North Atlantic Hurricane Models

RiskLink 17.0 (Build 1825)

April 12, 2017

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

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Chair, Florida Commission on Hurricane Loss Projection Methodology
State Board of Administration
1801 Hermitage Boulevard, Suite 100
Tallahassee, FL 32308

Re: Certification of the RMS North Atlantic Hurricane Models, RiskLink® 17.0 (Build 1825)

Dear Chair:

We are pleased to offer for your review the documentation, data, and exhibits supporting our request for certification of the above-referenced model.

Professionals having credentials and/or experience in the areas of meteorology, engineering, actuarial science, statistics, and computer/information science have reviewed RiskLink 17.0 (Build 1825); with model settings as specified in the FCHLPM Certified Hurricane Losses DLM profile for compliance with the Commission's 2015 standards. As shown in the enclosed Expert Certification Forms (G-1 to G-7), these persons have, in accordance with their professional standards and code of ethical conduct, certified that the model meets or exceeds the 2015 Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology, and the model is ready to be reviewed by the professional team.

Enclosed with this letter please find all the required documentation as outlined in the attached model submission checklist.

Please do not hesitate to contact me if there are any questions. We thank you for your consideration.

Sincerely,

Michael Young
Senior Director
Model Product Management

Enc

MODEL SUBMISSION CHECKLIST

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

Yes	***No***	***Item***
✓		*1. 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*
✓		*2. Summary statement of compliance with each individual standard and the data and analyses required in the disclosures and forms*
✓		*3. General description of any trade secret information the modeling organization intends to present to the Professional Team and the Commission*
✓		*4. Model Identification*
✓		*5. Seven Bound Copies (duplexed)*
✓		*6. 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*
✓		*7. All hyperlinks to the locations of forms are functional*
✓		*8. Table of Contents*
✓		*9. 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*
✓		*10. All tables, graphs, and other non-text items consecutively numbered using whole numbers, listed in Table of Contents, and clearly labeled with abbreviations defined*
✓		*11. All column headings shown and repeated at the top of every subsequent page for forms and tables*
✓		*12. Standards, disclosures, and forms in italics, modeling organization responses in non-italics*
✓		*13. All graphs and maps conform to guidelines in **II. Notification Requirements A.5e**.*
✓		*14. All units of measurement clearly identified with appropriate units used*
✓		*15. 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)*
✓		*16. Hard copy documentation identical to electronic version*
✓		*17. Signed Expert Certification Forms G-1 to G-7*
✓		*18. All acronyms listed and defined in submission appendix*

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

RMS has submitted Form S-6 with the RiskLink 11.0.SP2c submission, in compliance with the 2009 Standards.

North Atlantic Hurricane Models in RiskLink 17.0 (Build 1825)		October 31, 2016
Model Name and Identification	*Modeler Signature*	*Date*

SUPPLEMENTAL INFORMATION (CHECKLIST ITEM 3)

Information that has been requested regarding the disclosure of trade secret information to the Commission and professional team are described below:

- Trade secret information that RMS will make available to the professional team for review during their upcoming visit has been noted at various points throughout the submission document.

MODEL IDENTIFICATION

***Name of Model*:** North Atlantic Hurricane Models

***Model Version Identification*:** RiskLink 17.0 (Build 1825)

Interim Model Update Version Identification: N/A

***Model Platform Name and Identifications*:** N/A

***Interim Data Update Designation*:** N/A

***Name of Modeling Organization*:** Risk Management Solutions, Inc.

***Street Address*:** 7575 Gateway Boulevard

***City, State, ZIP Code*:** Newark, CA 94560

***Mailing Address, if different from above*:** Same as above

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Phone Number*:** 850-386-5292 ***Fax Number: N/A

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***Date*:** April 2017

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GENERAL STANDARDS

G-1 Scope of the Model and Its Implementation

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

The RMS North Atlantic Hurricane Models project loss costs and probable maximum loss levels from hurricanes for residential property for the following coverages, as appropriate to the type and composition of the policy form in question: primary structures, appurtenant structures, contents, and additional living expenses. Output from the model can explicitly and separately define expected losses for each of these coverages.

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.***

RMS uses a variety of systems to track and maintain documentation, data, and computer source code. These systems include the use of source control software, bug tracking systems, and internal documentation standards and protocols.

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.***

RMS stores all software, model, validation, and form creation data in centralized systems. These systems comply with the Computer/Information Standards included in the Report of Activities.

G-1.1 ***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 any 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 model being submitted for rate filing in Florida is the
North Atlantic Hurricane Models in
RiskLink 17.0 (Build 1825).

RMS is not submitting the model on any other platform at this time.

G-1.2 ***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.***

The North Atlantic Hurricane Models consist of four major model components, or modules:

- Stochastic Module
- Wind Field (or Wind Hazard) Module
- Vulnerability or Damage Assessment Module

- Financial Loss Module

Descriptions of each of the modules follow.

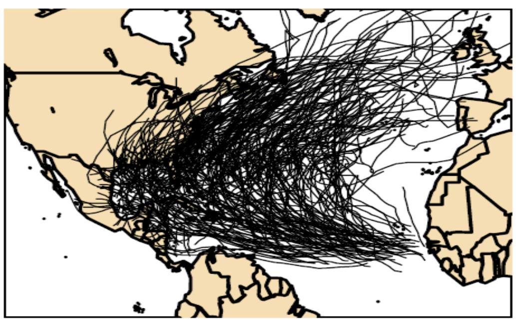
Stochastic Module

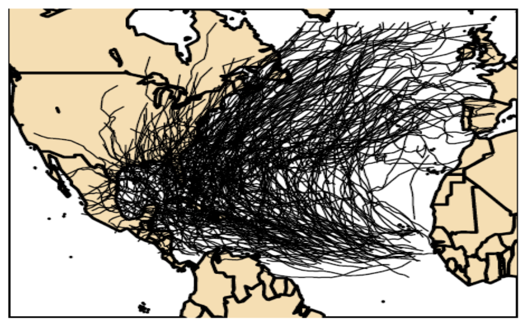
The stochastic module is made of a set of thousands of stochastic events that represents more than 100,000 years of hurricane activity. RMS scientists have used state-of-the-art modeling technologies to develop a stochastic event set made of events that are physically realistic and span the range of all possible storms that could occur in the coming years.

At the heart of the stochastic module is a statistical track model that relies on advanced statistical techniques (Hall & Jewson 2007a, 2007b) to extrapolate the HURDAT catalog (Jarvinen et al., 1984) and generate a set of stochastic tracks having similar statistical characteristics to the HURDAT historical tracks (see example in Figure 1). Stochastic tracks are simulated from genesis (starting point) to lysis (last point) using a semi-parametric statistical track model that is based upon historical data. Simulated hurricane tracks provide the key drivers of risk, including landfall intensity, landfall frequency and landfall correlation.

Figure 1: Comparison of Observations from 58 Years of HURDAT Tracks (1950–2007), to One "58-Year" Model Realization of the RMS Statistical Track Model

(a) Observed **(b) Modeled**





Track genesis location is sampled from a spatial Poisson process. The intensity field is derived from historical genesis locations, weighed according to their distance from site. The length scale involved in the smoothing process is optimized through cross validation to avoid both over fitting and unrealistic genesis points. Once the location of the first track point has been simulated, the central pressure (used as a measure of storm intensity) is sampled from the observed distribution of genesis central pressure. Then the track is simulated forward in time with a 6-hour increment, Δt, using the following equations (Hall & Jewson 2007a, 2007b):

$$x(t+\Delta t) = x(t) + u(t)\Delta t$$
$$y(t+\Delta t) = y(t) + v(t)\Delta t$$
$$p_c(t+\Delta t) = p_c(t) + \frac{\Delta p_c}{\Delta t}\Delta t$$

where u and v are the zonal and meridional components of the translational speed derived by running a weighted average of the historical records. The Δp_c variable is the 6-hourly change in central pressure. When the storm center is located over water, the model for Δp_c is a local linear regression with predictors that include the previous change in central pressure and the zonal and meridional components of the translational speed. When the storm center is located over land, Δp_c is computed using the filling rate associated with the landfall of interest (Colette et al., 2010). At each time step, central pressure is constrained to fall within the local Maximal Potential Intensity (Emanuel 1986) (when over water) and the local far field pressure.

RMS scientists have also used the best elements of numerical modeling in an effort to complement the historical records in areas where historical data is sparse. Because historical landfall details are generally poorly known, RMS has used a bogusing technique (Kurihara et al., 1993) to generate thousands of synthetic storms which inform the inland filling model (Colette et al., 2010), even though the model has been thoroughly tested and validated against the limited historical records.

Eventually, tracks are killed by sampling a logistic regression model at each time step. The model has various predictors including the difference between far field pressure and central pressure, making storms more likely to vanish when this difference is small.

Although central pressure is the main intensity variable in the model, RMS also derives a maximum wind time series (Vmax) that is similar to the HURDAT Vmax time series when the storm is over water but different when the storm is over land as our modeled time series provides equivalent over water Vmax. The Vmax model is a log-linear regression with pressure difference, and latitude as predictors. Note that only over water HURDAT points are used to fit the regression.

The last step is a calibration process ensuring that simulated landfall frequencies are in agreement with the historical record. Target landfall rates are computed on a set of 69 linear coastal segments by smoothing the historical landfall rates. This smoothing technique is widely used in the scientific community to reduce the local under-sampling or over-sampling issues associated with the limited historical records (115 years). The stochastic set is then adjusted toward these targets using methods such as selecting the optimum intensity time series among several candidates.

Importance sampling of the simulated tracks is performed to create the computationally efficient event set used for loss cost determinations. The hurricane model contains 20,239 stochastic events affecting Florida.

Wind Field (or Wind Hazard) Module

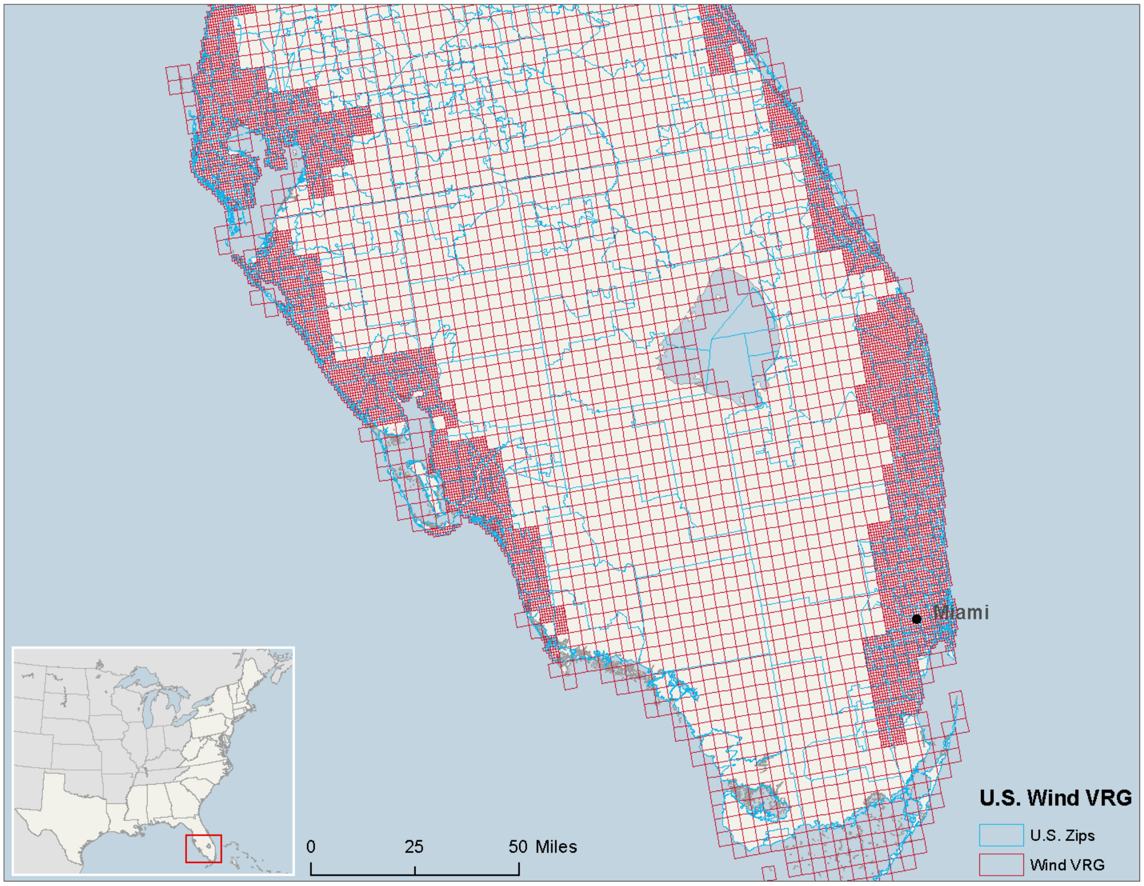
Once tracks and intensities have been simulated by the stochastic module, the wind field module simulates 10 meter 3-second gusts on a variable resolution grid (VRG) to be saved in the stochastic hazard database.

There are four parts of the wind field module:

- Variable resolution grid—Geographic framework used to store high resolution hazard information.
- Assign wind field parameters—Parameters, associated with the size and shape of the wind field, are generated for each track point along each stochastic event. For each track (and every 5 minutes) 10 meter, 1-minute mean winds equivalent over water are computed on the variable resolution grid.
- Downscale and convert wind speeds—Downscale and apply directional roughness and gust coefficients to generate 10 meter, 3-second gust wind speeds over local terrain.
- Maximum peak gust—Determine final hazard footprint from maximum gusts simulated at each site over the entire lifecycle of the storm.

Variable resolution grid: Terrain, coastline, and hurricane hazard can often vary dramatically across an individual ZIP Code. To capture this detail, RMS stores hazard data in a patented standard high-resolution grid, called a variable resolution grid (Carttar, 2012). VRG grid cell sizes are established such that the smallest cells occur where the hazard gradient is highest and/or high densities of exposure exist. Like U.S. ZIP Codes and counties, the VRG constitutes a set of geographic boundaries that can be used to store hazard information. Figure 2 compares the VRG for stochastic data in the North Atlantic Hurricane Models (shown in red) with ZIP Codes (in blue). While relative size of both is similar—with ZIP Codes also varying in size with population density—the VRG resolution is always finer than the ZIP Code.

Figure 2: Examples of Stochastic VRG (red boundaries) and ZIP Codes (blue boundaries) in South Florida



Wind field parameters: Size and shape of the time stepping wind fields are generated using an analytical wind profile derived from Willoughby et al. (2006), with parameters fitted from the extended best track dataset (Demuth et al., 2006) and the RMS HWind product (Powell et al., 2010).

At any given point in time and space, the 1-minute mean wind (equivalent over water) is entirely prescribed by the position from the storm center and the following set of parameters: maximum wind (Vmax), radius to maximum wind (Rmax), two shape parameters giving the radial profile inside and outside the eyewall, the angle between the location of the maximum winds and the track, and four additional parameters (empirical orthogonal functions, or EOFs) that reduce the variance between observed and modeled wind fields.

Rmax time series are given by a regression model with central pressure and latitude as predictors. The Rmax model is fitted on observations available in the extended best track dataset. RMS has filtered out years with missing Rmax values set to climatology.

All other wind field parameters have been fitted to the RMS HWind dataset, and additional validation has been performed using the extended best track dataset, especially for the radius of hurricane force winds. The RMS HWind database has been filtered to keep only snapshots with damaging winds. For each of the remaining 629 snapshots, the best values of the wind field parameters have been fitted, applying a high weight around the location of the maximum wind. These best fit values are then used as a training dataset to build linear regression models.

Downscale and convert wind speed: The simulated 1-minute mean wind (equivalent over water) at a site is then downscaled to account for local and upstream roughness conditions. This captures the transition from sea to land or any change in upstream roughness. The model formulation is based on a peer reviewed wind engineering model (Cook 1985, 1997) and roughness lengths are derived from the 15–30 m resolution ASTER satellite imagery (Advanced Spaceborne Thermal Emission and Reflection Radiometer, http://asterweb.jpl.nasa.gov) with a 2007–2014 vintage. An additional component of the roughness model converts mean winds over local terrain to 3-second gusts over local terrain (Deaves and Harris 1978; Harris and Deaves 1980; Deaves 1981; Cook 1985; Cook 1997; Wieringa 1993 and 2001; Vickery and Skerlj 2005).

The wind field model has been validated through the reconstruction of all damaging storms in the HURDAT database. The model is able to reproduce accurately hourly gust observations for a large range of wind stations (including coastal and inland stations). When considering Hurricane Andrew 1992 and all the major post 2004 U.S. landfalling hurricanes, the root mean squared error between observed and modeled hourly gusts is approximately 10 mph which is acceptable given the uncertainty associated with hurricane force wind observations.

Maximum peak gust footprints: The output from the wind field module is the hazard database that is made of the stochastic footprints. Each footprint contains the maximum damaging 3-second gust wind speed to affect each of the variable resolution grid cells. This information is pre-compiled for efficient access at run-time for loss calculation in the subsequent modules.

Vulnerability or Damage Assessment Module

Given an event, the model estimates the wind and surge (optional) hazards present at a user-specified site. Local wind and surge hazards are measured in terms of peak-gust wind speed and flood depth, respectively. These parameters are then used to derive the estimate of damage to a specific location. Estimated damage is measured in terms of a mean damage ratio (MDR) and a deviation around the mean represented by the coefficient of variation (CV). The MDR is defined as the ratio of the repair cost divided by replacement cost of the asset. The curve that relates the MDR to the peak gust wind speed is called a vulnerability function. RMS has developed vulnerability functions for hundreds of building classifications per vulnerability region. Each classification has a vulnerability function for damage to buildings due to wind and a vulnerability function for damage to building contents due to wind, as well as similar vulnerability functions for surge damage. Time element vulnerability functions (also known as additional living expenses [ALE] or business interruption [BI] vulnerability functions) are based upon the building damage function and the occupancy of the structure.

The vulnerability classes depend on a combination of:

- Construction Class
- Building Height (number of stories)
- Building Occupancy
- Year Built
- Floor Area (single-family residential and low-rise commercial only)
- Region of State (vulnerability region)

The possible classifications for each of the six primary characteristics are described in Disclosure V-1.6.

The vulnerability functions consist of a matrix of wind speed levels (measured as peak gust in mph) and corresponding MDRs. To calculate a MDR for a given location, RiskLink first determines an expected wind speed, and then looks up the corresponding MDRs for building and contents based on the building classification. RMS has also developed CVs associated with each MDR. The CV is used to develop a probability distribution for the damage at each wind speed and for each classification. A beta distribution is used for this purpose.

The vulnerability relationships are developed using structural and wind engineering principles underlying the RMS component vulnerability model (CVM) (Khanduri, 2003) coupled with analysis of historical storm loss data, building codes, published studies, and RMS internal engineering developments in consultation with wind engineering experts including the late Dr. Dale Perry and Dr. Norris Stubbs of Texas A&M University. The CVM allows objective modeling of the vulnerability functions, especially at higher wind speed ranges where little historical loss data is available. The CVM is also used to obtain the vulnerability relativities by building class and gain insight into the effects of hurricane mitigation. These approaches also build on the earlier input received from Dr. Peter Sparks of Clemson University, and the late Dr. Alan Davenport of the University of Western Ontario.

The engineering model based on the CVM is calibrated using historical claims data at ZIP Code resolution for building, contents, and time element coverages. The calibration process involves a comparison of modeled MDR with that obtained from observed losses. Since the vulnerability model is a function of the wind speed, the calibration involves varying both wind speed and vulnerability within the bounds established by i) the science and historical observations governing the hazard at a given location and ii) the engineering and historical observations governing the damageability of property at that location. Thus, one primary goal of calibration is to ensure that the vulnerability function is confined within the high and low vulnerability bounds as established by the CVM.

RMS also uses published documents, expert opinion, and conventional structural engineering analysis. RMS has reviewed research and data contained in numerous technical reports, special publications, and books related to wind engineering and damage to structures due to wind. References are provided in Disclosure G-1.4.

The RMS engineering staff includes several engineers with PhD qualifications in civil and structural engineering. These engineers have significant experience and expertise in the understanding of building performance and structural vulnerability, and are dedicated to the development of vulnerability relationships for risk models worldwide. RMS engineers have participated in several reconnaissance missions as described in Disclosure V-1.5.

The knowledge and data gathered during these site visits has been used in the calibration and validation of vulnerability functions. The final calibration of the vulnerability functions has been made using over $11 billion of loss data, with corresponding exposure information.

