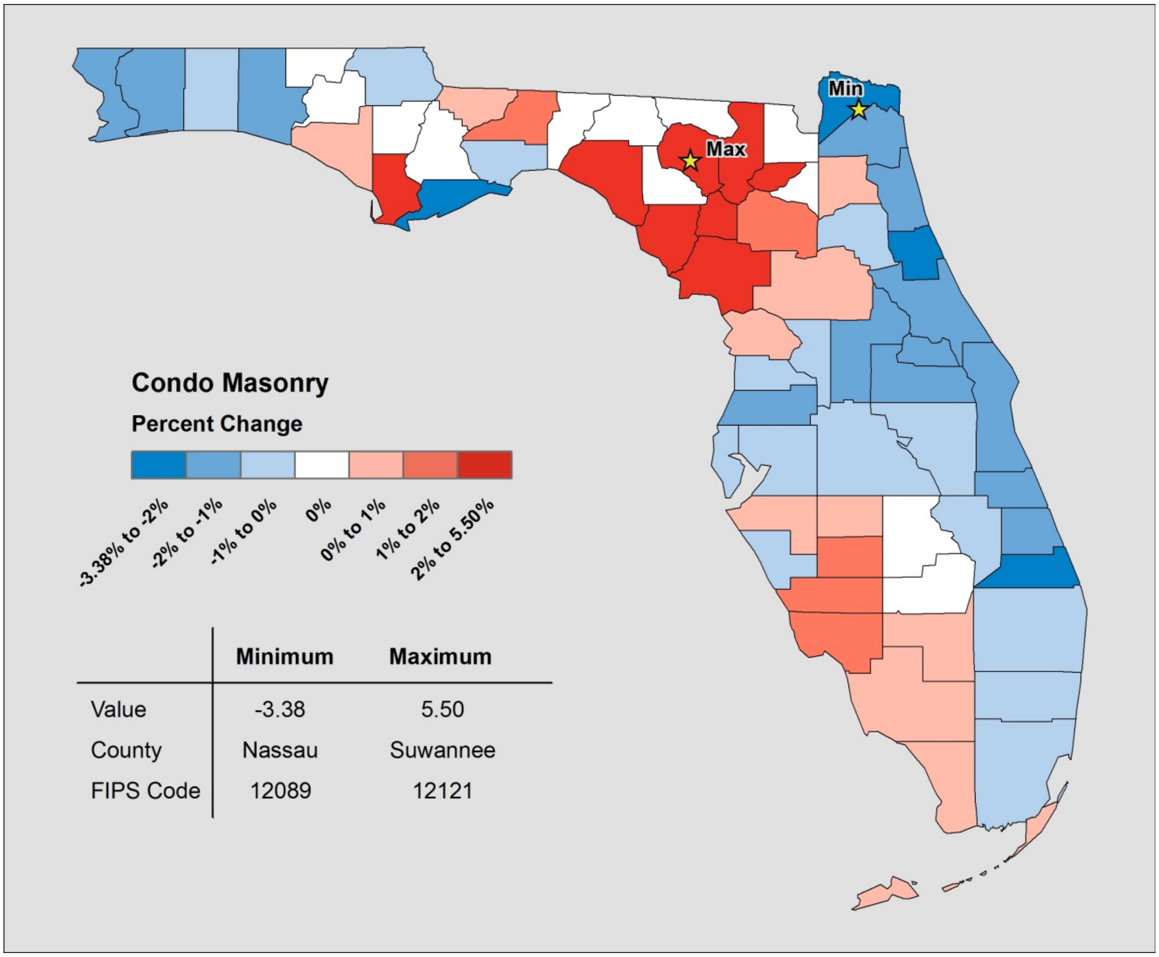


Figure 94. Percentage Change for Masonry Condo Unit Owners

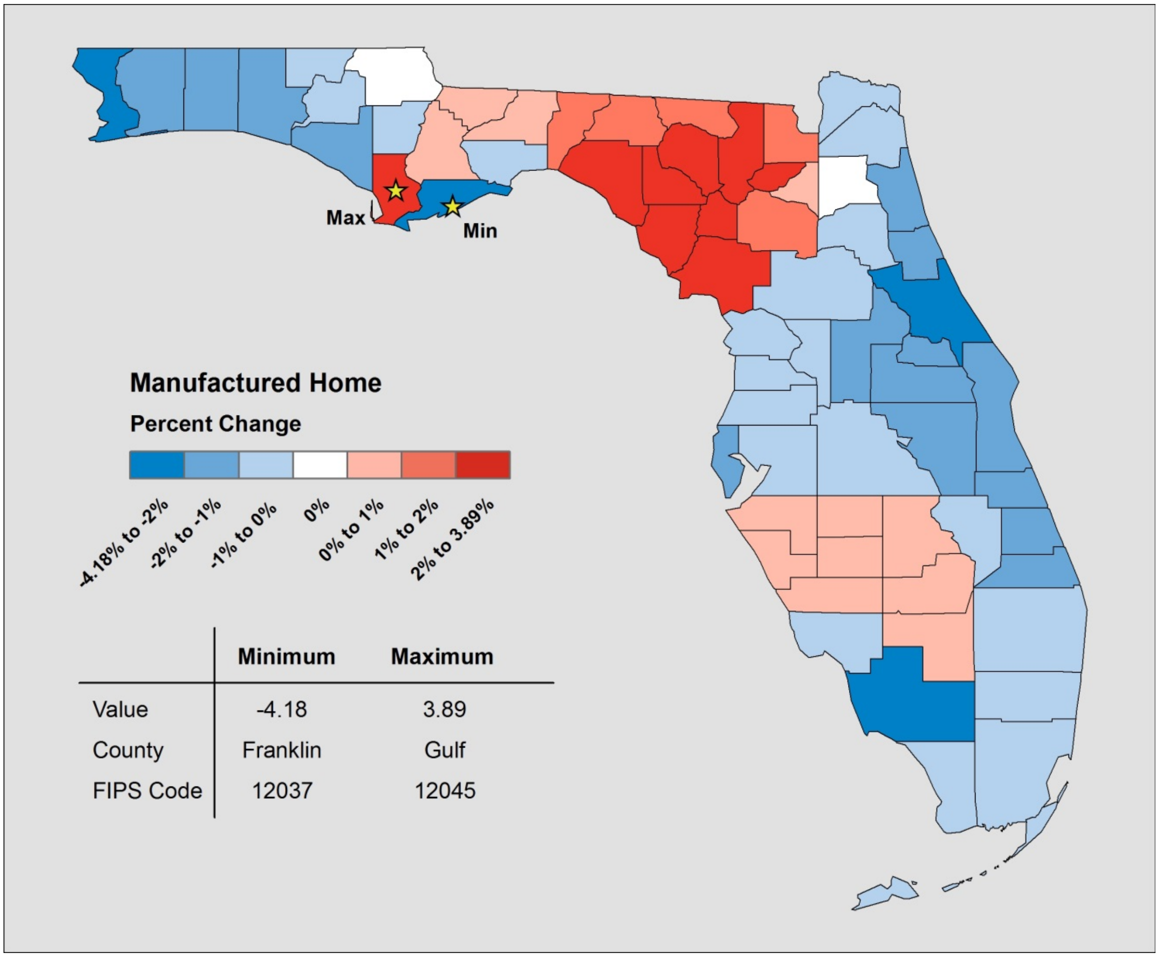


Figure 95. Percentage Change for Manufactured Home

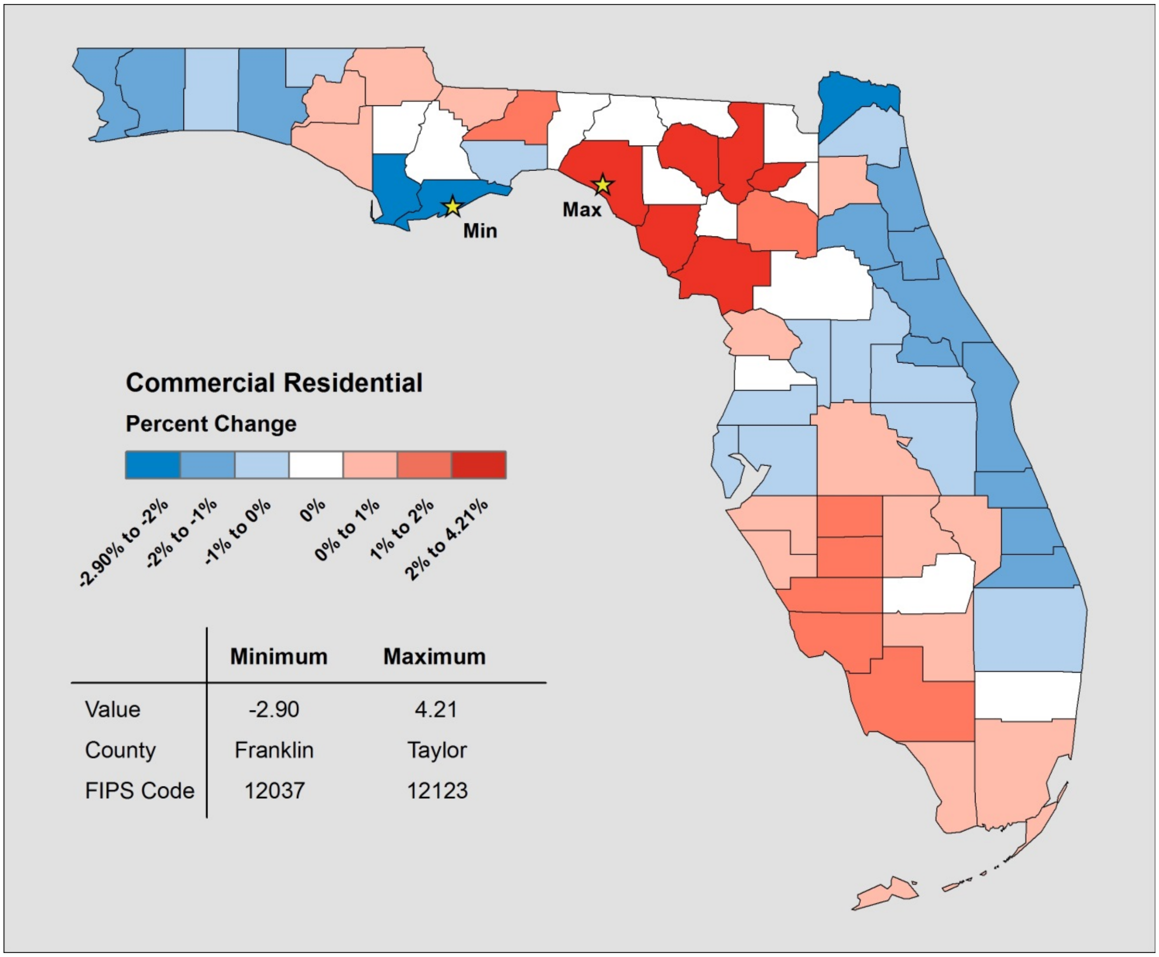


Figure 96. Percentage Change for Commercial Residential

<u>Standard A-6, Disclosure 7</u>

Form A-6: Logical Relationship to Risk (Trade Secret Item)

A. *Provide the logical relationship to risk exhibits in the format shown in the file named* "2015FormA6.xlsx*.*"

Form A-6 will be provided as a Trade Secret item.

B. *Create exposure sets for each exhibit by modeling all of the coverages from the appropriate Notional Set listed below at each of the locations in "Location Grid A" as described in the file* "NotionalInput15.xlsx." *Refer to the Notional Policy Specifications below for additional modeling information. Explain any assumptions, deviations, and differences from the prescribed exposure information.*

Exhibit	*Notional Set*
Deductible Sensitivity	*Set 1*
Construction Sensitivity	*Set 2*
Policy Form Sensitivity	*Set 3*
Coverage Sensitivity	*Set 4*
Building Code/Enforcement (Year Built) Sensitivity	*Set 5*
Building Strength Sensitivity	*Set 6*
Condo Unit Floor Sensitivity	*Set 7*
Number of Stories Sensitivity	*Set 8*

Models shall treat points in "Location Grid A" as coordinates that would result from a geocoding process. Models shall treat points by simulating loss at exact location or by using the nearest modeled parcel/street/cell in the model.

Report results for each of the points in "Location Grid A" individually, unless specified. Loss cost per $1,000 of exposure shall be rounded to 3 decimal places.

Exposure sets have been created using the specifications and grid points provided in NotionalInput15.xlsx provided by the Commission. Gross modeled losses have been used in the preparation of this form.

C. *All anomalies in loss costs that are not consistent with the requirements of Standard A-6, Loss Outputs and Logical Relationships to Risk, and have been explained in Disclosure A-6.12 shall be shaded.*

The loss costs are consistent with the requirements of Standard A-6.

D. *Create an exposure set and report loss costs results for strong owners frame buildings (Notional Set 6) for each of the points in "Location Grid B" as described in the file* "NotionalInput15.xlsx." *Provide a color-coded contour map of the loss costs. Provide a scatter plot of the loss costs (y-axis) against distance to closest coast (x-axis).*

An exposure set has been created for strong owners frame buildings (Notional Set 6) for each of the points in "Location Grid B", and loss costs have been produced. The color-coded contour map of loss costs and scatter plot of loss costs against distance to closest coast will be provided as Trade Secret items.

Form A-7: Percentage Change in Logical Relationship to Risk

A. Provide summaries of the percentage change in logical relationship to risk exhibits from the previously accepted model in the format shown in the file named "2015FormA7.xlsx."

The exhibits showing percentage change in logical relationship to risk from the previously accepted model have been prepared in the format specified and included in the submission appendix.

B. Create exposure sets for each exhibit by modeling all of the coverages from the appropriate Notional Set listed below at each of the locations in "Location Grid B" as described in the file "NotionalInput15.xlsx." *Refer to the Notional Policy Specifications provided in Form A-6, Logical Relationship to Risk (Trade Secret item), for additional modeling information. Explain any assumptions, deviations, and differences from the prescribed exposure information.*

Exhibit	*Notional Set*
Deductible Sensitivity	*Set 1*
Construction Sensitivity	*Set 2*
Policy Form Sensitivity	*Set 3*
Coverage Sensitivity	*Set 4*
Building Code/Enforcement (Year Built) Sensitivity	*Set 5*
Building Strength Sensitivity	*Set 6*
Condo Unit Floor Sensitivity	*Set 7*
Number of Stories Sensitivity	*Set 8*

Models shall treat points in "Location Grid B" as coordinates that would result from a geocoding process. Models shall treat points by simulating loss at exact location or by using the nearest modeled parcel/street/cell in the model.

Provide the results statewide (overall percentage change) and by the regions defined in Form A-5, Percentage Change in Output Ranges.

Exposure sets have been created using the specifications and grid points in NotionalInput15.xlsx provided by the Commission. For ease of readability, we have provided the Commission's specifications for the building strength notional set in the table below. Gross modeled losses have been used in the preparation of form A-7.

Table 52. Specifications for the Building Strength Notional Set

Policy Type	Type	Building Features Modeled
Owners & Renters	Weak	YB 1980, 1-story, Gable roof geometry, Shingle roof covering, 6d Nails roof deck attachment, Toe Nail roof wall anchorage, No opening protection
	Medium	YB 1998, 1-story Unknown roof geometry, Unknown roof covering, Unknown roof deck attachment, Unknown roof wall anchorage, Unknown opening protection
	Strong	YB 2007, 1-story, Hip roof geometry, Rated Shingle (110 mph) roof covering, 8d Nails HWS roof deck attachment, Straps roof wall anchorage, With opening protection

Policy Type	Type	Building Features Modeled
Condo Unit	Weak	YB 1980, 3-story, Gable roof geometry, Shingle roof covering, 6d Nails roof deck attachment, Toe Nail roof wall anchorage, No opening protection
	Medium	YB 1998, 3-story, Unknown roof geometry, Unknown roof covering, Unknown roof deck attachment, Unknown roof wall anchorage, Unknown opening protection
	Strong	YB 2007, 3-story, Hip roof geometry, Rated Shingle (110 mph) roof covering, 8d Nails HWS roof deck attachment, Straps roof wall anchorage, With opening protection
Manufactured Homes	Weak	YB 1974, 1-story, Untied foundation, Gable roof geometry, Shingle roof covering, Unknown roof deck attachment, Unknown roof wall anchorage, No opening protection
	Medium	YB 1992, 1-story, Unknown foundation tie-down, Unknown roof geometry, Unknown roof covering, Unknown roof deck attachment, Unknown roof wall anchorage, Unknown opening protection
	Strong	YB 2004, 1-story, Tied foundation, Gable roof geometry, Rated Shingle (110 mph) roof covering, Unknown roof deck attachment, Unknown roof wall anchorage, With opening protection
Commercial Residential	Weak	YB 1980, Concrete, 20-story, Flat roof geometry, BUR with Gravel roof covering, Unknown roof deck attachment, Unknown roof wall anchorage, No opening protection
	Medium	YB 1998, Concrete, 20-story, Unknown roof geometry, Unknown roof covering, Unknown roof deck attachment, Unknown roof wall anchorage, Unknown opening protection
	Strong	YB 2007, Concrete, 20-story, Flat roof geometry, BUR with Gravel roof covering, Unknown roof deck attachment, Unknown roof wall anchorage, With opening protection

In order to demonstrate the condo unit floor of interest sensitivity, we have modified the default input exposures to additionally code two fields:

Table 53. Additional Specifications for the Condo Unit Floor Notional Set

Policy Type	Additional Building Features Modeled
Condo Unit A	Terrain Roughness category B and Adjacent Building Height of 12 stories
Condo Unit B	Terrain Roughness category B and Adjacent Building Height of 12 stories

C. *Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include all tables in Form A-7, Percentage Change in Logical Relationship to Risk, in a submission appendix.*

Hard copy of Form A-7 is included in this appendix in Table 54 and Table 55 below and is provided in Excel format.

Table 54. Percentage Change in Logical Relationship to Risk—Deductible

Construction/ Policy	Region	Percent Change in Loss Cost					
		$0	$500	1%	2%	5%	10%
Frame Owners	Coastal	-0.1%	-0.1%	-0.1%	-0.1%	0.0%	-0.1%
	Inland	0.0%	0.1%	0.1%	0.1%	0.0%	-0.1%
	North	-0.4%	-0.4%	-0.4%	-0.3%	-0.3%	-0.3%
	Central	-0.4%	-0.4%	-0.3%	-0.3%	-0.3%	-0.3%
	South	0.2%	0.2%	0.2%	0.2%	0.2%	0.1%
	Statewide	-0.1%	-0.1%	-0.1%	0.0%	0.0%	-0.1%
Masonry Owners	Coastal	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
	Inland	0.0%	0.0%	0.1%	0.0%	-0.1%	-0.2%
	North	-0.4%	-0.4%	-0.4%	-0.3%	-0.3%	-0.3%
	Central	-0.4%	-0.4%	-0.3%	-0.3%	-0.3%	-0.4%
	South	0.1%	0.1%	0.2%	0.2%	0.1%	0.1%
	Statewide	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
Manufactured Homes	Coastal	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
	Inland	-0.3%	-0.3%	-0.3%	-0.3%	-0.2%	-0.1%
	North	-0.4%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
	Central	-0.6%	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%
	South	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
	Statewide	-0.2%	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%
Frame Renters	Coastal	-0.3%	-0.2%	-0.2%	-0.2%	-0.2%	-0.1%
	Inland	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	North	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.4%
	Central	-0.5%	-0.4%	-0.5%	-0.4%	-0.4%	-0.4%
	South	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	Statewide	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.1%
Masonry Renters	Coastal	-0.3%	-0.3%	-0.3%	-0.3%	-0.2%	-0.2%
	Inland	-0.2%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%
	North	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.4%
	Central	-0.6%	-0.5%	-0.5%	-0.5%	-0.4%	-0.4%
	South	-0.1%	-0.1%	-0.1%	-0.1%	0.0%	0.0%
	Statewide	-0.3%	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
Frame Condo Unit	Coastal	-0.3%	-0.3%	-0.3%	-0.3%	-0.2%	-0.2%
	Inland	-0.2%	-0.1%	-0.1%	-0.1%	-0.1%	-0.2%
	North	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.4%
	Central	-0.6%	-0.5%	-0.5%	-0.5%	-0.4%	-0.4%
	South	-0.1%	-0.1%	-0.1%	-0.1%	0.0%	0.0%
	Statewide	-0.3%	-0.3%	-0.3%	-0.2%	-0.2%	-0.2%
Masonry Condo Unit	Coastal	-0.3%	-0.3%	-0.3%	-0.3%	-0.2%	-0.2%
	Inland	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%	-0.3%
	North	-0.5%	-0.5%	-0.5%	-0.5%	-0.5%	-0.4%
	Central	-0.6%	-0.5%	-0.5%	-0.5%	-0.5%	-0.4%
	South	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	0.0%
	Statewide	-0.3%	-0.3%	-0.3%	-0.3%	-0.2%	-0.2%
Construction/ Policy	**Region**	**Percent Change in Loss Cost**					
		$0	**2%**	**3%**	**5%**	**10%**	
Commercial Residential	Coastal	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	
	Inland	0.1%	0.1%	0.1%	0.0%	-0.2%	
	North	-0.4%	-0.3%	-0.3%	-0.3%	-0.3%	
	Central	-0.4%	-0.3%	-0.3%	-0.4%	-0.4%	
	South	0.1%	0.1%	0.1%	0.2%	0.1%	
	Coastal	-0.1%	-0.1%	-0.1%	-0.1%	-0.1%	

Table 55. Percent Change in Logical Relationship to Risk—Construction

Policy	Region	Percent Change in Loss Cost	
		Masonry	Frame
Owners	Coastal	-0.1%	-0.1%
	Inland	0.0%	0.0%
	North	-0.4%	-0.4%
	Central	-0.4%	-0.4%
	South	0.1%	0.2%
	Statewide	-0.1%	-0.1%
Renters	Coastal	-0.3%	-0.3%
	Inland	-0.2%	-0.1%
	North	-0.5%	-0.5%
	Central	-0.6%	-0.5%
	South	-0.1%	0.0%
	Statewide	-0.3%	-0.2%
Condo Unit	Coastal	-0.3%	-0.3%
	Inland	-0.2%	-0.2%
	North	-0.5%	-0.5%
	Central	-0.6%	-0.6%
	South	-0.1%	-0.1%
	Statewide	-0.3%	-0.3%
Policy	**Region**	**Percent Change in Loss Cost**	
		Concrete	
Commercial Residential	Coastal	-0.1%	
	Inland	0.1%	
	North	-0.4%	
	Central	-0.4%	
	South	0.1%	
	Statewide	-0.1%	

Table 56. Percent Change in Logical Relationship to Risk—Policy Form

Region	Percent Change in Loss Cost		
	Frame Owners	Masonry Owners	Manufactured Homes
Coastal	-0.1%	-0.1%	-0.1%
Inland	0.0%	0.0%	-0.3%
North	-0.4%	-0.4%	-0.4%
Central	-0.4%	-0.4%	-0.6%
South	0.2%	0.1%	0.2%
Statewide	-0.1%	-0.1%	-0.2%

Table 57. Percent Change in Logical Relationship to Risk—Coverage

Construction/ Policy	Region	Percent Change in Loss Cost			
		Coverage A	Coverage B	Coverage C	Coverage D
Frame Owners	Coastal	-0.1%	-0.1%	-0.4%	0.3%
	Inland	0.0%	0.0%	-0.2%	0.9%
	North	-0.4%	-0.4%	-0.7%	0.1%
	Central	-0.4%	-0.4%	-0.6%	0.2%
	South	0.2%	0.2%	-0.2%	0.4%
	Statewide	-0.1%	-0.1%	-0.4%	0.3%
Masonry Owners	Coastal	-0.1%	-0.1%	-0.4%	0.3%
	Inland	0.0%	0.0%	-0.3%	0.9%
	North	-0.4%	-0.4%	-0.7%	0.1%
	Central	-0.4%	-0.4%	-0.6%	0.2%
	South	0.2%	0.2%	-0.2%	0.4%
	Statewide	-0.1%	-0.1%	-0.4%	0.3%
Manufactured Homes	Coastal	-0.1%	-0.1%	-0.5%	0.3%
	Inland	-0.3%	-0.3%	-0.7%	0.3%
	North	-0.3%	-0.3%	-0.6%	0.1%
	Central	-0.5%	-0.5%	-1.0%	-0.1%
	South	0.2%	0.2%	-0.3%	0.5%
	Statewide	-0.1%	-0.1%	-0.5%	0.3%
Frame Renters	Coastal			-0.5%	0.1%
	Inland			-0.4%	0.9%
	North			-0.7%	-0.2%
	Central			-0.8%	0.0%
	South			-0.2%	0.3%
	Statewide			-0.5%	0.2%
Masonry Renters	Coastal			-0.5%	0.1%
	Inland			-0.4%	0.9%
	North			-0.7%	-0.1%
	Central			-0.8%	0.1%
	South			-0.2%	0.3%
	Statewide			-0.5%	0.2%
Frame Condo Unit	Coastal	-0.1%		-0.5%	0.2%
	Inland	0.0%		-0.4%	1.0%
	North	-0.4%		-0.7%	-0.1%
	Central	-0.4%		-0.8%	0.1%
	South	0.2%		-0.2%	0.3%
	Statewide	-0.1%		-0.5%	0.2%
Masonry Condo Unit	Coastal	-0.1%		-0.5%	0.2%
	Inland	0.0%		-0.4%	1.0%
	North	-0.3%		-0.7%	0.0%
	Central	-0.4%		-0.8%	0.1%
	South	0.2%		-0.2%	0.2%
	Statewide	-0.1%		-0.5%	0.2%
Commercial Residential	Coastal	-0.1%		-0.5%	0.2%
	Inland	0.1%		-0.2%	1.3%
	North	-0.4%		-0.7%	0.0%
	Central	-0.4%		-0.7%	0.5%
	South	0.1%		-0.3%	0.1%
	Statewide	-0.1%		-0.5%	0.2%

Table 58. Percent Change in Logical Relationship to Risk—Building Code/Enforcement (Year Built) Sensitivity