The vulnerability of buildings modeled by each of the building classes represents the "average" vulnerability of a portfolio of buildings in that class. The vulnerability will vary depending upon specific characteristics of buildings in that portfolio. This variation can be addressed in the model through the use of secondary modifiers that can consider secondary building characteristics or mitigation measures to improve a building's wind resistance. The secondary modifiers could be building-characteristic specific (e.g., improved roof sheathing or anchors) or external (e.g., storm shutters). These secondary modifiers modify the base, "average" vulnerability functions according to specific building characteristics or mitigation measures. The secondary modifiers are discussed in Standard V-3.

Financial Loss Module

To calculate losses, the damage ratio for each stochastic event derived in the vulnerability module is translated into dollar loss by multiplying the damage ratio (including loss amplification as appropriate) by the value of the property. This is done for each coverage at each location. Using the mean and coefficient of variation, a beta distribution is fit to represent the loss distribution. From the loss distribution one can find the expected loss and the loss corresponding to a selected quantile.

RiskLink uses the loss distribution to estimate the portion of loss carried by each participant within a financial structure (insured, insurer, re-insurer). This distribution is used to calculate the loss net of any deductibles and limits.

Demand surge impacts on estimated losses are incorporated in the post-event loss amplification (PLA) component of the North Atlantic Hurricane Models. This component estimates the degree to which losses are escalated by a combination of economic, social and operational conditions that follow after a given event. The PLA component accounts for three separate mechanisms of escalation arising from:

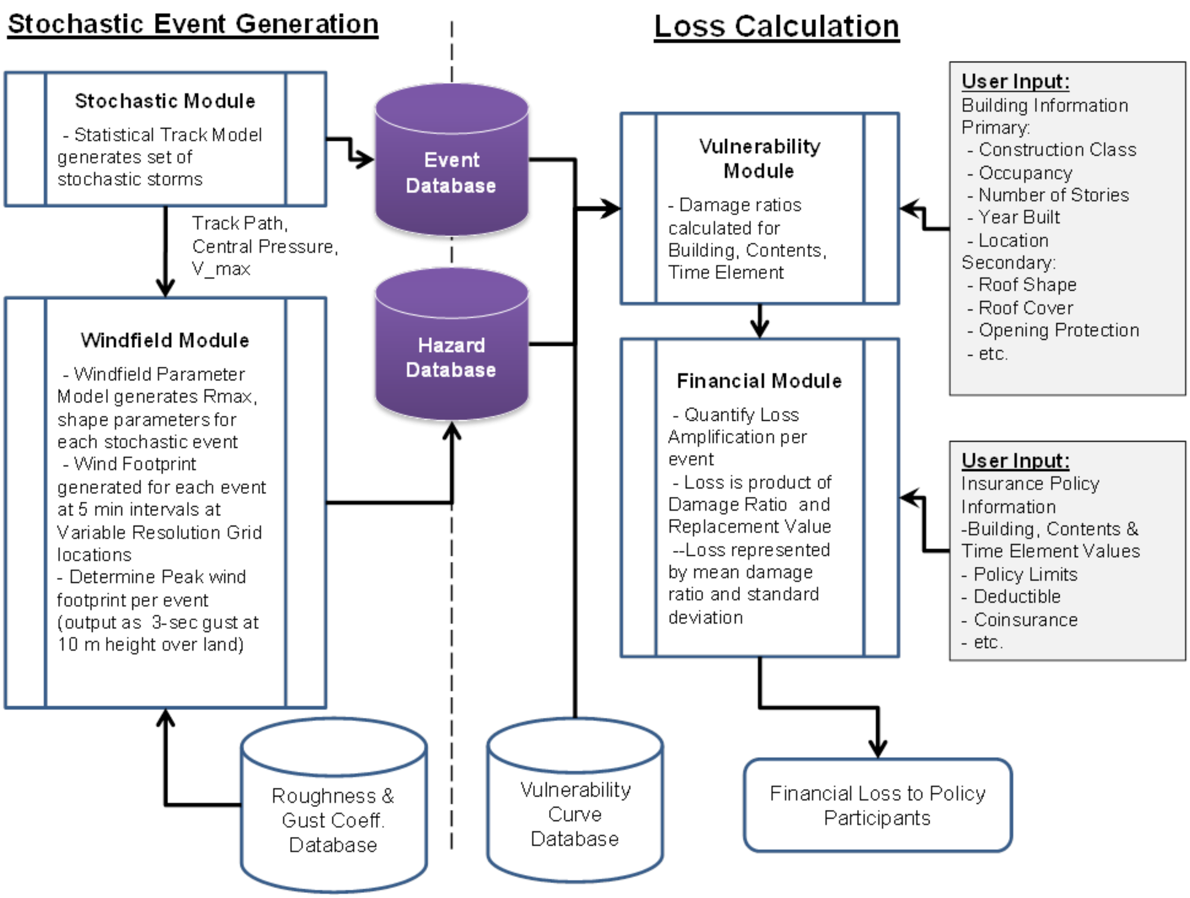
- Economic Demand Surge (EDS)—increase in the costs of building materials and labor costs as demand exceeds supply
- Claims Inflation (CI)—cost inflation due to the difficulties in fully adjusting claims following a catastrophic event
- Super Catastrophe Scenarios—coverage and loss expansion due to a complex collection of factors such as containment failures, evacuation effects, and systemic economic downturns in selected urban areas

These loss amplification factors are developed for each stochastic event in the model by coverage and applied to the damage ratio on a ground up basis.

G-1.3 Provide a flowchart that illustrates interactions among major model components.

The high-level flow chart is shown in Figure 3.

Figure 3: Flow Diagram of Major Model Components



G-1.4 Provide a comprehensive list of complete references pertinent to the model by standard grouping using professional citation standards.

Meteorological Standards References

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Robertson, J.P. (1992). *The Computation of Aggregate Loss Distributions*. Proceedings of the Casualty Actuarial Society, Vol. LXXIX.

G-1.5 Provide the following information related to changes in the model from the previously accepted submission to the initial model this year.

G-1.5.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.***

The following significant changes have been revised in the model relative to the previously submitted version:

Geocoding Module: Updates to the geocoding module have been incorporated. There are three components to the update:

- December 2015 postal code vintage data has been incorporated as per our policy to update geocoding data at least every 24 months.
- Integration of U.S. Postal Service (USPS) street information to supplement existing street geocoding files, leading to more accurate and confident street matching.
- Revision of methodology to assign primary county to ZIP Codes, based on residential census data.

Hazard Module Changes: There are three changes related to the hazard component.

- Stochastic Module—The rates associated with the stochastic event set have been revised based on updated data from the September 2015 version of the HURDAT2 dataset.
- Historical Footprint Recreations—The version of the HURDAT2 database published as of September 2015 includes re-analysis of years 1946–1955. RMS has revised the historical footprint recreations of 12 events in the model accordingly.
- Surface Roughness Data Update—New areas of urban growth have been incorporated into the surface roughness factors of the wind fields using more current satellite imagery to comply with Standard M-4.B.

Vulnerability Module Changes: Updates to the vulnerability module have been incorporated.

- Improvement of mobile/manufactured home vulnerability modeling and inventory distributions, including consideration of U.S. Housing and Urban Development (HUD) zone and a new year band for post-2008 structures, supported by installation standard changes, recent IBHS research, and claims data analyses.
- Recalibration of multi-family dwelling (MFD) vulnerability, including updates to condominium (association and unit owner) lines and inventory distributions, reflecting MFD component research, regional variation, and claims data analyses.
- Introduction of unique damage curves for unreinforced masonry (URM) and reinforced masonry (RM) construction classes, based on recent IBHS research highlighting the differences in vulnerability between these construction types.
- Activation of the construction quality secondary characteristic for mobile/manufactured homes, enabling the ability to model enhancements to tie down systems or signs of structural deterioration.
- New values for secondary characteristics, including roof covering, roof equipment hurricane bracing, photovoltaic solar panels, wall cladding type, and screen enclosures, to reflect RMS research on the impact of specific building attributes on wind vulnerability.

Other changes made to benefit users of RMS software that do not affect personal and commercial residential losses in Florida include:

- In the North Atlantic Hurricane Models
  - New floor area bands for low-rise commercial buildings
  - Updates to time element vulnerability for temporary lodging and general commercial buildings
  - Updates to non-residential vulnerability, such as automobiles and aircraft
  - Updates to medium-term rate forecast (not used in FCHLPM certified analysis profiles)
  - Updates to wind and storm surge vulnerability in Hawaii
  - Updates to wind vulnerability in Caribbean, Mexico, and Central America regions
  - Updates to RMS industry exposure databases (IEDs) and industry loss curves (ILCs) in the United States and the Caribbean
- Updates to RMS RiskAssessor Application
- Updates to RMS North America Earthquake Model
- Updates to RMS Marine Cargo Model
- Updates to RMS Southeast Asia Earthquake Models
- Introduction of South Korea and Taiwan typhoon models

G-1.5.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

RMS has compiled the percentage difference in average annual zero deductible statewide loss costs relative to RiskLink 15.0 (Build 1625) using the 2012 FHCF data. Overall, RiskLink 17.0 (Build 1825) is 1.5 lower than the previous submission.

2. Each individual model component change.

The contribution of significant model components is shown in Table 1. The changes are calculated progressively so that the changes to the hazard module are calculated after incorporating the updated geocoding. The percentage differences are calculated in an additive format, such that the total change is equal to the sum of the changes for each significant component change.

Table 1: Percentage Difference by Module

Statewide Percentage Difference	Component Module		
	Geocoding	Hazard	Vulnerability
-1.5%	0.0%	-1.0%	-0.6%

G-1.5.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.

Maps of the changes by significant component at a county resolution are shown in Figure 4 to Figure 6. Note that the scale in each map has been held constant to facilitate comparisons between components.

Figure 4: Percentage Change in Average Annual Loss with Zero Deductible by County due to Geocoding Changes

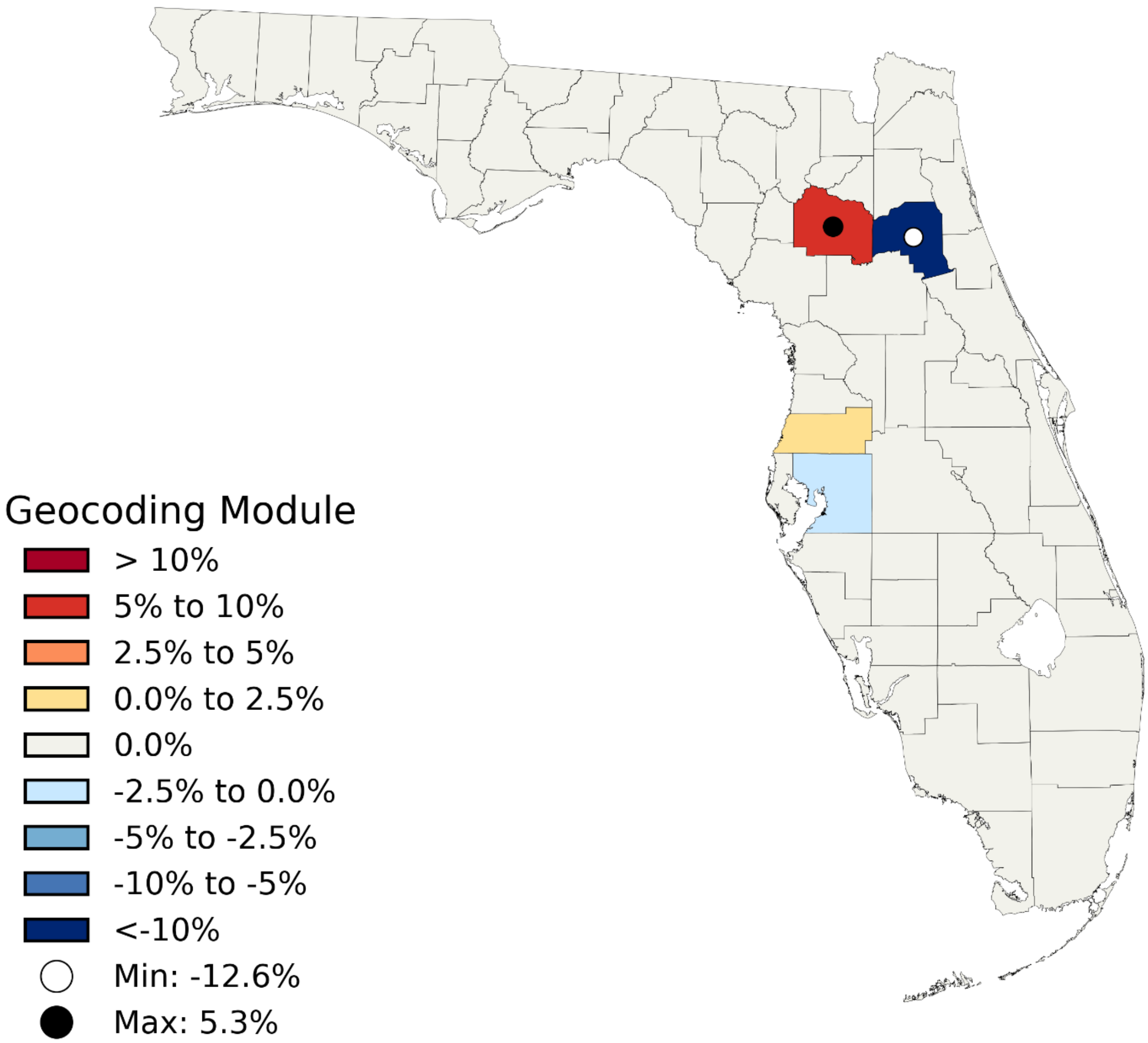


Figure 5: Percentage Change in Average Annual Loss with Zero Deductible by County due to Hazard Module Changes

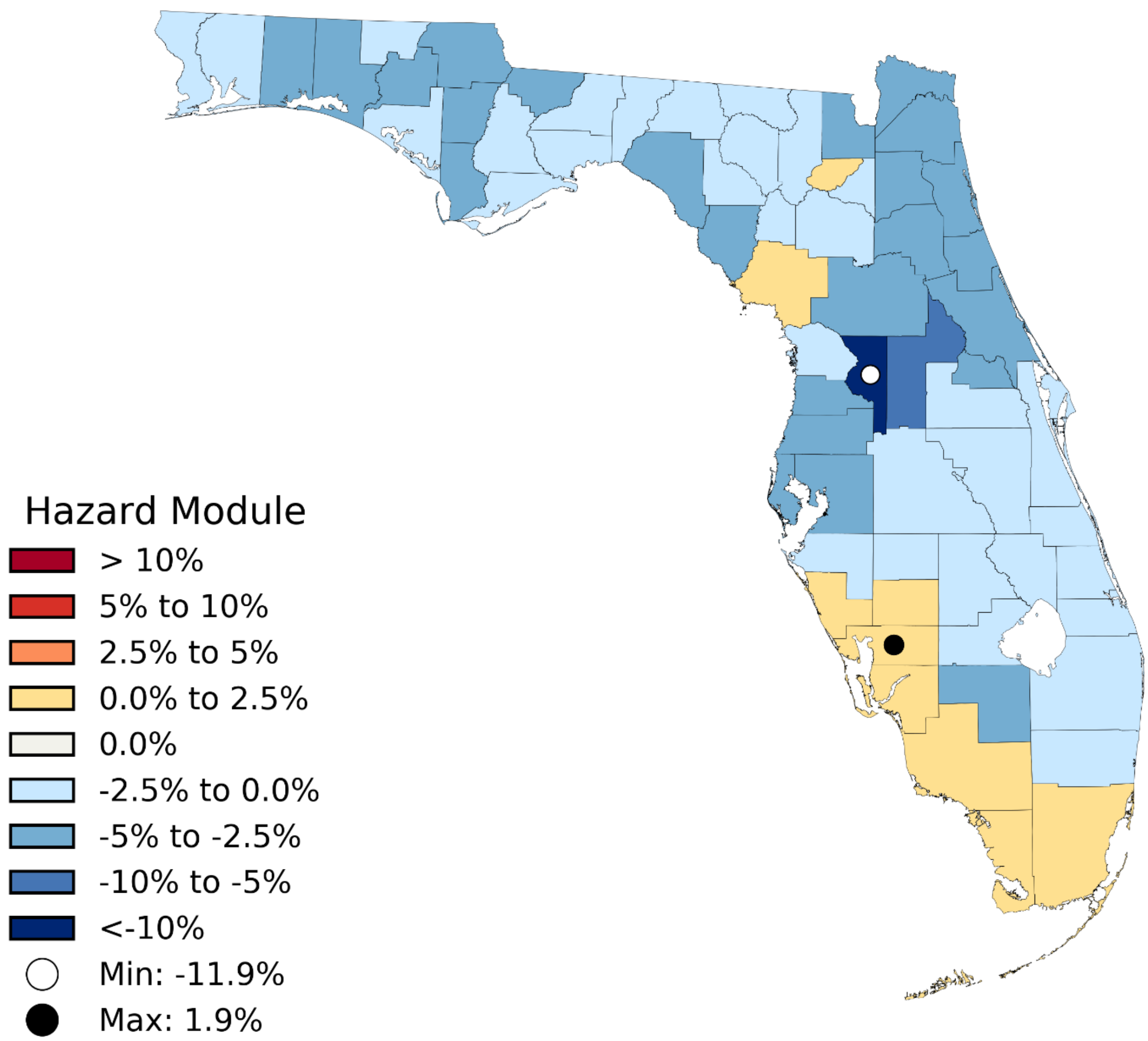
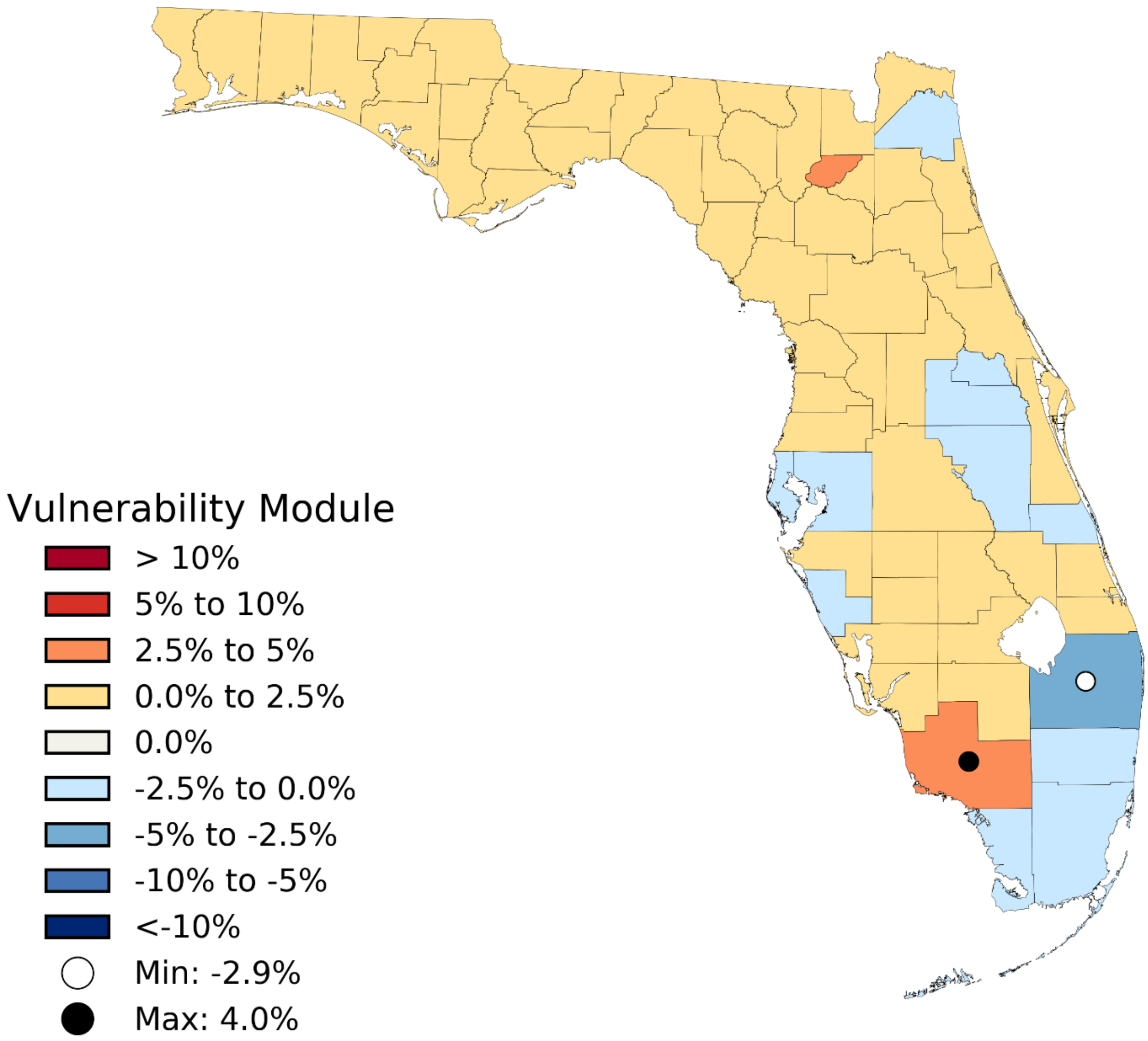


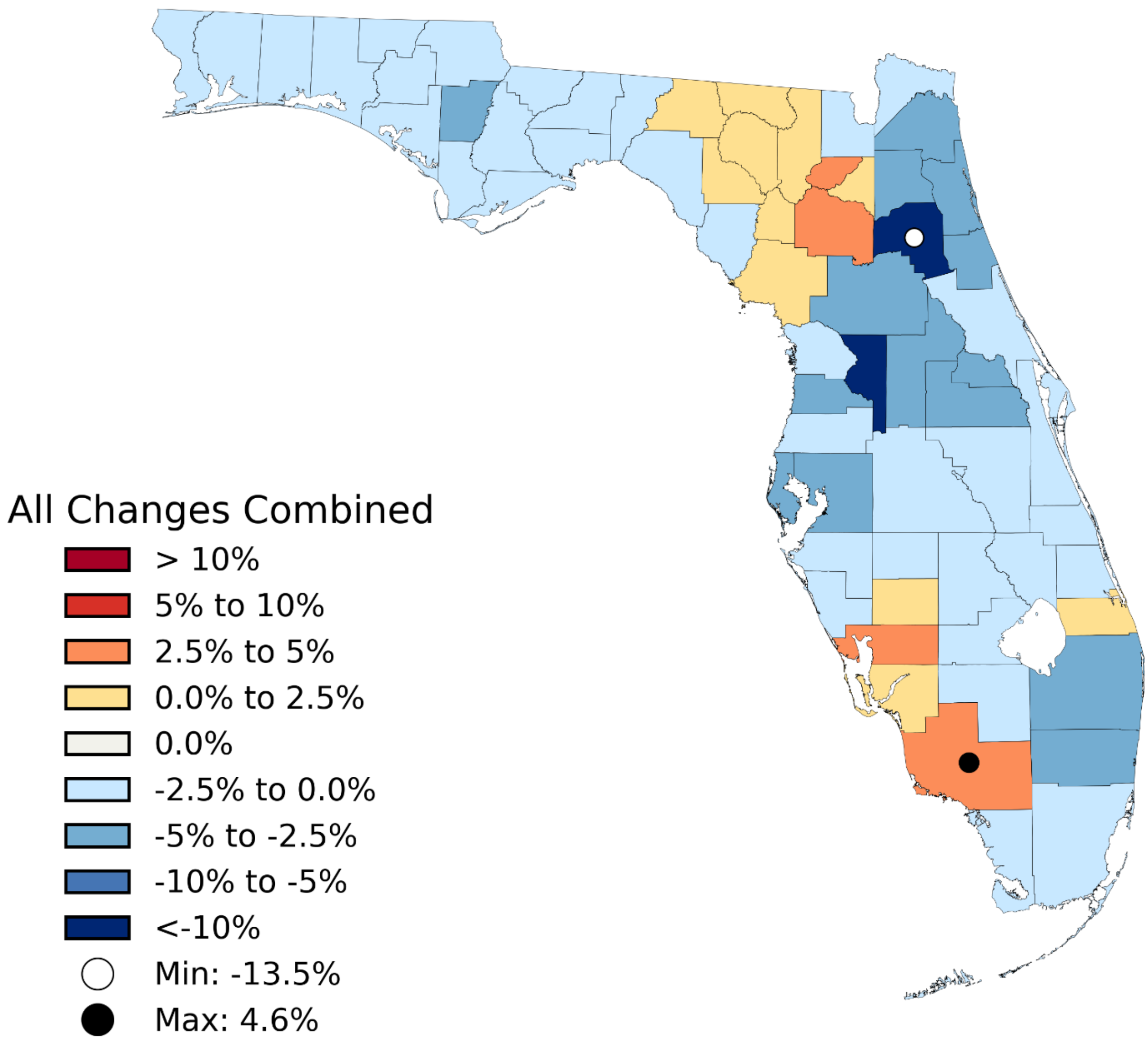
Figure 6: Percentage Change in Average Annual Loss with Zero Deductible by County due to Vulnerability Module Changes



G-1.5.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.

A map of the changes for all components combined is shown in Figure 7. Note that the scale of the map is the same as Figure 4 to Figure 6 to facilitate comparisons between components.

Figure 7: Percentage Change in Average Annual Loss with Zero Deductible by County due to All Changes Combined



G-1.6. 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.

RMS may, in the near future, decide to update the following data:

- Vintage of Geocoding data to new version, plus any associated geocoding software updates to support new geocoding data.

RMS will not be making any updates to this component while the current submission is being reviewed.

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.

Overall, RMS employs over 250 experts in hazard research, actuarial science, engineering, and software development who participate in various areas of model development (not all on the North Atlantic Hurricane Models). The team possesses a wide range of multi-disciplinary skills in engineering, the physical sciences, actuarial science, statistics data development, data analysis and numerical modeling, computer science/engineering, and quality assurance engineering. Of the model development staff, about 95% hold advanced degrees and over 50 possess PhD level qualifications in their fields of expertise. One-third of RMS total staff is focused solely on research, development, and innovation. These individuals possess the necessary skills, formal education, and experience, in all required disciplines, to develop hurricane loss projection methodologies.

B. The model and model submission documentation shall be reviewed by 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.

The education and experience of RMS staff and consultants reflect all of the professional disciplines listed above and are outlined in Disclosure G-2.2.A. Qualified modeling personnel and/or independent experts review all model modifications. These individuals abide by the standards of professional conduct adopted by their profession.

G-2.1 Organization Background

G-2.1.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.

Risk Management Solutions, Inc. (RMS) is a wholly owned subsidiary of DMG Information, Inc., part of the Daily Mail and General Trust plc, a U.K. Corporation.

G-2.1.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 North Atlantic Hurricane Models were developed only by employees of RMS and its consultants.

G-2.1.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 North Atlantic Hurricane Models were developed only by employees of RMS and its consultants.

G-2.1.D ***Describe any services other than hurricane modeling provided by the modeling organization.***

RMS provides products and services for the quantification and management of catastrophe risks. The company's natural hazard risk modeling solutions are used by over 400 insurers, reinsurers, trading companies, and other financial institutions worldwide. RMS receives revenues from software licenses, analytical reports, consulting services, and miscellaneous other services.

G-2.1.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.***

RMS has interacted with several departments of insurance (DOIs such as FL, HI, and LA) in the context of hurricane rate making. None of these relationships have been adversarial.

In 2005 and 2007, the Massachusetts Department of Insurance initiated reviews of rate filings for the Massachusetts Property Insurance Underwriting Association (MPIUA). Hearings on the MPIUA's proposed rates covered a variety of issues related to rate setting, including the catastrophe models used to estimate potential insured losses from hurricanes impacting Massachusetts. The MPIUA was asked to demonstrate that the RMS general U.S. Hurricane Model (version 6.0) was appropriate for developing rates in Massachusetts. The decision on the 2005 filing concluded that it was reasonable for the MPIUA to use the RMS model. The decision on the 2007 filing concluded that the MPIUA did not demonstrate that the RMS model was appropriately calibrated to Massachusetts.

G-2.2 Professional Credentials

G-2.2.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 highest degree obtained, employment or consultant status, and tenure is provided in the following tables. The relevant experience of these individuals is contained in the brief biographies provided in Appendix B.

Table 2: Individuals Involved in Meteorological Aspects of the Model

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Dr. Cathy Ansell	PhD, Atmospheric Physics Imperial College, London	S	2
Dr. Enrica Bellone	PhD, Statistics University of Washington	S	11

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Dr. Auguste Boissonnade	PhD, Civil Engineering Stanford University	S	21
Dr. Sagar Bora	PhD, Physics University of Bremen	S	3
Dr. Mark Dixon	PhD, Physics University of Warwick	S	6
Dr. Michael Drayton	PhD, Applied Mathematics Cambridge University	S/C	8/13
Dr. David Gatey	PhD, Wind Engineering and Environmental Fluid Mechanics University of Western Ontario	S	5
Dr. Shree Khare	PhD, Program in Atmospheric and Oceanic Sciences Princeton University	S	10
Dr. Timothy Hall	PhD, Physics Cornell University	C	N.A.[1]
Dr. Jara Imbers	PhD, Theoretical Physics University of Nottingham, UK	S	4
Ms. Sarah Hartley	MSc, Applied Meteorology University of Reading	S	3
Dr. Jo Kaczmarska	PhD, Statistical Science, University College London	S	3
Dr. Nicolas Joss Matthewman	PhD, Applied Mathematics University College London (UCL)	S	5
Dr. Robert Muir-Wood	PhD, Earth Sciences Cambridge University	S	20
Mr. Edida Rajesh	MS, Technology (Geophysics) Andhra University	S	20
Ms. Christina Robertson	MSc, Atmosphere Ocean and Climate University of Reading	S	7
Dr. Emilie Scherer	PhD, Atmospheric Science Paris VI University, France	S	7
Dr. Paul Wilson	PhD, Atmospheric Physics Imperial College London	S	9
Dr. Christine Ziehmann	PhD, Meteorology Frie University of Berlin	S	16

Table 3: Individuals Involved in Statistical Aspects of the Model

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Dr. Enrica Bellone	PhD, Statistics University of Washington	S	11
Dr. Auguste Boissonnade	PhD, Civil Engineering Stanford University	S	21
Dr. David Gatey	PhD, Wind Engineering and Environmental Fluid Mechanics University of Western Ontario	S	5
Dr. Timothy Hall	PhD, Physics Cornell University	C	N.A.[2]

[1] Non-RMS Staff
[2] Non-RMS Staff.

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Dr. Jo Kaczmarska	PhD, Statistical Science, University College London	S	6
Dr. Nicolas Joss Matthewman	PhD, Applied Mathematics University College London	S	5
Dr. Charles Menun	PhD, Structural Engineering University of California, Berkeley	S/C	4/8
Dr. Robert Muir-Wood	PhD, Earth Sciences Cambridge University	S	20
Mr. Edida Rajesh	MS, Technology (Geophysics) Andhra University	S	20
Dr. Emilie Scherer	PhD, Atmospheric Science Paris VI University, France	S	7
Dr. Nilesh Shome	PhD, Structural Engineering Stanford University	S	7
Mr. Joel Taylor	BS, Mathematics Bradley University	S	10
Mr. Rajkiran Vojjala	MS, Civil Engineering Stanford University, CA	S	12
Dr. Paul Wilson	PhD, Atmospheric Physics Imperial College London	S	9
Mr. Michael Young	MS, Engineering Science University of Western Ontario, Canada	S	13
Dr. Christine Ziehmann	PhD, Meteorology Frie University of Berlin	S	16

Table 4: Individuals Involved in Vulnerability Aspects of the Model

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Dr. Yasuyuki Akita	PhD, Environmental Science University of North Carolina, Chapel Hill	S	2
Dr. Auguste Boissonnade	PhD, Civil Engineering Stanford University	S	21
Dr. Peter Datin	PhD, Civil Engineering University of Florida, Gainesville, FL	S	5
Dr. Laura Eads	PhD, Civil & Environmental Engineering Stanford University, CA	S	3
Mr. Manabu Masuda	MS, Civil Engineering, Stanford University	S	13
Mr. Rohit Mehta	MS, Statistics, California State University, Hayward	S	16
Dr. Akwasi Mensah	PhD, Civil Engineering Rice University, Houston	S	2
Dr. Charles Menun	PhD, Structural Engineering University of California, Berkeley	S/C	4/8
Dr. Mohsen Rahnama	PhD, Structural Engineering, Stanford University	S	18
Mr. Agustin Rodriguez	MS, Structural Engineering University of California-Berkeley	S	15
Dr. Pooya Sarabandi	PhD, Structural Engineering Stanford university	S	10
Dr. Nilesh Shome	PhD, Structural Engineering Stanford University	S	7
Mr. Derek Stedman	MS, Civil & Environmental Engineering University of Western Ontario, Canada	S	3

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Dr. Vahid Valamanesh	PhD, Civil and Environmental Engineering Northeastern University	S	1
Mr. Rajkiran Vojjala	MS, Civil Engineering Stanford University, CA	S	12
Dr. Paul Wilson	PhD, Atmospheric Physics Imperial College London	S	9
Mr. Michael Young	MS, Engineering Science University of Western Ontario, Canada	S	13

Table 5: Individuals Involved in Actuarial Aspects of the Model

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Dr. Auguste Boissonnade	PhD, Civil Engineering Stanford University	S	21
Ms. Kay Cleary	BA, Psychology Northwestern University FCAS, MAAA	S	10
Dr. Weimin Dong	PhD, Civil Engineering Stanford University	S	27
Ms. Nathalie Grima	MS, Mathematics San Jose State University	S	12
Mr. Tim Huth	MA, Environmental Studies Brown University	S	4
Ms. Roopa Nair	MS, Statistics University of Delhi	S	9
Mr. Matthew Nielsen	MS, Atmospheric Science Colorado State University	S	11
Mr. Tom Sabbatelli	MS, Meteorology Pennsylvania State University	S	7
Ms. Neha Shah	BS, Applied Mathematics University of California, Los Angeles	S	10
Dr. Bronislava Sigal	PhD, Statistics Stanford University	S	8
Dr. Ajay Singhal	PhD, Civil Engineering Stanford University	S	15
Ms. Beth Stamann	Certificate of General Insurance Insurance Institute of America	S	21
Mr. Cody Stumpo	MS, Engineering Purdue University	S	8
Mr. Joel Taylor	BS Mathematics Bradley University	S	10
Mr. Kevin Van Leer	MS Atmospheric Science University of Illinois, Urbana-Champaign	S	4
Mr. Michael Young	MS, Engineering Science University of Western Ontario, Canada	S	13

Table 6: Individuals Involved in Computer/Information Science Aspects of the Model

Name	Credentials	Staff (S)/ Consultant I	Tenure (Years)
Mr. Suman Bhattacharya	Diploma in Electrical Engineering RK Mission Shilpamandira, Kolkata, India	S	9
Dr. Irina Behnert	PhD, Physics and MSc (DEA), History Pantheon Sorbonne, Paris	S	10

Name	Credentials	Staff (S)/ Consultant I	Tenure (Years)
Ms. Masha Bilyak	BS, Economics and Management Polytechnic University in Lvov, Ukraine	S	16
Mr. Jason Bryngelson	MS, Structural Engineering San Jose State University	C/S	2/20
Mr. Jordan Byk	MBA, Marketing and Finance Rutgers – The State University of New Jersey	S	10
Mr. David Carttar	MS, City Planning University of California, Berkeley	S	22
Ms. Monisha Chahal	MS, Computer Programming IBM Education, New Delhi	S	16
Mr. Umesh Chander	MS, Computer Science – Northwestern Polytechnic University, Fremont, CA	S	10
Dr. Ching-Yee Chang	PhD. Chemical Physics/Atmospheric Science, University of Maryland, College Park	S	4
Ms. Chethana Chidambara	BE Computer Science UVCE, Bangalore University, India	S	3
Mr. Tommy Chou	BA, Developmental Studies of Industrial Societies University of California, Berkeley	S	12
Ms. Karen Clarke	BSE, Biomedical Engineering University of Iowa	S	7
Mr. Sushil Dhyani	MCA, Master of Computer Application University of Rohtak (India)	S	12
Mr. David Glaubman	BS, Mathematics Northeastern University, Boston	S	12
Ms. Olga Goldin	BS, Power Engineering, Azerbaijan University of Oil and Chemistry	S	21
Mr. Atin Jain	MS, Physics (Specialization Electronics) Rewa University, India	S	7
Mrs. Vidya Karthigeyan	MS, Computer Information Systems California State University, East Bay	S	9
Ms. Veena Krishnamoorthy	MS, Physics Madurai Kamaraj University	S	9
Mr. James Lord	MS, Civil Engineering Carnegie Mellon university	S	9
Ms. Jenny Lu	MS Computer Science Wuhan University, Wuhan, China	S	3
Mr. Rohit Mehta	MS, Statistics, California State University, Hayward	S	16
Mr. Bruce Miller	BS, Engineering Physics University of Colorado	S	21
Dr. Rakesh Mohindra	PhD, Earth Sciences Indian Institute of Technology, Roorkee, India	S	16
Dr. Gilbert Molas	PhD, Civil Engineering University of Tokyo	S	21
Mr. Venkat Morampudi	MS, Computer Science University of Alabama	S	10
Mr. Geoffrey Overton	BS, Geography University of Nebraska at Omaha	S	10
Mr. Narvdeshwar Pandey	MS, Future Studies and Planning, Dev Ahilya University, Indore, India MS, Mathematics Gorakhpur University, India	S	13

Name	Credentials	Staff (S)/ Consultant I	Tenure (Years)
Mr. Ghanshyam Parasram	BA, Mechanical Engineering Jawahar Lal Nehru Technological University, India	S	17
Mr. Rahul Patasariya	BS, Civil Engineering, Indian Institute of Technology, India	S	9
Ms. Sudha Raghavan	Masters in Computer Applications, Mother Teresa University	S	8
Mr. Rhoderick Rivera	BS, Computer Engineering University of Illinois, Urbana-Champaign	S	11
Ms. Shraddha Sahay	BS, Electrical Engineering Visvesvaraya Technological University, Karnataka, India	S	9
Mr. Chris Sams	BA Geography University of Kansas	S	14
Ms. Debjani Sen	MS, Liberal Arts Southern Methodist University	S	9
Ms. Neha Shah	BS, Applied Mathematics University of California, Los Angeles	S	10
Ms. Richa Sharma	BTech, Information Technology UPTU, Lucknow	S	6
Dr. Ajay Singhal	PhD, Civil Engineering Stanford University	S	15
Mr. Puja Sinha	BS, Electrical Engineering Nagpur University, India	S	10
Mr. Jayant Srivastava	MS, Computer Science, Institute of Management and Technology, India	S	16
Mr. Cody Stumpo	MS, Engineering Purdue University	S	8
Mr. William Suchland	BA, Geography, Computer Assisted Cartography University of Washington	S	20
Mr. Avinash Takale	MS, Computer Application Shivaji University, Maharashtra, India	S	8
Mr. Daniel Temesi	MS, Computer Science and Economics University of Szeged, Hungary	S	1
Mr. Srinivas Thupakula	BS Civil Engineering Indian Institute of Technology Kanpur, India	S	5
Ms. Monika Tomar	MS, Computer Applications (MCA) Bundelkhand University, Jhasi, India	S	14
Mr. Yogesh Vani	MS, Computing Technologies, Telecommunication Systems California State University, Hayward	S	11

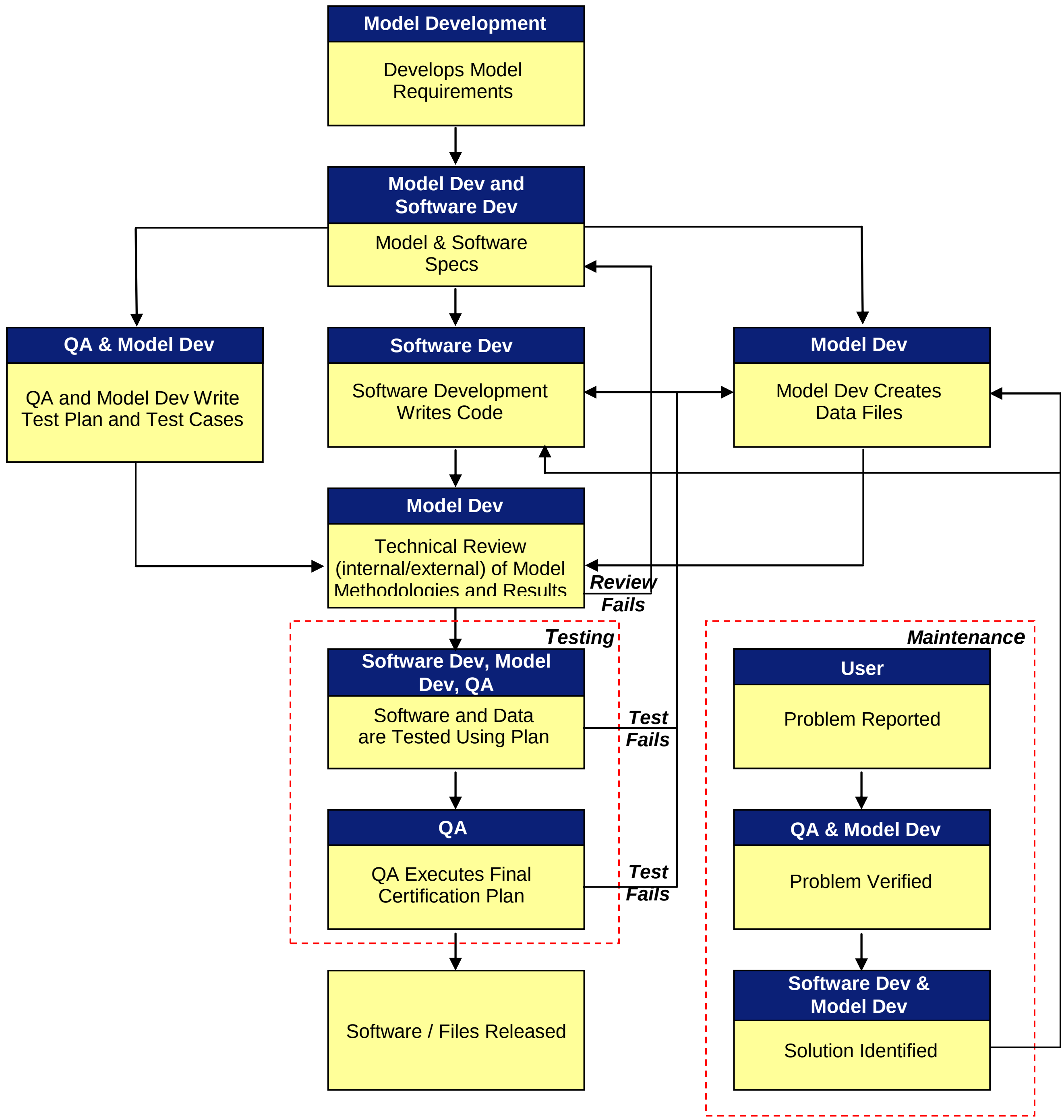
G-2.2.B Identify any new employees or consultants (since the previous submission) engaged in the development of the model or the acceptability process.