Construction/ Policy	Region	Percent Change in Loss Cost		
		Year Built 1980	Year Built 1998	Year Built 2004
Frame Owners	Coastal	-0.1%	0.6%	2.0%
	Inland	-0.4%	0.4%	1.8%
	North	-0.3%	0.4%	1.6%
	Central	-0.6%	0.2%	1.8%
	South	0.2%	0.9%	2.3%
	Statewide	-0.1%	0.6%	2.0%
Masonry Owners	Coastal	-0.1%	0.6%	2.1%
	Inland	-0.4%	0.4%	1.8%
	North	-0.3%	0.4%	1.6%
	Central	-0.6%	0.2%	1.8%
	South	0.2%	0.9%	2.3%
	Statewide	-0.1%	0.6%	2.0%
Construction / Policy	**Region**	**Percent Change in Loss Cost**		
		Year Built 1974	**Year Built 1992**	**Year Built 2004**
Manufactured Homes	Coastal	-0.2%	-0.1%	-0.2%
	Inland	-0.4%	-0.3%	-0.4%
	North	-0.4%	-0.3%	-0.6%
	Central	-0.6%	-0.6%	-0.6%
	South	0.1%	0.1%	0.2%
	Statewide	-0.2%	-0.2%	-0.2%
Construction / Policy	**Region**	**Percent Change in Loss Cost**		
		Year Built 1980	**Year Built 1998**	**Year Built 2004**
Frame Renters	Coastal	-0.3%	0.5%	2.0%
	Inland	-0.5%	0.3%	1.8%
	North	-0.4%	0.3%	1.5%
	Central	-0.7%	0.1%	1.7%
	South	0.0%	0.8%	2.2%
	Statewide	-0.3%	0.5%	1.9%
Masonry Renters	Coastal	-0.3%	0.5%	2.0%
	Inland	-0.6%	0.2%	1.6%
	North	-0.4%	0.3%	1.5%
	Central	-0.7%	0.1%	1.7%
	South	-0.1%	0.7%	2.2%
	Statewide	-0.3%	0.4%	1.9%
Frame Condo Unit	Coastal	-0.3%	0.4%	1.9%
	Inland	-0.6%	0.2%	1.6%
	North	-0.4%	0.2%	1.4%
	Central	-0.7%	0.0%	1.6%
	South	0.0%	0.7%	2.1%
	Statewide	-0.3%	0.4%	1.9%
Masonry Condo Unit	Coastal	-0.3%	0.4%	1.9%
	Inland	-0.6%	0.2%	1.6%
	North	-0.4%	0.2%	1.4%
	Central	-0.8%	0.0%	1.6%
	South	-0.1%	0.7%	2.1%
	Statewide	-0.3%	0.4%	1.9%

Construction / Policy	Region	Percent Change in Loss Cost		
		Year Built 1980	Year Built 1998	Year Built 2004
Commercial Residential	Coastal	-0.1%	0.1%	2.1%
	Inland	-0.4%	0.4%	1.8%
	North	-0.2%	0.6%	1.8%
	Central	-0.6%	0.1%	1.8%
	South	0.2%	0.0%	2.3%
	Statewide	-0.1%	0.1%	2.1%

Table 59. Percent Change in Logical Relationship to Risk—Building Strength

Construction/ Policy	Region	Percent Change in Loss Cost		
		Weak	Medium	Strong
Frame Owners	Coastal	-0.1%	0.6%	-2.1%
	Inland	-0.4%	0.4%	-1.8%
	North	-0.3%	0.4%	-1.9%
	Central	-0.6%	0.2%	-2.0%
	South	0.2%	0.9%	-2.2%
	Statewide	-0.1%	0.6%	-2.1%
Masonry Owners	Coastal	-0.1%	0.6%	-2.1%
	Inland	-0.4%	0.4%	-1.8%
	North	-0.3%	0.4%	-1.9%
	Central	-0.6%	0.2%	-2.0%
	South	0.2%	0.9%	-2.2%
	Statewide	-0.1%	0.6%	-2.1%
Manufactured Homes	Coastal	-0.2%	-0.1%	-0.2%
	Inland	-0.4%	-0.3%	-0.4%
	North	-0.4%	-0.3%	-0.6%
	Central	-0.6%	-0.6%	-0.6%
	South	0.1%	0.1%	0.2%
	Statewide	-0.2%	-0.2%	-0.2%
Frame Renters	Coastal	-0.2%	0.5%	-2.3%
	Inland	-0.5%	0.3%	-2.0%
	North	-0.4%	0.3%	-2.1%
	Central	-0.7%	0.1%	-2.1%
	South	0.0%	0.8%	-2.4%
	Statewide	-0.3%	0.5%	-2.2%
Masonry Renters	Coastal	-0.3%	0.5%	-2.1%
	Inland	-0.6%	0.2%	-1.8%
	North	-0.4%	0.3%	-2.0%
	Central	-0.7%	0.1%	-2.0%
	South	0.0%	0.8%	-2.2%
	Statewide	-0.3%	0.5%	-2.1%

Construction/ Policy	Region	Percent Change in Loss Cost		
		Weak	Medium	Strong
Frame Condo Unit	Coastal	-0.3%	0.4%	-2.2%
	Inland	-0.6%	0.2%	-1.9%
	North	-0.4%	0.2%	-2.0%
	Central	-0.7%	0.0%	-2.1%
	South	0.0%	0.7%	-2.3%
	Statewide	-0.3%	0.4%	-2.2%
Masonry Condo Unit	Coastal	-0.3%	0.4%	-2.1%
	Inland	-0.6%	0.2%	-1.8%
	North	-0.4%	0.2%	-1.9%
	Central	-0.8%	0.0%	-2.0%
	South	-0.1%	0.7%	-2.2%
	Statewide	-0.3%	0.4%	-2.1%
Commercial Residential	Coastal	-0.1%	0.1%	-2.0%
	Inland	-0.4%	0.4%	-2.1%
	North	-0.2%	0.6%	-2.0%
	Central	-0.6%	0.1%	-2.2%
	South	0.2%	0.0%	-1.9%
	Statewide	-0.1%	0.1%	-2.0%

Table 60. Percent Change in Logical Relationship to Risk—Condo Unit Floor

Construction/ Policy	Region	Percent Change in Loss Cost			
		3rd Floor	9th Floor	15th Floor	20th Floor
Condo Unit A	Coastal	-0.3%	-2.2%	-2.8%	-0.3%
	Inland	-0.6%	-1.4%	-1.7%	-0.6%
	North	-0.4%	-2.0%	-2.5%	-0.4%
	Central	-0.8%	-2.3%	-2.8%	-0.8%
	South	-0.1%	-2.1%	-2.8%	-0.1%
	Statewide	-0.3%	-2.1%	-2.7%	-0.3%
Condo Unit B	Coastal	-0.3%	-2.1%	-2.8%	-0.3%
	Inland	-0.6%	-1.4%	-1.7%	-0.6%
	North	-0.4%	-1.9%	-2.5%	-0.4%
	Central	-0.8%	-2.2%	-2.7%	-0.8%
	South	-0.1%	-2.0%	-2.7%	-0.1%
	Statewide	-0.3%	-2.1%	-2.7%	-0.3%

Table 61. Percent Change in Logical Relationship to Risk—Number of Stories

Construction/ Policy	Region	Percent Change in Loss Cost		
		1 Story	2 Story	
Frame Owners	Coastal	-0.1%	-0.1%	
	Inland	0.0%	0.0%	
	North	-0.4%	-0.4%	
	Central	-0.4%	-0.4%	
	South	0.2%	0.1%	
	Statewide	-0.1%	-0.1%	
Masonry Owners	Coastal	-0.1%	-0.1%	
	Inland	0.0%	0.0%	
	North	-0.4%	-0.4%	
	Central	-0.4%	-0.4%	
	South	0.1%	0.1%	
	Statewide	-0.1%	-0.1%	
Frame Renters	Coastal	-0.3%	-0.3%	
	Inland	-0.1%	-0.1%	
	North	-0.5%	-0.5%	
	Central	-0.5%	-0.5%	
	South	0.0%	0.0%	
	Statewide	-0.2%	-0.2%	
Masonry Renters	Coastal	-0.3%	-0.3%	
	Inland	-0.2%	-0.2%	
	North	-0.5%	-0.5%	
	Central	-0.5%	-0.6%	
	South	-0.1%	-0.1%	
	Statewide	-0.3%	-0.3%	
Construction/ Policy	**Region**	**Percent Change in Loss Cost**		
		5 Story	**10 Story**	**20 Story**
Commercial Residential	Coastal	-0.1%	-0.1%	-0.1%
	Inland	0.1%	0.1%	0.1%
	North	-0.4%	-0.4%	-0.4%
	Central	-0.4%	-0.4%	-0.4%
	South	0.1%	0.1%	0.1%
	Statewide	-0.1%	-0.1%	-0.1%

Standard A-6, Disclosure 9

Form A-8: Probable Maximum Loss for Florida

A. *Provide a detailed explanation of how the Expected Annual Hurricane Losses and Return Periods are calculated.*

In Form A-8, the Total Loss column contains the sum of all event losses for only events whose individual losses fall within the bounded range. The Number of Hurricanes column shows the corresponding number (count) of events in the catalog whose losses fall within the range. The Average Loss column contains the quotient of the Total Loss and Number of Hurricanes for each range. The Expected Annual Hurricane Losses column is the quotient of the Total Loss for the range and the (constant) number of years in the catalog of 50,000. Finally, the Return Period column shows the return period, or reciprocal of exceedance probability, for the loss amount from the Average Loss column, calculated in accordance with the event-ranking methodology described in Standard A-3, Disclosure 1.

B. *Complete Part A showing the personal and commercial residential probable maximum loss for Florida. For the Expected Annual Hurricane Losses column, provide personal and commercial residential, zero deductible statewide loss costs based on the 2012 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named* "hlpm2012c.exe*."*

In the column, Return Period (Years), provide the return period associated with the average loss within the ranges indicated on a cumulative basis.

For example, if the average loss is $4,705 million for the range $4,501 million to $5,000 million, provide the return period associated with a loss that is $4,705 million or greater.

For each loss range in millions ($1,001-$1,500, $1,501-$2,000, $2,001-$2,500) the average loss within that range should be identified and then the return period associated with that loss calculated. The return period is then the reciprocal of the probability of the loss equaling or exceeding this average loss size.

The probability of equaling or exceeding the average of each range should be smaller as the ranges increase (and the average losses within the ranges increase). Therefore, the return period associated with each range and average loss within that range should be larger as the ranges increase. Return periods shall be based on cumulative probabilities.

A return period for an average loss of $4,705 million within the $4,501-$5,000 million range should be lower than the return period for an average loss of $5,455 million associated with a $5,001- $6,000 million range.

The 2012 FHCF aggregate exposure data has been modeled with a zero deductible assumption. Gross, zero deductible modeled losses have been used in the preparation of this form according to the specifications provided.

C. *Provide a graphical comparison of the current model Residential Return Periods loss curve to the previously accepted model Residential Return Periods loss curve. Residential Return Period (Years) shall be shown on the y-axis on a log 10 scale with Losses in Billions shown on the x-axis. The legend shall indicate the corresponding model with a solid line representing the current year and a dotted line representing the previously accepted model.*

A graphical comparison of the exceedance probability curves based on modeling the data as described in B.1. for both the current and previously accepted submission is provided.

D. *Provide the estimated loss and uncertainty interval for each of the Personal and Commercial Residential Return Periods given in Part B Annual Aggregate and Part C, Annual Occurrence. Describe how the uncertainty intervals are derived. Also, provide in Parts B and C, the Conditional Tail Expectation, the expected value of losses greater than the Estimated Loss Level.*

Estimated loss and uncertainty intervals are provided for each return period. The uncertainty intervals are 95% confidence intervals based on bootstrapping method, and were computed using the software MatLab. The conditional tail expectation, the expected value of losses greater than the estimated loss level are provided in Part B Annual Aggregate and Part C, Annual Occurrence. The Conditional Tail Expectation was calculated as the expected value of losses greater than the Estimated Loss level.

E. *Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include Form A-8, Probable Maximum Loss for Florida, in a submission appendix.*

A hard copy of Form A-8 is included in this appendix in Table 62 and Table 63 and is provided in Excel format.

Table 62. Part A: Personal and Commercial Residential Probable Maximum Loss for Florida

LOSS RANGE (MILLIONS)			TOTAL LOSS	AVERAGE LOSS (MILLIONS)	NUMBER OF HURRICANES	EXPECTED ANNUAL HURRICANE LOSSES*	RETURN PERIOD (YEARS)
$	to	$500	2,664,885	126	21082	53.3	2.1
$501	to	$1,000	3,542,526	722	4908	70.9	2.7
$1,001	to	$1,500	3,696,203	1,232	3000	73.9	3.2
$1,501	to	$2,000	3,565,158	1,737	2053	71.3	3.6
$2,001	to	$2,500	3,485,160	2,237	1558	69.7	4.0
$2,501	to	$3,000	3,533,390	2,741	1289	70.7	4.3
$3,001	to	$3,500	3,501,133	3,245	1079	70.0	4.7
$3,501	to	$4,000	3,233,084	3,742	864	64.7	5.1
$4,001	to	$4,500	3,309,933	4,244	780	66.2	5.5
$4,501	to	$5,000	3,109,398	4,747	655	62.2	5.8
$5,001	to	$6,000	5,941,618	5,491	1082	118.8	6.4
$6,001	to	$7,000	5,609,717	6,485	865	112.2	7.1
$7,001	to	$8,000	5,569,127	7,495	743	111.4	7.9

LOSS RANGE (MILLIONS)			TOTAL LOSS	AVERAGE LOSS	NUMBER OF HURRICANES	EXPECTED ANNUAL	RETURN PERIOD
$8,001	to	$9,000	5,100,423	8,515	599	102.0	8.7
$9,001	to	$10,000	4,848,964	9,489	511	97.0	9.5
$10,001	to	$11,000	4,556,313	10,498	434	91.1	10.3
$11,001	to	$12,000	4,682,211	11,476	408	93.6	11.2
$12,001	to	$13,000	4,457,555	12,486	357	89.2	12.2
$13,001	to	$14,000	3,479,914	13,488	258	69.6	13.1
$14,001	to	$15,000	3,939,107	14,482	272	78.8	13.9
$15,001	to	$16,000	4,212,777	15,488	272	84.3	15.0
$16,001	to	$17,000	3,447,778	16,497	209	69.0	16.1
$17,001	to	$18,000	3,324,848	17,499	190	66.5	17.0
$18,001	to	$19,000	3,427,263	18,526	185	68.5	18.2
$19,001	to	$20,000	2,988,853	19,535	153	59.8	19.3
$20,001	to	$21,000	2,669,771	20,537	130	53.4	20.3
$21,001	to	$22,000	3,243,025	21,477	151	64.9	21.5
$22,001	to	$23,000	2,338,382	22,484	104	46.8	22.7
$23,001	to	$24,000	3,101,369	23,495	132	62.0	23.8
$24,001	to	$25,000	2,078,173	24,449	85	41.6	25.1
$25,001	to	$26,000	2,218,896	25,505	87	44.4	26.1
$26,001	to	$27,000	2,724,405	26,451	103	54.5	27.5
$27,001	to	$28,000	2,446,492	27,489	89	48.9	29.0
$28,001	to	$29,000	2,591,587	28,479	91	51.8	30.5
$29,001	to	$30,000	2,005,985	29,500	68	40.1	32.1
$30,001	to	$35,000	9,417,748	32,363	291	188.4	36.2
$35,001	to	$40,000	8,381,044	37,415	224	167.6	44.1
$40,001	to	$45,000	8,052,269	42,605	189	161.0	53.6
$45,001	to	$50,000	6,880,909	47,455	145	137.6	64.9
$50,001	to	$55,000	5,728,817	52,558	109	114.6	77.4
$55,001	to	$60,000	4,825,686	57,449	84	96.5	91.1
$60,001	to	$65,000	4,877,273	62,529	78	97.5	107.1
$65,001	to	$70,000	3,973,847	67,353	59	79.5	125.6
$70,001	to	$75,000	3,921,751	72,625	54	78.4	143.7
$75,001	to	$80,000	3,413,672	77,583	44	68.3	170.1
$80,001	to	$90,000	5,034,093	85,324	59	100.7	200.8
$90,001	to	$100,000	5,307,621	94,779	56	106.2	261.8
$100,001	to	$ Max.	22,077,636	138,853	159	441.6	925.9
Total			**216,537,791**	**4,667**	**46397**	**4,330.8**	**n/a**

**Personal and commercial residential zero deductible statewide loss using 2012 FHCF personal and commercial residential exposure data – file name: hlpm2012c.exe.*

Table 63. Part B– Personal and Commercial Residential Probable Maximum Loss for Florida (Annual Aggregate)

Based on 100K Bootstrap			
Return Period (Years)	Estimated Loss Level (Millions)	Uncertainty Interval (Millions)	Conditional Tail Expectation
Top Event	341,541	297016 to -	--
1,000	150,697	137537 to 158540	193,575
500	120,232	111883 to 127384	162,962
250	97,022	93396 to 101145	134,836
100	64,718	61614 to 67017	101,036
50	44,076	42253 to 45549	76,804
20	22,339	21541 to 23048	49,241
10	11,212	10908 to 11572	32,490
5	4,028	3901 to 4157	19,703

Table 64. Part C–Personal and Commercial Residential Probable Maximum Loss for Florida (Annual Occurrence)

Based on 100K Bootstrap			
Return Period (Years)	Estimated Loss Level (Millions)	Uncertainty Interval (Millions)	Conditional Tail Expectation
Top Event	314,093	281766 to -	--
1,000	146,537	134373 to 155216	188,085
500	116,424	109215 to 123364	158,070
250	92,403	87798 to 97239	130,268
100	60,796	57601 to 63385	96,135
50	41,132	39374 to 42482	72,593
20	20,230	19541 to 20963	45,970
10	10,082	9770 to 10412	30,095
5	3,623	3509 to 3746	18,151

The 95% uncertainty intervals for the individual return periods were calculated using the method of bootstrapping. To derive the intervals, we repeatedly sampled with replacements from our dataset of 50,000 modeled occurrence losses. We then ranked and identified the return period losses of interest in Form A-8 for each of the samples drawn. The procedure was repeated 100,000 times, yielding a bootstrap distribution at each of the return periods of interest. The 95% uncertainty intervals shown in Form A-8 represent the 0.025 and 0.975 percentiles of the 100K bootstrap distribution determined for each return period.

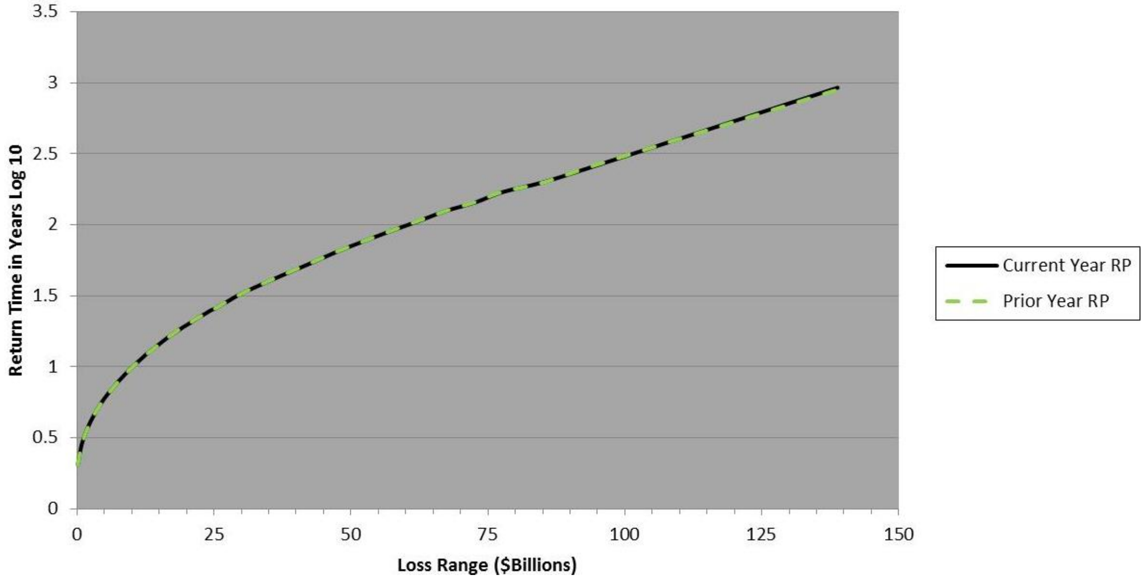


Figure 97. Part C: Personal and Commercial Residential Loss Curve Comparison

Standard A-6, Disclosure 10

Appendix 6: Model Output Forms

Import Log

```
********************************
**     Touchstone v.4.1     **
********************************

********** Log header **********
Description:    [Import] initiated by [AIR-WORLDWIDE\i56289] on [CSG16HN04FLCM]
Time Subm 123]
Time Starte 207]
Time Ende 424]
Duration:      [00:07:58]
Status:        [Completed]
Owner:         [AIR-WORLDWIDE\i56289]
DataImport Version: [4.1.0.50]


********** Log Data Source Information **********
Import Type: [CSV]
Import Date Format: [Default]
Data Source: [\\CSG16HN04FLCM\AIRWork\IMPORT\61.FormA2A3A8S_non_OR_FHCF2012_zro_ded_20140714_Contract.txt]
    Data Tables: [61.FormA2A3A8S_non_OR_FHCF2012_zro_ded_20140714_Contract.txt 61.Map_30157701-cb3b-43c9-898d-0301da868ba3
        61.Default_56e0756d-1875-4782-96c0-1463a3bd4dcc 61.FormA2A3A8S_non_OR_FHCF2012_zro_ded_20140714_Location.txt ]
Delimiter:  ]
Text Qualifier: [Double Quote]
Has Header: [Y]

********** Log Import Options **********
Destination Database        : [FCHLPM_15_TS41RC1_Patch_A_Forms_Exp]
Destination SQL Server      : [CSG16DB04\SQL2014]
Target Type                 : [Exposure Set]
Target Name                 : [A2A3A8S_non_OR_FHCF2012_zro_ded]
Contract Type               : [Primary]
Mapping Set                 : [FCHLPM_15_FormA2A3A8_2012FHCF]
Continue Geocode with Import Errors: [Y]
Duplicate Contract          : [Skip+Error]
Location Error              : [Reject Location]
Fail After                  : [Unlimited]
Max Errors                  : [0]
Existing Geocode            : [Preserve]
Geocoder                    : [AIR Geocode]
Include Decommissioned Offshore Platforms : [No]
Min HPC Cores               : [1]
Max HPC Cores               : [4]
Job Priority                : [Normal]
Job Scheduled Time          : [Execute Immediately]
Currency                    : [USD]

Auto Exposure View: Yes
Project Name: [FCHLPM_15_TS41RC1_Patch_A_Forms]
Exposure View Name: [A2A3A8S_non_OR_FHCF2012_zro_ded]
Generate Exposure Summary: Yes

********** Log Summary Statistics **********
Elapsed Time: [00.00:07:50]
Total No. of records: [235875]
No. of records successfully processed: [235875]
Percentage of records successfully Imported: [100.00%]
```

Summary of Property Records NOT IMPORTED: |
No. of Contracts NOT IMPORTED: |[0]|
No. of Locations NOT IMPORTED: |[0]|
No. of Location Details NOT IMPORTED: |[0]|
No. of Sublimits NOT IMPORTED: |[0]|
No. of Layers NOT IMPORTED: |[0]|
No. of Reinsurance Treaty NOT IMPORTED: |[0]|
No. of Reinsurance Facultative NOT IMPORTED: |[0]|
No. of Reinsurance (Unknown) NOT IMPORTED: |[0]|
No. of Step Functions NOT IMPORTED: |[0]|
No. of Location Groups NOT IMPORTED: |[0]|

Geocode Statistics :|
GeoCoding Elapsed Time: [00.00:02:46]

[235870] locations records required geocoding
[235870] locations records were successfully geocoded
[0] location records were not geocoded

Summary of Geocode Match Level :|
[0] address(es) are matched at the Exact Address level
[0] address(es) are matched at the ZIP9 Address level
[0] address(es) are matched at the Relaxed Address level
[235870] address(es) are matched at the Postal Code Centroid Address level
[0] address(es) are matched at the Street level
[0] address(es) are matched at the City Centroid level
[0] address(es) are matched at the County Centroid level
[0] address(es) are matched at the CRESTA level
[0] address(es) are matched at the Subarea2 level
[0] address(es) are matched at the Area level
[0] address(es) are not matched
[0] address(es) are matched at the User Supplied level
[0] address(es) were not geocoded due to errors

********* Error Summary **********

********* Business Errors **********

********* Business Validation Warnings **********

********* Geocoding Errors **********

Analysis Log

Touchstone

o Analysis Header Info

Analysis Type:	Detailed Loss Analysis
Analysis Name:	FormA8S5_50k_Wind_DS_AP_ET_LocSum_Cov
Template Name:	AIR Default Loss Template
Analysis SID:	31
Result SID:	8
Activity ID:	35
HPC Job ID:	3514
Description:	N/A
User:	AIR-WORLDWIDE\i56289
Time Submitted:	10/05/2016 00:27:45
Time Started:	10/05/2016 05:00:06
Time Ended:	10/05/2016 06:32:01
Duration:	01:31:54
Status:	Completed

o Error Summary

o System Info

System Version:	4.1.0.50
SQL Server Name:	CSG16DB03
HPC Head Node:	csg41flcmashn

o Analysis Target Info

Analysis Target Type:	Portfolio
Analysis Target Name:	FormA2A3A8S_non_OR_FHCF_zro_ded
Exposure View Filter:	Not Applied

Exposure Set(s): Database : Exposure Set Name

-------- ------------------

FCHLPM_15_TS41RC1_Patch_A_Forms_Exp : A2A3A8S_non_OR_FHCF2012_zro_ded

Analysis Statistics: Analyzed

Policy Count: 5
Total Location Count: 235870
Property Location Count: 235870
Workers Location Count: 0
Layers Count: 0
SubLimits Count: 0
Reinsurance Count: 0
Total Replacement Value: 2,076,280,603,137

o Event Set Options

Event Set Name:	50K US AP (2017) - Standard
Event Set Type:	Stochastic
Event Filter:	Off
Demand Surge:	On
Custom Demand Surge:	No

Perils: Tropical Cyclone - Wind

Hazard Models:	Model:	Model Version:	Catalog:	Catalog Version:	Events:	Scenarios:
AIR Hurricane Model for Hawaii	23	3.9.0	AIR Hurricane Model for Hawaii	04.01.0509	10330	50000
AIR Hurricane Model for Offshore Assets	27 (24)	1.9.0	AIR North Atlantic Basinwide Hurricane Model	17.00.0808	723844	
AIR Hurricane Model for the U.S.	27 (21)	16.0.0	AIR North Atlantic Basinwide Hurricane Model	17.00.0808	723844	
AIR Tropical Cyclone Model for Caribbean	27 (25)	9.0.0	AIR North Atlantic Basinwide Hurricane Model	17.00.0808	723844	
AIR Tropical Cyclone Model for Central America	27 (67)	2.1.0	AIR North Atlantic Basinwide Hurricane Model	17.00.0808	723844	
AIR Tropical Cyclone Model for Mexico	27 (29)	1.0.0	AIR North Atlantic Basinwide Hurricane Model	17.00.0808	723844	

o Financial Model Options

Correlation: Off
Disaggregation: Off
Average Properties: On
Invalid Con/Occ Pairs: Ignore
Apply residential location terms: AIR Default behavior
Intra-Policy Correlation factor: 0%
Inter-Policy Correlation factor: 0%

o Reinsurance Options

Program Name: N/A
Order of application of Fac: On
FAC Reinsurance Count: 0
Treaty Reinsurance Count: 0

o Custom Model Options

Custom Model: N/A

o Output Options

Loss Perspectives: Ground Up
Retained
Gross
Net of Pre-CAT

Event Losses By: Portfolio
Geography: Event Total
Summary (AAL Only): Location Summary

Loss Details: Coverage

o Analysis Management Options

Min-Max Cores: 1-16
Scheduled On: 10/05/2016 05:00:04
Priority: Normal
Processing Resource: OnPremises
Result Server: CSG16DB03
Result Database: FCHLPM_15_TS41RC1_Patch_A_Forms_Res
Results Currency Set: AIR Default
Results Currency: USD
Move Marine Craft Geocodes: Off

Commodity Prices
Gas: 2.93
Oil: 53.3

o Flexibility Options

Not available.
o Terrorism Options

Terrorism Not Covered - Coverage solely provided by Standard Fire Policies (SFP)

Standard A-1, Disclosure 5

Appendix 7: Curriculum Vitæ

Dr. Carol Friedland Ph.D., P.E., C.F.M.