This submission includes nine new individuals: Yasuyuki Akita, Cathy Ansell, Sarah Hartley, Tim Huth, Akwasi Mensah, Roopa Nair, Tom Sabbatelli, Daniel Temesi, and Vahid Valamanesh. Their education, employment status, tenure, and relevant experience are included in Disclosure G-2.2.A and Appendix B.

G-2.2.C Provide visual business workflow documentation connecting all personnel related to model design, testing, execution, maintenance, and decision-making.

Figure 8 illustrates a typical workflow used at RMS.

Figure 8: RMS Model Development, Testing, and Maintenance Business Workflow Diagram



In Figure 8, Model Development includes all individuals listed in Table 2 to Table 5. Software development and QA includes the individuals listed in Table 6. Users are RMS clients (internal and external).

G-2.3 Independent Peer Review

G-2.3.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***
2. ***Statistics***
3. ***Vulnerability***
4. ***Actuarial Science***
5. ***Computer/Information Science***

The methodology used in the current hurricane model has evolved over time. In addition to the extensive testing that RMS has itself performed on its North Atlantic Hurricane Models, contributions and model reviews performed by external experts whose names and reputations rest upon the quality of their work, have contributed to model improvements.

When significant changes to a model component are made, RMS may retain the services of an external expert to review the methodology, techniques, and other relevant changes to the model. This submission involves significant changes to the hazard and vulnerability modules and therefore RMS has engaged with experts for two external reviews.

Dr. Robert Hart is an Associate Profession of Meteorology at the Florida State University. Dr. Hart received his PhD in Meteorology in 2001 from Pennsylvania State University. Dr. Hart's career has focused on hurricane modeling and track forecasting, and has been doing periodic consulting with RMS since 2007. RMS has retained Dr. Hart's services to conduct a peer review of changes to the meteorological aspects of the North Atlantic Hurricane Models in RiskLink 11.0. His review was completed on October 29, 2010.

Mr. Thomas Smith is president of TLSmith Consulting, Inc. and is an internationally recognized expert on wind performance of buildings. Mr. Smith has performed building investigations after several tornados and 15 hurricanes—for eight of the hurricane investigations he was a member of the FEMA research teams. Mr. Smith contributed to several FEMA guides and documents including, FEMA's residential *Coastal Construction Manual* (FEMA 55), *Home Builder's Guide to Coastal Construction* (FEMA 499), and *Design Guide for Improving Critical Facility Safety from Flooding and High Winds* (FEMA 543). He is also a contributing author of AIA's *Buildings at Risk: Wind Design Basics for Practicing Architects* (1997), and he authored *Low Slope Roofing II* (NCARB, 2003). Tom Smith was retained by RMS to conduct an external review of the vulnerability model changes being made in RiskLink 11.0 in September 2010.

G-2.3.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.

RMS engages with external consultants, researchers, or experts using one of two methods; publication in a peer reviewed journal, or external expert reviews conducted under the condition of non-disclosure agreements. The following peer reviews relevant to this version of the model in each of these two categories are:

External Expert Reviews

Copies of Dr. Robert Hart's and Mr. Tom Smith's assessment reports as described under Disclosure G-2.3.A are attached in Appendix C and Appendix D. There are no unresolved or outstanding issues related to these reviews. Both of these views are directly applicable to RiskLink 17.0 pursuant to the Report of Activities (ROA) 2015 standards.

Dr. Hart's review of the hazard module as it was incorporated in RiskLink 11.0 is shown in Appendix C. The aspects he reviewed and commented on have not changed and meet the current ROA standards.

Mr. Smith reviewed the vulnerability module in RiskLink 11.0. Although there have been changes made in the vulnerability module since then, the basic methodology and application remain as they were. His review is therefore still applicable to the vulnerability module, and has not been nullified by either model or standard changes.

Peer Reviewed Journals

RMS has published details about the development of its statistical track module and wind field module in the following papers listed below. Upon publication, no unresolved or outstanding issues were identified.

- Hall, T.M. and S. Jewson (2007a) "Statistical modeling of North Atlantic tropical cyclone tracks." Tellus 59A:486–498.
- Colette, A, Leith N., Daniel V., Bellone E., Nolan D.S. (2010): "Using Mesoscale Simulations to Train Statistical Models of Tropical Cyclone Intensity over Land." Mon. Weather. Review, 138, 2058–2073.
- Hall, T. and S. Jewson (2007 b): "Comparison of Local and Basin-Wide Methods for Risk Assessment of Tropical Cyclone Landfall." Journal of Applied Meteorology and Climatology, 47, 361–367.

G-2.3.C Describe the nature of any on-going or functional relationship the organization has with any of the persons performing the independent peer reviews.

There currently is no on-going or functional relationship with the reviewers.

G-2.4 Provide a completed Form G-1, General Standards Expert Certification. Provide a link to the location of the form [Form G-1].

G-2.5 Provide a completed Form G-2, Meteorological Standards Expert Certification. Provide a link to the location of the form [Form G-2].

G-2.6 Provide a completed Form G-3, Statistical Standards Expert Certification. Provide a link to the location of the form [Form G-3].

G-2.7 Provide a completed Form G-4, Vulnerability Standards Expert Certification. Provide a link to the location of the form [Form G-4].

G-2.8 Provide a completed Form G-5, Actuarial Standards Expert Certification. Provide a link to the location of the form [Form G-5].

G-2.9 Provide a completed Form G-6, Computer/Information Standards Expert Certification. Provide a link to the location of the form [Form G-6].

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.

RMS acquires its ZIP Code data primarily from a third-party developer, which bases its information on the ZIP Code definitions issued by the United States Postal Service. It is RMS policy to update these ZIP Codes at least every 24 months.

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

The RMS model does not use ZIP Code centroids as proxies for exposure. If a building location is entered as a ZIP Code, then the model uses wind speeds that are exposure weighted averages of wind speeds across the ZIP Code extent. These exposure weighted averages are derived from residential population data.

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

ZIP Code information is examined by RMS for consistency and is subject to standardized quality control testing and checking by experts employed by RMS for that purpose.

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.

RiskLink uses ZIP Code tables in the geocoding, vulnerability, and hazard modules. RMS has a methodology for making consistent updates to relevant ZIP Code data when the vintage is updated.

E. Geocoding methodology shall be justified.

The RMS geocoder uses industry proven methods and data, thorough testing for consistency, validation processes that justify and support change, and benchmarking against alternative industry suppliers to ensure accuracy and performance. The methods are consistent and justifiable.

G-3.1 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.

A set of four internal databases use postal code data: one for assigning a geographical coordinate to user-input ZIP Codes; and another two for assigning exposure-weighted wind-speed averages to individual events (stochastic and historical) in the model; a fourth database to determine vulnerability and inventory regions. The USPS vintage of the ZIP Code data used in the submitted model is December 2015.

G-3.2 Describe in detail how invalid ZIP Codes are handled.

There are two reasons for a ZIP Code to be considered invalid by RiskLink. First, the ZIP Code in question may not exist, either because of a typographical error or because of an expired ZIP Code. Second, the ZIP Code may be more current than the ZIP Codes in the reference database in the product.

In cases when a building cannot be geocoded, its vulnerability and financial characteristics are excluded from consideration in the analysis. Locations that are not included in the analysis are easily identified.

G-3.3 Describe the data, methods, and process used in the model to convert among street addresses, geocode locations (latitude-longitude), and ZIP Codes.

Geocoding is the process of converting user supplied address information into locations that can be used by the model. There are generally four steps in the geocoding process.

- Address standardization: User supplied address information is parsed into address elements, such as building number, street name, pre/post directional, etc., and converted into standardized nomenclature and/or format (i.e., “N.” becomes North).
- Address matching: The geocoding engine searches for a match between address element inputs and valid reference data for address elements contained in an internal geographic database. In the U.S., RiskLink uses reference data from a variety of third-party sources/vendors to provide the most accurate geocoding resolution possible.
- Geographic interpolation (if necessary): Once a valid address is found, the coordinates (latitude/longitude) are assigned to the record. Interpolation along street elements may be necessary for street-level geocoding. Building or parcel level geocoding does not require interpolation because pre-compiled coordinates of the building footprints may be contained in the geographic database to allow for a precise location placement.
- Ancillary data retrieval: Additional information not supplied by the user, such as county, enclosing ZIP Codes, or state codes are added to the record to allow the model to reference model components stored by postal code or county.

Zip aggregate records (such as FHCF data) do not go through address matching or geographic interpolation, but the ZIP Codes are checked for validity prior to ancillary data retrieval.

Table 7: List of Supported Geocoding Resolutions

Name	Description
Coordinate	User-specified latitude/longitude coordinate pairs used directly in modeling process. Only ancillary data retrieval is applied to location supplied with coordinate level geocoding data. Requires prior knowledge of the latitude/longitude coordinate pair.
Building	Geocodes to the exact center of the building footprint.
Parcel	Geocodes to the exact center of the parcel boundaries for street-address match.
Street Address	The geocoder matches street segment resolution reference data that contains address ranges and side of street parity. Includes interpolation along street centerline and an offset from the centerline.
Blockface	The geocoder matches street segment resolution reference data that contains address ranges but not side of street parity. Includes interpolation along street centerline.
Street Name	The geocoder matches the street name only, either because the address number is invalid or missing. Uses a centroid for the street (length) factoring coarser address input (such as postcode).
Postcode	The geocoder places the location on the exposure weighted centroid of the postal code (e.g., U.S. ZIP Code) in which it falls. In the U.S., postal code centroids are population weighted to provide a better representation of exposure. Populated-weighted centroids and geographic centroids are not usually the same place.
City	The geocoder validates the name of the city and returns coordinates, and sets both latitude and longitude to zero.
County	The geocoder validates the name of the county/state and sets both latitude and longitude to zero.

G-3.4 List and provide a brief description of each model ZIP Code-based database (e.g., ZIP Code centroids).

See response in Disclosure G-3.1

G-3.5 Describe the process for updating model ZIP Code-based databases.

RMS receives quarterly updates of geocoding data, including ZIP Codes and associated boundaries, from its third party sources, which are run through a series of quality and consistency checks. When preparing data and software for release, RMS selects the most recent geocoding update, performs quality and consistency testing which includes verifying boundary alignments, and centroid alignments. Where appropriate, additional data development is performed. A quality confirmed postcode database is then provided to the development teams for inclusion in the other three databases described in Disclosure G-3.1. The development teams make updates that ensure consistency between the latest vintage of Zip Codes, the treatment of missing/incomplete data, and various vintages of exposure datasets that could be used by clients.

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.

In the North Atlantic Hurricane Models, vulnerability, meteorological, and actuarial functions are theoretically sound and are developed independently without compensation for potential bias from the other two components. For example, vulnerability functions relating damage ratios to wind speeds are fixed within the model and are not dependent on other aspects of the loss model. Relationships within the model among the meteorological, vulnerability, and actuarial components are reasonable.

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.

The preparation of the submission follows a development and editorial review process that involves multiple personnel who review and edit appropriate sections depending on areas of expertise. For this submission to the FCHLPM, Beth Stamann has coordinated the editorial process as described in the disclosure below. Beth has reviewed and edited where necessary all documents for accuracy and completeness.

Beth joined RMS in August of 1995. She worked within the client development organization until October 2007 when she moved to the public policy group as senior documentation specialist. Her responsibilities have included formatting, review of grammar, and contributing to verification of accuracy, completeness and compliance of a wide-range of documents including but not limited to: change impact reports, client requests for proposals, meeting documentation, contracts, affidavits, analytical service reports, presentations, exhibits, client communications, marketing collateral, correspondence, and client invoicing. Beth is currently a member of the model knowledge management group where her responsibilities include editing, review and preparation of RMS peril model documentation for publishing. For the last nine years she has been involved with the RMS submissions and development of other regulatory support documents.

Through her career at RMS, Beth has demonstrated proficiency in the use of Microsoft® Word, Excel, and PowerPoint applications, as well as Adobe Acrobat and source control software.

G-5.1 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.

RMS uses source control software to control the document creation and editing process for the submission document, form development, and related information. For the main submission document, RMS maintains and tracks edits to the document using edit tracking features in Microsoft Word and the source control system. Subject matter experts make edits on "sub-documents" that are submitted to the submission editor for inclusion into the main document, in accordance to a set of standard operating procedures maintained by the submission editor. Incremental changes to the document are checked-in by the submission editor, Beth Stamann. Form development is also tracked and edited within our source control system.

RMS follows a review process with multiple reviewers to ensure that final subject matter content reflects edits suggested by each subject matter expert. The submission editor maintains a list of review responsibilities and review tasks. This review process also includes specific checks to ensure that the paper and electronic version of specific files are identical in content.

G-5.2 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.

Each signatory is responsible for the content of their respective standards. Signatories, subject matter experts, and forms analysts submit information to be included in the submission to the submission editor. Once incorporated, signatories must verify that all changes have been incorporated and approve the final version of the document.

RMS also uses a two-person review process whereby the content of each section/form is reviewed by someone other than the content provider. When appropriate, signatories may also review other standard sections to ensure consistency between results and submission language.

G-5.3 Provide a completed Form G-7, Editorial Review Expert Certification. Provide a link to the location of the form [Form G-7].

METEOROLOGICAL STANDARDS

M-1 Base Hurricane Storm Set

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.

The RMS hurricane model has been developed and validated using the official NHC HURDAT2 database (as available in September 2015) spanning the time frame from 1900 to 2014 inclusive. There has not been any modification to the official HURDAT2 track set.

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 trends, weighting or partitioning of the Base Hurricane Set are used in this model.

M-1.1 Specify the Base Hurricane Storm Set release date and the time period used to develop and implement landfall and by-passing storm frequencies into the model.

The base hurricane storm set is made of all hurricanes contained in the official HURDAT2 database (as available in September 2015) spanning the time frame from 1900 to 2014 inclusive. The HURDAT database is referenced in Jarvinen et al. (1984) and the new format data HURDAT2 in Landsea and Franklin (2013). NOAA's reanalysis of hurricane seasons included in the September 2015 vintage is described Landsea et al. (2004), Landsea et al. (2008), Landsea et al. (2012), Landsea et al. (2014), and Hagen et al. (2012).

M-1.2 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.

There has not been any modification to the official HURDAT2 track set.

M-1.3 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.

There has not been any modification to the official HURDAT2 track set.

M-1.4 Provide a completed Form M-1, Annual Occurrence Rates. Provide a link to the location of the form [Form M-1].

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.

Each component of the hazard model is based on information documented in currently accepted scientific literature:

- The track path model is based on Hall and Jewson (2007)
- The over water intensity model is similar in concept to the track path model
- The inland filling model (modeling the central pressure time series when the storm moves over land) is described in Colette et al. (2010)
- The Vmax and Rmax models are regression models (e.g., Weisberg 1985) with autocorrelated errors
- The analytical wind profile is a modified version of the profile proposed in Willoughby et al. (2006)
- The wind profile parameters are modeled as generalized linear models (e.g., McCullagh and Nelder, 1989)
- The roughness and gust models are based on the methodologies proposed by Cook (1985) and Cook (1997)

M-2.1 Identify the hurricane parameters (e.g., central pressure, radius of maximum winds) that are used in the model.

The hurricane parameters used in the hazard model are:

- Translation speed and storm heading (also known as bearing)
- Central pressure
- Inland filling rate
- "Equivalent over water" maximum wind
- Radius of maximum winds
- Wind profile parameters
- Far field pressure

M-2.2 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.

The variables defining the wind speed at a site are:

- Radial distance from the storm center to the site (dependent on site location)
- Angle between the translational speed and the site radial vector (dependent on site location)
- Translational speed of the storm (dependent on the storm center location)
- Equivalent over water 1-minute mean wind (dependent on central pressure and far field pressure)
- Radius of maximum winds (dependent on central pressure and latitude)
- Wind profile parameters (dependent on the radius of maximum wind and central pressure)
- Roughness and gust coefficients (dependent on site location)

M-2.3 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 are modeled as described below:

Translational speed and heading

The track translational speed and heading are derived from the zonal and meridional track speeds. The mean of the zonal and meridional components vary in space and are distance weighted functions of zonal and meridional steps from HURDAT. Deviations from the zonal and meridional means are modeled as Gaussian random variables that are both autocorrelated and cross-correlated. Variance and correlation coefficients also vary in space and are estimated from HURDAT tracks using weights that depend on the distance between site and HURDAT track points.

Central pressure

Central pressure is the main intensity variable in the model. Central pressure time series are obtained through the change in central pressure (Δp_c). The model for Δp_c is a linear regression with predictors that include the previous change in pressure, the total pressure drop from genesis and the zonal and meridional track steps. The coefficients of the model are estimated locally using HURDAT data weighted according to the distance from site to HURDAT track point.

Inland filling rate

The inland filling rate is drawn from a normal distribution with a mean that depends on pressure difference (FFP-p_c), translational speed and Rmax at the time of landfall, as well as two predictors that describe the proportion of the storm over different terrain at and just after the time of landfall: the proportion of the storm to the right of the track that is over water, and the proportion of the storm that is over terrain classified as urban or forest.

"Equivalent over water" maximum wind

Vmax is modeled as a lognormal random variable, with a mean that depends on latitude and pressure difference. Deviation from the mean exhibits 1st order autocorrelation. Central pressure, Vmax, and latitude data from HURDAT are used to estimate the coefficients of the model.

Radius of maximum winds

Rmax is modeled as a lognormal random variable, with a mean that depends on latitude and central pressure. Deviation from the mean exhibits 1st order autocorrelation. Simulated Rmax values are truncated on the right according to their category by pressure. The coefficients for the model are estimated using the extended best track dataset as discussed in Demuth et al. (2006).

Wind profile parameters

The shape parameters X1 and N are modeled as Gamma random variables that depend on Rmax and translational speed, as well as a lagged version of X1 and N respectively (lag 1). The position of Vmax with respect to the track is described by the wind field parameter Amax, which is assumed to follow a truncated Gaussian distribution. The mean depends on translational speed, Rmax and previous values of Amax. EOF coefficients are modeled as Gaussian random variables.