Bert S. Turner Department of Construction Management Tel: 225-578-1155
Louisiana State University
Baton Rouge, LA 70803 Email: friedland@lsu.edu

Education

Ph.D., Civil Engineering, Minor: Disaster Science & Management, Louisiana State University, May 2009

M.S., Civil Engineering, Louisiana State University, May 2006

B.S., Civil Engineering, Minor: Spanish, University of Wyoming, May 1998

Professional Certifications

Professional Engineer in Civil Engineering, Wyoming Registration No. 10094
ASFPM Certified Floodplain Manager (CFM), National Certification No. US-12-06337

Academic Appointments

Assistant Professor (August 2009-present), Department of Construction Management, Louisiana State University, Baton Rouge, LA

Part-Time Instructor (2007-2009) Department of Construction Management & Industrial Engineering, Louisiana State University, Baton Rouge, LA

Teaching Assistant (2005-2007) Department of Construction Management & Industrial Engineering, Louisiana State University, Baton Rouge, LA

Research Assistant (2003-2005) Department of Civil & Environmental Engineering, Louisiana State University, Baton Rouge, LA

Professional Appointments

Research Intern (summer 2006), *ImageCat, Inc., Long Beach, CA*

Intern (summer 2005), *Swiss Reinsurance Group, Armonk, NY*

Engineering Intern (summer 2004), *Cermak, Peterka, Petersen (CPP), Inc., Fort Collins, CO*

Project Engineer, Field Engineer, Estimator (1999-2003), *Kiewit Industrial Co., Overland Park, KS*

Staff Engineer (1998 – 1999), *MSE-HKM, Inc., Billings, MT*

Professional Contributions

Professional Affiliations

Member, American Society of Civil Engineers (ASCE), 1993-present

Member, American Association of Wind Engineers (AAWE), 2004-present

Member, Association of State Floodplain Managers, 2012-present

Member, American Society for Engineering Education, 2011-2013

Member, Sigma Lambda Chi International Construction Honor Society, 2008-present

Professional Committees and Activities

Member, ASCE Technical Council on Wind Engineering (TCWE) Structural Wind Engineering Committee (SWEC), 2010-present

Member, ASCE 7 Standard Flood Loads Subcommittee, 2012-2016

Member, ASCE 24 Standard Committee for Flood Resistant Design and Construction, 2010-2015

Member, ASCE Technical Activities Committee on Dynamic Effects, Multiple Hazard Mitigation Committee 2010-present

Steering Committee Member, 2013 Americas Conference on Wind Engineering (12ACWE)

Member, ASCE Coasts, Oceans, Ports & Rivers Institute (COPRI)

Member, ASCE Structural Engineering Institute (SEI)

Member, ASCE Energy Division, Petrochemical Committee, Task Committee on Wind-Induced Forces, 2005-2006

Publications and Presentations

Refereed Journal Publications

Friedland, C.*, Joyner, T. A., Massarra, C., Rohli, R., Treviño, A., Ghosh, S., Huyck, C., & Weatherhead, M. (2016). Isotropic and anisotropic kriging approaches for interpolating surface-level wind speeds across large, geographically diverse regions. *Geomatics, Natural Hazards and Risk*. doi:10.1080/19475705.2016.1185749

Ittmann, J., Friedland, C.*, & Okeil, A. (2016). Personal liability of the practicing engineer. *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*. doi:10.1061/(ASCE)LA.1943-4170.0000125

Matthews, E., Friedland, C. J.*, & Orooji, F. (2016). Optimization of sustainability and flood hazard resilience for home designs. *Procedia Engineering, 145*, 525-531. doi:10.1016/j.proeng.2016.04.040

Reed, D. A.*, Friedland, C. J., Wang, S., & Massarra, C. C. (2016). Multi-hazard system-level logit fragility functions. *Engineering Structures, 122*,14-23.

Joyner, T. A., Friedland, C. J.*, Rohli, R. V., Treviño, A. M., Massarra, C., & Paulus, G. (2015). Cross-correlation modeling of European windstorms: A cokriging approach for optimizing surface wind estimates. *Spatial Statistics, 13*, 62-75. http://dx.doi.org/10.1016/j.spasta.2015.05.003

Jiang, S., & Friedland, C. J.* (2015). Automatic urban debris zone extraction from post-hurricane very high-resolution satellite and aerial imagery. *Geomatics, Natural Hazards and Risk*, *7*(3), 933-952. doi: 10.1080/19475705.2014.1003417

Adams, S. M., Levitan, M. L.*, & Friedland, C. J. (2014). High resolution imagery collection for post-disaster studies utilizing unmanned aircraft systems (UAS). *Photogrammetric Engineering & Remote Sensing, 80*(12), 1161-1168.

Matthews, E. C., Sattler, M., & Friedland, C. J.* (2014). A critical analysis of hazard resilience measures within sustainability assessment frameworks. *Environmental Impact Assessment Review*, *49*(0), 59-69. http://dx.doi.org/10.1016/j.eiar.2014.05.003

Dunn, C. L., Friedland, C. J.*, & Levitan, M. L. (2013). Statistical representation of design parameters for hurricane risk reduction structures. *Structural Safety, 45*(0), 36-47. http://dx.doi.org/10.1016/j.strusafe.2013.08.009

Ittmann, J., Friedland, C.*, & Okeil, A. (2013). Enforceability of limitation of liability clauses in engineering contracts. *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 5*(3), 128-135. doi: 10.1061/(ASCE)LA.1943-4170.0000125

Bohn, F., & Friedland, C. J.* (2013). Why the 100-year flood? *Louisiana Civil Engineer, 21*(3), 16-18.

Friedland, C.*, & Gall, M. (2012). True cost of hurricanes: Case for a comprehensive understanding of multihazard building damage. *Leadership and Management in Engineering, 12*(3), 134-146. doi: 10.1061/(ASCE)LM.1943-5630.0000178

Conference Proceedings

“Mitigating wind and flood: The increased wind vulnerability of static elevation vs. amphibious retrofit,”

English, E., Orooji, F., and Friedland, C.J., 8th International Colloquium on Bluff Body Aerodynamics and Applications, Boston, MA, June 7-11, 2016.

“Optimization of Sustainability and Natural Hazard Resilience for Home Designs,”

Matthews, E., Friedland, C., and Orooji, F., International Conference on Sustainable Design, Engineering and Construction (ICSDEC 2016), Tempe, AZ May 18-20, 2016.

“Integration of BIM throughout an Industrial Construction Educational Track,”

Friedland, C., Orooji. F., Zhu, Y., Chokwitthaya, C., Pecquet, C, and Kenney, J., Proceedings of the 10th BIM Academic Symposium, Kissimmee, FL, April 4-5, 2016. “Amphibious Construction vs. Permanent Static Elevation: Flood Resilience Without Increased Vulnerability to Wind,”

English, E., Friedland, C., and Orooji, F., 1st International Conference on Amphibious Architecture, Design & Engineering (ICAADE 2015), Bangkok, Thailand, August 26-29, 2015.

“A New Approach to Combined Flood and Wind Mitigation for Hurricane Damage Prevention,” English, E., Friedland, C., Orooji, F., and Mahtani, N., 14th International Conference on Wind Engineering (ICWE14), Porto Alegre, Brazil, June 21-26, 2015.

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"H*Wind hurricane time history extraction for defined locations," Madani, S. A., M. Baradaranshoraka & C. J. Friedland. 12th Americas Conference on Wind Engineering (12ACWE). Seattle, WA, June 16-20, 2013.

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"Unmanned aerial vehicle data acquisition for damage assessment in hurricane events," Adams, S.M., C.J. Friedland, and M.L. Levitan. Proceedings, *8th International Workshop on Remote Sensing for Disaster Management*. 2010. Tokyo, Japan.

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“Results of neighborhood level analysis of structural storm surge damage to residential structures,” Friedland, C.J., B.J. Adams, and M.L. Levitan. Proceedings, *Fifth International Workshop on Remote Sensing for Post-Disaster Response*. 2007. Washington, DC.

“A hydrologic flood forecasting system for Mesoamerica,” Villalobos-Enciso, J.E. and C. Friedland. Proceedings, *32nd International Symposium on Remote Sensing of Environment*. 2007. San José, Costa Rica.

“Deployment of remote sensing technology for multi-hazard post-Katrina damage assessment,” Ghosh, S., B.J. Adams, J.A. Womble, C. Friedland, and R.T. Eguchi. Proceedings, *The 2nd International Conference on Urban Disaster Reduction*. 2007. Taipei, Taiwan.

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Narges Pourghasemi

Mobile: 949-300-5159 npghasemi@yahoo.com Lake Forest, CA 92609

Sr. Software Engineer / Software Consultant

A versatile and result-oriented Software Developer professional with expertise in System Analysis, Design, Development and Product Enhancement. Over 20 years of consistently proven success, designing and developing Software (full SDLC practice) for E-commerce, web applications, Distributive systems, GUI, animation and Embedded Systems.

Equally effective working alone or in teams; Excellent Customer-Interface skills; Distinguished academic and teaching experience. Proven ability to quickly grasp new challenges, master new technologies and achieve tangible results. **US Citizen.**

Industries: Cloud, Enterprise Software, SaaS, Aerospace, Air travel, Flight Entertainment, Automative, Insurance, Financial, Entertainment, Natural Language Processing, Medical Devices.

Technical Proficiencies

Languages / Frameworks	Java, Spring WS, MVC, hibernate, EJB/ Java Beans, JPA, Deltaspike, Java Servlets, Java Swing, JavaScript, C/C++, JSP, ASP, HTML, XML/XSL, CSS, Ajax, Python, PERL, PHP, Velocity, X11/Motif, OpenGL, LISP, FORTRAN, Assembly, Groovy, UNIX Shell Scripts (ksh, csh, bsh, FreeBSD), awk, sed, MySQL, JDBC, Oracle 11, SQL, DB2, iBatis/MyBatis, ETL.
Operating Environments	Java EE Platform, UNIX, Linux, LAMP, Timesys Embedded Linux, ARM, AIX, HP-UX, Mac OS , X-Window, Xcode VMS, VOS, IRIX, SUN, IBM AS400/i-series, IBM RISC, MS Windows, GDS/CRS, Apache Tomcat, Websphere, Jboss 7, WildFly, Agile Scrum.
Communications	HTTP, X.25, MATIP, EDIFACT, FTP, TCP/IP and Sockets.
Tools/Utilities	IDE (*Eclipse*, *Net Beans*, JBoss Studio, *MS Visual Studio*, *IntelliJ,Xcode*); *GUI Builders* (Builder Xcessory, UIM/X); SCM(Rational ClearCase/ClearRequest, Visual SourceSafe, AccuRev, CVS, SVN, Maven); *Debuggers* (xde, dbx, gdb, xdb), AC3D, GIMP, PhotoShop CS4 SDK, vi, Emacs, WebEX, Visio, UML, VMware, SoapUI.

EXPERIENCE

MERCURY TECHNOLOGY GROUP, Irvine, CA — Feb 2015- Present

Senior Java EE Web Application Developer- Solutions – Development of new Web application Software solutions, Portal, in support of company's cloud services infrastructure and customer offerings.
Environment: Java EE platform, Spring Web Services, MVC, hibernate, EJB/ Java Beans, JPA, SOAP, WSDL, RESTful, Apache Deltaspike, Tomcat, JBoss 7, WildFly, Oracle 11, SQL, Maven, SVN, Linux, Eclipse, SoapUI, SVN.

SOLERA HOLDINGS INC. (formerly DST), Lake Forest, CA — 2011- Oct 2014

e-Commerce Application Developer (Java EE Web Services Developer) – Development, Enhancement, basic project management, and updating assortment of eCommerce Enterprise Web Applications for the Aftermarket Automotive Industry, using Java, IBM DB2/SQL, SOAP/REST. Integration of in-house and 3rd party web services, application, Catalog providers and Electronic Data, i.e, EPICOR (formerly Activant), MOTOR FleetCross, ADP Dealer Services, and ACDelco OE. GUI design, and software technical documentation.
Environment: Java, Java EE platform,Web Services, Servlets, SOAP, WSDL, RESTful, AXIS, Apache Tomcat, WebSphere, JAXB, JDBC, IBM DB2, SQL, MyBatis (iBATIS), IBM iSeries(AS400), XML/XSD, Myeclipse, SoapUI, SVN, FTP, HTTP, Linux, PHP.

IMS COMPANY, Brea, CA — 2011

Sr. Software Engineer – Development of an application for Acceptance Testing Procedure, Performance Verification and Environmental Stress testing of Hardware parts used for a portable in-flight entertainment embedded device. *Environment*: C++, Linux/ Ubuntu, SVN, ARM, VMware, Curses, Eclipse, UML, Timesys Embedded Linux, Agile.

Independent Software Consultant — 2004 – 2012

- APPLIED INSURANCE RESEARCH (AIR WORLDWIDE CO.), Boston, MA (2006, 2007, 2008, 2010, 2012)
  IT Audit – Review the software and the development process of the Hurricane Insurance Model written in **C++** & Fortran to ensure that they comply with the Florida Commission standards. Provided recommendations for improvements in implementation and documentations, which some of them incorporated into Florida Hurricane Commissions Standards.
- THE WALT DISNEY TELEVISION ANIMATION – Glendale, CA (2010)
  Software Consultant- Implemented assortment of tools including: Writing a script in Python to execute commands on the specified hostname (remote shell) with some security measurements. Writing Photoshop plug-ins for formatting in different color space. Researched for Parallelism of Video encoding. *Environment*: Mac OS 6, Window 7, MS Visual Studio, C/C++, Python, Shell scripts, Linux, Sockets, Photoshop CS4 SDK and plug-in.
- TANDEM DIABETES CARE – San Diego, CA (2009-2010)
  Software/Firmware Consultant - Developed scripts in Lisp to test embedded system medical devices. This tool used for Hardware testing using Emacs on Mac OS X; and the Firmware was written in C.
- Freelance Software/Web Developer - Orange County, CA (2008-2009, 2011)
  Design and Development of Websites and Marketing solutions for assortment of Professionals and Services, including Architectural Firm, Dental offices.
- CHARLES RIVER ANALYTICS, INC. , Cambridge, MA (2006)

Narges Pourghasemi **Page 2**

Designed and implemented a Graphical User Interface of an editor for the emulator data exploited in a Context-driven Infospace Configuration for Air Force Research Lab, using **Java Swing**, XML. Wrote the User Manual for this tool; and reformatted other tools documentations into the User Manuals. Research and Analysis of using B-Net for the application.

- KAYAK, Concord, MA (2005)
  Assisted in development of *Internet Travel Product,* for a travel meta-search company, using Java, J2EE/Tomcat/Struts, extensive HTTP Protocols, XML/DOM/SOAP/AXIS/WSDL, AJAX, Velocity, PHP, HTML, MySQL, CVS, Mac OS X.
- TAXWARE, Salem, MA. (2004–2005)
  Ported the Tax Management application from SUN Solaris to AIX and Linux platforms. Enhanced, optimized and fixed software defects of the application's front-end. Environment: X/Motif, Builder Xcessory GUI builder, C on variety of Unix/Linux platforms.

LANGUAGE WEAVER, Los Angeles, CA 2009
Sr. Software Developer in Test - Designed and Developed stress and performance tools for software testing and quality assurance including a multithread test tool for REST based application in Java and scripts in Perl, Groovy and Ruby. Environment: J2EE, Java, Mod Perl, Ruby, Groovy, Linux, VM, SVN, Agile, SCRUM.

DIGITAL RIVER, Eden Prairie, MN /Aliso Viejo, CA 2008
Principal Software Engineer – Designed and Developed the web application User interface for a middle tier management service for complex business services in multi-data center, clustered environment, transparent remoting, service oriented architecture and plugins framework. Environment: J2EE, Java, JavaScript, XHTML/CSS, AJAX, Tomcat, CVS.

TALEND, Costa Mesa, CA 2007
Technical Consultant – Combined pre-sale/post-sale and technical consultant for an open source data integration tool. Worked with the business developer teams to manage the technical sales cycle and with the customers and partners to bring the technical expertise. Presented more than 60 WebEx demonstration to the prospective customers.
Environment: Java, PERL, Eclipse RCP, MySql, XML, PHP, Tomcat, ETL, Data Integration, JasperSoft reporting tool.

SITA (formerly EQUANT Application Services), Burlington, MA. 1999 - 2003
Senior Software Engineer – Advance Travel Solutions- Contributed to various projects for a spectrum of clients in the provision of E-Commerce and On-Net application solutions with focus on global airline and travel. The EDI-Application Gateway is constructed around the industry standard seven-layer model for communication architectures.

- Conducted the *Message Switch System* setup for a **$20M contract project** with *CCRA (Canada Customs and Revenue Agency)* to provide advanced passenger information on all passengers traveling on in-bound international flights to Canada. On time completion of this work, with high degree of quality, and in the absence of an accountable engineer, helped contribute to a new $4M target achievement for phase one (Message Switch) of the project.
- **Web application Development:** Enhanced the SITA Flight Finder Web Applications for the AirOne (Italian Airline) reservation, for the Canada3000 Airline reservation and in-house utility applications, and for SITA Air Cargo Carriers. Environment: ASP, JSP, HTML CSS, **Java**, J2SE, Java Servlets, **MVC**, Java Beans, JavaScript , MySQL, JDBC, PERL.
- Enhanced *communication interface of* the *SITA Interline Through Check-In (ITCI)* system, *Air Faring* and *E-Ticketing* Interfaces, to support EDIFACT interchange.
- Improved the message exchange interfaces between Amadeus CRS and SITA host servers using the MATIP (Mapping of Airline Traffic over IP) protocol for Type *A* (Conversational, Host to Host) and *Type B* traffics.
- Wrote utility programs to allow batch files to work under different operating systems after porting the base model and test suite from Stratus/VOS to UNIX;
- Assisted for development of a Gateway system to be used to bridge the *Canada3000* Tour Operator sales into *SITA's Gabriel **CRS** (Computer Reservation Systems)* for centralized inventory control.
- Initiated porting, the complex source base which included the application and the operating environment, from RISC platform to SUN Solaris. Conformed the updated Software Environment and System Configuration;
- Rapidly grasped knowledge of the application systems, core products and CRS interfaces, and the company proprietary software development and runtime environment, in a short period of time and was appointed to provide full time support to a major client, *Carlson Wagonlit Travel*. Served as a consultant; assisted in work estimate, enhancements, for *American Express*.
  - Provided consultant services and developed constant enhancements to the APIs and CRS Gateways based on customer requests and CRS changes.
  - Interfaced with Client staff to determine change/enhancement requirements.
  - Coordinated all work and frequent releases. Provided written release notes; ensured on time releases.
  - Maintained API documentation, and handled writing procedures for support of system and status reports.
- Worked on several projects concurrently and communicated with cross functional teams located in Atlanta and UK.

Environment: *Proprietary Software Environment*, C *based and Scripting Proprietary Languages*, C, NT 4.0, X.25, MATIP, TYPE A/B *messages*, TCP/IP, SUN Solaris , VOS/Stratus, PERL and MS Visual Studio, Source Safe.

Narges Pourghasemi **Page 3**

U.F.A. INC., Woburn, MA. *1994 -1999*

Senior Software Engineer – Involved in all phases of software development and GUI Design for simulation and modeling of an air traffic management system on a distributed system.

- Responsible for Data Preparation component for the major client, DFS (Germany's Federal Aviation Administration). Involved in design and development/enhancement of graphical editors and support tools.
- Created a library from scattered codes for the graphical display of radar geographical backgrounds. The creation of this library, subsequently used in the Situation Display and all Data Preparation applications, made code enhancement much easier.
- Designed and developed tools for data extraction and conversion from large external data sources: *Jeppesen Sanderson* navigation database and *ICAO FPL* recorded Flight Plans database.
- Designed and developed the Graphical User Interfaces (GUI) for Data Preparation utilities.
- Evaluated and used the COTS GUI builder (UIM/X) for prototyping and development.
- Designed and developed Radar Message Filter Editor, an X Window/GUI based tool, for the Raytheon Company.
- Consulted in pre-sales activities, scheduling, time/cost estimation, and all *Software and User specifications* issues.

Environment: **C**, IBM RISC 6000, UNIX, X11/Motif, UIM/X, ClearCase, DSEE, TCP/IP, Sockets, SGI, SUN, Apollo.

EDUCATION

NORTHEASTERN UNIVERSITY- Boston, M.A. 2004-2005
Ph.D. Candidate (ABD) in *Computer System Engineering*, Industrial Eng. Dept.
Area of Concentration: *Software Engineering, User Interface Design/Human factor (User adaptive interfaces)*.

GEORGE WASHINGTON UNIVERSITY - Washington, D.C.
Professional Degree in Engineering; *Computer Science/Artificial intelligence;* minor in *Medical Engineering*.

UNIVERSITY OF NEW HAMPSHIRE - Durham, N.H. **M.S.** in Computer Science (*Artificial intelligence)*

UNIVERSITY OF TEHRAN - **B.S.** in Computer Science and Mathematics.

Microsoft Windows Embedded Certificate - Developing Embedded Solutions for Windows XP Embedded.

Appendix 8: Model Evaluation

Model Evaluation by Dr. Carol Friedland

2015 Vulnerability Standards

External Reviewer Comments

AIR's 2015 Vulnerability Standard submission has been reviewed. Comments are provided for each topic area.

*V-1 Derivation of Building Vulnerability Functions**

*(*Significant Revision)*

A. *Development of the building vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) laboratory or field testing, (3) rational structural analysis, and (4) post-event site investigations. Any development of the building vulnerability functions based on rational structural analysis, post-event site investigations, and laboratory or field testing shall be supported by historical data.*

The vulnerability functions in the AIR hurricane model were developed using research results published in the engineering literature, post-hurricane damage investigations conducted by experts in wind engineering, and insurance loss data. AIR has used results of structural analysis performed by wind engineering experts, post-hurricane field investigation results, updated engineering literature, computational simulations, and analysis of loss data to update and improve the vulnerability standards since their initial development.

B. The derivation of the building vulnerability functions and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles.

AIR's Hurricane Model vulnerability functions and associated uncertainties were derived by experts in wind and structural engineering from published literature and have been validated by results of damage surveys and historical claims data. To deal with the uncertainties, the damage functions include probability distributions around the mean damage ratio that varies as a function of wind speed. The vulnerability functions have been peer reviewed, both internally and externally. This overall approach to development of the vulnerability functions is theoretically sound and consistent with fundamental engineering principles.

C. Residential building stock classification shall be representative of Florida construction for personal and commercial residential buildings.

The building stock classification set has been derived from census, tax assessor, engineering surveys, construction reports, and other sources. From these data, building stock classifications representative of Florida construction have been chosen.

D. Building height/number of stories, primary construction material, year of construction, location, building code, and other construction characteristics, as applicable, shall be used in the derivation and application of building vulnerability functions.

The AIR model includes 32 vulnerability functions based on primary construction material (e.g., wood frame, masonry veneer – detailed in Disclosure V.1.6) and number of stories for single family residential (i.e., traditional construction and manufactured housing) and commercial residential (i.e., apartment buildings and condominiums). For single family residences, which are most commonly just one or two story, there is no variation of vulnerability functions with height. Building height is categorized for commercial residential structures based on primary construction material, with a maximum of three height categories. Building code and enforcement are accounted for regionally and temporally through application of vulnerability adjustment modifiers. Other construction characteristics are addressed through the Individual Risk Model.

E. Vulnerability functions shall be separately derived for commercial residential building structures, personal residential building structures, manufactured homes, and appurtenant structures.

The AIR Model includes separate vulnerability functions for commercial residential and personal residential primary structures, manufactured homes, and appurtenant structures.

F. The minimum windspeed that generates damage shall be consistent with fundamental engineering principles.

The AIR model uses a sustained (one-minute) average wind speed of 40 mph as the minimum threshold for wind damage. This lower bound has been verified through engineering research, damage surveys, and historical claims data.

G. Building vulnerability functions shall include damage as attributable to windspeed and wind pressure, water infiltration, and missile impact associated with hurricanes. Building vulnerability functions shall not include explicit damage to the building due to flood, storm surge, or wave action.

The AIR vulnerability functions explicitly account for damage as a function of wind speed (and by extension, wind pressure). Damage due to water infiltration and windborne missile impacts are handled implicitly, having been calibrated and validated using insurance claims data. Storm surge, flooding, and wave action are not explicitly included in the AIR model.

Disclosures

1. Describe any modifications to the building vulnerability component in the model since the previously accepted model

The building vulnerability component of the AIR model addresses seven key updates. Three of these updates address temporal factors to make the model relevant to 2016, namely: pre-computed factors that adjust base wind structural vulnerability when year built information is unavailable; vulnerability adjustments that account for structural aging and building technology changes, along with aging and deterioration of roofs; and combining the effects of building code-related updates, aging, and building technology-related vulnerability changes into updated year built categories.

Additionally, separate vulnerability functions have been developed for buildings built according to the Florida Building Code 2010. Three changes to secondary risk features have been made: “certified structures" has been extended to commercial occupancies, "roof year built" defaults to a new roof for buildings less than ten years old; and "seal of approval" and "secondary water resistance" characteristics have been enhanced.

These modifications are reasonable and reflect the changing characteristics of the residential building stock.

2. Provide a flow chart documenting the process by which the building vulnerability functions are derived and implemented.

Figure 1 of AIR's V-1 response shows the process by which the vulnerability functions were derived and implemented. The flowchart shows how published research, engineering expertise, and results of damage surveys are combined to create the vulnerability functions, which are calibrated and validated by insurance industry claims and loss data.

3. Describe the nature and extent of actual insurance claims data used to develop the building vulnerability functions. Describe in detail what is included, such as, number of policies, number of insurers, date of loss, and number of units of dollar exposure, separated into personal residential, commercial residential, and manufactured home.

AIR has made extensive use of insurance claims data in validation of the model, from multiple companies and multiple storms since 1986. In addition to data specific to Florida, loss data from other areas has also been evaluated, including 2012 Hurricanes Isaac and Sandy. Several different comparisons of actual versus modeled losses are provided in Figures 2 through 7 of AIR's V-1 response. These figures demonstrate the generally good agreement between modeled and actual losses. As expected, the actual loss data show more scatter around the mean than the modeled data. This is due to many factors, not the least of which includes variation in rainfall amounts in different storms and different locations in the same storm, and differences within the loss data, including level of detail and methods of reporting by different insurance companies.

4. Describe the assumptions, data (including insurance claims data), methods, and processes used for the development of the building vulnerability functions.

The vulnerability functions are based on engineering analysis, post-event damage surveys, expert consultation, and analysis of claims and industry loss data. In addition to the academic and industry background of AIR's engineering team, assessment of peer-reviewed literature and input from external reviewers ensure reasonable results. Figures 8 through 10 provide a comparison of insurance claims data with simulated damage ratios for three building types for several companies and historic events, and show good general agreement between simulation and insurance claims data.

5. Summarize post-event site investigations, including the source, and provide a brief description of the resulting use of these data in the development or validation of building vulnerability functions.

AIR has fielded post-hurricane investigations for every significant landfalling hurricane since Hugo in 1989, including several more recent hurricanes in 2004, 2005, 2008, 2011, and 2012. These site inspections have served to enhance the in-house expertise on wind damage vulnerabilities and to help identify and confirm performance issues of different types of construction. Generalizations regarding the performance of buildings in past events have found that "engineered" structures perform better that their "non-engineered" counterparts (both commercial and residential), the importance of year built on residential vulnerability, wind effects on non-structural elements, damage regimes for residential buildings based on windspeed, the improved wind resistance of masonry full-height exterior walls compared with wood-framed construction, and the importance of time effects for building vulnerability. This information obtained from post-event site investigations has been incorporated into the development and validation of the vulnerability model.

6. Describe the categories of the different building vulnerability functions. Specifically, include descriptions of the building types and characteristics, building height, number of stories, regions within the state of Florida, year of construction, and occupancy types in which a unique building vulnerability function is used. Provide the total number of building vulnerability functions available for use in the model for personal and commercial residential classifications.

Vulnerability functions are included in the AIR Hurricane Model for approximately 32 separate construction types that address the majority of personal and commercial residential construction in Florida, classified by primary construction characteristics. These functions are further modified for secondary risk characteristics, including region, year of construction, and building codes. Vulnerability functions for commercial residential occupancies are developed considering building height, as such structures vary more widely than the typical 1-2 stories for single family residences.

7. Describe the process by which local construction practices and building code adoption and enforcement are considered in the development of the building vulnerability functions.

To account for variations in building code provisions, the AIR model divides the state of Florida into separate regions based on wind speed, terrain exposure, and code requirements for Windborne Debris Regions (WBDR) and High Velocity Hurricane Zones (HVHZ). Variations in local construction practices, building code adoption, code enforcement, and their effects on projected losses are handled as secondary risk characteristics in the Individual Risk Model, where detailed information can be input by the model user.

8. Describe the relationship between building structure and appurtenant structure vulnerability functions and their consistency with insurance claims data.

The building structure and appurtenant structure vulnerability functions are calculated independently. Damage to an appurtenant structure is calculated separately from the primary structure based on the hazard and known characteristics of the appurtenant structure. Appurtenant structure vulnerability functions were developed through analysis of claims data, published research, and damage surveys when possible. Figure 11 shows a comparison of actual and simulated damage rations for structures and appurtenant structures. Combined with Figures 8 through 10 in Disclosure V.1.4, these results show good general agreement.

9. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop building vulnerability functions for unknown residential construction types or for when some building characteristics are unknown..

Data provided by client companies, the census, and tax assessors are used to identify typical residential construction types within a region. Using these data, vulnerability functions for unknown residential construction types are developed through a weighted average of residential building vulnerability curves based on the prevalence of building construction types in that region. This is a sound practice, as residential buildings tend to exhibit similar regional characteristics. This weighting does not apply to manufactured homes.

10. Describe how vulnerability functions are selected when input data are missing, incomplete, or conflicting.

Similar to the procedure discussed in V-1.9, the AIR model uses a weighted average of vulnerability functions and known regional distribution of primary building characteristics (i.e., construction, occupancy, height, year built) to estimate a weighted average vulnerability function representative of the distribution of known building characteristics.

11. Identify the one-minute average sustained windspeed and the windspeed reference height at which the model begins to estimate damage.

The AIR model uses a sustained (one-minute) average wind speed of 40 mph as the minimum threshold for wind damage, measured at a reference height of 10 m, which is the standard for measurement and reporting of wind speeds. This lower bound wind speed is consistent with damage surveys and published literature.

12. Describe how the duration of windspeeds at a particular location over the life of a hurricane is considered.

The AIR hurricane model includes the effects of hurricane duration using a stepwise procedure. For each given location, for the first time period during the storm when the sustained winds exceed 40 mph, the damage occurring during this time period is estimated, and the remaining undamaged portion of the exposure is determined. For each successive time period where the winds exceed 40 mph, the same procedure is followed, and the remaining undamaged portion is subjected to damage in each time interval. In this manner, longer duration storms having the same maximum speed as shorter duration storms will show accumulation of additional damage, as has been reflected in damage surveys. There is very little information in the technical literature on this topic. The AIR hurricane model team members presented a well-received paper on duration effects and how to model them at the 11th America's Conference on Wind Engineering in Puerto Rico in June 2009.

13. Describe how the model addresses wind borne missile impact damage and water infiltration.

The AIR hurricane model implicitly addresses wind borne missile impact damage and water infiltration to the extent that these damage types are included in historic insurance claims data. Additionally, the debris environment can be described through additional secondary characteristics (if known), selected by the user. The ability of the structures to resist water infiltration can also be described through mitigation techniques as a secondary characteristic through the Individual Risk Model.

14. Provide a completed Form V-1, One Hypothetical Event. Provide a link to the location of the form here.

See the section entitled Form V-1, One Hypothetical Event for reviewer comments.

V-2 Derivation of Contents and Time Element Vulnerability Functions

A. Development of the contents and time element vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) tests, (3) rational structural analysis, and (4) post-event site investigations. Any development of the contents and time element vulnerability functions based on rational structural analysis, post-event site investigations, and tests shall be supported by historical data.

The vulnerability functions for contents and time element impact in the AIR hurricane model were developed using research results published in the engineering and insurance literature, post-event damage investigations conducted by experts in wind engineering and damage, and analysis of available loss data. AIR has used updated research literature, computational simulations, and analysis of loss data to update and improve the contents and time element impact on vulnerability functions since their initial development

B. The relationship between the modeled building and contents vulnerability functions and historical building and contents losses shall be reasonable.

The relationship between modeled and historical structure and contents loss is demonstrated in Figure 13 of AIR's V-2 response. This figure demonstrates that the relationship between building and contents vulnerability functions and historical building and contents losses are reasonable.

C. Time element vulnerability function derivations shall consider the estimated time required to repair or replace the property.

The time element vulnerability is based on the mean building damage, the estimated time to repair or replace the property, and the estimated cost of time element coverage. The estimated time required to repair or replace the property implicitly considers damage to the surrounding infrastructure.

D. The relationship between the modeled building and time element vulnerability functions and historical building and time element losses shall be reasonable.

The relationship between the modeled building and time element vulnerability functions and historical building and time element losses, demonstrated in Figure 14 of AIR's V-2 response, shows good agreement between modeled and historical data.

E. Time element vulnerability functions used by the model shall include time element coverage claims associated with wind, flood, and storm surge damage to the infrastructure caused by a hurricane.

The time element vulnerability functions include time element coverage claims associated with wind, flood, and storm surge damage to infrastructure to the extent that these data are reflected in the model validation data (i.e., damage surveys and insurance claims data).

Disclosures

1. Describe any modifications to the contents and time element vulnerability component in the model since the previously accepted model.

There have been no changes to the AIR U.S. Hurricane Model contents and time element vulnerability components related to wind hazards.

2. Provide a flow chart documenting the process by which the contents vulnerability functions are derived and implemented.

Derivation and implementation of the contents vulnerability functions follow the same process used in the derivation and implementation of the building vulnerability functions, which is sound.

3. *Describe the assumptions, data (including insurance claims data), methods, and processes used to develop and validate the contents vulnerability functions.*

Vulnerability functions for contents coverage are calculated as a function of building damage. Contents vulnerability functions are treated differently for personal and commercial residential structures, as the relationship between building and contents losses are different for these categories of buildings. AIR uses the same process to validate contents loss functions as is used for building vulnerability validation. Validation considers content vulnerability functions from aggregate industry level losses to evaluation of claims data for individual policies, considering losses before and after application of policy terms. Figures 15 and 16 show a comparison of actual and modeled content losses over multiple company data sets and for various storms. It is expected that there would be significant variability in these data, and Figures 15 and 16 also show general agreement between actual and modeled content losses.

4. Provide the total number of contents vulnerability functions. Describe whether different contents vulnerability functions are used for personal residential, commercial residential, manufactured home, unit location for condo owners and apartment renters, and various building classes.

Because contents vulnerability is a function of building vulnerability, there is a unique contents vulnerability function for each building construction/occupancy type. There are separate underlying contents vulnerability functions for personal and commercial residential buildings, as described in V-2.3.

5. Provide a flow chart documenting the process by which the time element vulnerability functions are derived and implemented.

Derivation and implementation of the time element vulnerability functions follow the same process used in the derivation and implementation of the building vulnerability functions, which is sound.

6. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop and validate the time element vulnerability functions.

The time element vulnerability is based on the mean building damage, the estimated time to repair or replace the property, and the estimated cost of time element coverage. For low wind speeds, building damage is low and time element vulnerability is also low; however, at high wind speeds with significant damage, time element vulnerability can be significant, which has been seen in recent events.

AIR uses the same process to validate time element loss functions as is used for building vulnerability validation. Validation considers time element vulnerability functions from aggregate industry level losses to evaluation of claims data for individual policies, considering losses before and after application of policy terms. Figures 17 and 18 show a comparison of modeled time element losses and actual loss data over multiple company data sets and for various storms. These figures show good general agreement between actual and modeled losses for time element coverage.

7. Describe how time element vulnerability functions take into consideration the damage (including damage due to storm surge, flood, and wind) to local and regional infrastructure.

Time element vulnerability functions implicitly take into consideration local and regional infrastructure damage to the extent they are reflected in the historical insurance loss data used in model development, calibration, validation.

8. Describe the relationship between building structure and contents vulnerability functions.

The vulnerability functions for contents coverage is calculated as a function of mean building damage. The contents damage functions have been developed from claims data, published studies, and expert engineering judgment. Values for contents losses are provided separately from building damage.

9. Describe the relationship between building structure and time element vulnerability functions.

The time element vulnerability is based on the mean building damage and the estimated time to repair or reconstruct the damaged building. The relationships between building loss of use and building damage have been established based on published construction data and engineering judgment. Validation data implicitly include infrastructure damage and the costs for temporary relocation and other needs in the time element vulnerability functions.

10. Describe the assumptions, data (including insurance claims data), methods, and processes used to develop contents and time element vulnerability functions for unknown residential construction types and for when some of the primary characteristics are unknown.

Contents and time element vulnerability functions are a function of the building vulnerability functions. To develop contents and time element vulnerability functions for unknown residential construction types or for types with unknown primary characteristics (partially unknown), the procedure to develop the unknown or partially unknown building vulnerability function (V-1. 9) is followed, and used as the basis for the unknown or partially unknown contents and time element vulnerability functions.

V-3 Mitigation Measures

A. Modeling of mitigation measures to improve a building's hurricane wind resistance, the corresponding effects on vulnerability, and their associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles. These measures shall include fixtures or construction techniques that enhance the performance of the building and its contents and shall consider:

- *Roof strength*
- *Roof covering performance*
- *Roof-to-wall strength*
- *Wall-to-floor-to-foundation strength*
- *Opening protection*
- *Window, door, and skylight strength*

The modeling organization shall justify all mitigation measures considered by the model.

AIR's Individual Risk Model incorporates features to allow consideration of the identified wind mitigation measures. The Individual Risk Model allows for consideration of a range of mitigation measures through modification functions, which vary with wind speed. This approach to modeling the effectiveness of mitigation measures is theoretically sound and consistent with fundamental engineering principles.

B. Application of mitigation measures that enhance the performance of the building and its contents shall be justified as to the impact on reducing damage whether done individually or in combination.

The effects of mitigation measures within the AIR model have been validated from previous hurricane damage reports, engineering judgment, and available loss data. The percentage change in losses associated with the individual mitigation measures demonstrates their relative effectiveness in various wind speed regimes. Combinations of mitigation measures provide additional protection compared to single measures, but the benefits are appropriately not always equal to the linear sum of benefits from the individual measures. For example, a building having storm shutters that protect impact resistant windows would have a mitigation credit of less than the sum of these two individual measures, as there is some redundancy in the protection offered by shutters and impact glass.

Disclosures

1. Describe any modifications to mitigation measures in the model since the previously accepted model.

Three changes to secondary risk features have been made: "certified structures" has been extended to commercial occupancies, "roof year built" defaults to a new roof for buildings less than ten years old; and "seal of approval" and "secondary water resistance" characteristics have been enhanced.

2. Provide a completed Form V-2, Mitigation Measures – Range of Changes in Damage. Provide a link to the location of the form here.

See comments provided in the section entitled Form V-2, Mitigation Measures – Range of Changes in Damage.

3. Provide a description of the mitigation measures used by the model, whether or not they are listed in Form V-2, Mitigation Measures – Range of Changes in Damage.

The mitigation measures listed in Table 3 of AIR's V-3 response are comprehensive and reasonable reflections of factors that affect building performance in windstorms.

4. Describe how mitigation measures are implemented in the model. Identify any assumptions.

Mitigation is implemented through AIR's Individual Risk Model using modification functions. Each modification function captures the changes in building vulnerability from the computed base vulnerability function associated with a particular mitigation measure as a function of wind speed. This modification is reflective of the effectiveness of the mitigation feature(s) in reducing damage under different intensity winds. Mitigation effects are determined based on structural engineering expertise and building damage observations. Mitigation modification functions that represent a combination of building features are applied to the base vulnerability functions to provide vulnerabilities for mitigated buildings. The way in which mitigation modifies the base vulnerability function is based on various 'rates and weights.' Rates account for the prevalence of use among the various mitigation options. Weights account for situations where more than one mitigation option is present. The AIR Individual Risk Model assigns two types of weights to each mitigation measure, one for when the multiple mitigation features are related to performance of the same system (e.g., the roof system), and the other for combinations of the effects of features that are more complex. The values of the weighting functions are dependent on wind speed. AIR's system for handling mitigation options is robust and capable of handling mitigation of single elements, whole building systems (e.g., roof systems—comprised of roof coverings, decking, framing, and attachment of decking and framing), and combinations of multiple elements and systems.

5. Describe how the effects of multiple mitigation measures are combined in the model and the process used to ensure that multiple mitigation measures are correctly combined.

Within the AIR model, the effects of mitigation measures are not simply calculated as the linear sum of individual measures, but consider the combination of effects with multiple mitigation and across varying wind speeds, described in V-3.4. This is a sound theoretical approach, and validation is performed to ensure that modeled mitigation factors are representative of historical insurance loss data. The system of weighting functions appears well designed and able to account for the wide range of possible interactions of various mitigation measures.

6. Describe how building and contents damage are affected by performance of mitigation measures. Identify any assumptions.

The performance of mitigation measures is explicitly accounted for in the estimation of building damage through the development of modified building vulnerability functions as described in V-3.4. The performance of mitigation measures is accounted for in the calculation of contents damage, as contents damage is calculated as a function of building damage.

7. Describe how mitigation measures affect the uncertainty of the vulnerability. Identify any assumptions.

AIR vulnerability functions are characterized by a mean damage ratio as a function of hazard intensity with an associated probability distribution around the mean damage ratio. Inclusion of mitigation measures alters the mean damage ratio and in turn the associated probability distribution. This practice is sound and consistent with engineering principles.

Form V-1: One Hypothetical Event

A. Windspeeds for 96 ZIP Codes and sample personal and commercial residential exposure data are provided in the file named "FormV1Input15.xlsx." The windspeeds and ZIP Codes represent a hypothetical hurricane track. Model the sample personal and commercial residential exposure data provided in the file against these windspeeds at the specified ZIP Codes and provide the damage ratios summarized by windspeed (mph) and construction type.

The windspeeds provided are one-minute sustained 10-meter windspeeds. The sample personal and commercial residential exposure data provided consists of four structures (one of each construction type – wood frame, masonry, manufactured home, and concrete) individually placed at the population centroid of each of the ZIP Codes provided. Each ZIP Code is subjected to a specific windspeed. For completing Part A, Estimated Damage for each individual windspeed range is the sum of ground up loss to all structures in the ZIP Codes subjected to that individual windspeed range, excluding demand surge and storm surge. Subject Exposure is all exposures in the ZIP Codes subjected to that individual windspeed range. For completing Part B, Estimated Damage is the sum of the ground up loss to all structures of a specific type (wood frame, masonry, manufactured home, or concrete) in all of the windspeed ranges, excluding demand surge and storm surge. Subject Exposure is all exposures of that specific type in all of the ZIP Codes.

One reference structure for each of the construction types shall be placed at the population centroid of the ZIP Codes. Do not include contents, appurtenant structure, or time element coverages.

Reference Frame Structure: One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Toe nail truss to wall anchor Wood framed exterior walls 5/8" diameter anchors at 48" centers for wall/floor/foundation connections No shutters Standard glass windows No door covers No skylight covers Constructed in 1995	**Reference Masonry Structure**: One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Weak truss to wall connection Masonry exterior walls No vertical wall reinforcing No shutters Standard glass windows No door covers No skylight covers Constructed in 1995
Reference Manufactured Home Structure: Tie downs Single unit Manufactured in 1980	**Reference Concrete Structure**: Twenty story Eight apartment units per story No shutters Standard glass windows

Based on experience, the AIR Model results presented in Parts A and B appear reasonable in absolute magnitude and in the ranges and trends. In the Part B submission, the relative performance of the construction types appears reasonable. Manufactured homes have a long and well documented history of poor performance compared to site built homes (although the performance of newer manufactured homes has been improving). This expected result is demonstrated. Similarly, concrete buildings historically outperform wood framed or masonry buildings, which is reflected in Part B results. Masonry buildings are shown to slightly outperform wood framed buildings, which is also expected due to the increased strength of the exterior walls.

B. Confirm that the structures used in completing the form are identical to those in the above table for the reference structures. If additional assumptions are necessary to complete this form (for example, regarding structural characteristics, duration, or surface roughness), provide the reasons why the assumptions were necessary as well as a detailed description of how they were included.

The AIR model requires a sustained (one-minute) wind speed time profile to calculate damage ratios. Therefore, a hypothetical storm was used to provide responses for V-1. Additionally, the AIR model considers actual terrain surface roughness to calculate the wind speeds used in Form V-1.

C. Provide a plot of the Form V-1 (One Hypothetical Event), Part A data.

Form V-1 Part A data are plotted in Figure 80. The results are reasonable for the reference structures and wind speeds.

D. Include Form V-1, One Hypothetical Event, in a submission appendix.

Form V-2: Mitigation Measures – Range of Changes in Damage

A. Provide the change in the zero deductible personal residential reference building damage rate (not loss cost) for each individual mitigation measure listed in Form V-2, Mitigation Measures, Range of Changes in Damage, as well as for the combination of the four mitigation measures provided for the Mitigated Frame Building and the Mitigated Masonry Building below.

The effectiveness of different hurricane mitigation measures is presented in the tables of AIR's Form V-2 response. The values appear reasonable and appropriate in magnitude and variation with wind speed, based on reviewer experience. For example, improved roof to wall connections provide negligible benefits at 60 mph, as that wind speed generally will not cause roof to wall failures. The mitigation value of improved roof to wall connections then increases with increasing wind speed, again as expected. The use of window shutters provides moderate reductions at 60 mph, increasing in effectiveness at 85 and 110 mph, when windborne debris is more prevalent, then decreasing in effectiveness at higher wind speeds with greater missile energy.

The general magnitudes and trends in change in damage for the fully mitigated frame and masonry buildings appear reasonable and in line with reviewer experiences and expectations. For example, damage for the mitigated frame and masonry buildings is approximately half as much as the reference structure for sustained wind speeds of 85-110 mph. This very significant improvement in performance is expected, as the selected mitigation options address several of the most common design and construction deficiencies that prevent buildings from performing satisfactorily at speeds near design code values.

B. If additional assumptions are necessary to complete this form (for example, regarding duration or surface roughness), provide the rationale for the assumptions as well as a detailed description of how they are included.

The AIR model requires a sustained (one-minute) wind speed time profile to calculate damage ratios. Therefore, a set of events were created to approximate the wind speeds at the specified locations. Duration effects were not accounted for in the response to V-2.

C. Provide this form in Excel format without truncation. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include Form V-2, Mitigation Measures, Range of Changes in Damage, in a submission appendix.

All comments in this review are based on a PDF copy of AIR's submission.

Reference Frame Building: One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Toe nail truss to wall anchor Wood framed exterior walls 5/8" diameter anchors at 48" centers for wall/floor/foundation connections No shutters Standard glass windows No door covers No skylight covers Constructed in 1995	**Reference Masonry Building:** One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Weak truss to wall connection Masonry exterior walls No vertical wall reinforcing No shutters Standard glass windows No door covers No skylight covers
Mitigated Frame Building: ASTM D7158 Class H (150 mph) shingles 8d nails, deck to roof members Truss straps at roof Plywood Shutters	**Mitigated Masonry Building:** ASTM D7158 Class H (150 mph) shingles 8d nails, deck to roof members Truss straps at roof Plywood Shutters

Reference and mitigated buildings are fully insured building structures with a zero deductible building only policy.

Place the reference building at the population centroid for ZIP Code 33921.

Windspeeds used in the form are one-minute sustained 10-meter windspeeds.

Form V-3: Mitigation Measures—Mean Damage Ratios and Loss Costs (Trade Secret Item)

A. Provide the mean damage ratio (prior to any insurance considerations) to the reference building for each individual mitigation measure listed in Form V-3 (Mitigation Measures – Mean Damage Ratios and Loss Costs, Trade Secret item) as well as the percent damage for the combination of the four mitigation measures provided for the Mitigated Frame Building and the Mitigated Masonry Building below.

The table in the V-3 form response provided to the Reviewer contains Mean Damage Ratios for the reference and mitigated frame and masonry structures, as well as for structures with single mitigation options. The general magnitudes and trends of the mean damage ratio variation with wind speed for these structures and mitigation options appear reasonable and in line with reviewer experiences and expectations. As discussed in V-2, mean damage ratios for the mitigated wood frame structure are on the order of half as much as the reference structure for sustained wind speeds of 85-110 mph, which is an expected result, as the selected mitigation options address several of the most common design and construction deficiencies that prevent buildings from performing satisfactorily at speeds near design code values. At sustained winds of 160 mph, the mitigation measures still provide significant improvement in mean damage ratio, but relatively less compared to the reference structure. This again is an expected result, as wind loads and debris associated with these higher wind speeds are well beyond those anticipated in the design code, exposing many more potential failure modes than the common ones addressed by the four selected mitigation options.

B. Provide the loss cost rounded to three decimal places, for the reference building and for each individual mitigation measure listed in Form V-3 (Mitigation Measurers – Mean Damage Ratios and Loss Costs, Trade Secret item) as well as the loss cost for the combination of the four mitigation measures provided for the Mitigated Frame Building and the Mitigated Masonry Building below.