Far field pressure

Far field pressure is not modeled as a random variable, but it varies according to spatial position and time of the year. The monthly climatology of sea level pressure over a grid covering the model domain is used as a proxy for far field pressure.

M-2.4 Describe if and how any hurricane parameters are treated differently in the historical and stochastic storm sets and provide rationale.

For historical storms, hurricane parameters are treated as in the stochastic set except that the longitude, latitude, central pressure (when available), and over water Vmax are fixed and set to the corresponding HURDAT2 values. In addition, simulated parameters may be constrained by relevant meteorological data which are available for the historical storm, including estimates for observed Rmax, and wind speeds observed at recording stations over the storm's lifetime.

M-2.5 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 wind field model directly simulates 1-minute mean winds equivalent over water.

M-2.6 Describe how the windspeeds generated in the windfield model are converted from sustained to gust and identify the averaging time.

The wind field model first simulates 1-minute mean winds equivalent over water. These are converted to local 3-second gust wind speeds in two stages: first, the 1-minute mean winds equivalent over water are converted to 1-minute mean winds over local terrain by applying the local roughness coefficient. Then, these 1-minute mean winds over local terrain are converted to 3-second gusts over local terrain by applying the local gust coefficient. The RMS gust coefficients are a function of roughness lengths and follow the ones published in the scientific literature: Deaves and Harris (1978), Harris and Deaves (1980), Deaves (1981).

The table below lists the gust factor values for four different land use classes.

Table 8: Gust Factors for Typical Land Use Classes

Typical Land Use	1-Minute to 3-Second Gust Factor
Water	1.15
Open terrain	1.22
Suburban	1.39
City center	1.52

M-2.7 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 storm data.

Genesis and translational speeds are derived by smoothing the historical HURDAT records. Only post 1950 HURDAT tracks are used as historical data was less reliable before airplane reconnaissance.

The 6-hourly changes in central pressure are derived by smoothing the historical HURDAT records. Only post 1979 pressure increments are considered as the central pressure HURDAT records are complete only since the second half of the 1970's when visible and infrared satellite imagery started to be used.

Modeled Vmax are calibrated and validated using HURDAT2 and the landfall summaries (http://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html) for years within the 1900–2014 time frame.

Modeled central pressures are derived from HURDAT records from the years 1900–2008.

Stochastic tracks are simulated using the model described in Disclosure M-2.3, based on analysis of historical storm tracks in the Atlantic Basin taken from the HURDAT database. Tracks are simulated from genesis to decay, and the central pressure is superimposed on the tracks by taking into account interaction with land along the track. More details on stochastic hurricane tracks are given in Disclosure G-1.2.

M-2.8 If the historical data are partitioned or modified, describe how the hurricane parameters are affected.

The historical data has not been partitioned or modified.

M-2.9 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.

RMS makes use of the RMS landfall gates to validate landfall frequencies. These landfall gates are 50-mile-long coastal segments as shown on Figure 9. Hurricane frequency distributions along the RMS landfall gates are given on Figure 10 and Figure 11 for Category 1–2 and Category 3–5 hurricanes. Saffir-Simpson category is based on 1-minute wind speed at time of landfall.

Figure 9: RMS Landfall Gates

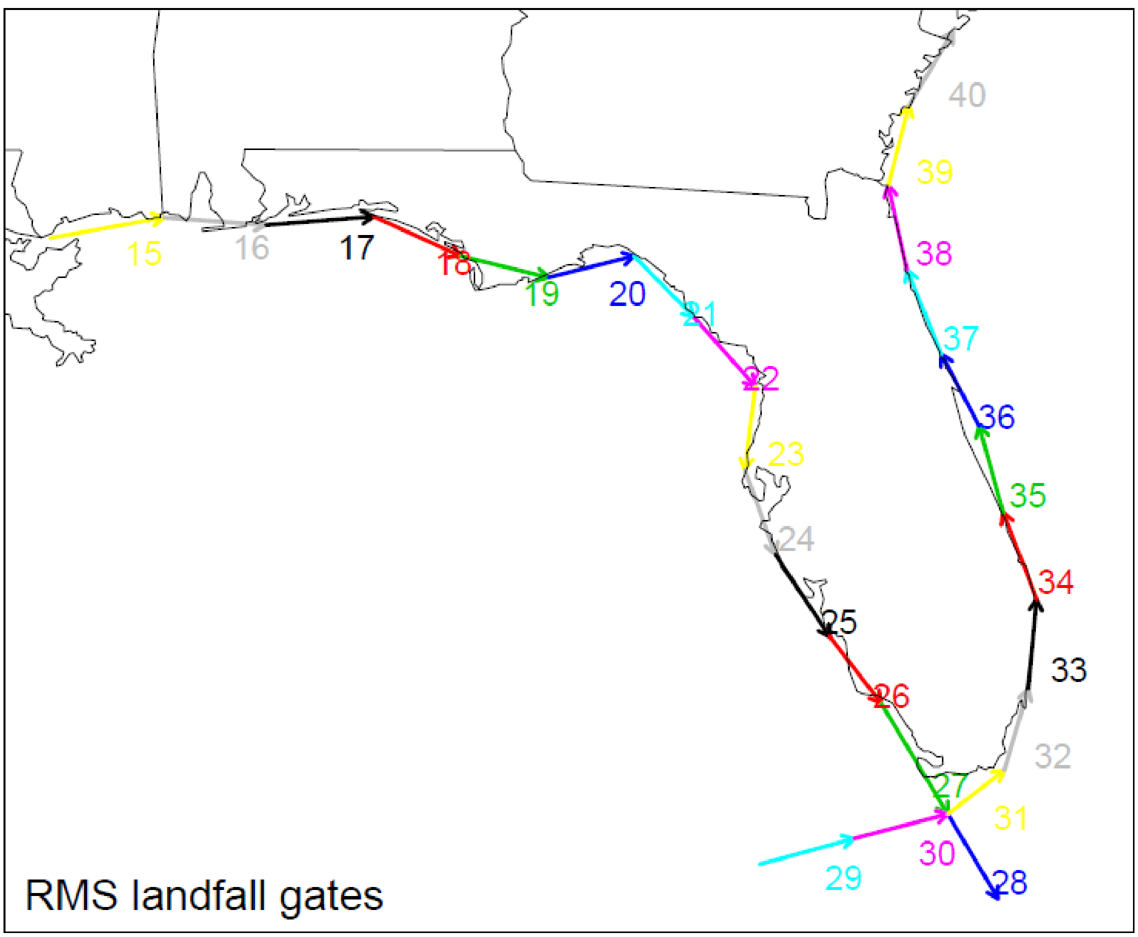


Figure 10: Historical Landfall Counts (1900–2014) by Landfall Gate for Category 1–2 Storms

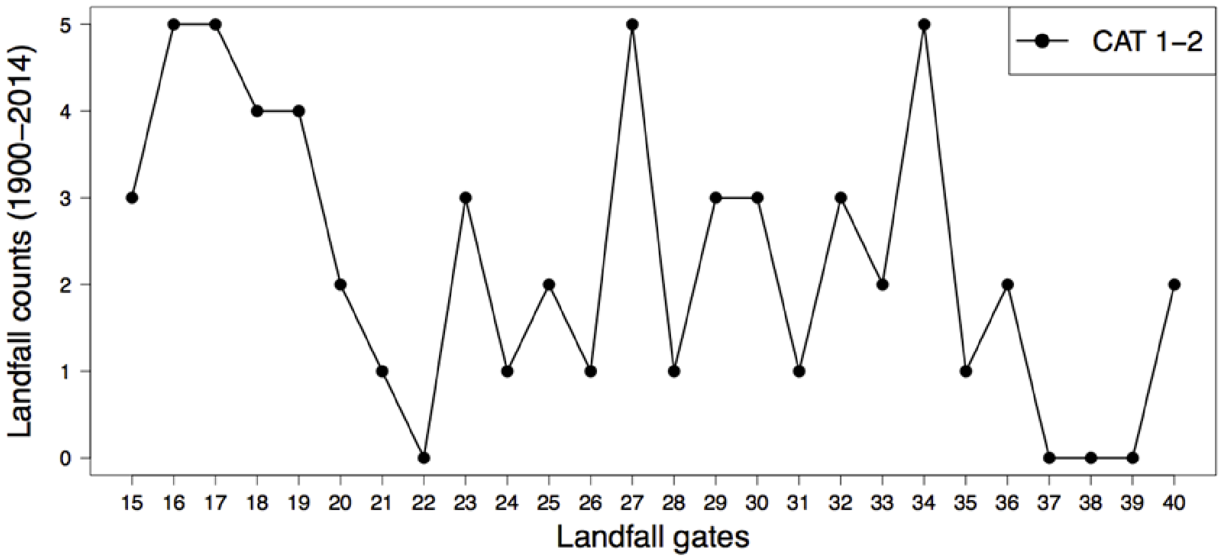
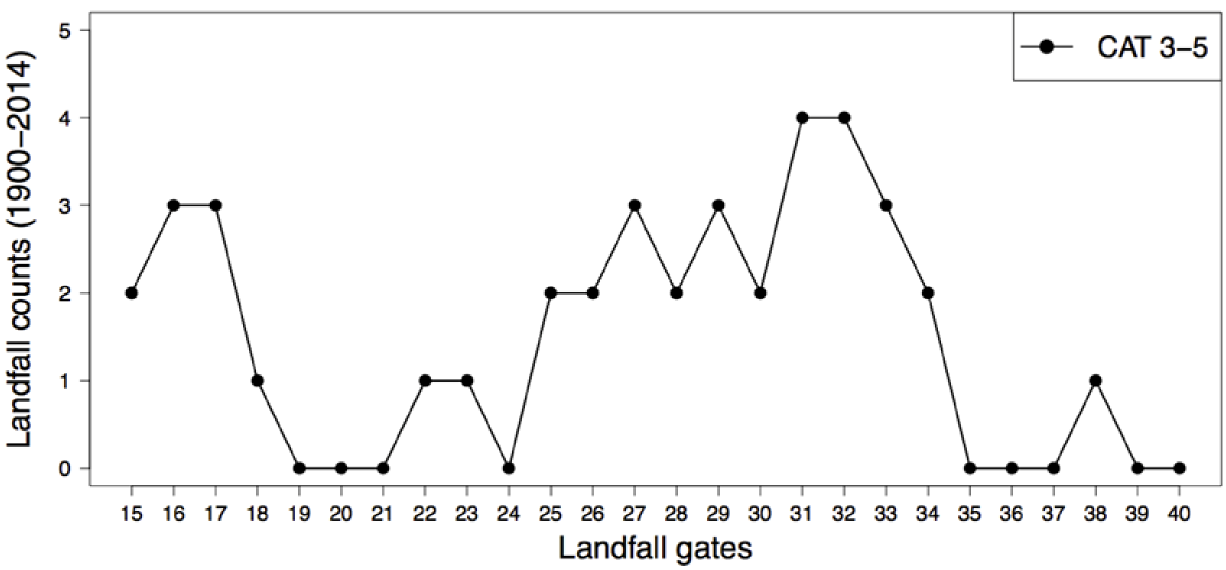


Figure 11: Historical Landfall Counts (1900–2014) by Landfall Gate for Category 3–5 Storms



M-2.10 Describe any evolution of the functional representation of hurricane parameters during an individual storm life cycle.

Hurricane parameters in the RMS model evolve with the changes that each storm experiences. As a storm travels over water, the central pressure is simulated using the RMS over water intensity model and as it moves over land it is modeled using the RMS inland filling model. For hurricanes that are transitioning to extra-tropical storms, the calculations for the Vmax and Rmax time series gradually evolve to represent the extra-tropical nature of the storm. The methodology used to calculate the roughness factors, however, remain the same everywhere, even as the storm moves over water.

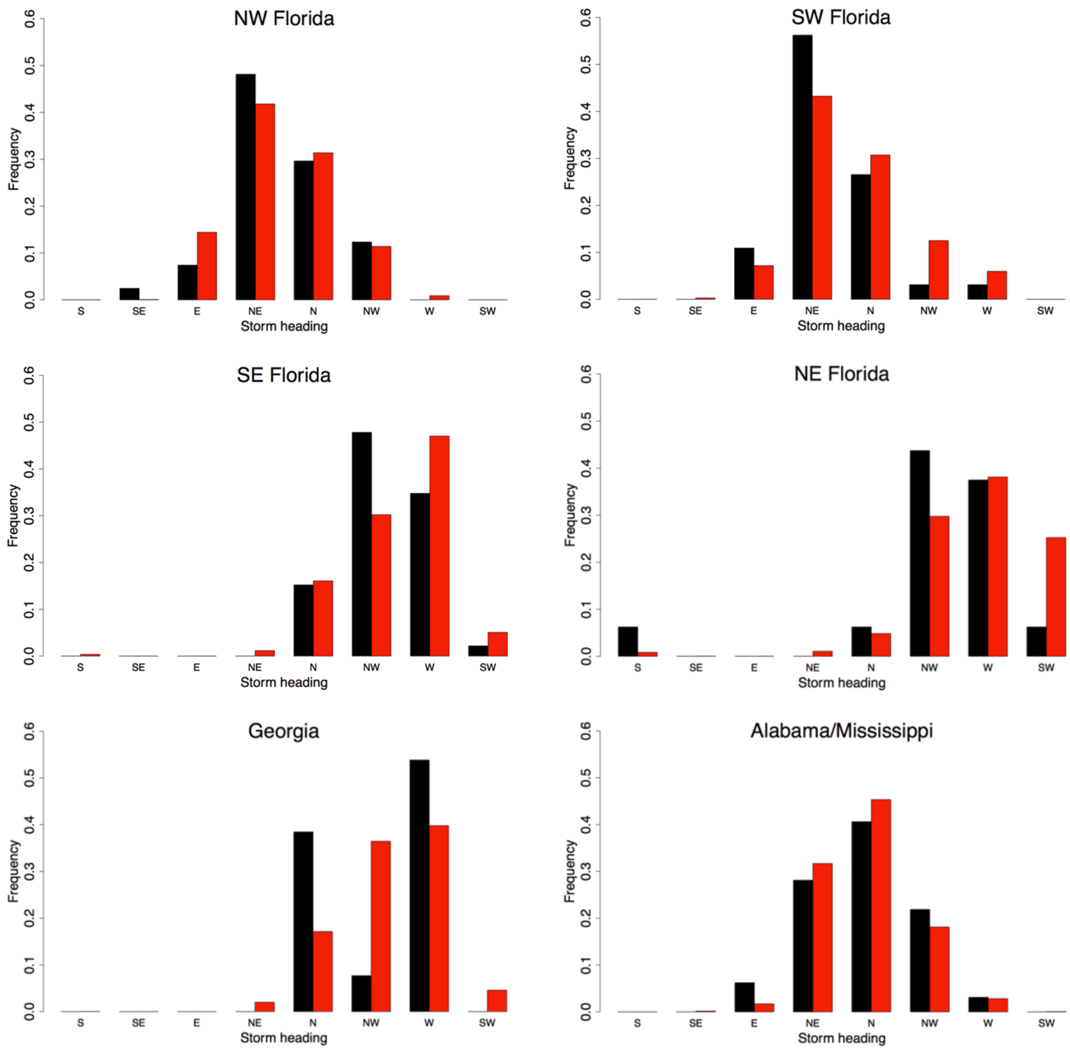
M-3 Hurricane Probabilities

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

Modeled distributions of hurricane parameters and characteristics are consistent with historical hurricanes in the Atlantic Basin:

- **Forward speed**—Modeled and historical distributions are compared in Disclosure S-1.6 for Florida and adjacent states.
- **Storm heading**—Figure 12 shows the comparison between observed and modeled storm heading distribution for the each of the four Florida regions and adjacent regions. There is generally a good agreement between both distributions.
- **Central pressure**—Modeled and historical distributions are compared in Disclosure S-1.6.
- **Inland filling rate**—The range of modeled filling rates is compared against historical central pressure time series in Disclosure M-5.2.
- **"Equivalent over water" maximum wind (Vmax)**—Modeled and historical landfall frequencies (by intensity and by region) are compared in Form M-1. Modeled and historical Vmax distributions at landfall are compared in Disclosure S-1.6.
- **Radius of maximum winds**—Modeled and historical distributions are compared in Disclosure S-1.6.
- **Wind profile parameters**—As described in Disclosure M-4.1, the wind parameters have been fitted using RMS HWind snapshots. The quartiles of modeled radii (>110mph, >74mph, and >40mph) are presented in Form M-3 and the distribution of the radius to hurricane force winds is compared to historical observations available in HURDAT2 and the extended best track dataset (Demuth et al., 2006) in Disclosure M-6.3.

Figure 12: Observed (black) and Modeled (red) Histograms of Storm Heading for Landfalls in each Florida Region and Adjacent Regions—Storm Heading "N" Stands for a Storm Heading North



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).***

Modeled landfall frequencies are consistent with what has been observed historically for each geographical area of Florida and neighboring states, as demonstrated in Form M-1. The model is consistent both in terms of the total rate of hurricanes making landfall by region, and the rate of hurricanes of various intensities by region.

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

Hurricane intensities are defined using the maximum 1-minute sustained 10-meter wind speed. This applies both to modeled hurricanes from the RMS stochastic set and historical hurricanes from the base hurricane storm set.

M-3.1 ***Provide a complete list of the assumptions used in creating the hurricane characteristics databases.***

Data sources and probability distributions used to generate hurricane parameters and characteristics are listed in Form S-3. No additional assumptions were made in creating any of these databases.

M-3.2 ***Provide a brief rationale for the probability distributions used for all hurricane parameters and characteristics.***

A description of the probability distributions used for all hurricane parameters is given in Form S-3.

M-4 Hurricane Windfield Structure

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

Wind fields generated by the RMS model are consistent with observed historical hurricanes in the Atlantic Basin. The basis for developing the wind field structure is the record of historical hurricanes. The functions used to model the wind fields have been tested thoroughly against various historical storms.

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

The RMS database that describes the land use and land cover is derived from the 15–30 m resolution ASTER satellite imagery (Advanced Spaceborne Thermal Emission and Reflection Radiometer). To ensure consistency the RMS database was compared to the NLCD 2011 database to identify regions where land use land cover changed, for which the existing ASTER imagery was validated against NLCD 2011 and Google Earth, and updated where necessary.

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 raw land use and land cover classes derived from the 15–30 m resolution ASTER satellite imagery are merged into 10 typical land-use classes grouping classes of similar roughness together. Each class is assigned a representative roughness length which is within the range of published mapping schemes from scientific literature (e.g., Cook 1985; Wieringa 1992, 1993; ASCE 7-98).

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 effects of the vertical variation of winds are accounted for in the vulnerability curves.

M-4.1 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 RMS model is based on an optimized version of the Willoughby profile (Willoughby et al., 2006). Figure 13 shows the radially averaged profile for typical Florida values:

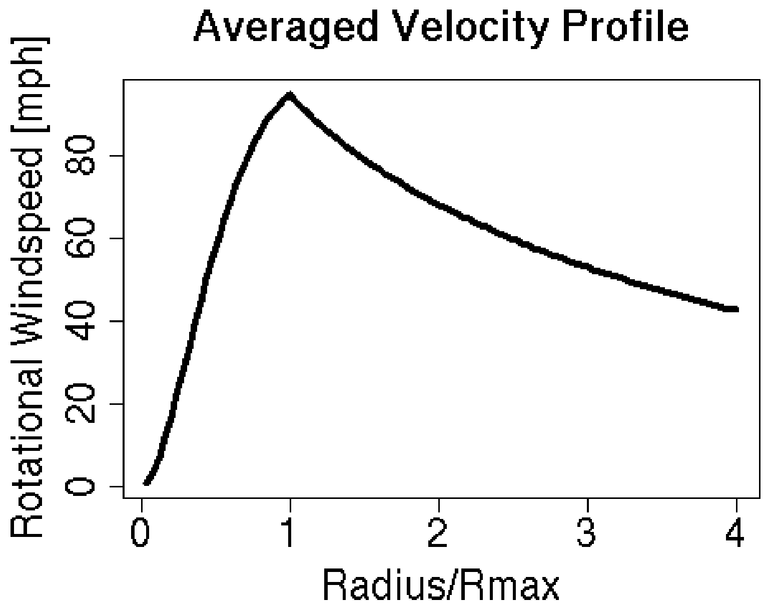
- Translational velocity—5 m/s (11.2 mph)
- Latitude—27.5 N
- Pressure difference—58.5 hPa

Given these parameters, the stochastic model yields the following mean values for the remaining wind parameters used to generate the average wind profile:

- Rmax—36 km (22 miles)
- Vmax—49 m/s (110 mph)
- X1 (decay length parameter)—107 km (66.5 miles)
- N (power law parameter)—1.85

The wind profile models the 10 m winds directly and has been derived using more than 600 over-water RMS HWind snapshots (e.g., Powell et al., 2010).