The loss cost reflects the mean damage ratio presented in V-3 applied to the structure value. As detailed in V-3.A, the mean damage ratios are in line with expected results, yielding appropriate loss cost.

C. If additional assumptions are necessary to complete this Form (for example, regarding duration or surface roughness), provide the rationale for the assumptions as well as a detailed description of how they are included.

The AIR model requires a sustained (one-minute) wind speed time profile to calculate damage ratios. Duration effects were not accounted for in the response to V-3.

D. Provide a graphical representation of the vulnerability curves for the reference and the fully mitigated building.

Graphical representation of the mean damage data presented in V-3 accurately represent the tabular values provided, and are appropriate, as discussed in V-3.A.

Reference Frame Building: One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Toe nail truss to wall anchor Wood framed exterior walls 5/8" diameter anchors at 48" centers for wall/floor/foundation connections No shutters Standard glass windows No door covers No skylight covers Constructed in 1995	**Reference Masonry Building**: One story Unbraced gable end roof ASTM D3161 Class F (110 mph) or ASTM D7158 Class G (120 mph) shingles ½" plywood deck 6d nails, deck to roof members Weak truss to wall connection Masonry exterior walls No vertical wall reinforcing No shutters Standard glass windows No door covers No skylight covers Constructed in 1995
Mitigated Frame Building: ASTM D7158 Class H (150 mph) shingles 8d nails, deck to roof members Truss straps at roof Plywood Shutters	**Mitigated Masonry Building**: ASTM D7158 Class H (150 mph) shingles 8d nails, deck to roof members Truss straps at roof Plywood Shutters

Reference and mitigated buildings are fully insured building structures with a zero deductible building only policy.

Place the reference building at the population centroid for ZIP Code 33921.

Windspeeds used in the form are one-minute sustained 10-meter windspeeds.

CONCLUSION

AIR's response to the Florida Commission's 2015 Vulnerability Standards appears thorough and complete. The vulnerability functions have been developed and validated through research reported in the insurance and wind and structural engineering literature, engineering analysis, post-storm field investigations by engineering experts, and historical insurance claims data. The AIR team has significant experience and expertise in this area, and has actively presented results of its vulnerability research at national and international engineering conferences. The methodology used in development of the vulnerability functions is theoretically sound. Implementation of these vulnerability functions produces reasonable damage ratios in line with insurance loss data and reviewer expectations.

Carol Friedland, Ph.D., PE

October 21, 2016

Model Evaluation by Narges Pourghasemi

A Peer Review of AIR Hurricane Model for the U.S. (version 16.0.0) as implemented in Touchstone® 4.1.0

Touchstone® is a product of AIR Worldwide

Narges Pourghasemi – Independent Auditor

September 28-30, 2016

Overview

This document summarizes the peer review I conducted in September of 2016 for AIR Worldwide's implementation of their AIR Hurricane Model for the U.S. within the Touchstone® software. The intent of the review is to ensure that not only the application development process follows the current industry-standard software engineering practices but also it complies with the software standards and requirements established by the Florida Commission on Hurricane Loss Projection Methodology as well.

Findings of the Peer Review

This review is based on AIR's Touchstone® version 4.1.0 and Model 21 version 16.0.0. The findings are grouped according to the seven computer standards established by the Florida Commission on Hurricane Loss Projection Methodology as of November 2015. During the peer review, I interviewed the documentation manager, personnel or proxies from the following groups: Product Management, Research & Modeling Group, Software Development Group, Database Group, Release Engineer, Quality Assurance and IT/Security personnel, and Client Services Group, who demonstrated their knowledge of the pertinent subjects. In this interview process, the requirements for all sections C1-C7 of the Florida Commission's standards were discussed and reviewed with the personnel of each group, face to face or via WebEx web conferencing.

Standard C-1: Documentation

AIR Worldwide maintains a central document management and repository *AIRPort*, for both internal user and external client's documentations. The documentations are created separately from the source code and stored in the repository which easily accessible online by all staff and designate external client users. Internal user access to this repository via AIR intranet by their network (Active Directory) credentials and external user access it through their own Portal on AIR public website. During entire audit process, AIR personnel were utilizing this *AIRPort* repository to present the software documentations, requirements, software design and implementation, data base schema definitions, test procedures and plans, software release procedures, code guidelines and IT policy.

I have reviewed this repository for both internal and external client use. All the documents for all sections or groups consist of a revision history, author, approver, and table of contents. The finalized document is converted to PDF and is locked for further editing, and stored in the repository.

Software and model-related documentation is generated and maintained by each of these groups: Software Documentation, Research, Modeling, Software Development, Client Services and Support and Quality Assurance. Each document is referenced under the *Help Topic* for the pertinent section. It is verified that each of these groups reviewed and signed out the documentation for each version as indicated in the document version history. Touchstone® also has an online Help system that is accessible from within the software. A separate Link to Florida Commission Help system is designated in *AIRPort* as well.

The hard copy of the *Enhancements and Florida Commission Documentation Map*, which includes updates and enhancements to both Model 21 V16.0.0 and software enhancements for Touchstone® V4.1.0 *was reviewed and verified.* This document contains a table that fulfills the Florida Commission requirement from Section CI-1.D. Computer/Information Standards - Documentation. This table includes a column that itemizes the version-specific changes, and the other columns in this table maps the itemized changes to the pertinent documents in the Computer Standards documentation set C1-C7.

Similar to earlier version of Touchstone®, the implementation of Model 21 by the software development group ensures consistency of the model results with those produced by the Research version.

In this version of Model 21, there were no significant formulas or calculation changes. There were some code changes due to update to Individual Risk Module and “remove intensity reuse". Other changes were the result of modeling data due to updates from external sources, event parameters updates, slight changes in Landfall coast changes, and HURDAT2 re-analysis changes due to inclusion of one new historical hurricane event. The annual HURDAT2 and ZIPAll data updates impact the Catalog Generation, Physical Properties, and ZIPAll centroid components of the model, which resulted in an update of these components accordingly. One significant change was the removal of zip-code dependencies and replacing the Zip code resolution to grid-based resolution. Point in Polygon approach for U.S. Reverse Geo coding was another enhancement to this Model21 version.

Updates in regard to these changes in the documentation, requirements, data, implementation and testing were discussed. The pertinent C1-C7 Standards were verified for each of these categories, including: documentation, code review, changes history in the source control management tool, requirements, implementation, verification and security.

Standard C-2: Requirements

The online central repository, *AIRPort*, stores the requirement documentation required for the development of the Model 21 hurricane model as well as Touchstone®. These requirements address:

- Touchstone® and the Model 21 released-based enhancements.
- Requirements for the Loss Analysis Engine, the Touchstone® user interface, hardware, software, and security.
- Model 21 and related subcomponents requirements.
- Data Sources requirements, such as databases and third party applications required for operation of Model 21 and Touchstone®.
- Security and Quality Assurance requirements.

In the requirements there were sections indicating the Motivations for the requirements, business requirements, overview, model and software updates pertinent to the requirements. It was requested for all groups to demonstrate how they access the “requirements” online, how the content is transferred to the design documentation, and what module will be changed. It was explained that how the user requirements, research requirement and update data model requirements are brought into more granular requirements; and in product management meetings with association of data management group, the requirements are translated into design document. Product Management creates requirement documents for each component which stored in *AIRPort*.

The released-based enhancements document provides a high-level overview of the major features or enhancements that have been made to Touchstone® and Model 21. The Enhancements and Documentation mapping spreadsheet links to the requirements documents for all changes.

Model 21 requirements are reviewed annually and the HURDAT2 and *ZIPAll* components are updated every year. These are requirements for Catalog Generation, Physical Properties, *ZIPAll*, software code, and data files used during model development. The end result data is the input to the Hurricane model. Additional requirements include the HURSIM, Individual Risk, Loss Data, and Demand Surge requirements. These requirements specify the format of the loss estimate output data files and summarize the business rules and processes that are applied to create the output data. The *Loss Data* requirements indicate that, as part of the process to validate U.S. hurricane damage functions, AIR analyzes client claims data. The requirements for version updates were focused for review.

Standard C-3: Model Architecture and Component Design

Technical personnel in Research, Modeling, Software Development, and Database groups were interviewed in regards to the architecture and structure of the pertinent components. The Touchstone® Development and Implementation Help Topics provide documentation that details the technical construction (software components and database) of Touchstone® and includes architectural diagrams, model frameworks, class definitions, and logical, workflow, and other flowcharts. In particular, it describes the business and architecture overview of Touchstone®. The high-level process steps for porting the model to C++ and integrating it into Touchstone® are shown via flowcharts and diagrams, which include:

- *High Level Overview of Development and Implementation* flow chart
- *Research Group Model Development's* flow chart
- *Model Porting and Implementation of Model 21 libraries into Touchstone®* flow chart
- *Touchstone® Development* flowchart
- *Touchstone® Testing* flowchart
- *Touchstone® Packaging and Release* flowchart

The online documentation provides Model 21 component and HURSIM diagrams. The flow charts in the *Research Model Development Help Topics* depict the high-level process steps for developing the model in FORTRAN, as well as it components. The detailed control and data flow charts are:

- ZIP Centroid and ZIPAll
- Physical Properties
- Catalog Generation
- HURSIM
- Loss Data
- Individual Risk Module (Vulnerability)
- Touchstone® Loss Analysis Engine

The interface specifications for all components are included in the Touchstone® Architecture Overview Help topic, Model21 Catastrophe Model and Touchstone® Hazard Model Framework documentation. Also Different architecture layers: App service layer, Analysis service layer was reviewed.

It was verified that all related database tables and their schema definitions were stored in versioned source control and documented.

The model design and component architecture for version updates were focused for review. The vulnerability custodians of modeling group explained the Vulnerability module, the correlation of HURSIM, primarily and secondary items of IRM (Individual Risk Model) and their impacts. The modeling group also discussed the new enhancements of grid-based zip code and removal of zip code dependency from Individual Risk Module, which is a standalone component. They described how IRM and HURSIM both feed to Touchstone for damage function. The grid-base preprocessing and grid attributes, grid size and number of grids were discussed. Other subject of discussion was Intensity distribution and the modeling and research group show how the adjustment done for landfall and Landfall frequency adjustment table was reviewed.

As part of new enhancements for US Reverse Geocoding during import, the Product Management group demonstrated the motivation and requirements to change the import processing logic for user-supplied and preserved geocodes to use a new Point-in-Polygon method for ZIP Code assignment and related backfill information, instead of the legacy tFindClosest ZIP Centroid method. If the user-supplied and preserved geocode is near a ZIP Code boundary, the legacy tFindClosest method could potentially assign a different ZIP Code than expected, and the change to Point-in-Polygon method improves the accuracy of this ZIP Code assignment. The design is in a separate component of the import and validation processing, for which the specific changes were demonstrated. They showed the constraints which include the feature not impacting locations in waterways and not impacting locations outside of the U.S. They also showed the user import option of switching to preserve or ignore the user-supplied geocode during import.

Standard C-4: Implementation

The developers in Research, Modeling, and Software Development groups were interviewed to discuss the implementation and development of Model 21 and Touchstone®. They discussed the interaction and communication of the different groups in regards to data transfer, model porting, code reviews and guidelines. The code development and implementation is performed by the following groups in FORTRAN, C++, C#/.NET, SQL, TSQL and Java programming languages:

- Research group develops HURSIM using FORTRAN.
- Modeling Development group, which ports the FORTRAN model into C++ and creates the Model 21 library for use in Touchstone®.
- Software Development group implement the user interface, data import, and other required tools in C#/.NET. They also utilize SQL for data management.
- Other tool required for modeling data adjustment, i.e. add/removal of event sets is written in Java by research/modeling group.
- Miscellaneous tools including the utility program for line counts (VBScript).

Documentation for the model implementation performed by the Research and Modeling groups is provided in both Research Model Development and Touchstone® Software Development Help Topics. *AIRPort* Help Topic on Model .dll Porting and Implementation, explains how the modeling and conversion of simulation data is processed and integrated into Touchstone®. This technical documentation includes flowchart and diagrams, which outlines the interface and coupling of the model and engine and provides fully traceable component identification using diagrams.

The documentation provides flowcharts that describe how the various classes and the functions interact in the model. During the interview with each group, sample of code in C#, C++, FORTRAN, Java, and SQL were reviewed and it was verified sufficient documentation and comment was provided. More enhanced exception handling for Divide by zero, access violation and array bounds exceeded was added.

It is verified that AIR Worldwide maintains the technical documentation, coding standards and guidelines for all the utilized programming languages in the online Document Repository. The developers were questioned in regards to following these guidelines. It was also recommended that the Research group define all constant variables in a single location in a configuration file at the beginning of all Java and C++ programs.

The personnel, who managed or administered all of the Databases for different groups were interviewed. They presented a complete overview of all databases maintenance, including how all the database scripts, which are used for table creation/definition, are stored in a Source Control Management tool. The connectivity of database servers was discussed, including security through linked servers, backup, and database server access, and database access credentials. The presentation covered all subjects related to:

- Existence of guideline standards for database table creation, naming conventions for column/field name, and versioning of database in relation to the Touchstone® versioning method.
- Use of different database for development and testing and how the database is detached for release (replicate of the final version of development).
- Method of importing data into the database, as well as exporting data from database for review or usage in other components.

- How the requirements for change of data definition or content is relayed (creating a ticket in the *ClearQuest* issue tracking system).
- Database administration and data definitions, as well as scripts were also reviewed and discussed.

The Touchstone® data is organized into several inter-related SQL databases as well as binary data files. The primary data of interest to users are:

- AreaCode data, which contains detailed exposure information used to uniquely identify various geographic areas.
- User exposure data, as well as options and event sets used during analyses.
- Loss data, which contains the results of analyses.
- Common data

The Model Porting group described the use of the Data File Converter to convert the AIR catastrophe models input files from ASCII format into binary files for use by Touchstone®. This process was also documented online.

All data is stored in *Microsoft Team Foundation Server (TFS).*

The Research and Modeling and the Software Development groups use *Microsoft Visual Studio Team Foundation Server (TSF) and Microsoft Visual Source Safe (VSS)* (for legacy code) for Source control management and to track software and documentation change history. During the interview the location and change history of the component in VSS and TSF were verified.

The Research Model Development Help Topic provides the components documentation, as well as a document that identifies the equations/formulas used in the development of Model 21, including the terms and variables. This document also maps the implementation source code terms and variable names to the appropriate equation/formulas. Although there were no new updated formulas/equations, the document has included this mapping from the last version of the model. The implementations for version updates were focused for review.

AIR Worldwide has developed a script to generate line count for the Touchstone® engine components, Model 21 components, Physical properties, catalog generation and Data File Converter.

It was verified that a secure FTP site within AIR VPN is used for transferring any data.

Standard C-5: Verification

As part of interviews with Research, Modeling and Software Development Groups, the processes for testing and verification of Model 21 and Touchstone® software and data were extensively discussed and reviewed. The online verification Help Topics provide comprehensive testing documentation, which include test cases for the Research model components, Model 21, Data file Converter, and Touchstone®.

Verification and Quality Assurance for both data and the model is performed by three groups: Model QA, Core QA, and SW QA. Core QA is responsible for validating the output, seasonality, file format, and verification of geo-spatial data. Implementation of any FORTRAN version of a model into Touchstone® occurs in multiple stages. In order to ensure that compatibility and accuracy is maintained between the FORTRAN version of the model and its implementation into Touchstone®, a series of testing is performed at every phase. During the process of implementing the Model 21 into Touchstone®, the following testing is performed:

- Data Files Testing (Catalog, Damage Function, and Building Code Factor data)
- Loss Number Testing

- Unit Testing of Model 21 in Touchstone®, in which the core functionality of the methods that are sensitive to inputs or are responsible for loss changes.
- Model 21 Basic QA Test Cases and Final QA Test cases which are the same type of test but include all test cases for FORTRAN and Touchstone® respectively.

The first set of testing, performed by Research, includes testing of the following model components: Catalog Generation, Physical Properties, and Individual Risk. After porting the FORTRAN model into C++, these tests are replicated to verify the results. QA teams demonstrated a test plan for “Remove Intensity Reuse”.

The Touchstone® and Model 21 code was reviewed to inspect sufficient flag triggered output statements. It was verified that code for Touchstone®, Model 21 and auxiliary tools includes statements for error and exception handling as appropriate.

The overall testing, including user interface and integration testing, is performed using automated SILK testing tool. AIR Worldwide uses Microsoft SQL Server SQL Management Studio to verify and view SQL information and to retrieve data. A text file comparison is used to compare text files, log files, output files, results and changes in scripts, etc. AIR utilizes *SpecFlow* Behavior Driven Development test framework to define, manage and execute automated acceptance tests as business readable specifications. The QA team demonstrated how to specify the analysis option written in *Gherkin* language and convert the test stories to C#/.NET code for automated acceptance testing.

It is verified that smoke, regression and aggregation testing is driven by test cases using SILK (for automatically verification and comparison) and Microsoft Excel (for comparison of results). QA teams were using *ClearQuest* for issue tracking if something fails.

The crosschecking procedures and results for verifying equations was reviewed and verified in the documentation.

AIR Worldwide has defined general guidelines for testing the Touchstone® User Interface. The document provides a detailed test plan for each of the major functions supported by the Touchstone® User Interface. A sample run of the testing was also observed during the interview process. The verification procedures for version updates were focused for review.

Standard C-6: Model Maintenance and Revision

The control process, including revisions and versioning, for Model 21 and Touchstone® was discussed with the personnel of each group involved in modeling, implementation, validation, release and documentation.

Model Change Control Process:

AIR Worldwide continually reviews model assumptions in regards to new meteorological, more recent research papers and findings, and periodically enhances the model. An updated model is identified with a new version number. The following areas of Model 21 are subject to annual review and enhancement:

- Catalog generation
- Windfield generation
- Damageability
- Insured loss calculations
- Zip Code centroids and corresponding physical parameters of elevation, surface friction and distance to coast.

Source Code, Data and Documentation Maintenance

Research, Modeling, and Software Development groups use *Microsoft Visual SourceSafe (VSS) and* Microsoft *Visual Studio Team Foundation Server (TFS)* for source control management and to track software and documentation change history. The latter platform is also used for internal Touchstone® documentation. The model's data files, which are maintained by the Research group, are stored on Data Servers for which the AIR Data Control Workbook is used to log these model data that is ready for transfer from the Research group to the Modeling group.

AIR also uses *Microsoft SharePoint* (internally known as *AIRPort*) to manage project, archive and monitor requirements; store and share end user's or internal Touchstone® documentation. A tracking tool, *ClearQuest*, is used for project management, logs, defects, revision, enhancement, and change requests assignment tracking.

Model and Software Revision Policy

A major release of Touchstone® occurs annually. A major release may incorporate new hurricane data from the previous year, improvement in the hurricane model, new user functionality, and possibly new software architecture. Between major releases, AIR Worldwide may release minor versions containing software bug fixes and user functionality enhancements. The final product release is only accessible by release engineer and privileged users. The Touchstone® software and model versioning methodology is documented in *AIRPort*.

It was verified that a "version history table" maintains the list of all model revisions as specified in C-6.D of the Computer Standards.

Standard C-7: Security

AIR Worldwide has instituted multiple security measures to ensure the safety and integrity of its software. AIR Worldwide has implemented access control at both the physical level and at the software level. AIR Worldwide's office is housed in a building staffed with security guards 24 hours each day. A security badge and proper electronic encoding is required in order to access AIR Worldwide's office. AIR is using a secure data center for its servers. File servers in the office are housed in a separate room which only badge employees with special authorization are allowed to enter the room.

In addition to discussing security measurements with the Research, Modeling, Software Development and Quality Assurance groups, the IT security personnel was interviewed in regards to overall security information and event management (SIEM) and measurements. Verisk Analytics, AIR's parent company, has a designated a security team that works with the IT department at AIR.

Access to AIR Worldwide's software resources is safeguarded by firewall, internal and external network authentication, virtual private network (VPN), and secure File Transfer Protocol. All user accounts on the network are controlled using Windows Active directory. User passwords expire every 60 days. It was recommended to use two-factor authentications. AIR utilizes a monitoring mechanism, *Veronis*, for protecting file and email servers from malicious attacks and uses *FireEye* for its network security and threat protection. All software installs are done by authorized IT personnel via a helpdesk request.

AIR employees are required to participate in an annual, online security-training course. Afterwards, participants must take a test to demonstrate their comprehension of the content.

Procedures for disaster management and the information security incident response plan were presented. Also, the backup procedure for source code, documentation and data using *CommVault*, as well as off-site storage of backup data, was discussed.

Conclusion

It is my opinion that AIR Worldwide's implementation of Model 21 within Touchstone® is in compliance with the computer standards established by the Florida Commission on Hurricane Loss Projection Methodology. It is also my opinion that the software engineering practices at AIR Worldwide are in accordance with current software industry standards.

Appendix 9: The AIR Hurricane Model for the U.S.: Accounting for Secondary Risk Characteristics

Executive Summary

This document provides an overview of AIR's Individual Risk Module (IRM) for modeling the impact of secondary risk characteristics on damageability and insured hurricane losses in the United States. The capability is part of the vulnerability component of the AIR Hurricane Model for the U.S. and is included in AIR's detailed loss estimation software, Touchstone®. This document facilitates a better understanding of the impact of secondary building and environmental features on damage and loss. It will also assist clients in deriving mitigation factors to be used for property loss costs.

AIR's approach is an engineering based framework designed to estimate the performance of residential and commercial buildings under wind loads. It is based on engineering principles and data regarding building performance during high winds.

The general, or base, damage functions used by the AIR Hurricane Model for the U.S. are individually developed for the "typical" building with certain "primary" risk characteristics, which include age, height, construction type and occupancy class. The construction and occupancy classes are broadly defined, without reference to individual—or secondary—structural characteristics. AIR's general damage functions were validated and calibrated using extensive and detailed actual hurricane loss data. The relative abundance of hurricane loss data greatly facilitates the determination of average or "typical" building performance.

Modification functions (or secondary risk characteristics) are applied to the general damage functions to reflect the performance enhancement or diminution of a wide variety of secondary structural and environmental characteristics. These might include roof covering, roof pitch, type of window protection or proximity to trees (which are potential sources of wind-borne missiles). Detailed claims data from 2004 and 2005 storms have been used to validate the impact of these secondary risk characteristics on building vulnerability.

The modification functions referenced above reflect the difference between the performance of a building with known structural and environmental characteristics and that of the typical building. For example, the modification function for a residential wood frame building with hip roof indicates how it would perform differently from a typical residential wood frame building whose roof is mathematically defined to exhibit average performance.

The modification functions are themselves functions of wind speed. That is, the effectiveness of mitigating characteristics varies according to the wind speed. In addition, the combined effect of the modification functions for different secondary risk characteristics is complex and not necessarily additive or multiplicative.

With the release of Version 12.0 of the AIR Hurricane Model for the U.S. (July 2010), users will observe that the marginal impact of secondary risk characteristics on building vulnerability is dependent on the year that the structure was built and on its location. This is due to the fact that for a class of structure, the AIR Hurricane Model for the U.S. defines a *typical* building in terms of *typical* secondary risk characteristics for each location and year built. User input of secondary risk characteristics will overwrite the *default secondary risk characteristics*, and a new vulnerability function is created. The new function may reflect lower or higher vulnerability than the default, depending on the effect of user's input relative to default features.

For example, if a user inputs "engineered shutters," this will result in no, or minor, reductions in vulnerability for a home built in Miami after 2002 but a large reduction in vulnerability for a home built before 1995 in Tallahassee, Florida. This coherent, logic-based approach provides a framework that properly accounts for the overlap of the impact of different secondary features (e.g., year built and mitigation features), and avoids potential double-counting of secondary features in the model.

The AIR methodology follows a structured approach to quantify the impact of more than 25 secondary risk characteristics, covering a range similar to that in the public domain—and, in particular, that used in the Florida Department of Community Affairs (DCA) study. Touchstone users may use these factors to develop rating credits in a manner similar to the one presented in this document.

Introduction

The AIR Hurricane Model for the U.S. in Touchstone includes the capability to account for the impact of secondary building and environmental characteristics on the vulnerability of individual risks. The modeling methodology was developed using an engineering based framework in a structured approach.

Based on structural engineering expertise and building damage observations made following historical hurricanes, more than 25 building features (see Table 1) have been identified as having a significant impact on building damage and losses. Options corresponding to each feature (see Table 7) are identified based on construction practice. Algorithms for modifying the damage functions are developed based on engineering principles and observational data. The AIR Hurricane Model for the U.S. in Touchstone supports any combination of multiple building features and produces a modification function that is applied to the base vulnerability function. The modification function captures the changes to building vulnerability that result when certain building features are present, and when information on such building features is known. The modification function varies with wind intensity to reflect the relative effectiveness of a building feature when subject to different wind speeds.

This document provides a brief overview of the component parts of all AIR natural hazard peril models, followed by a more detailed overview of the damage estimation, or vulnerability, component. That section is followed by details regarding wind-induced loads and resulting damage, a discussion of building and environmental features that affect building performance, and information on AIR's development of loss modification factors for a range of building features similar to those used in the Florida public domain study.

Overview of AIR Catastrophe Modeling Technology

Figure 1 illustrates the various components of AIR's catastrophe models. In the case of the AIR Hurricane Model for the U.S., the "Event Generation" module is used to create the stochastic storm catalog. More than one hundred years (1900-present) of historical data regarding the frequency of hurricanes and their meteorological characteristics are used to fit statistical distributions for each model parameter, including landfall location and storm heading at landfall, and the intensity variables of central pressure, radius of maximum winds, forward speed and storm track. By stochastically drawing from these distributions, the fundamental characteristics of each simulated storm are generated. The result is a large, representative catalog of potential events.

Once values for each of the important meteorological characteristics have been stochastically assigned, each simulated storm is propagated along its track. Peak 1-minute sustained wind speeds and wind duration are estimated for each geographical location affected by the storm to calculate "Local Intensity."

The "Damage Estimation" component of the model overlays the local intensity of the simulated event onto a database of exposed properties. The model then calculates the resulting monetary damage by applying damage functions, which capture the effects of the intensity of the event, which varies by location, on exposed buildings. Separate damage functions are developed for different construction types and occupancy classes. Similarly, separate damage functions for each of building, contents, loss of use, and business interruption are applied to the replacement value of the insured property to calculate losses for these coverages.

Finally, the “Insured Loss Calculation” is made by applying the policy conditions to the total damage estimates. Policy conditions may include deductibles by coverage, site-specific or blanket deductibles, coverage limits and sublimits, loss triggers, coinsurance, attachment points, and limits for single or multiple location policies, and risk specific reinsurance terms.

After all of the insured loss estimations have been completed, they can be analyzed in ways of interest to risk management professionals. For example, the model produces complete probability distributions of losses, or exceedance probability curves, for gross and net losses and for both annual aggregate and annual occurrence losses. Output may be customized to any desired degree of geographical resolution down to location level, as well as by line of business, and within line of business, by construction class, coverage, etc. The model also provides summary reports of exposures, comparisons of exposures and losses by geographical area, and detailed information on potential large losses caused by the extreme events that make up the tail of the distribution.

Damage Estimation Overview

The **Damage Estimation** component of the AIR Hurricane Model for the U.S. applies the local intensity of the simulated event to a database of exposed properties. The model determines damage estimation through the use of damage, or vulnerability, functions, which illustrate the interaction between buildings (and contents) and the local intensity to which they are exposed.

Uncertainty in damage comes from many sources including variability in the strength of building components and variability in building features as well as the level of uncertainty in the local intensity at the location under consideration. Further, uncertainty in the human response (whether windows are covered, for example) can significantly affect the damage severity. As claims analyses indicate that a single parametric distribution cannot be used to model the variability in the flood damage data, AIR engineers use a combination of beta and Bernoulli probability distributions (also called an “inflated beta” distribution) to capture the uncertainty in damage at a location.

The damage functions relate the mean damage level, as well as the variability of damage, to the measure of intensity at each location. That is, the AIR Hurricane Model for the U.S. estimates a complete distribution around the mean level of damage, for each local intensity and each type of structure. Because different structure types will experience different degrees of damage, the damage functions vary according to construction and occupancy. Losses are calculated by applying the appropriate damage function to the replacement value of the insured property.

The AIR damage functions incorporate the results of well documented engineering studies, tests, and structural calculations. They also reflect the relative effectiveness and enforcement of local building codes. AIR engineers refine and validate these functions through the use of post-disaster field survey data and through an exhaustive analysis of detailed loss data from actual events.

Separate damage functions for buildings, contents, and time element provide not only estimates of the mean, or expected, damage ratio corresponding to each wind speed, but also probability distributions around each mean. In the case of building damageability, the damage ratio is the dollar loss to the building divided by the corresponding replacement value of the building. As can be seen in Figure 98, the model ensures non-zero probabilities of zero and one hundred percent loss (for individual properties).

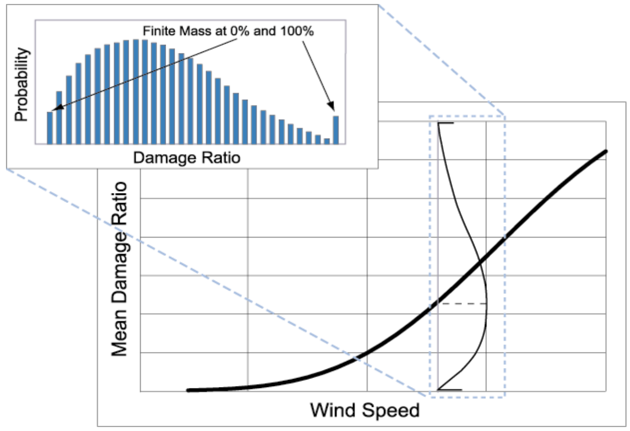

Figure 98. Representative Damage Function

AIR damage functions have been extensively validated using detailed actual loss data provided by a number of clients for various storms. Validation is performed by comparing simulated and actual losses for client companies by state or county, and line of business. Using detailed data, AIR has fine-tuned of damage ratios by construction class, coverage type, and wind speed.

Accounting for Secondary Risk Characteristics

Wind Induced Loads

Winds that are close to the earth's surface, are subjected to frictional drag from the terrain roughness. As the distance from the surface increases, these frictional effects decrease and, at a certain height, become negligible. The height at which the surface roughness is negligible is referred to as the *gradient height*. The layer of air below this height, where the wind is turbulent and its speed increases with height, is known as the atmospheric boundary layer whose height ranges from the ground surface to between 1,000 and 2,000 feet. All structures are located in this atmospheric boundary layer and act as bluff bodies to wind.

When wind comes into contact with buildings, the airflow streamlines separate at the sharp corners of buildings such as wall corners, eaves, roof ridges and roof corners (Figure 99). This separation induces additional turbulence in airflow causing highly fluctuating pressures on the building surfaces. The direction of wind with respect to the building (angle of attack) is also a significant factor in the magnitude and fluctuation of pressures acting on the surfaces of the building.

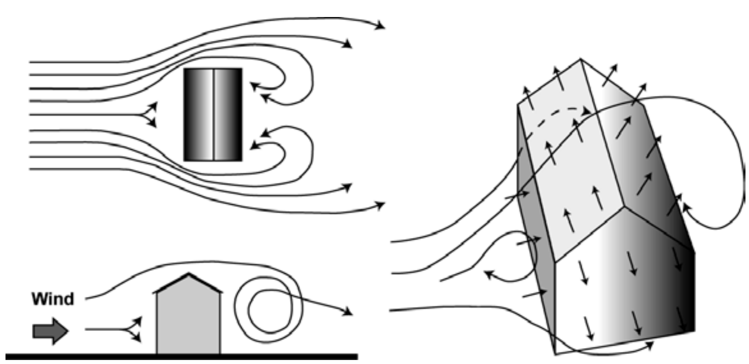

Figure 99. Wind Flow Around Buildings Can Generate Severe Pressure and Suction Forces

In general, when wind acts on a building, the windward wall experiences a pressure pushing inward (positive pressure) while the sidewall and the leeward wall will experience a suction pressure outward (negative pressure). The roof, depending on its slope, will experience uplift (negative pressure). Wind forces are significantly increased at corners, ridges, and at abrupt changes in the direction of wind flow.

Two important flow mechanisms with respect to buildings are discussed below.

Flow Separation

When wind impinges the front wall, it flows upward past the roofline. The wind is unable to turn abruptly at the roofline and so continues past the roof edge, thus separating from the roof eave. Suction forces are often found on the roof under the separated flow, especially near the separation point. The wind that has separated slowly comes back to its original flow direction there by reattaching on the roof surface. The point of reattachment depends on the dimensions of the buildings, roof geometry, the wind speed, and wind direction relative to the building.

Roof Corner Vortex

Wind approaching the roof corner at a quartering angle flows up over the roof, and rolls up into two vortices of opposite rotational directions originating at the building corner. These vortices are much like miniature tornadoes, producing high speeds under the vortices. These roof corner vortices are sometimes called the delta wing vortices (Figure 100).

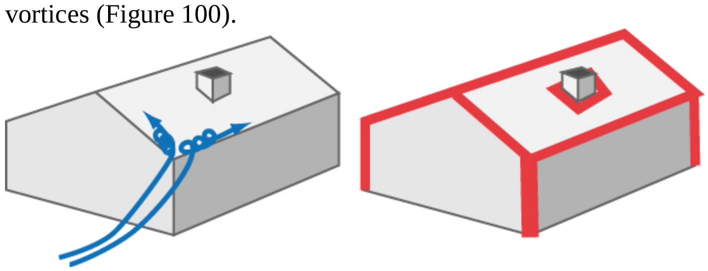

Figure 100. Wind Flow Separation Around Roof

Wind Damage

Damage surveys traditionally classify buildings as either engineered or non-engineered.; in general, an engineered building will have less susceptibility to wind damage than a non-engineered building. Most residential dwellings are classified as non-engineered. An example is a wood-frame single-family dwelling, which may not have received attention from a structural engineer during construction. Commercial structures that are built in accordance with building codes and under the supervision of a structural engineer, are classified as engineered. A typical engineered structure is a high-rise reinforced concrete building..

Wind Damage to Non-Engineered Buildings

Figure 101 illustrates the dynamic process by which non-engineered buildings are damaged by wind. Wind primarily affects non-structural elements, such as different components of the building envelope. In most cases, damage is fairly localized. Roofs and openings in the façade (e.g., windows and garage doors) are typically the first elements to be damaged. Loss of the first shingle allows wind to penetrate and lift the next shingle. Unsecured slates may peel off; metal roofs may roll up and become detached .

Damage accelerates as wind speeds increase. The loss of the first window, either because of extreme pressure or of wind-induced projectiles, can create a sudden build-up of internal pressure that can lift a roof system off the building from inside, even if it is properly secured.

At high wind speeds, the integrity of the entire structure can be compromised, particularly in cases where the roof provides lateral stability by supporting the tops of the building's walls. Structural collapse may occur during extreme wind events. Even if the structure remains intact, once the building envelope is breached, contents are vulnerable to wind as well as accompanying rain.

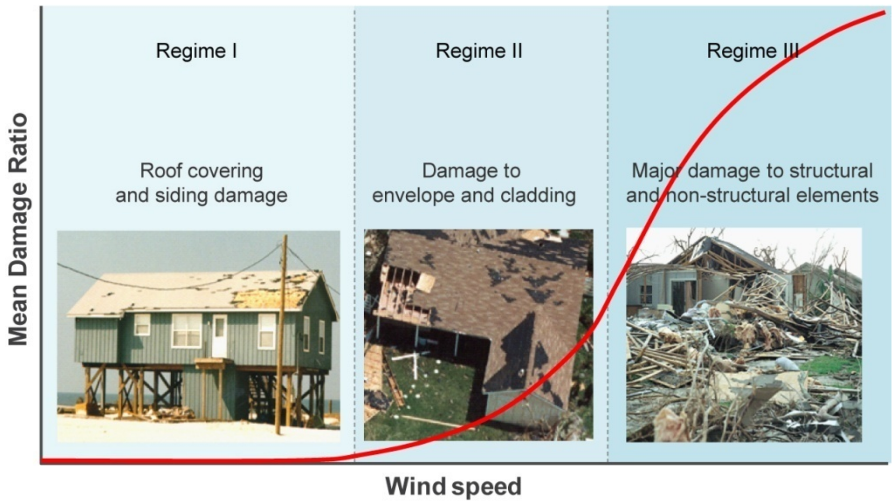

Figure 101. Damage Profile of Non-engineered Buildings

Wind Damage to Engineered Buildings

For engineered buildings, damage typically occurs to the following building (non-structural) components:

- Mechanical equipment
- Roofing
- Wall cladding
- Breaching of doors and windows

Complete structural collapse is a rare for well-engineered buildings. Even so, damage to non-structural components of a building can add up to a significant financial loss.

Examples of typical damage patterns can be seen in Figure 102.

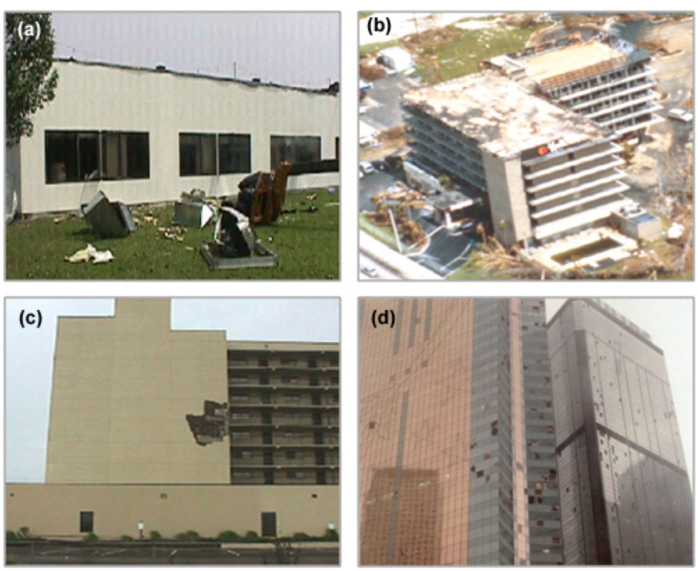

Figure 102. Damage to (a) Mechanical Equipment, (b) Roof, (c) Cladding, and (d) Windows

Building and Environmental Features

AIR accounts for the impact of secondary building and environmental characteristics, or features, on the wind vulnerability of individual risks. The methodology was developed at AIR using a structured, engineering based framework that is based on structural engineering expertise and building damage observations made in the aftermath of actual hurricanes.

In the AIR Hurricane Model for the U.S., options for each characteristic are identified based on construction type. Algorithms for modifying the vulnerability functions, for both structural and nonstructural damage, are developed based on engineering principles and observations of building performance. The AIR Hurricane Model for the U.S. supports the effects of any combination of building features on the building damage and produces a modification to the vulnerability function. The modification function captures the changes to building vulnerability that result when certain building features are present and when information on such building features is known. The modification function varies with wind intensity to reflect the relative effectiveness of a building feature when subjected to different wind speeds.

Figure 103 illustrates the application of modification factors to the basic damage functions.

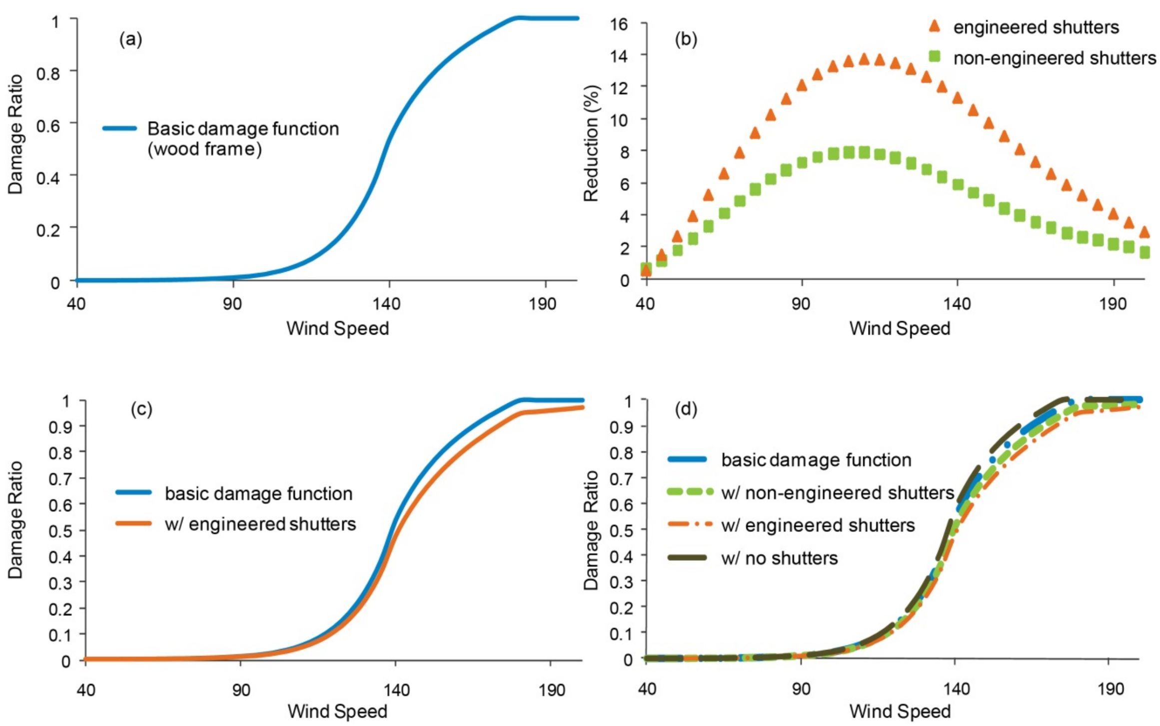

Figure 103. (a): Basic Damage Function for Wood Frame Construction; (B) Reduction in Damage for Engineered Vs. Non-engineered Shutters; (C) Basic Damage Function and Modified Function for Engineered Shutters; (D) Envelope of Damage Functions, All Protection Options

Individual Risk Features (Secondary Risk Characteristics)

The first step in the development of the modification functions is the identification of building and environmental characteristics that impact the performance of a building in high winds. These features are selected based on research and damage surveys, which detail building performance in high wind. Some can be categorized as non-structural (cladding, for example), while others are structural (roof and wall systems, for example); still others address very general features such as building condition and, finally, environmental features include such things as the proximity to trees.

The building characteristics supported in the AIR Hurricane Model for the U.S. are shown in Table 65**.** For each of these, various options are available, as discussed below. For the AIR Location Detail Codes, please refer to the latest version of the *UNICEDE® /px Data Exchange Format Preparer's Guide*, which is available at http://www.unicede.com/.

Table 65. Secondary Risk Characteristics Supported by the AIR Hurricane Model for the U.S. in Touchstone

Adjacent Building Height	Roof Covering
Appurtenant Structures	Roof Cover Attachment
Building Condition	Roof Deck
Certified Structures	Roof Deck Attachment
Exterior Doors	Roof Geometry
Floor of Interest	Roof Pitch
Foundation Connection	Roof Year Built
Glass Percentage	Seal of Approval
Glass Type	Small Debris Source
Large Missile Source	Terrain Roughness
Project Completion Percentage	Tree Exposure
Project Phase	Wall Attached Structures
Roof Anchorage	Wall Type
Roof Attached Structures	Wall Siding
	Window Protection

Appurtenant Structures

An appurtenant structure is a building that is located on a property but is not an integral part of the main building. Appurtenant structures may require a different treatment in analysis from the main building. For example, a pool enclosure may provide protection of a recreational pool from everyday wind and sun exposure. However, if winds are high enough to damage the main building, then the pool enclosure may become flying debris, and increase the amount of damage to the main building. The following appurtenant structures can be entered:

Unknown/default	Masonry boundary wall
Detached garage	Other fence
Pool enclosure	No appurtenant structures
Shed	No pool enclosure

Adjacent Building Height

This entry describes average height of buildings adjacent to the building of interest. Building height is expressed as the number of stories, with the default (0) indicating unknown height. For the hurricane peril, this field is in conjunction with Floor of Interest and Terrain Roughness.

Building Condition

This condition assessment of a building is based on its external appearance. The condition of the outside of the building and its maintenance, described as good, average, or poor, is used to determine a estimate of expected performance. Buildings with signs of distress or duress are likely to experience additional damage during a hurricane. Some examples of these signs are: an aging roof, aging exterior walls or cladding; loose roof tiles or chimney damage; or damage from previous hurricanes.

Foundation Connection

This entry describes the connection type between the structure and foundation and is a critical factor in single-family dwellings made of wood-frame and tilt-up construction. The connection transfers the vertical and lateral loads on the building to the foundation during wind events. The valid entries are:

Unknown/default

Hurricane ties

Nails/Screws

Anchor Bolts

Gravity/Friction

Adhesive/Epoxy

Structurally connected

For Industrial Facilities (occupancy classes between 400 - 488), this field represents the anchorage of equipment at the facility. The valid entries are anchored, unanchored, or unknown anchorage.

Certified Structures

Fortification standards were developed by the Insurance Institute for Business Home and Safety (IBHS). They are designed to help strengthen homes and businesses through retrofitting and new construction standards to improve their strength and resistance to natural perils.

Residential and commercial buildings that meet certain levels of standards are eligible for gold, silver, or bronze certification, which represent the level of disaster protection. The supported entries are:

Unknown/default

Fortified Home™/Business (IBHS) Bronze Option 1

Fortified Home™/Business (IBHS) Bronze Option 2

Fortified Home™/Business (IBHS) Silver Option 1

Fortified Home™/Business (IBHS) Silver Option 2

Fortified Home™/Business (IBHS) Gold Option 1

Fortified Home™/Business (IBHS) Gold Option 2

Fortified for Safer Living®/Safe Business (IBHS)

Exterior Doors

Exterior doors, and the frames that hold them, are weak in resisting wind loads. They deflect considerably under high wind loads and thus fail. This entry describes the type of exterior doors in the building as different types have different amounts of wind resistance. The valid entries are:

Unknown/default

Single width doors

Double width doors

Reinforced single width doors

Reinforced double width doors

Sliding doors

Reinforced sliding doors

Floor of Interest

Different floors of a building experience varying degrees of damage as well as different types of damage. This entry identifies the floor concerned, if coverage is not for the entire building. Replacement values (building, contents, and BI) as well as policy terms should be entered for the floor of interest and not the whole building. This field should be used in conjunction with the Terrain Roughness and Average Adjacent Building Height.

Glass Percentage

In general, the greater the percent of glass in a wall, the greater the wall's vulnerability to damage. This entry represents the percentage of the wall area that is glass.

Unknown/default (or no floor of interest)	20% to 60%
Less than 5%	Greater than 60%
5% to 20%	

Glass Type

Different types of glass have different levels of resistance to wind loads and debris impact. The valid entries for glass type are:

Unknown/default	Heat strengthened
Annealed	Laminated
Tempered	Insulating glass units

Large Missile Source

A source of a large missile is any object within 100 feet of the property that could potentially become large flying debris in hurricane winds and breach the building envelope. Examples of large missile sources include outdoor furniture, loose boards or building materials, or wood planks or studs on nearby buildings that can become dislodged in high winds.

Project Completion Percentage

This percentage applies to Average Project Loss at Phase 5 for builder's risk policies, or the average loss over the duration of the project. It indicates the percentage of the project (0%-99%) that is completed at the start of the policy and is determined by the cost of the project. If no builder's risk is selected then other phase losses are selected and the percentage complete entry will be ignored.

Project Phase

For builder's risk policies, this secondary feature can be used to identify the phase of construction that is currently underway. If no builder's risk is selected (0), then construction is assumed to be complete and regular risk is applied. Buildings under construction have varying degrees of vulnerability that depends on the construction phase:

No builder's risk/default

Phase 1: Foundation and Substructure

Phase 2: Superstructure

Phase 3: Walls and Roofing

Phase 4: Interior, Mechanical (Conveying, Plumbing, HVAC, Fire Protection, Electrical, Furnishings, Misc.

Phase 5: Average Project Loss (the average loss over the duration of the project)

Worst Loss: The project phase when the loss potential is highest.

Roof Anchorage

The type of connection that secures the roofing support to the walls affects how well wind loads are transferred to the walls, reducing the vulnerability of the roof. The anchorage types are:

Unknown/default	Gravity or Friction
Hurricane ties	Adhesive epoxy
Nails or Screws	Structurally connected roof
Anchor bolts	Clips

Roof Attached Structures

Structures that are attached to a property's roof, such as mechanical equipment, may be more vulnerable to winds than the main building, particularly if they are not well anchored. Some roof attached structures help protect the roof from damage. Supported roof attached structures are:

Unknown/default	Overhang/Rake
Chimneys	Dormers
Air conditioning units	Waterproof membrane/fabric
Skylights	Secondary water resistance (e.g., bitumen tape)
Parapet walls	Other

Roof Covering

The material used for the roof covering has a significant impact on the roof's ability to resist wind damage. If the roof covering is damaged, then the interior of the building and its contents become more vulnerable. Supported roof covering materials are:

Unknown/default	Built-up roof with gravel
Asphalt shingles	Built-up roof without gravel
Wood shingles	Single ply membrane
Clay/concrete tiles	Single ply membrate ballasted
Light metal panels	Standing seam metal
Slate	Hurricane wind rated roof covering

Roof Cover Attachment

The type of connection that secures the roof covering to the roof deck affects the roof's vulnerability to wind. Attachments that become damaged to high winds can increase the vulnerability of the roof covering. Supported roof covering attachments include:

Unknown/default	Adhesive/epoxy
Screws	Mortar
Nails/staples	

Roof Deck

The roof deck material affects how well wind loads are transferred from the roof to underlying joists and purlins. A damaged roof deck results in a breached building envelope, which causes significant building and contents damage.

Supported roof deck materials are:

Unknown/default	Metal deck with concrete
Plywood	Pre-cast concrete slabs
Wood planks	Reinforced concrete slabs
Particle board/OSB	Light metal
Metal deck with insulation board	

Roof Deck Attachment

The type of connection that secures the roof deck to the underlying roof system affects the roof's vulnerability to wind. Attachments that become damaged to high winds can increase the vulnerability of the roof deck. Supported roof covering attachments include:

Unknown/default	Structurally connected
Screws/bolts	6d nails @ 6" spacing, 12" on center
Nails	8d nails @ 6" spacing, 12" on center
Adhesive/epoxy	8d nails @ 6" spacing, 6" on center

Roof Geometry

The shape of a roof has a significant effect on its wind vulnerability. Wind vortices at the corners result in suction forces that can lift the roof. Large complex roof geometries tend to reduce the intensity of the wind pressure and the resulting uplift forces. The supported roof geometries are:

Unknown/default	Hip	Mansard
Flat	Complex	Pyramid
Gable end without bracing	Stepped	Gambrel
Gable end with bracing	Shed	

Roof Pitch

The roof pitch refers to its slope angle, which affects the suction forces of winds. Greater roof pitches lower the uplift forces, thereby improving the wind resistance of the roof. A low pitch is under 10°, a medium is between 10° and 30° while a high pitch is a slope greater than 30°.

Roof Year Built

This secondary feature indicates the year the current roof was put in place. Roofs lose their strength over time and become more vulnerable to wind loads. Older roofing systems may not have been as well-designed for wind resistance and ones that meet stricter code requirements.

Seal of Approval

This secondary feature accounts for the level of engineering provided to the design of a building. A fully engineered structure is one that has been designed by a Professional Engineer (PE), who is required to provide a seal of approval to the calculations and drawings of the building plan. These structures have the greatest resistance to wind loads.

A partially engineered structure is one that has been inspected by a PE who has determined the building is "deemed to comply" with the respective building code. No seal is required for a partially engineered designation. A minimally engineered structure is one that does not meet conditions well enough to warrant a seal of approval or "deemed to comply" designation.