Figure 13: Radially Averaged Velocity Profile Based on the Parameters Given in the Text



Past modeling approaches at RMS have relied on the Holland profile (Holland 1980). Figure 14 and Figure 15 show the comparison between RMS HWind wind fields (http://www.rms.com/perils/hwind/legacy-archive/) and modeled wind fields for Hurricane Charley (August 13, 2004—16:30 UTC) and Hurricane Andrew (August 24, 1992—04:00 UTC) based on the Holland and Willoughby models. In order to better assess the model skills across different snapshots, RMS presents "composite wind fields" where both the size and the orientation have been normalized. From the plots it is clearly seen that the optimized Willoughby model out performs the Georgiou/Holland model.

Figure 14: Hurricane Charley on August 13, 2004–16:30 UTC. a) RMS HWind Snapshot b) RMS HWind Composite, c) Best Fit for the Georgiou/Holland Model, d) Best Fit for the RMS Wind Field Model—All Wind Speeds are 1-Minute Mean 10 m Winds in mph

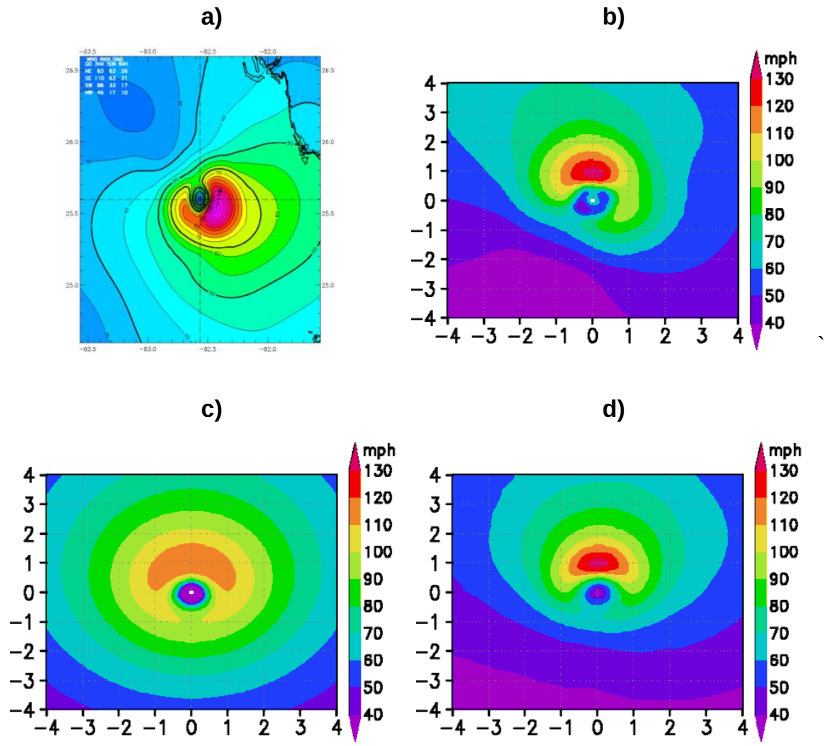
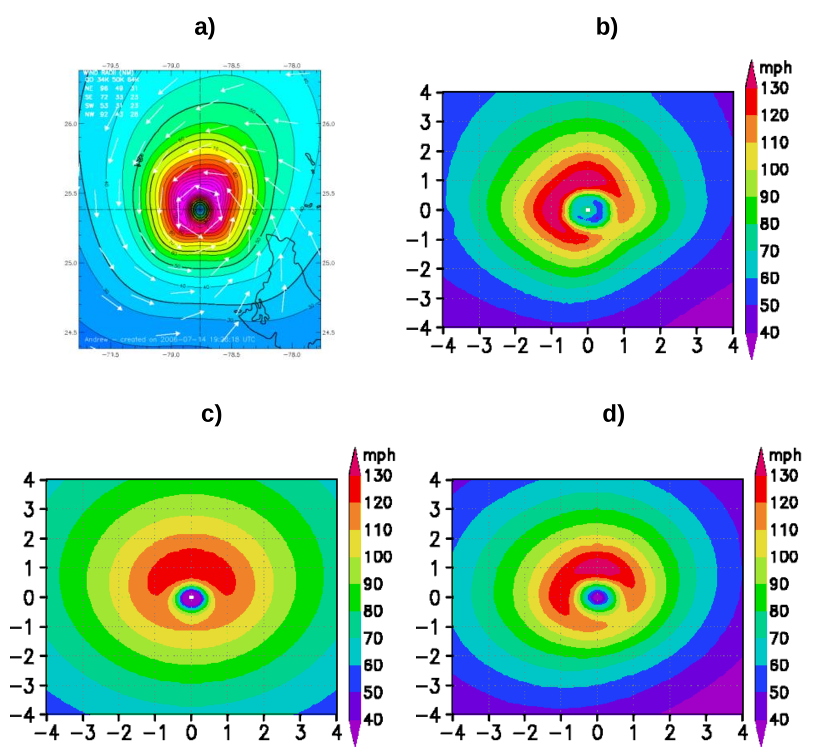


Figure 15: As Figure 14, but for Hurricane Andrew on August 24th 1992–04:00 UTC



M-4.2 ***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 wind profile has not changed since the previous submission.

M-4.3 ***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 wind field has not changed in any way since the previous submission.

M-4.4 ***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.***

The vertical variation of winds is accounted for in the vulnerability curves, where the curves depend on the height of the building. Historical and stochastic storms are treated in the same way.

M-4.5 ***Describe the relevance of the formulation of gust factor(s) used in the model.***

The model calculates the over land gust wind speeds by location via modeling the local surface roughness as well as the change in the local roughness conditions upstream of a particular location. The RMS gust model incorporates these roughness conditions into the computation of the peak gust wind speed at the 10 m elevation. The gust factor methodology follows peer-reviewed wind engineering literature (Deaves and Harris 1978; Harris and Deaves 1980; Deaves 1981; Cook 1985; Cook 1997; Wieringa 1993 and 2001; Vickery and Skerj 2005).

M-4.6 ***Identify all non-meteorological variables (e.g., surface roughness, topography) that affect windspeed estimation.***

Variables that affect the modeled wind speed are the surface roughness conditions, both at the site and upstream to the site by direction. The effect of topography on wind speeds in Florida is negligible.

M-4.7 ***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 land-use land-cover data for Florida was developed from ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer, http://asterweb.jpl.nasa.gov/) satellite imagery collected between 2001 and 2014. As discussed in Standard M-4.B the land-use and land-cover data was compared to the NLCD 2011 data set to ensure consistency and identify regions where land use land cover has changed. Consistency checks between the RMS and NLCD 2011 databases ensured that land use and land cover derived from satellite imagery collected from earlier years maintain consistency with the land cover described by NLCD 2011.

M-4.8 ***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 land use is available at 15–30 m resolution. The raw land-use classes are merged into 10 typical land-use classes grouping classes of similar roughness together. Each class is assigned a representative roughness length which is within the range of published mapping schemes from scientific literature (e.g., Cook 1985; Wieringa 1992, 1993; ASCE 7-98). Aggregate roughness maps are generated on a 200 m resolution grid, and are used by the roughness model to calculate roughness coefficients (roughness and gust factors) on the same grid. The roughness and gust model is based on Cook (1985, 1997) modified by a local correction factor. The correction factor was derived from station data of actual hurricanes. The 200 m roughness factors on the 200 m grid are aggregated to the RMS variable resolution grid (1–10 km) using weights that depend on insured exposure.

M-4.9 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.

For the generation of historical footprints, the HURDAT and extended best track dataset are insufficient, since the wind model requires additional parameters. For this reason, the stochastic model is used to generate various versions of the historic storms all having a different time series of the wind model parameters. The realization (time series of track parameters) is chosen, that yields the best agreement with the station observations. Therefore, the historic reconstructions agree well with the observed spatial patterns as can be seen when comparing to wind station data. The sources of station observations are:

- HURDAT reanalysis data (NOAA); Landsea and Franklin 2012; Landsea et al., 2014; Hagen et al., 2012
- National Hurricane Center reports (NOAA) http://www.nhc.noaa.gov/data/publications.php
- ISD from National Climatic Data Center (NCDC, National Oceanic and Atmospheric Administration, NOAA); Lott et al., 2001; Smith et al., 2011
- Florida Coastal Monitoring Program (FCMP); Masters 2004; Balderrama et al., 2011
- TTUHRT from Texas Tech University, Weiss and Schroeder 2008

Figure 16 to Figure 23 show footprints and time series at two example stations for hurricanes Charley (2004), Jeanne (2004), Wilma (2005), and King (1950). Figure 24 shows a snapshot of the wind field for King close to landfall, and a comparison with a Monthly Weather Review illustration of the eye passage over Miami.

Figure 16: Footprint of Hurricane Charley (2004). Shown is the maximum 3-sec peak gust (in mph). The triangles are stations and are colored according to the observed maximum peak gust. Gray triangles indicate stations that failed and did not record the maximum 3-sec gust. The pink markers indicate the stations for which a time series is shown in Figure 17.

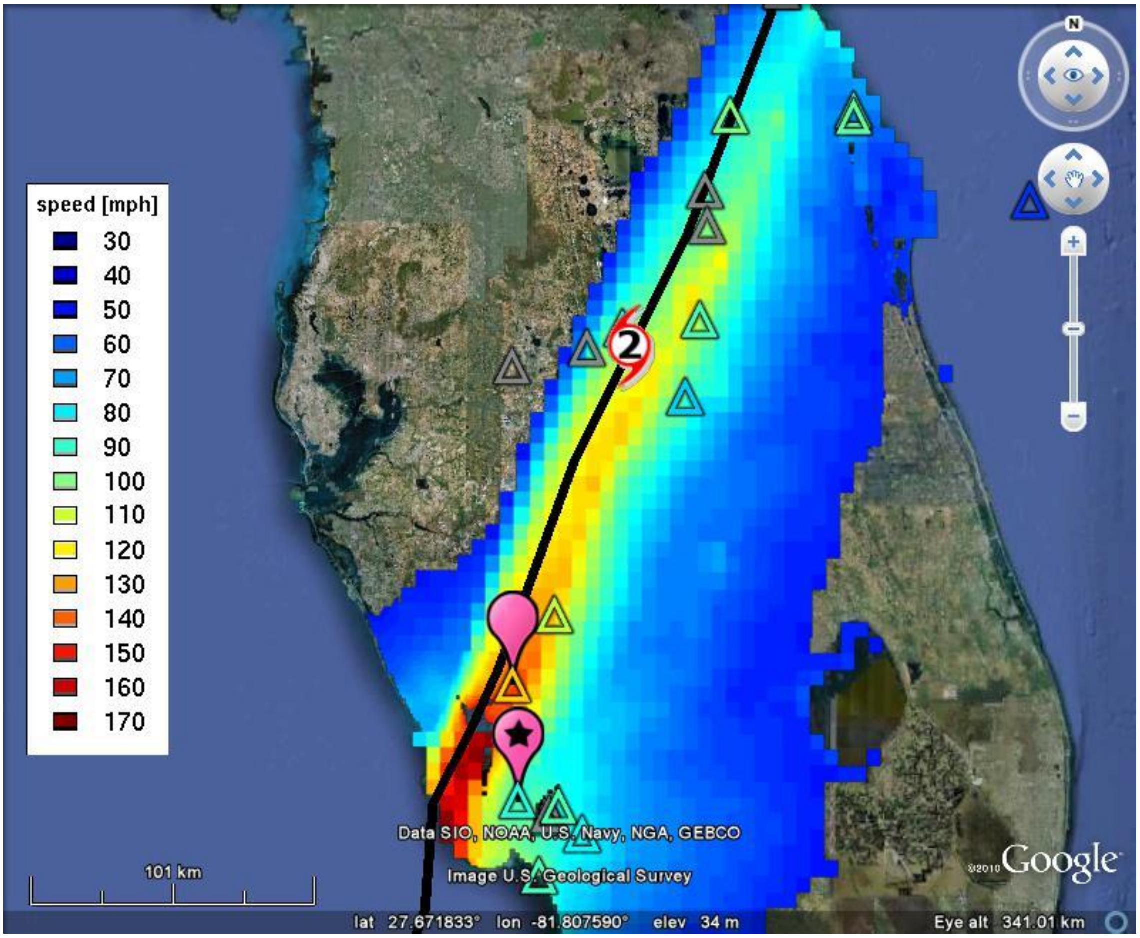


Figure 17: Two Station Time Series of 3-Second Gust Wind Speeds Comparing Model with Observations for Hurricane Charley (2004)

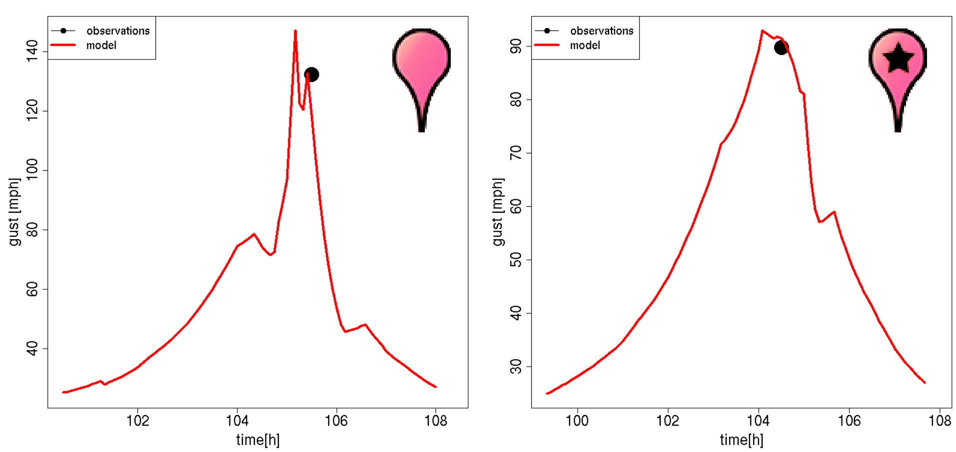


Figure 18: As Figure 16 but for Hurricane Jeanne (2004)

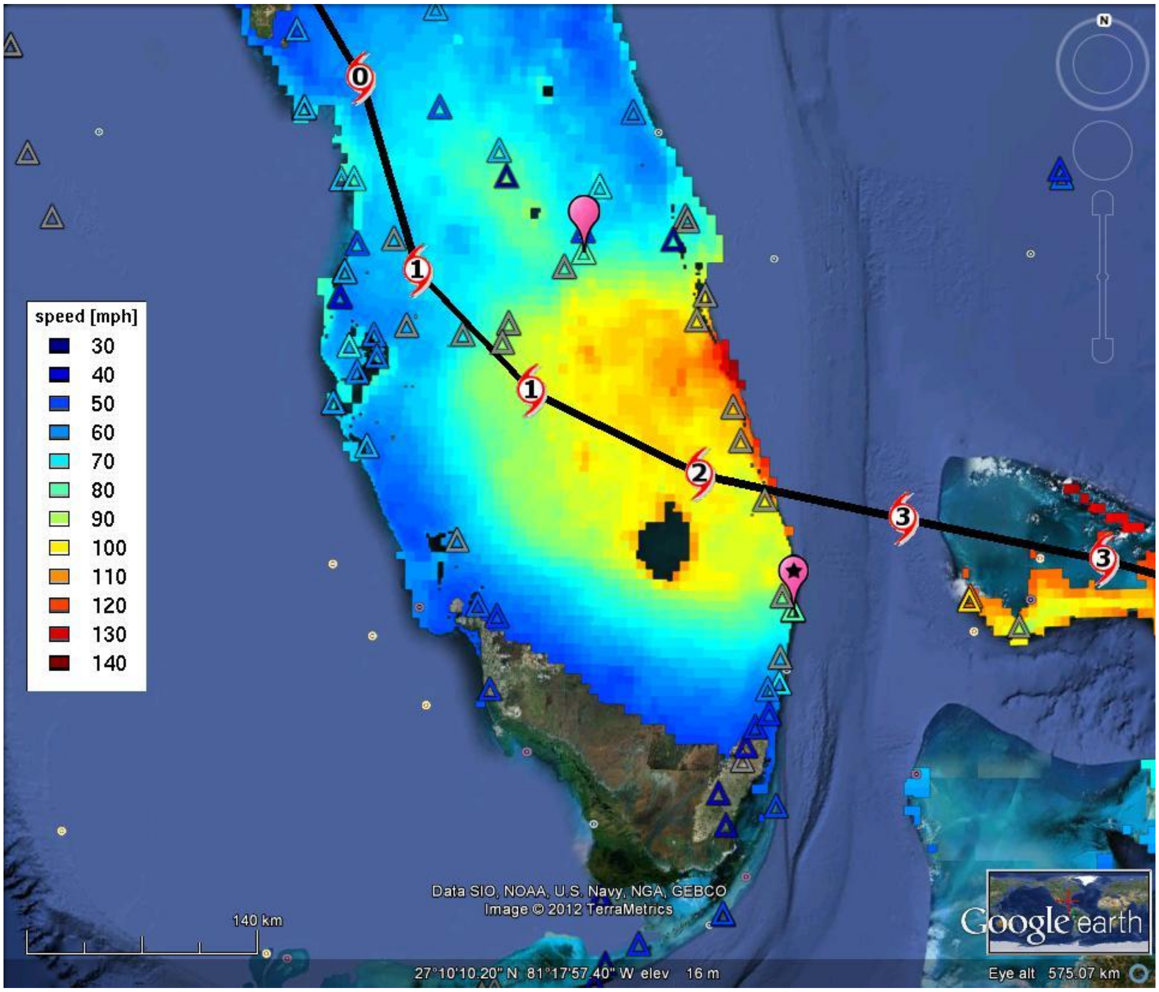


Figure 19: Two Station Time Series of 3-Second Gust Wind Speeds Comparing Model with Observations for Hurricane Jeanne (2004)

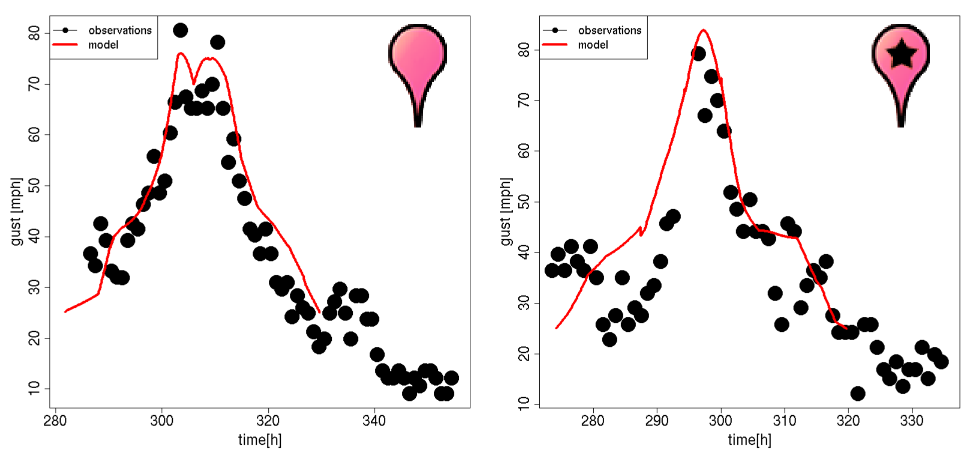


Figure 20: As Figure 16 but for Hurricane Wilma (2005)