Small Debris Source

Roof gravel, trash bins, tree branches, or other small debris can be carried aloft by high winds and breach window glass. This secondary feature indicates if there is a potential for small debris within a radius of 200 ft. of the building.

Terrain Roughness

As hurricane winds travel over land, their speed can be significantly affected by the terrain. The effects of the surrounding terrain therefore greatly affect a building's vulnerability to winds.

Type A. Large city centers with at least 50% of the buildings higher than 70 ft. (21.3 m). This exposure category is limited to areas for which terrain representative of Exposure A prevails in the upward direction, for a distance of at least 0.5 mi. (0.8km), or 10 times the height of the building, whichever is greater. The model accounts for channeling effects or increased velocity pressures due to other structures situated alongside the building.

Type B. Urban and suburban areas, wooded areas, or other terrain with numerous closely-spaced structures the size of single-family homes or larger. This exposure category is limited to areas for which terrain representative of Exposure B prevails in the upwind direction for a distance of at least 1,500 ft. (460 m) or 10 times the height of the building or other structure, whichever is greater.

Type C. Open terrain with scattered obstructions having heights generally less than 30 ft. (9.1 m). This category includes flat open country and grasslands.

Type D. Flat, unobstructed areas exposed to winds flowing over open water for a distance of at least 1 mi. (1.61 km). This exposure applies to buildings and other structures exposed to the winds coming off the water. Exposure D extends inland from the shoreline a distance of 1,500 ft. (460 m), or 10 times the height of the building or structure, whichever is greater.

Tree Exposure

Strong winds can snap trees or blow them over, causing them to fall on nearby buildings. This can cause significant damage, particularly if they breach the building envelope. This secondary feature provides an indication of whether a falling or snapped tree hazard exists near the building.

Wall Attached Structures

Buildings may have objects that are physically attached to its exterior walls but are not an integral part of the main building structure. These attached structures are often more vulnerable than the main building, particularly if the anchorage is inadequate. They are more exposed to winds and may become dislodged and create a breach, or become flying debris. Supported wall attached structures include:

Unknown/default	Double door garage
Carports/Canopies/Porches	Reinforced double door garage
Single door garage	Screened porches/ Glass patio doors
Reinforced single door garage	Balcony

Wall Siding

The wall siding material of a building, which is used to protect the walls from weathering, affects its vulnerability to wind loads. Any breach in the wall siding can expose the wall to wind and allow pressure to build up and create more damage.

Supported wall siding materials are:

Unknown/default	Aluminum/vinyl
Veneer brick/masonry	Stone panels
Wood shingles	Exterior insulation finishing system (EIFS)
Clapboard	Stucco

Wall Type

The external wall material of a building affects its vulnerability to wind loads. Any breach in the wall can allow pressure to build up inside the building and create more damage. Supported materials are:

Unknown/default	Particle board
Brick/unreinforced masonry	Metal panels
Reinforced masonry	Pre-cast concrete elements
Plywood	Cast-in-place concrete
Wood planks	Gypsum board

Window Protection

This secondary feature indicates whether engineered shutters or nonengineered shutters are installed. Both types can provide window protection against strong winds, particularly engineered shutters.

Example of Secondary Risk Characteristics: Roof System

This section provides an example of how individual elements of a structural system (in this case, the roof system) combine to influence damage and loss due to hurricanes.

The main function of a roof is to enclose the building space and protect it from the damaging effects of rain, wind, heat, and snow. Consideration is also given to factors such as strength and stability under anticipated loads, heat insulation, lighting, ventilation, sound insulation, and aesthetics, etc.

In the AIR Hurricane Model for the U.S. as implemented in Touchstone, a roof system comprises the following features:

- Roof age
- Roof covering
- Roof covering attachment
- Roof deck
- Roof deck attachment
- Roof geometry
- Roof pitch

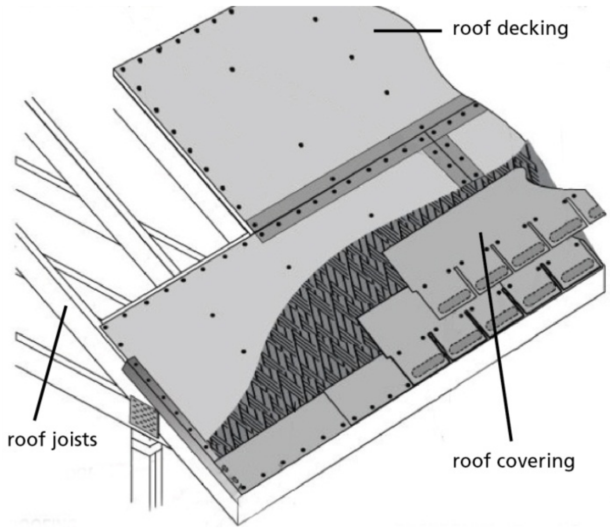

Figure 104. Some Key Components of a Roof System

Brief descriptions of some of the features that influence damageability and loss due to hurricanes are provided below.

Roof Covering

The roof covering is the material covering the framework of the roof structure in order to safeguard the roof against the weather. This material is fixed to the underlying structure by means of a range of fittings and fixtures.

Climatic conditions influence the performance and durability of roof coverings. Strong winds may dislodge certain types of roof coverings such as slates, tiles, and asphalt shingles, particularly if they are not properly affixed. Extreme temperature changes can cause the material to crack and joints to leak, if they are not properly protected. Fog, salt, or smoke and other gases can corrode metal roofing that is protected such as by being painted regularly. Rubber membranes and asphalt shingles can become brittle and crack as a result of prolonged exposure to ultraviolet radiation. The various effects described above can result in poor roof performance, reduced roof life, or both.

Roof coverings are fastened to roof decks, which are supported by structural members such as girders, trusses, or rigid frames. In the case of shell roofs, the decks serve as principal supporting members. In some cases, the roof covering and the deck are combined into one unit, such as with corrugated roofing. Because of these varying roofing systems, the type of roof covering and the type of roof deck should be selected concurrently.

The weight of the roof covering affects the design, weight, and the cost of both the roof deck and its supporting structure or framework. A heavier roof covering requires a stronger supporting structure, which adds to the cost. For example, sheet metal coverings are very lightweight, and shingles can be classified as light to medium in weight, whereas clay tiles and slates are considered to be heavy roof coverings. Supporting structures and roof decks are designed according to the weight of the chosen roof covering Figure 105**.** shows typical wind damage to a roof covering.

Figure 105. Wind Damage to a Roof Covering

Roof Deck

The roof deck transfers the roof loads to the underlying trusses or rafters. Damage to the roof deck constitutes a breach of the building envelope and can result in significant building and interior damage. Some commonly used roof deck materials are plywood, precast concrete slabs, reinforced concrete slabs, and light metal. Figure 106 shows wind damage to a roof deck.

Figure 106. Wind Damage to a Roof Deck

Roof Geometry

The magnitude of aerodynamic loads that are applied to a roof is largely determined by its geometry, or shape, as it affects the intensity of wind pressures and the resulting uplift resistance. Common roof shapes include gable and hip, although a variety of roof shapes are possible. Below are some brief descriptions of more common roof shapes.

Gable Roof. A gable roof slopes in two directions so that the end formed by the intersection of the slopes is a vertical triangle (Figure 107).

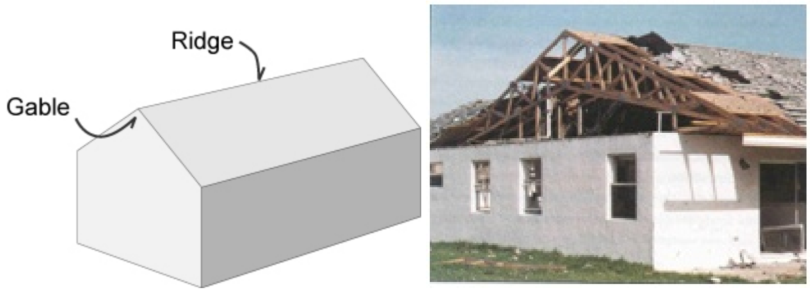

Figure 107. Illustration of a Gable Roof and Hurricane Damage

Hip Roof. A hip roof slopes in four directions so that the end formed by the intersection of the slopes is a sloped triangle (Figure 108).

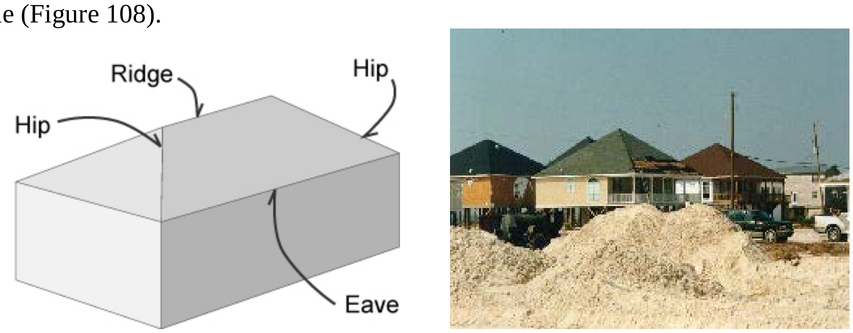

Figure 108. Illustration and Examples of Hip Roofs

Mansard Roof. Like the hip roof, this roof also slopes in four directions but there is a break in each slope (Figure 109)

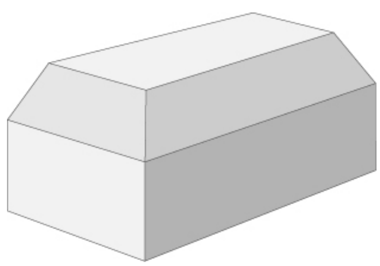

Figure 109. Illustration of a Mansard Roof

Methodology for Accounting for Secondary Risk Characteristics

Building aerodynamics is a complex phenomenon due to the fact that the performance of a building depends on the interaction of several building components. Moreover, damage due to wind is progressive: failure at a localized level can eventually grow to a catastrophic level. Thus it is important to recognize the way in which damage progresses and the role and importance of building components at each stage of failure.

AIR's methodology for accounting for secondary risk characteristics follows a structured, logical approach that groups building characteristics according to their function. In this way, the methodology reflects the contribution of each characteristic to the overall building performance. This methodology relies on expert experience in wind engineering, damage observation from post-disaster surveys, and data from wind tunnel experiments. The ultimate goal is to develop a modification function that is applied to the base damage function—one that appropriately captures the impact of one or more selected building characteristics.

Weightings are used to combine the effects of secondary risk characteristics whose interaction is complex and not necessarily additive. These are introduced to evaluate features that modify the performance of the system. If we consider the roof system, age, pitch, and geometry modify the performance of the roof as a whole and therefore the weight should be used as a multiplier. The weights are dependent on wind speed and construction class, and are appropriately selected to reflect the importance of a feature at certain levels of a building's damage state.

Evaluating Building Performance

There are two primary metrics for evaluating the impact of a building or environmental feature on overall building performance. The first is a weighted value assigned to the various *options* for building or environmental features. The value for any given option of any given feature reflects the relative prevalence of use among the options and is independent of other features. That is, the value is designed such that the most commonly used option is assigned a value close to 1.0. The implication is that a building with this option is expected to perform very similarly to the average, or "typical," building represented by the base damage functions.

The value assigned for an option that is considered to be more vulnerable (less wind resistive) than the most commonly chosen one is greater than 1.0. That is, a building with this option will be more vulnerable than the average building. Similarly, the value assigned for an option that is considered to be less vulnerable (more wind resistive) than the most prevalent one will be less than 1.0. Such a building will be less vulnerable than the average building. The value for a given option is a constant. If no information is available on the option, the default value is 1.00, which means that the base damage function is used without modification.

The second metric is of two types. One type is used to develop simple weighted averages, which are used to evaluate the loss contribution of several features that together constitute a system, such as a roof. They are wind-speed dependent; that is, the contribution of each feature varies with wind speed. For example, a roof system may consist of three features: roof covering, roof deck, and roof attachment. The loss contribution to the roof system from these three features is expected to be different at different wind speeds. At low wind speeds, the roof covering drives the damage. As wind speeds increase, the roof deck becomes more vulnerable. In this case, roof deck failure will result in loss of roof covering regardless of the type (or option) of roof covering present. Therefore, as wind speed increases, the weight assigned to roof deck increases. In contrast, at higher wind speeds, the weight for roof covering decreases because it is already lost. The weights for the system as a whole add up to 1.0.

The second type of weighting combines the effects of features whose interaction is complex and not necessarily additive. These are introduced to evaluate features that modify the performance of the system. If we consider a roof system again, the roof age, roof pitch, and roof geometry modify the performance of the roof as a whole and therefore the weight should be used as a multiplier. The weights are dependent on wind speed and construction class, and are appropriately selected to reflect the importance of a feature at certain levels of building damage.

Example of Wind Speed Dependency

As noted above, the performance of secondary building characteristics is wind-speed dependent. This can be further explained by considering in detail a single feature, such as roof-wall anchorage. Roof-wall anchorage provides the means to establish a load path to transfer wind loads from the roof to the walls.

This anchorage can be provided through:

- Hurricane straps
- Structural connections
- Nails
- Epoxy/adhesive
- Anchor bolts
- Gravity/friction

By selecting hurricane straps as one of the options for "roof wall anchorage" we can observe varying mitigation benefits in three different wind speed regimes.

- For lower wind speeds, the mitigation benefits (in terms of reduced damage) of hurricane straps are similar to any other roof-wall anchorage mechanism. Hence mitigation benefits are not high at these wind speeds.
- At higher wind speeds, hurricane straps are very effective in reducing damage. At these wind speeds, the presence of straps is most important. Hence mitigation benefits are high.
- At very high wind speeds, the effectiveness of hurricane straps in reducing the damage decreases. Hence, mitigation benefits are not high.

Because of its inherent weakness, there are no mitigation benefits for "epoxy/adhesive" as an option for "roof wall anchorage." In fact, "penalties" are applied and the size of the penalty is wind speed dependent.

- At low wind speeds, the effectiveness of "epoxy/adhesive" is similar to other roof-wall anchorage mechanisms. Hence we do not see any large penalties being exacted in this wind speed domain.
- At higher wind speeds, however, the choice of a weak roof-wall anchorage has a significant impact on damage. Hence we see high penalty being exacted.
- At very high wind speeds, most roof-wall anchorage mechanisms would be ineffective. Thus the penalty for choosing a weak one is small.
- The above examples illustrate how different wind speeds impact the accrual or non-accrual of mitigation benefits for a particular feature (Figure 110).

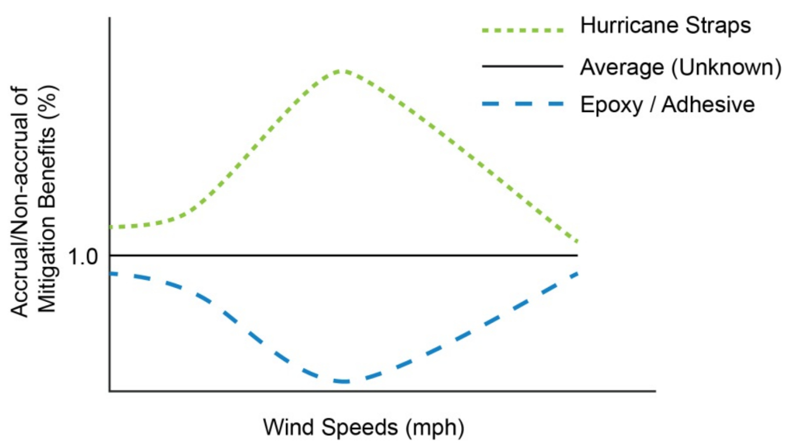

Figure 110. Mitigation Benefits of Various Roof-Wall Anchorage Options

Sample Mitigation Curves

Failure of windows during a hurricane is often due to the impact of flying debris or to the exceedance of the window's pressure capacity. Window failure is a breach of the building envelope and allows wind and water to enter the building. Even if there is no structural damage to the building, this intrusion of water would cause damage to contents and building interior finishes, which can lead to substantial losses. Protecting the windows is critical in reducing the potential damage to a building. One mitigation option is the installation of engineered storm shutters.

As can be seen in Figure 111, the percentage reduction in damage achieved by the installation of engineered storm shutters is wind speed dependent. At lower and high wind speeds the percentage of reduction in damage is comparable to that of any other equivalent window protection mechanism. Hence we do not see any higher order percentage reduction of damage at lower and higher wind speeds. The effectiveness of engineered storm shutters is greatest in the middle range of wind speeds, where shutters have the greatest marginal impact on damage reduction.

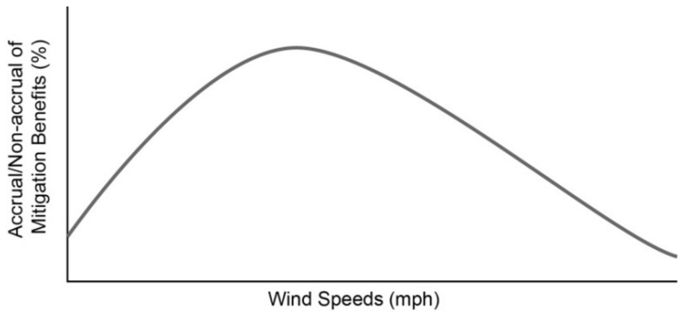

Figure 111. Modification Function for Engineered Storm Shutters

Damage to the roof covering can also result in significant water damage to the interior of the building and contents. A sample modification curve for a slate roof covering is provided in Figure 112.

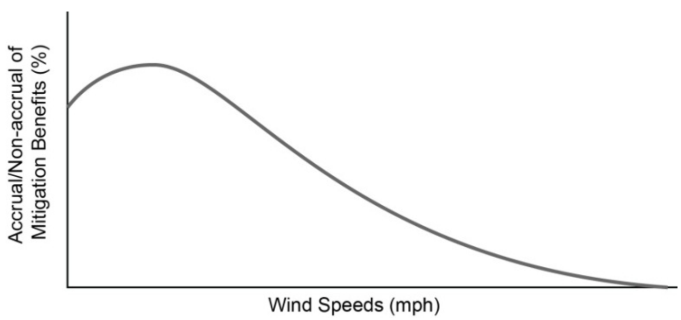

Figure 112. Modification Function for Slate Roofing

Spatial and Temporal Dependency of the Marginal Impact of Secondary Risk Characteristics

For a given construction type, occupancy class, and height, the AIR Hurricane Model for the U.S. defines a typical building in terms of default secondary risk characteristics, for each location and year built, to estimate its vulnerability. Thus the *marginal* impact on vulnerability of secondary risk characteristics is also dependent on the location of the structure and the year it was built. User input of secondary risk characteristics will overwrite the default characteristics, and a new vulnerability function is estimated depending on the user's input relative to default features. For example, an input of "engineered shutter" will provide no to minor reduction in vulnerability for a Miami home built after 2002, but will provide a large reduction in vulnerability for a Tallahassee home built before 1995. This coherent approach provides a framework that properly accounts for the overlap of the impact of different secondary features (e.g., year built and mitigation features) and avoids potential double counting of secondary features in the model. However, the overall vulnerability for a structure in Miami is likely to be lower than that of a building in Tallahassee. It is this marginal impact of secondary risk characteristics that will be different.

Validating the Impact of Secondary Risk Characteristics

The quality and level of detail of exposure and claims data has improved over time. Before the 2004 and 2005 hurricane seasons, most of the data was aggregated at the ZIP Code level with little to no information about individual building characteristics. Data from more recent storms indicates that most companies have started capturing exact addresses and primary building characteristics such as construction, occupancy, height, and year-built. Many clients have also captured detailed building characteristics such as roof covering type, type of opening protection, and roof sheathing connection, etc. AIR has analyzed this data to validate the impact of individual characteristics and characteristics in combinations. Figure 113 compares modeled and observed mitigating impacts of key individual building characteristics, as well as of the combined characteristics in a single building (mitigated building).

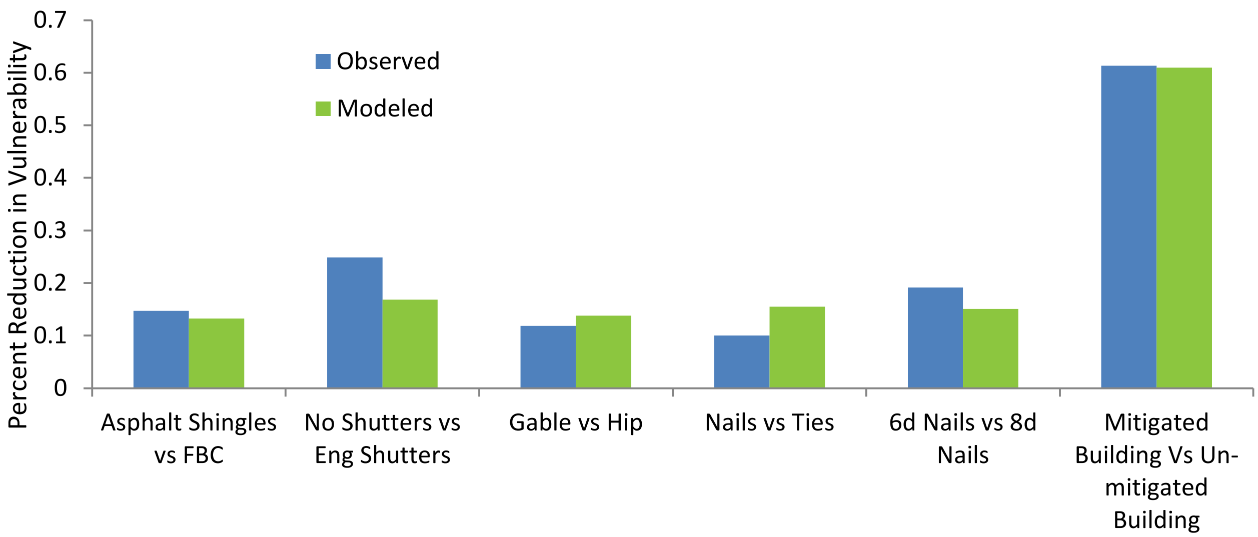

Figure 113. Validation of the Impact of Secondary Risk Characteristics, Alone and in Combination

Proper Use of the Secondary Risk Characteristic "Seal of Approval"

Even when building codes are mandatory, the level of engineering participation in the design and construction of a structure can vary regionally. In Florida, for example, a professional engineer typically performs an inspection and undertakes load calculations before engineering drawings are sealed. For many coastal counties in Texas, a professional engineer inspects the buildings, but design load calculations are not performed. For many other states, basic inspection is sufficient to meet the building code requirements.

In the AIR Hurricane Model for the U.S., the secondary risk characteristic "Seal of Approval" was developed to account for the differing effects the same class of mitigation features may have on the vulnerability of a structure. For example, the impact of a good roof-to-wall connection (e.g., strap) may be much higher for a home that received engineering attention during construction (e.g., design calculations were completed to ensure there are continuous horizontal and vertical load paths) than the impact on a home where such detailed engineered attention was not paid. The purpose of these features is not to turn a house with bad building characteristics into a good house with mitigation features, but to distinguish between the impact of a mitigation feature based on the level of engineering attention. Thus, the Seal of Approval will not change the vulnerability of a structure with otherwise poor building characteristics.

There are three options for the Seal of Approval:

Fully Engineered Structure: The structure has been designed by a Professional Engineer. The Professional Engineer is required to seal the calculations and drawings by the local jurisdiction.

Partially Engineered Structure: The structure has been inspected by a Professional Engineer and found “deemed-to-comply” with the respective Building Code. The local jurisdiction does not require the Professional Engineer to seal the calculations.

Minimally Engineered Structure: The Structure does not satisfy any of the conditions mentioned above.

Following are examples to illustrate the use of Seal of Approval in the model.

A Miami structure built in 2009:

The model assumes a well mitigated and Fully Engineered Structure for this location and year-built. Thus, using the Partially or Minimally Engineered options under Seal of Approval would increase the vulnerability of structures.

A Mississippi structure built in 1995:

The model does not assume a mitigated structure for this location and year-built. Thus, applying any option under Seal of Approval will not modify the vulnerability functions.

A Mississippi structure built in 1995 with user-selected secondary risk characteristics, such as high-wind rated roof covering, hurricane ties, and engineered shutters:

Since the user has selected secondary risk characteristics that will make the structure a mitigated structure, selecting the Partially Engineered or Fully Engineered options will further reduce the vulnerability of the structure.

Please note that when year-built is unknown, the Seal of Approval characteristic does not have an impact on the vulnerability.

Mitigation Credits for Construction to Florida Building Code 2001 (FBC 2001)

For buildings built to the minimum requirements of the Florida Building Code (FBC 2001), AIR has identified six unique building categories for Florida, as listed in Table 66, by taking into consideration the design wind speed, terrain exposure category, and the requirements of Wind-borne Debris Region (WBDR) and High Velocity Hurricane Zone (HVHZ).

Table 66. Building Categories According to the Florida Building Code (FBC 2001)

Building Category	Wind Speed*** (mph)	Exposure	WBDR**
1	<120	B	No
2	≥ 110	C	Yes
3	≥ 120	B	No
4	≥ 120	B	Yes
5	≥ 120	C	Yes
6	HVHZ*	C	Yes

* Broward and Miami-Dade counties

** In these areas, buildings can be designed for internal pressures instead of providing opening protections. In the model, explicit assumption about opening protection has not been made except for Region 6 where it is required to have the opening protection.

*** The wind speeds specified as per FBC 2001 are "nominal" or "basic" wind speeds as per allowable stress design (ASD)

Figure 114 shows the geographical locations of these building categories in Florida. The vulnerability functions for these six unique building categories were derived by selecting the relevant building features and options from the AIR individual risk module that meet the minimum requirements of the Florida Building Code 2001. For example, AIR building category 6 is located in the High Velocity Hurricane Zone (HVHZ) and is designed for a wind speed of 146 mph and Exposure C (Open country), as specified in FBC 2001. The code stipulates all openings be protected in the HVHZ.

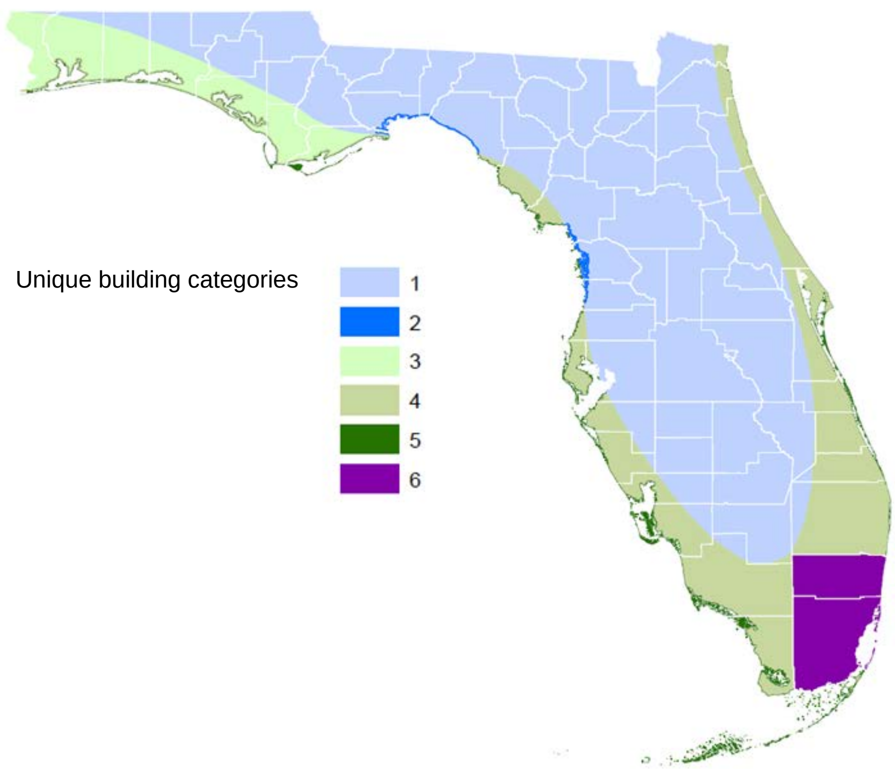

Figure 114. Buildings That Meet the Minimum Requirements Of the Florida Building Code (Fbc 2001)

Table 67 illustrates the roof covering, roof covering attachment, roof deck, roof-deck attachment, roof anchorage, opening protection, and exterior door options selected for residential wood frame category 6 buildings to meet the minimum requirements of the Florida Building Code.

Table 67. Model Parameters for Building Category 6 According to the Minimum Requirements of FBC 2001

Parameter	Building 6
Wind Speed	146 mph
Exposure	C
WBDR	Yes
HVHZ	Yes
Roof Covering	FBC Equivalent
Roof Cover Attachment	Nails / Staples
Roof Deck	Plywood
Roof-Deck Attachment	8d@6"/6"
Roof Anchorage	Hurricane Straps
Window Protection	Engineered Shutters
Exterior Doors	Impact Resistant - Reinforced

Mitigation Credits for Construction to Florida Building Code 2010 (FBC 2010)

For buildings built to the minimum requirements of the Florida Building Code 2010, AIR has identified eleven unique building categories for Florida, as listed in Table 68, by taking into consideration the design wind speed, terrain exposure category, and the requirements of Wind-borne Debris Region (WBDR) and High Velocity Hurricane Zone (HVHZ).

Table 68. Building Categories According to the Florida Building Code 2010

Building Category	Wind Speed*** (mph)	Exposure	WBDR**
1	115 ≤ < 130	B	No
2		C	No
3	130 ≤ < 140	B	No
4		C	No
5		B	Yes
6		C	Yes
7	140 ≤ < 155	B	Yes
8		C	Yes
9	≥ 155	B	Yes
10		C	Yes
11	HVHZ*	C	Yes

* Broward and Miami-Dade counties

** In the model, the opening protection is explicitly assumed for buildings in the WBDR.

*** The design wind speeds as per FBC 2010 are for risk Category II buildings and are “ultimate” wind speeds as per Load and Resistance Factor Design (LRFD)

Figure 115 shows the geographical locations of these building categories in Florida. The vulnerability functions for these eleven unique building categories were derived by selecting the relevant building features and options from the AIR individual risk module that meet the minimum requirements of the Florida Building Code 2010. For example, AIR building category 11 is located in the High Velocity Hurricane Zone (HVHZ) where the design wind speed is 170 mph and 175 mph in the Broward and Miami-Dade counties for risk Category II buildings, respectively, as specified in FBC 2010. In addition, Exposure C (Open country) is assumed in HVHZ. The code stipulates all openings be protected in High Velocity Hurricane Zone.

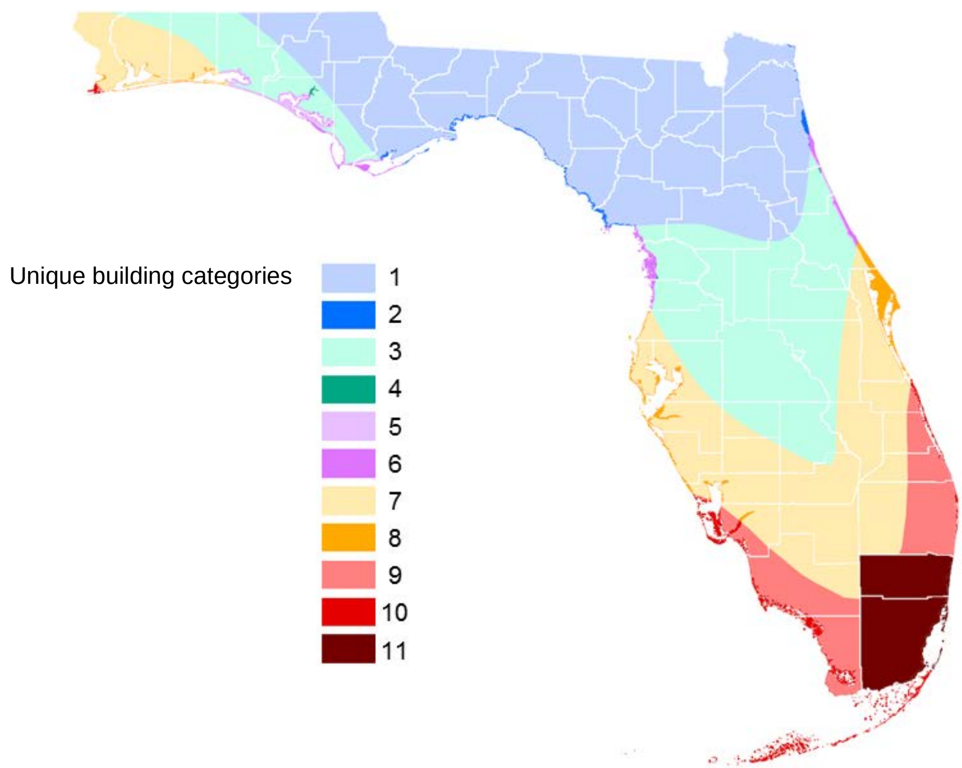

Figure 115. Buildings That Meet the Minimum Requirements Of the Florida Building Code 2010

Table 69 illustrates the roof covering, roof covering attachment, roof deck, roof-deck attachment, roof anchorage, building foundation connection, opening protection, door, wall attached structures, and mechanical system options selected for residential wood frame category 11 buildings to meet the minimum requirements of the Florida Building Code 2010.

Table 69. Model Parameters for Building Category 11 According To the Minimum Requirements of FBC 2010

Parameter	Building 11
Wind Speed	170 or 175 mph
Exposure	C
WBDR	Yes
HVHZ	Yes
Roof Covering	FBC Equivalent
Roof Cover Attachment	Screws
Roof Deck	Plywood
Roof-Deck Attachment	Structurally Connected
Roof Anchorage	Hurricane Straps
Foundation Connection	Hurricane Straps
Window Protection	Engineered Shutters
Exterior Doors	Impact Resistant - Reinforced
Wall Attached Structures	None
Roof Attached Structures	Secondary Water Resistance - Yes

Evaluating Wind Loss Mitigation Credits with the Touchstone Location Detail Record

On June 6, 2002, the Florida Department of Insurance issued an Informational Memorandum **(**0470M) which outlined provisions of the Florida Statute Section 627.0629(1). The new statute requires that rate filings received by the Florida Department of Insurance on or after June 1, 2002, include credits for "fixtures or construction techniques demonstrated to reduce the amount of loss in a windstorm". The statute further requires all insurers to make a rate filing which includes actuarially reasonable differentials by February 28, 2003.

This document provides guidance to companies who wish to use Touchstone for evaluating these wind mitigation credits. According to the statute, the following 6 areas must be considered:

- Roof strength
- Roof covering performance
- Roof-to-wall strength
- Wall-to-floor-to-foundation strength
- Opening protection
- Window, door, and skylight strength

The Information Memorandum states that other construction techniques have also been demonstrated to influence loss and thus should also be considered:

- Roof shape
- Wall Construction
- Opening Protection for non-glazed openings (e.g., doors)
- Gable End Bracing for roof shapes other than hip

The Touchstone Location Detail Record

The location detail record (record 64 in the UPX file and record 74 in the UFX file) contains several building and environmental features that influence loss from windstorms. Table 70 shows the features of particular relevance to the Florida Statute.

Note that some features can be used to address more than one area of interest. For example, while roof geometry is a separate category, it also influences roof strength.

Table 70. Building Features Relevant to the Florida Statute

Mitigation Category	Touchstone Location Detail Field
Enhanced Roof Strength	Roof Deck Roof Deck Attachment Roof Covering Roof Covering Attachment Roof Geometry Roof Pitch Year Roof Built
Opening Protection	Window Protection
Opening Protection for Non-glazed Openings	Exterior Doors Wall Attached Structures
Roof Covering Performance	Roof Covering Roof Covering Attachment
Roof Shape	Roof Geometry
Roof to Wall Strength	Roof Anchorage Wall Type Wall Siding
Wall Construction	Wall Type Wall Siding
Wall to Floor to Foundation Strength	Foundation Connection
Window, Door, Skylight Strength	Glass Type Exterior Doors Wall Attached Structures

Developing Mitigation Credits

In 2001, the Florida Department of Community Affairs (DCA) commissioned a study to estimate the loss reduction potential of different wind resistive building features. Loss cost relativities were presented for a set of primary rating factors, with various options for each factor. The Florida Department of Insurance recognizes the “public domain” DCA study as one basis for deriving credits, but notes that insurers may rely upon other studies.

AIR has developed loss modification factors for a similar range of building features. Touchstone users may use these factors to develop rating credits in a similar manner as presented in the public domain study. It is important to note that the AIR and DCA studies were developed independently, and as a result have differences in methodology, features, and conclusions. While there is no direct mapping of the rating tables used in the DCA study to the AIR secondary characteristics, AIR has developed a list of characteristics that provide a similar range of relativities. The DCA features and closest AIR selections are shown in Table 71.

Table 71. DCA Features and Corresponding AIR Secondary Characteristics

DCA Feature	Similar AIR Category and Selections
Opening Protection None Basic Hurricane	Window Protection None Non-Engineered Shutters Engineered Shutters
Roof Cover Non FBC Equivalent FBC Equivalent	Roof Covering + Roof Covering Attachment Asphalt Shingles + Nails FBC Equivalent+Nails
Roof Deck Attachment A B C	Roof Deck + Roof Deck Attachment Plywood + 6d nails @ 6”/12” Plywood + 8d nails @ 6”/12” Plywood + 8d nails @ 6”/6”
Roof Shape Hip Other	Roof Geometry Hip Gable End without Bracing
Roof Wall Connection Toe Nails Clips Single Wraps Double Wraps	Roof Anchorage Nails/Screws Clips Hurricane Ties
Secondary Water Resistance	Secondary Water Resistance
No Secondary Water Resistance	No Secondary Water Resistance

The AIR study made use of the same 31 points used to define locations in the public domain study. The analysis showed that loss relativities did not vary significantly by location. The resulting AIR wind loss mitigation relativities are therefore presented as the mean of the relativities across all locations, and take into account locations in each of the wind speed and terrain exposure combinations implemented in the Florida Building Code.

(Reference Damage Rate—Mitigated Damage Rate)/Reference Damage Rate)*100

Table 72. Percent Changes in Damage from Different Mitigation Features

	Wood Frame Building					Reinforced Masonry Building				
Wind Speed (mph)	**60**	**85**	**110**	**135**	**160**	**60**	**85**	**110**	**135**	**160**
Roof Strength										
Braced Gable Ends	10.1	13.6	13.2	9.9	6.3	9.7	13.5	13.2	9.8	6.1
Hip Roof	14.0	17.5	16.7	12.8	9.0	13.4	17.2	16.5	13.1	8.8
Roof Covering										
Metal	-4.5	-2.6	-1.2	-0.5	-0.5	-4.3	-2.5	-1.1	-0.5	-0.5
ASTM D7158 Class H Shingles (150 Mph)	0.6	0.5	0.3	0.1	0.1	0.6	0.5	0.3	0.2	0.1
Membrane	0.0	7.6	8.2	0.0	0.0	0.0	8.1	8.4	0.0	0.0
Nailed Deck (8d)	12.8	22.8	24.2	17.8	10.2	12.3	22.2	23.7	18.1	10.0
Roof to Wall Strength										
Clips	1.7	5.1	10.7	11.6	7.6	1.7	5.4	10.8	11.8	7.4
Straps	2.2	6.5	13.1	14.1	9.8	2.2	6.7	13.2	14.5	9.6
Wall to Floor Strength										
Ties or Clips	0.0	0.4	0.6	2.6	7.0	0.0	0.4	0.5	2.6	6.8
Straps	0.0	0.8	2.2	6.1	12.7	0.0	0.9	2.1	6.1	12.3
Wall to Foundation Strength										
Larger Anchors or Closer Spacing	0.0	0.4	0.6	2.6	7.0	-	-	-	-	-
Straps	0.0	0.8	2.2	6.1	12.7	-	-	-	-	-

		Wood Frame Building					Reinforced Masonry Building				
Wind Speed (mph)		**60**	**85**	**110**	**135**	**160**	**60**	**85**	**110**	**135**	**160**
Vertical Reinforcing		-	-	-	-	-	0.0	1.1	2.2	6.9	15.0
Opening Protection											
Window Shutters	**Structural Wood Panel**	9.4	13.2	12.5	10.0	8.2	8.8	12.9	12.2	9.7	7.9
	Metal	9.4	13.2	12.5	10.0	8.2	8.8	12.9	12.2	9.7	7.9
Door and Skylight Covers		1.7	3.7	5.2	5.0	4.4	1.5	4.0	4.9	4.9	4.3
Window, Door, Skylight Strength											
Windows	**Impact Rated**	5.0	7.5	6.6	4.5	2.1	4.8	7.0	6.2	4.6	3.7
Entry Doors	**Meets Windborne Debris Requirements**	1.7	3.7	5.2	5.0	4.4	1.5	4.0	4.9	4.9	4.3
Garage Doors	**Meets Windborne Debris Requirements**	2.6	4.0	3.7	2.1	1.4	2.8	4.7	3.9	2.3	1.4
Sliding Glass Doors	**Meets Windborne Debris Requirements**	-0.3	-0.6	-0.8	-0.7	-0.6	-0.3	-0.7	-0.8	-0.7	-0.6
Skylight	**Impact rated**	1.7	1.8	1.6	1.0	0.6	1.5	2.0	1.5	1.0	0.6
All Mitigation Measures in Combination											
Mitigated Building		26.1	45.0	50.5	41.5	26.5	24.7	42.9	48.4	40.6	26.1

Appendix 10: Remapped ZIP Codes

Table 73. Remapped ZIP Codes

FCHLPM ZIP	Remapped ZIP
32004	32082
32006	32073
32007	32177
32026	32091
32030	32068
32035	32034
32041	32097
32042	32044
32050	32068
32056	32055
32067	32073
32072	32087
32079	32043
32085	32084
32099	32220
32105	32180
32111	34472
32115	32114
32116	32118
32120	32114
32121	32119
32123	32119
32126	32118
32133	32179
32135	32136
32138	32666
32147	32148
32157	32181
32158	32159
32160	32656
32170	32169
32173	32174
32175	32174
32178	32177
32182	32134
32183	32179
32185	32666
32192	32617
32201	32202
32203	32209
32215	32222
32228	32227
32229	32218
32231	32207
32232	32209
32235	32206
32236	32205
32238	32244
32239	32277
32240	32250
32241	32223
32245	32216
32247	32207
32255	32207
32260	32259
32302	32301
32313	32304
32314	32301
32315	32303
32316	32304
32318	32305
32323	32322
32326	32327
32329	32320
32330	32351
32337	32344
32341	32340
32345	32344
32353	32351
32357	32331
32360	32334
32361	32344
32362	32305
32402	32401
32406	32405
32410	32456
32411	32408
32412	32401
32417	32407
32422	32433
32432	32442
32434	32433
32447	32446
32452	32425
32457	32456
32461	32413
32463	32428
32512	32507
32513	32503
32516	32506
32520	32502
32521	32507
32522	32502
32524	32501
32530	32583
32537	32536

FCHLPM ZIP	Remapped ZIP
32538	32567
32540	32541
32549	32548
32559	32509
32560	32533
32562	32561
32572	32570
32588	32578
32591	32501
32602	32601
32604	32603
32610	32611
32612	32603
32614	32608
32616	32615
32627	32601
32633	32640
32634	32686
32635	32605
32639	34449
32644	32626
32654	32640
32655	32643
32658	32615
32662	32640
32663	32686
32664	32667
32681	32667
32683	34449
32692	32680
32697	32054
32704	32712
32706	32744
32710	32818
32715	32714
32716	32714
32718	32708
32719	32708

FCHLPM ZIP	Remapped ZIP
32721	32720
32722	32720
32723	32724
32727	32726
32728	32725
32733	32792
32739	32738
32747	32771
32753	32713
32756	32757
32762	32765
32768	32712
32772	32771
32774	32763
32775	32754
32777	32757
32781	32780
32783	32780
32790	32789
32791	32779
32793	32792
32794	32751
32795	32746
32802	32801
32853	32803
32854	32804
32855	32805
32856	32806
32857	32807
32858	32808
32859	32809
32860	32810
32861	32811
32867	32817
32869	32809
32872	32822
32877	32837
32878	32828

FCHLPM ZIP	Remapped ZIP
32887	32821
32891	32803
32896	32801
32897	32801
32902	32901
32906	32905
32910	32907
32912	32904
32923	32922
32932	32931
32936	32935
32941	32901
32954	32953
32956	32955
32957	32958
32959	32927
32961	32960
32964	32960
32965	32962
32969	32966
32970	32967
32978	32958
33001	33050
33002	33014
33008	33009
33017	33015
33022	33020
33041	33040
33045	33040
33051	33050
33061	33060
33072	33069
33075	33067
33077	33071
33081	33021
33082	33028
33083	33023
33084	33024

FCHLPM ZIP	Remapped ZIP
33090	33030
33097	33073
33101	33128
33102	33126
33111	33131
33112	33122
33114	33134
33116	33176
33119	33139
33124	33181
33151	33127
33152	33122
33163	33180
33164	33162
33188	33174
33197	33157
33206	33126
33231	33131
33233	33133
33245	33145
33256	33156
33257	33157
33261	33161
33265	33175
33266	33166
33269	33169
33280	33162
33283	33183
33302	33304
33303	33301
33310	33311
33318	33322
33320	33321
33329	33324
33335	33334
33337	33324
33338	33324
33339	33306

FCHLPM ZIP	Remapped ZIP
33345	33351
33346	33316
33355	33325
33394	33301
33402	33480
33416	33406
33419	33404
33420	33410
33421	33411
33422	33417
33424	33426
33425	33426
33427	33486
33429	33432
33443	33441
33448	33446
33454	33467
33459	33440
33464	33460
33465	33462
33466	33461
33468	33458
33474	33436
33475	33455
33481	33431
33482	33484
33488	33433
33497	33428
33503	33598
33508	33511
33509	33511
33521	34785
33524	33540
33526	33525
33530	33567
33537	33523
33539	33542
33550	33584

FCHLPM ZIP	Remapped ZIP
33564	33566
33568	33569
33571	33573
33574	33525
33583	33584
33586	33570
33587	33527
33593	33523
33595	33594
33601	33602
33608	33621
33622	33607
33623	33607
33631	33607
33655	33602
33660	33619
33661	33619
33664	33607
33672	33602
33674	33604
33675	33605
33677	33607
33679	33629
33681	33611
33682	33612
33685	33615
33686	33616
33687	33617
33688	33618
33689	33619
33694	33624
33730	33713
33731	33701
33733	33713
33736	33706
33738	33708
33740	33706
33742	33702

FCHLPM ZIP	Remapped ZIP
33743	33710
33744	33708
33747	33711
33758	33765
33766	33759
33769	33765
33775	33772
33779	33770
33780	33781
33784	33713
33802	33803
33804	33805
33806	33803
33807	33813
33820	33830
33826	33825
33831	33830
33835	33834
33836	33837
33840	33803
33845	33844
33846	33812
33847	33830
33848	34758
33851	33844
33854	33898
33855	33898
33856	33898
33858	33837
33862	33852
33863	33860
33867	33898
33871	33870
33877	33859
33882	33880
33883	33880
33885	33881
33888	33884

FCHLPM ZIP	Remapped ZIP
33902	33901
33906	33907
33910	33990
33915	33990
33918	33903
33927	33953
33929	33928
33930	33935
33932	33931
33944	33471
33945	33922
33949	33950
33951	33950
33965	33913
33970	33936
33975	33935
33994	33905
34101	34102
34106	34102
34107	34102
34133	34135
34136	34135
34137	34114
34143	34142
34146	34145
34204	34203
34206	34205
34216	34217
34218	34217
34220	34221
34230	34236
34250	34221
34264	34203
34265	34266
34267	34266
34268	34266
34270	34243
34272	34275

FCHLPM ZIP	Remapped ZIP
34274	34275
34276	34236
34277	34231
34278	34234
34280	34209
34281	34207
34282	34207
34284	34285
34290	34287
34295	34223
34421	34420
34423	34429
34430	34432
34445	34442
34447	34448
34451	34450
34460	34461
34464	34465
34477	34471
34478	34471
34483	34472
34487	34448
34489	34488
34492	34491
34603	34601
34605	34601
34611	34606
34636	34601
34656	34653
34660	34683
34661	34601
34674	34667
34679	34667
34680	34653
34682	34683
34692	34690
34697	34698
34712	34711

FCHLPM ZIP	Remapped ZIP
34713	34714
34729	34715
34740	34787
34742	34741
34745	34741
34749	34748
34755	34715
34770	34769
34777	34787
34778	34787
34789	34788
34948	34950
34954	34983
34958	34957
34973	34972
34979	34950
34985	34952
34991	34990
34992	34997
34995	34994

Appendix 11: List of Acronyms

AAL	Average Annual Loss
AIRPort	AIR intranet
ACV	Actual cash value
ALERT	AIR Loss Estimates in Real Time
AOML	Atlantic Oceanographic and Meteorological Laboratory
BCP	Business Continuity Plan
CCSG	AIR’s Consulting and Client Services Group
CRM	Customer relationship management
CP	Central pressure, generally in units of mb (millibars)
CRESTA	Catastrophe Risk Evaluation and Standardizing Target Accumulations
CSV	Comma Separated Value
DMG	AIR’s Data Management Group
DMZ	Demilitarized zone
DR	Disaster Recovery
EP	Exceedance probability
ERT	Emergency Response Team
ESDU	Engineering Sciences Data Unit
FBC	Florida Building Code
FCHLPM	Florida Commission on Hurricane Loss Projection Methodology
FHCF	Florida Hurricane Catastrophe Fund
FSA	Forward sortation area
FTP	File transfer protocol
GB	Gigabyte
GIS	Geographic information system
GWRF	Gradient Wind Reduction Factor
HIPAA	Health Insurance Portability and Accountability Act
HPC	High performance computing
HRD	Hurricane Research Division
HTML	HyperText Markup Language
HURDAT2	Revised Atlantic Hurricane Database
HURSIM	AIR’s research hurricane simulation code
HVHZ	High-Velocity Hurricane Zone

ID	Identification
IRM	Individual Risk Module
ISO	Insurance Services Office
ITV	Insurance to value
Kt	Knot (unit)
LAN	Local area network
LDU	Local delivery unit
LRFD	Load and Resistance Factor Design
LULC	Land Use Land Cover
METAR	A format for reporting weather information
Model 21	Another name for AIR Hurricane Model for the U.S.
MRLC	Multi-Resolution Land Characteristics
MSDN	Microsoft Developer Network
NCCI	National Council on Compensation Insurance
NLCD	National Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
OS	Operating system
PC	Personal computer
PDF	Portable Document Format
PIAF	Project Information and Assumptions Form
PM	Product Management
PML	Probable maximum loss
PWF	Peak Weighting Factor
QA	Quality assurance
RAF	Radial Adjustment Function
RAM	Random access memory
Rmax	Radius of maximum winds
RMT	Recovery Management Team
SDG	AIR's Software Development Group
SSH	Secure Shell
SQL	Structured Query Language
SST	Sea surface temperature
TB	Terabyte
TFS	Team Foundation Server
UI	User interface

USPS	United States Postal Service
VB	Visual Basic
VC	Visual C++
Vmax	Maximum sustained surface wind speed
VPN	Virtual private network
VSS	Visual SourceSafe
WBDR	Wind-borne Debris Region
ZIP	Zone Improvement Plan

About AIR Worldwide

AIR Worldwide (AIR) provides catastrophe risk modeling solutions that make individuals, businesses, and society more resilient. AIR founded the catastrophe modeling industry in 1987, and today models the risk from natural catastrophes, terrorism, and pandemics globally. Insurance, reinsurance, financial, corporate, and government clients rely on AIR's advanced science, software, and consulting services for catastrophe risk management, insurance-linked securities, site-specific engineering analyses, and agricultural risk management. AIR Worldwide, a Verisk Analytics (Nasdaq:VRSK) business, is headquartered in Boston with additional offices in North America, Europe, and Asia. For more information, please visit www.air-worldwide.com.