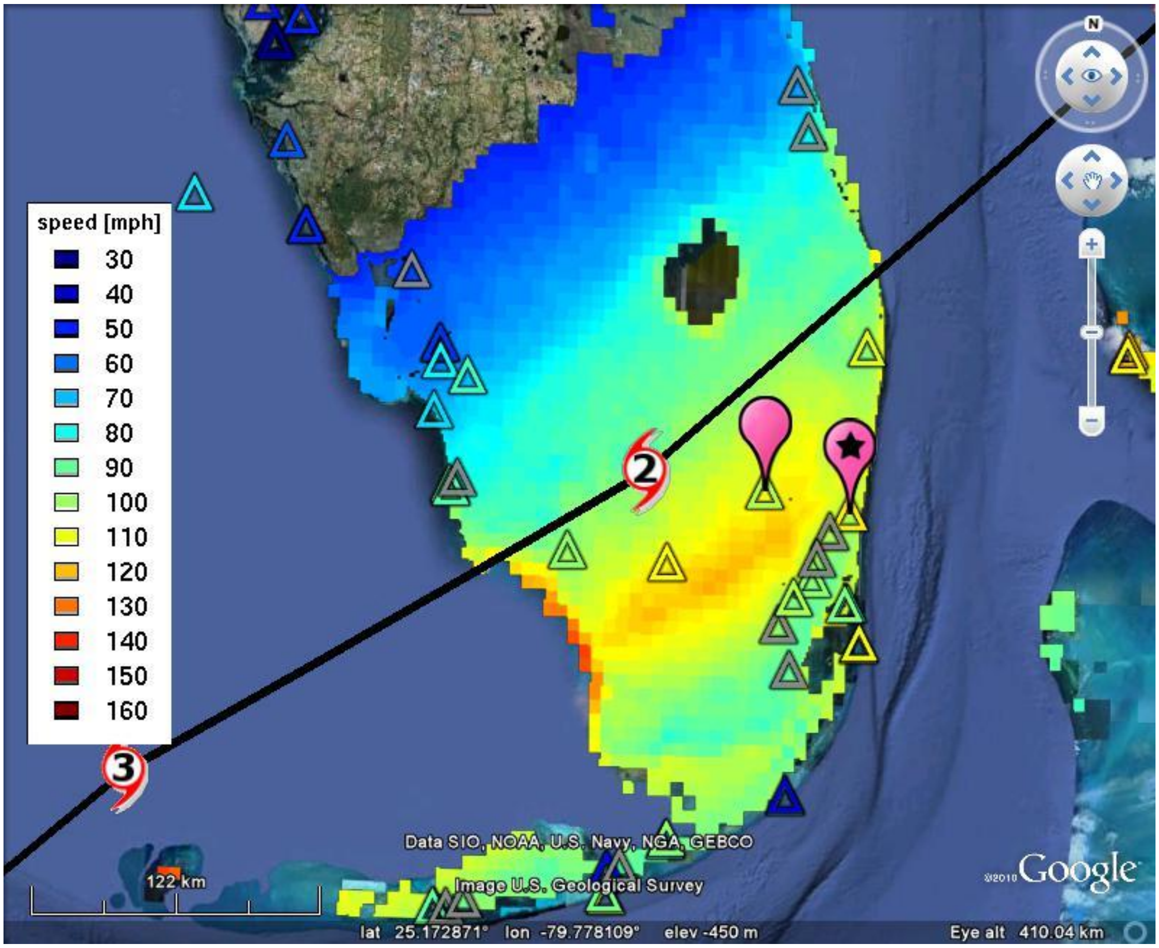


Figure 21: Two Station Time Series of 3-Second Gust Wind Speeds Comparing Model with Observations for Hurricane Wilma (2005)

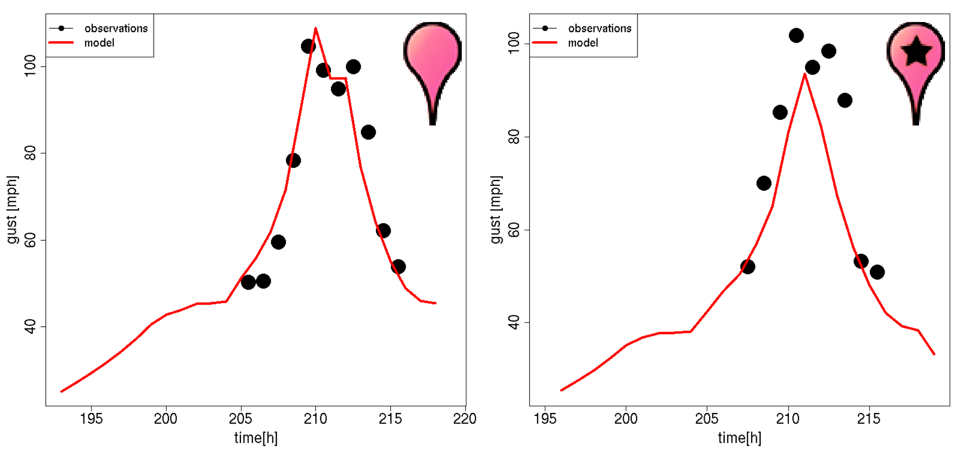


Figure 22: As Figure 16 but for Hurricane King (1950)—Gray Triangles Indicate Stations for which no Peak Wind Speed was Provided

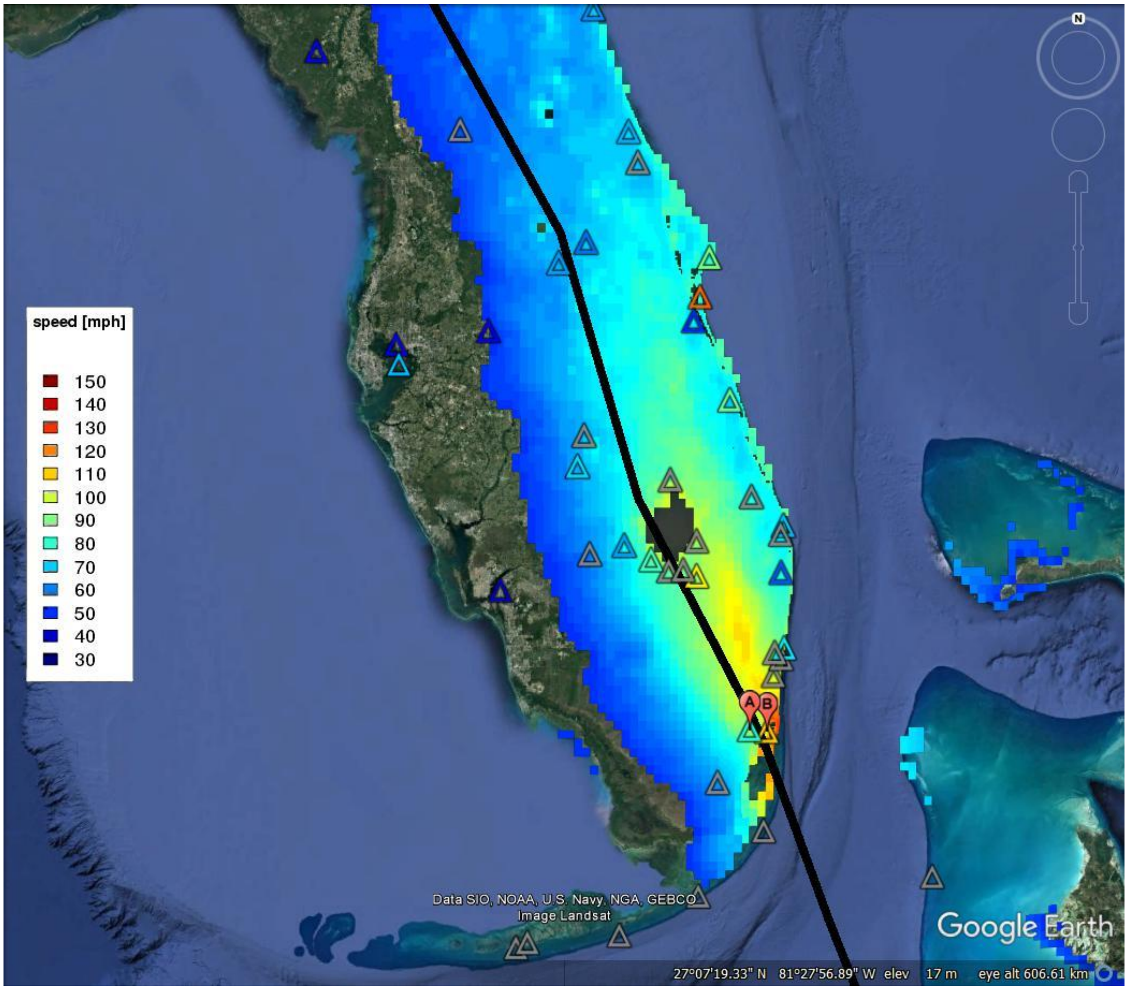


Figure 23: Station Time Series for (A) Miami Airport and (B) Miami Downtown Weather Bureau of 3-Second Gust Wind Speeds Comparing Model with Observations for Hurricane King (1950)

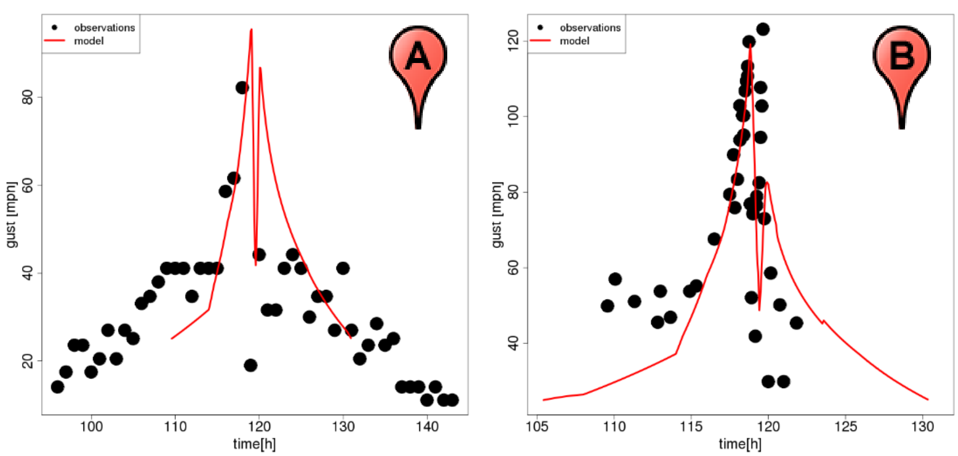


Figure 24: Passage of the calm center of the hurricane eye over Miami for King 1950, as shown in Monthly Weather Review (Left panel). Snapshot of the reconstructed model wind field for King 1950 (Right panel), showing passage of the calm center of the hurricane eye over Miami just after landfall. Stations shown in Figure 22 are marked.

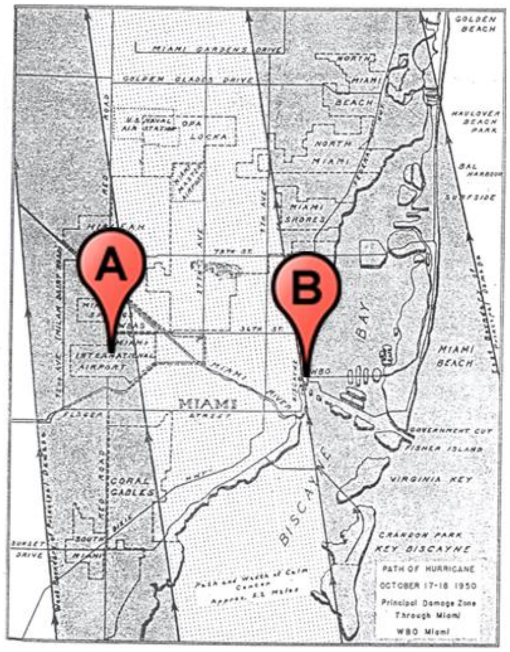
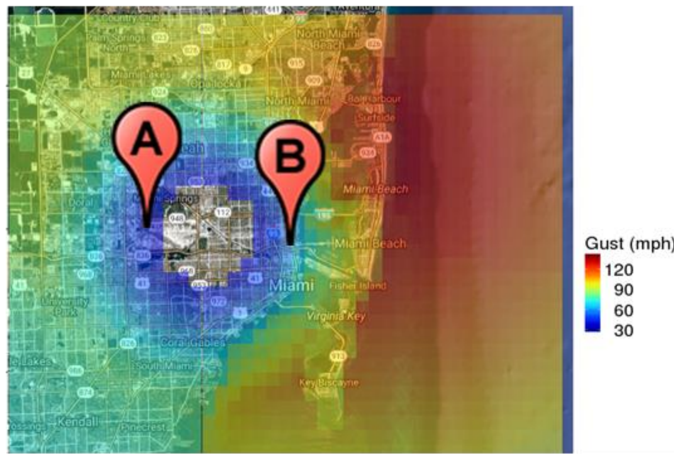


FIGURE 5.—Map showing hurricane King's path across Miami and vicinity. Darker shading indicates areas of greatest damage.



M-4.10 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).

Charley (2004), Jeanne (2004), Wilma (2005), and King (1950) vary substantially from each other. Charley was an intense storm (Category 4) with a small Rmax and a fast filling rate, while Wilma was weaker (Category 3) but affecting a larger area (large Rmax) with a slow filling rate. Jeanne was a Category 3 at landfall, but differed from both Wilma and Charley in that it made landfall on the southeastern coast of Florida, the first major hurricane to hit in that area since 1899. King was the only one of these major hurricanes to strike Miami directly, with an Rmax small enough to enable the calm center of the hurricane eye to pass between the Miami Airport and Downtown Weather Bureau stations. This variability is taken into consideration by assigning a set of realistic track parameters (Vmax, Rmax, etc.) to each of these storms. As demonstrated in Disclosure M-4.9, modeled wind fields are in agreement with observations for these four hurricanes.

M-4.11 Describe any variations in the treatment of the model windfield for stochastic versus historical storms and justify this variation.

Stochastic and historic storms are modeled with the same wind field model. In the stochastic catalog the gusts over land reflect the changes in land use land cover data described in Standard M-4.B. The historical gusts are calculated as in the previous submission in order to remain consistent with the urban exposures of the 2004–2005 seasons.

M-4.12 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 [Form M-2].

The open terrain land-use type is the smoothest land surface in the model. This is why the wind fields assuming open terrain have generally higher wind speeds than the wind fields assuming real terrain (as the roughness length over land are generally larger).

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 RMS inland filling model simulates central pressure decay rates that are consistent with historical records as demonstrated in Disclosures M-5.1 and S-1.6. The model follows a methodology similar to the one proposed in Vickery (2005) and is described in detail in Colette et al. (2010).

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 is modeled using well accepted wind engineering methods following Cook (1985, 1997), Land-use land-cover data is sampled upstream of each site along eight different directional sectors. The methodology has been validated against the most recent measurements (e.g., Zhu et al., 2010, Masters 2004) from Hurricanes Rita and Ike.

M-5.1 Describe and justify the functional form of hurricane decay rates used by the model.

Hurricane decay rates are modeled through the RMS over land intensity model, also called “inland filling model.” This filling process happens shortly after landfall as storms are removed from their primary energy source, namely the heat fluxes from the warm oceanic tropical waters. The formulation of the model follows the one proposed by Vickery (2005):

$$P_c(t - t_0) = FFP - \left(FFP - P_c(t_0)\right)e^{-\alpha(t-t_0)}$$

where:

- P_c is the storm central pressure,
- T_0 is the time of landfall
- FFP is the far field pressure
- α inland filling rate

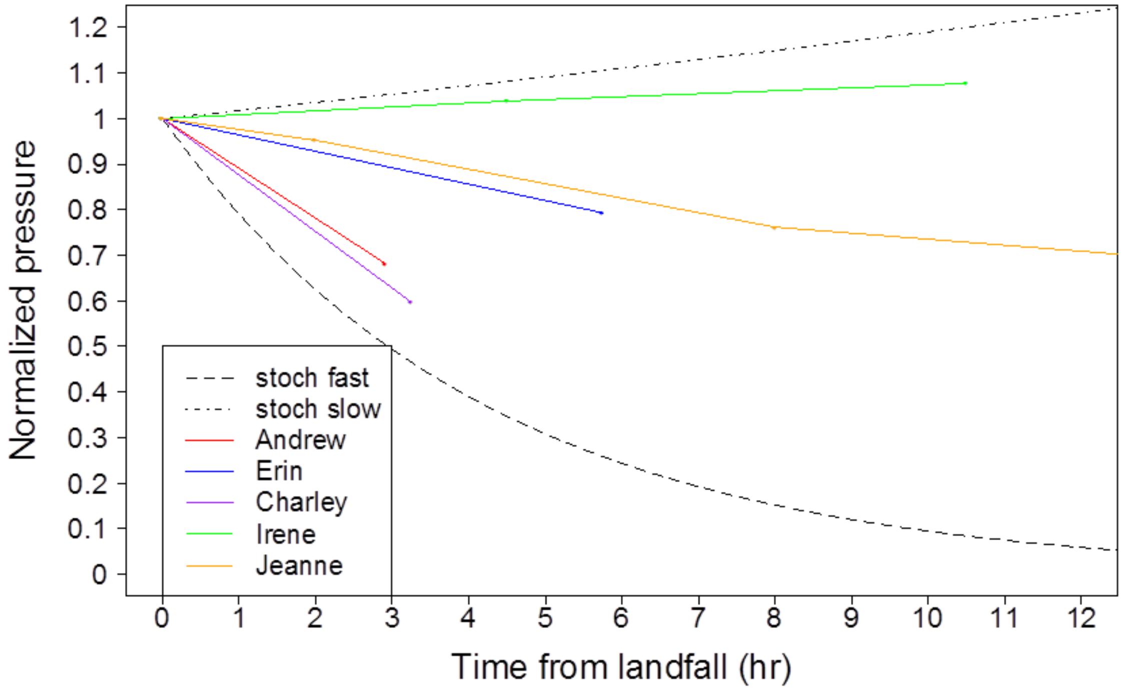
In Florida, the inland filling rate is drawn from a normal distribution with a mean that depends on pressure difference (FFP-$P_c(t_0)$), translational speed and Rmax at the time of landfall, as well as two predictors that describe the proportion of the storm over different terrain at and just after the time of landfall: the proportion of the storm to the right of the track that is over water, and the proportion of the storm that is over terrain classified as urban or forest.

On average, small storms fill faster than large storms, intense storms fill faster than weak storms and fast moving storms fill faster than slow moving storms. Also, storms hitting the south tip of Florida and keeping a large area of their circulation over water will fill more slowly than more generic landfalling storms.

M-5.2 Provide a graphical representation of the modeled decay rates for Florida hurricanes over time compared to wind observations.

Figure 25 illustrates a comparison of the normalized central pressure time series for key historical Florida land-falling storms compared with the RMS stochastic set’s fastest (0.1th percentile) and slowest (99.9th percentile) filling rates. This figure demonstrates that the RMS inland filling model is able to capture the full population of observed decay rates ranging from fast decay (Andrew 1992, Charley 2004) to slow decay (Erin 1995, Jeanne 2004) or even weak intensification for low intensity storms hitting the south tip of Florida (Irene 1999).

Figure 25: Normalized central pressure time series as a function of time from landfall. The dashed black lines give the stochastic model envelope (0.1th and 99.9th percentiles). Colored time series correspond to historical central pressure time series.



To perform a comparison between observed and modeled wind speeds, RMS scientists have reconstructed historical events starting from the modeled central pressure time series and not the historical HURDAT central pressure time series. The modeled pressure time series has been calculated using the RMS inland filling model (given the storm characteristics). This pressure time series is used to develop a wind footprint which is compared to station observations. Figure 26 presents one of these comparisons for Hurricane Frances 2004. This figure shows the model-derived peak gust footprint (in mph) for Hurricane Frances 2004 with wind stations used for comparison. Figure 27 is a scatterplot of modeled 3-second gusts compared against observed hourly maximum 3-second gusts from the stations. Table 9 presents the maximum gusts recorded and modeled at both inland and coastal stations. There is no systematic bias between modeled and observed gusts (both for coastal and inland stations).

Figure 26: Three-second gust wind footprint (in mph) for Hurricane Frances (2004). Triangles locate a subset of stations used for the reconstruction. As mentioned in the text, the central pressure time series is given by the RMS inland filling model and not by the HURDAT time series.

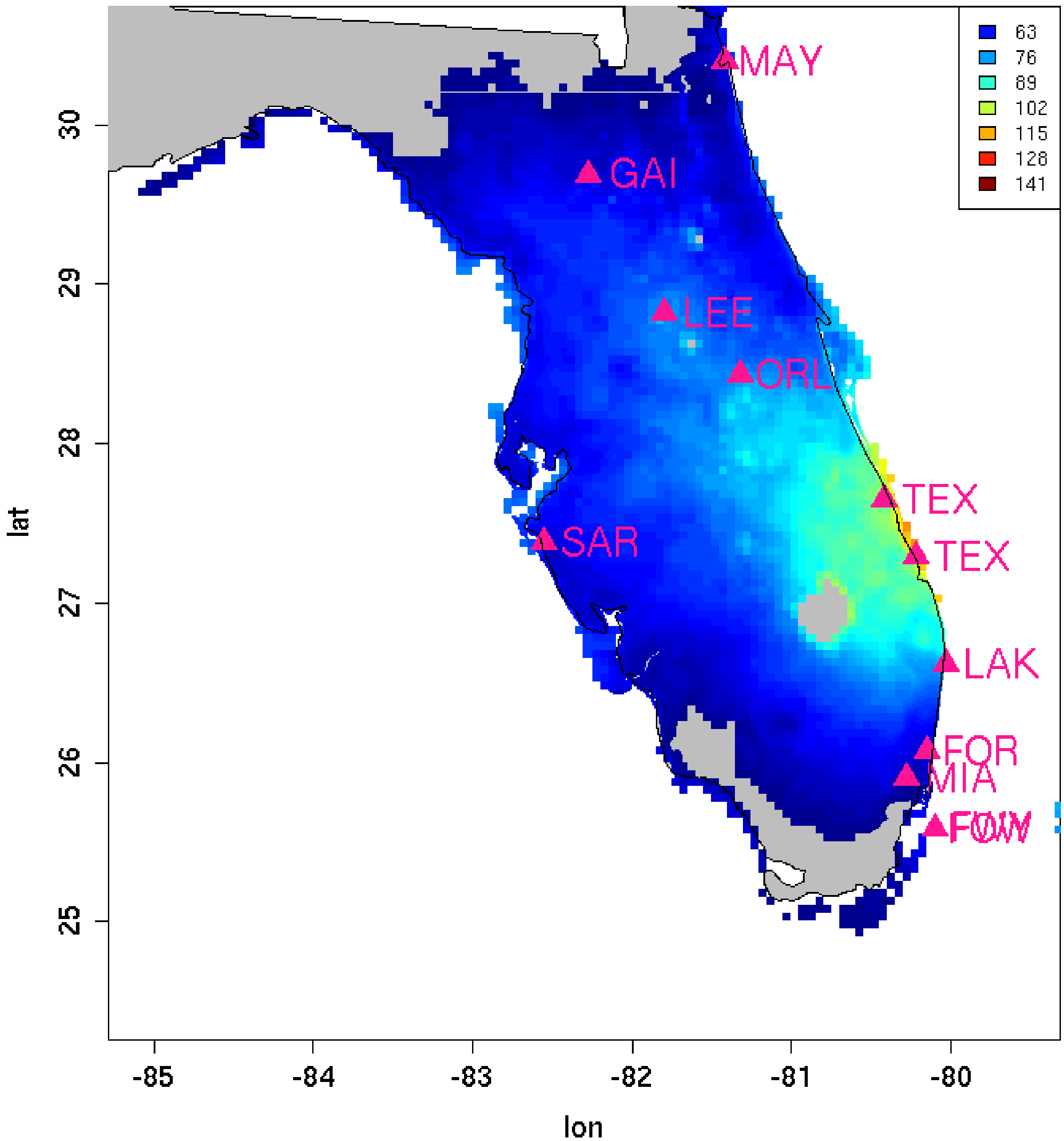


Figure 27: Scatterplot of Modeled versus Observed 3-Second Gusts (mph) for Hurricane Frances

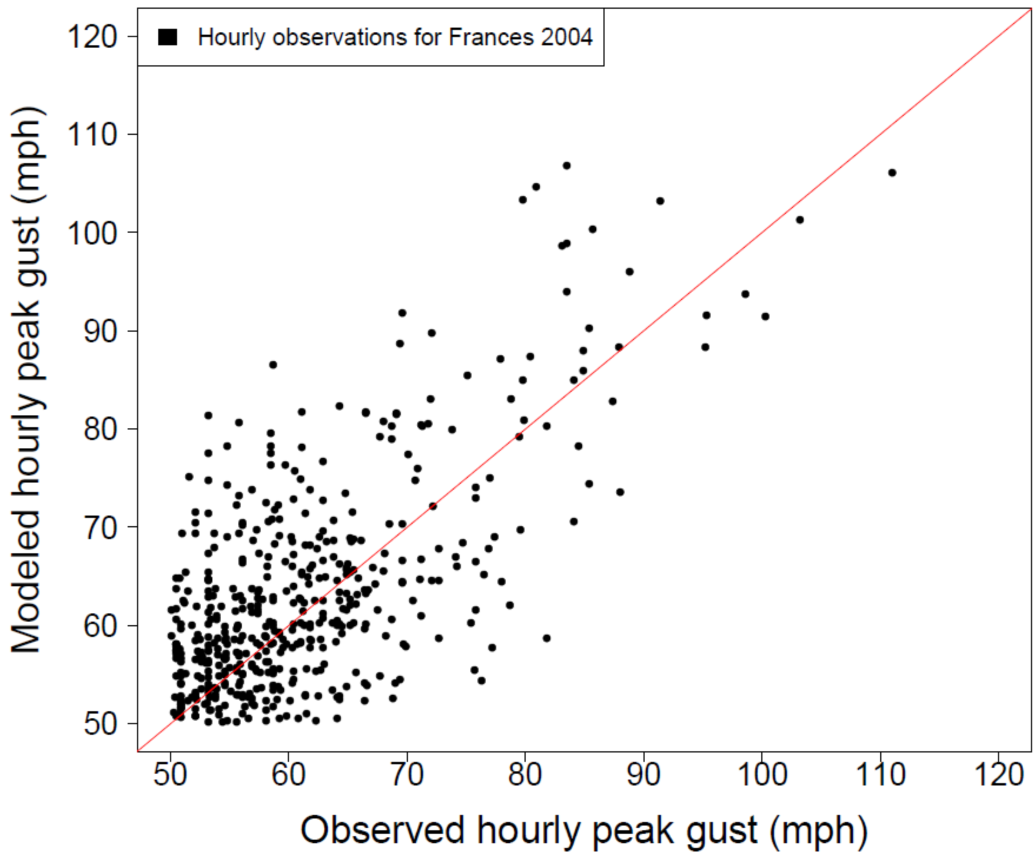


Table 9: Observed and Modeled Maximum Peak Gusts at the Stations with Locations given on Figure 26

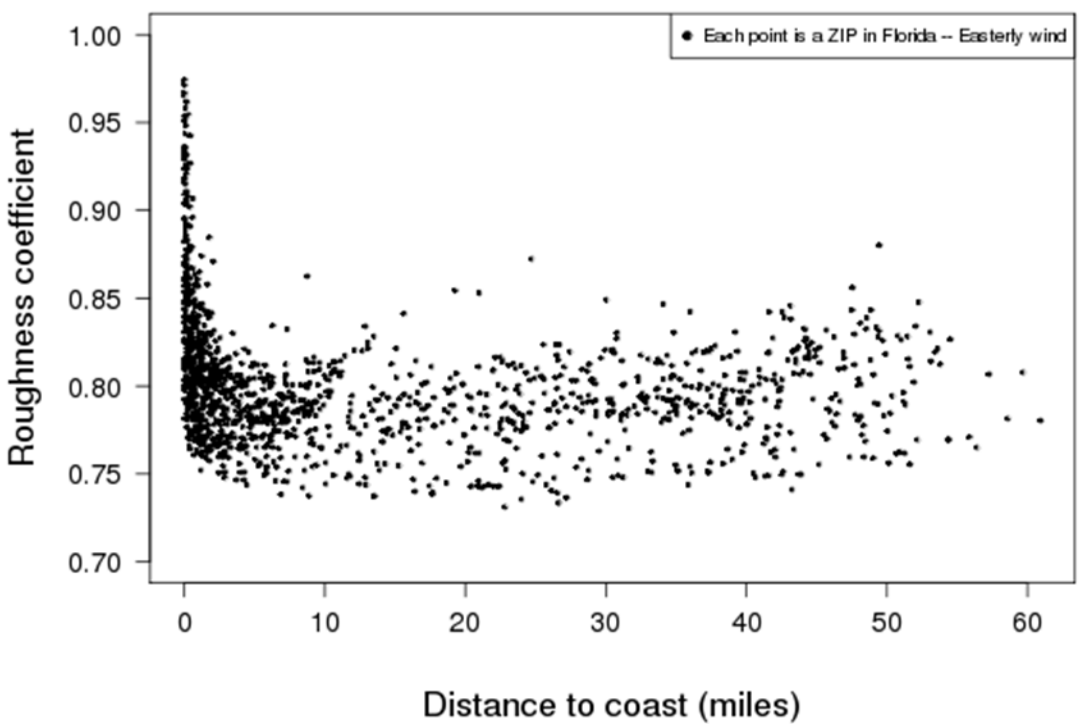
Code	Station_name	Observed Peak Gust (mph)	Modeled Peak Gust (mph)
FWY	FWYF1	65.8	64.1
SET	SETTLEMENT POINT	91.4	106.8
SPG	SPGF1	111	106.0
TEX	TexasTech Frances 04 SBCCOM_CI	95.3	91.6
MIA	MIAMI/OPA LOCKA	55.8	54.3
LAK	LAKE WORTH	75.1	90.1
TEX	TexasTech Frances 04 WEMITE 1	85.7	104.7
FOW	FOWEY ROCKS	65.7	64.1
ORL	ORLANDO INTL ARPT	71.2	73.8
FOR	FORT LAUDERDALE HOLLYWOOD INT	56.9	56.7
MAY	MAYPORT NS	60.4	59.9
LEE	LEESBURG MUNI ARPT	61.8	70.3
GAI	GAINESVILLE REGIONAL AP	66.4	55.4

M-5.3 Describe the transition from over-water to over-land boundary layer simulated in the model.

RMS models the transition from over-water to over-land boundary layer using the roughness and gust factors described in Standard M-4. Over-water roughness lengths have been derived from GPS sonde observations (Powell et al., 2003).

The water to land transition occurs over a finite fetch and the model accounts for the surface roughness upwind of each site of interest and along eight directional sectors. Figure 28 illustrates the dependency of the ZIP Code roughness factors with distance to coast. Roughness coefficients of coastal ZIP Codes are close to 1 and the drop in the roughness coefficient is localized within the first couple of miles from the coast. The spread around the mean is an outcome of the different roughness environments of each ZIP Code, with more built-up ZIP Codes having lower roughness factors.

Figure 28: Roughness Coefficient as a Function of Distance to Coast (in miles)—Each Point Corresponds to a Florida ZIP Code



M-5.4 Describe any changes in hurricane parameters, other than intensity, resulting from the transition from over-water to over-land.

Except for central pressure, all other hurricane parameters have a single model that is applied both over-water and over-land. As a reminder, because the Rmax model is dependent on central pressure, storms have a tendency to increase in size after landfall.

M-5.5 Describe the representation in the model of passage over non-continental U.S. land masses on hurricanes affecting Florida.

Hurricanes affecting Florida are part of the RMS North Atlantic hurricane track set. If a storm hits Cuba or Hispaniola, the inland filling model is triggered causing a weakening in storm intensity before it goes back over water. In the vicinity of Puerto Rico, storms have also a tendency to decay rather than intensify (as can be demonstrated from the HURDAT2 records).

M-5.6 Describe any differences in the treatment of decay rates in the model for stochastic hurricanes compared to historical hurricanes affecting Florida.

When modeling historical events, RMS uses observed central pressure time series as available in HURDAT2. Nevertheless, Disclosure M-5.2 has demonstrated that historical reconstructions using modeled central pressure time series can accurately simulate station wind observations.

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 the asymmetry increases with increasing translational speeds, all other factors being held constant.

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

The mean wind speeds decrease with increasing surface roughness; all other factors being held constant.

M-6.1 Describe how the asymmetric structure of hurricanes is represented in the model.

At each time step, the wind field is first computed relative to the moving frame. At this stage, the wind field is symmetric and is given by the vector field: $\boldsymbol{v}_r(r)$. The absolute wind field $\boldsymbol{v}_a(r,\theta)$ is obtained by performing the following vector sum:

$$\boldsymbol{v}_a(r,\theta) = \boldsymbol{v}_r(r) + \beta\boldsymbol{v}_t$$

where: v_t is the translational speed of the storm and β is a scalar lower than 1.

M-6.2 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 [Form M-3].

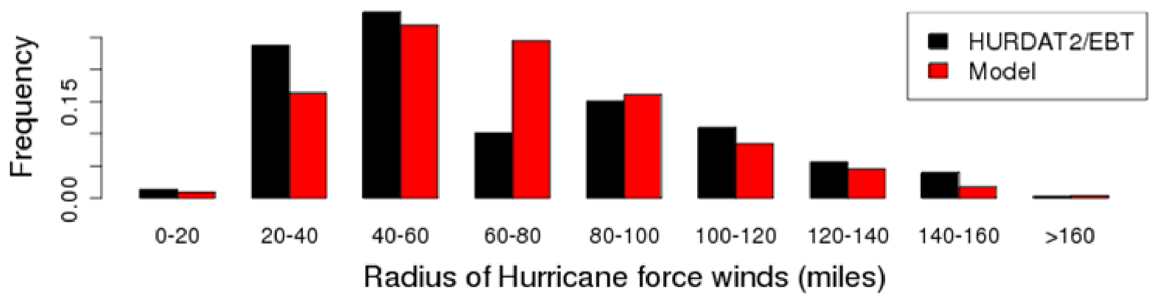
M-6.3 Discuss the radii values for each wind threshold in Form M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds, with reference to available hurricane observations such as those in HURDAT2. Justify the appropriateness of the databases used in the radii validations.

Modeled radii of maximum winds (Rmax), hurricane force winds and gale force winds have been compared to historical values in HURDAT2, supplemented by values in the extended best track dataset (Demuth et al., 2006) for periods over which HURDAT2 is not available. The comparison has been made using all tropical hurricanes in the basin, and not only storms hitting Florida. The comparison is generally very good, with the stochastic model spanning the range of observed values.

As an example, Figure 29 shows the comparison between historical and modeled radii of hurricane force winds for hurricanes having a central pressure between 930 and 970 hPa. We can see that the two distributions are close and that the model is capturing small storms like Charley 2004 and large storms like Isabel 2003 or Ike 2008.

For the radius of gale force winds, it should be noted that the model has a tendency to simulate slightly smaller radii than the values available in the extended best track dataset, especially on the low side of the distribution.

Figure 29: Radius of Hurricane Force Wind Histograms Comparing Observed Radii from HURDAT2 and Extended Best Track datasets (HURDAT2/EBT) (in black) with Simulated Radii (in red) for Hurricanes having a Central Pressure between 930 and 970 hPa



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.

RMS uses empirical methods in model development and implementation to match stochastic storm generation to historical data. These methods are supported by those described in currently accepted scientific literature and are outlined in Standards M-2 and M-3.

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.

The results of the RMS model are checked at all stages of development to ensure that the stochastic storm set includes physically realistic hurricanes and preserves the statistical characteristics of historical data. In addition, vulnerability curves have been developed based largely on actual event insured loss data.

Extensive comparisons using accepted scientific and statistical methods reflect good agreement between modeled and historical data. The checks performed by RMS include goodness-of-fit tests for the following:

- Central pressure (CP)
- Maximum 1-minute sustained wind (Vmax)
- Translational speed (also known as forward speed)
- Radius-to-maximum winds (Rmax)
- Landfall frequency
- Track crossing frequencies over a grid covering Florida

S-1.1 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 [Form S-3].

A list of variables and the distributions RMS uses for each follows. Graphical comparisons and p-values for goodness-of-fit tests are provided in Disclosure S-1.6.

Central Pressure

Central pressure is modeled through the change in pressure along the tracks. The mean pressure change varies in space and depends on several predictors. Deviations from the mean are assumed to be Gaussian. Central pressure is re-calibrated at landfall to match the distribution of historical values from HURDAT (Jarvinen et al., 1984.) RMS performed Kolmogorov-Smirnov and chi-square goodness-of-fit tests for the cumulative distribution function of pressure at landfall. The corresponding p-values show a reasonable agreement with the historical data.

Inland Filling Rate

The filling rate as hurricanes hit land follows a Gaussian distribution. The mean depends on several predictors which describe the intensity, size, and speed of the storm at landfall and other characteristics such as the area of the storm over different types of terrain. The coefficients of the relationship are estimated using least squares from synthetic storms created using the bogusing technique (Kurihara et al., 1993). The model fitting, selection and validation are described in Colette et al. (2010). The predictive power of the filling model is assessed using pressure time series over land from the HURDAT dataset. Histograms of observed and simulated filling rates in Florida, as well as plots of predicted pressure series over land for several historical hurricanes, show good agreement between model and data.

Maximum 1-Minute Sustained Winds (equivalent over water)

RMS uses a lognormal distribution for Vmax. The mean of Vmax depends on pressure difference (FFP-CP) and latitude, with the coefficients of the relationship estimated using HURDAT over-water data. A further calibration step ensures that the Vmax distributions by landfall region reproduce well the historical distributions from HURDAT2 (Landsea and Franklin 2013), for the period 1900–2014. RMS performed Kolmogorov-Smirnov and chi-square goodness-of-fit tests for the cumulative distribution function of Vmax at landfall. The corresponding p-values show a reasonable agreement with the historical data.

Track Translational Speed and Heading

Translational speed and storm heading are derived from the zonal and meridional track steps. The mean steps in both directions are location dependent and estimated from historical tracks in HURDAT. Deviations from the mean are assumed to be Gaussian with variances, autocorrelations and cross-correlations that are also location dependent and estimated by smoothing historical data. All length-scales involved in the smoothing weights are estimated using leave-one-out cross-validation (Hall and Jewson, 2007). RMS performed Kolmogorov-Smirnov and chi-square goodness-of-fit tests for the cumulative distribution function of translational speed at landfall. The corresponding p-values show a reasonable agreement with the historical data. The storm heading is validated using histograms by landfall segment.

Radius to Maximum Winds

RMS uses a lognormal distribution, truncated on the right side according to the storm category by pressure. The mean is a function of central pressure and latitude, the coefficients of the relationship being estimated using the extended best track dataset (Demuth et al., 2006). RMS performed Kolmogorov-Smirnov and chi-square goodness-of-fit tests for the cumulative distribution function of Rmax at landfall. The p-values for these tests showed a reasonable agreement with the historical data.

Wind Profile Parameters

The parameters X1 and N, which govern the shape of the wind field inside and outside the eye, are modeled as Gamma random variables. The means depend on previous values of X1 and N respectively, and on Rmax and translational speed. The coefficients of the model are estimated via iteratively reweighted least squares using RMS Hwind data (Powell et al., 2010). The modeled distributions for these parameters are validated by comparing histograms of various wind radii to the observed equivalents.

The position of Vmax with respect to the track is described by the wind profile parameter Amax, which is assumed to follow a truncated Gaussian distribution. The mean depends on translational speed, Rmax and previous values of Amax. The standard deviation depends on translational speed. A histogram of observed and stochastic Amax values is shown in Figure 40.

The coefficients corresponding to the four EOFs described in Disclosure G-1.2 are assumed to follow an autoregressive model of order 1.

Storm Frequency

RMS uses a Poisson frequency distribution with storm specific mean. The means of these distributions are calibrated toward the smoothed numbers of landfalls by coastal segment in the full historical set. RMS has performed the conditional chi-square and Neyman-Scott tests. RMS also performed a chi-square goodness-of-fit test to compare the modeled and historical landfall distributions over different sub-regions and intensities. The p-values show overall reasonable agreement.

Completed Form S-3 is provided at Form S-3: Distributions of Stochastic Hurricane Parameters.

S-1.2 Describe the nature and results of the tests performed to validate the windspeeds generated.

Wind speeds have been extensively validated against station data (from NOAA, Florida Coastal Monitoring Program, and Texas Tech University) over land, and RMS HWind and buoy data (from the National Data Buoy Center) over water. The modeled wind speeds are compared to observed data both at specific time steps (snapshot comparisons) and in terms of the maximum achieved at each location (footprint comparisons).

The example validations presented in this section compare model and station data for several storms, including Andrew (1992) and all the historical events from 2004 onward, at locations in Florida and a buffer surrounding it. Observed and modeled wind speeds are 3-second peak gusts.

We tested for overall bias in the estimates by comparing the average modeled wind speed to the average observed wind speed. This comparison shows a negligible over-estimate of less than 1 mph over all footprints. The comparison gives similar results over all snapshots, indicating a very slight over-estimate of less than 2 mph. The proportion of data points for which the modeled values are within 10%, 20%, 30%, and 40% of the observed wind speeds are shown in Table 10, for all footprints and all snapshots.

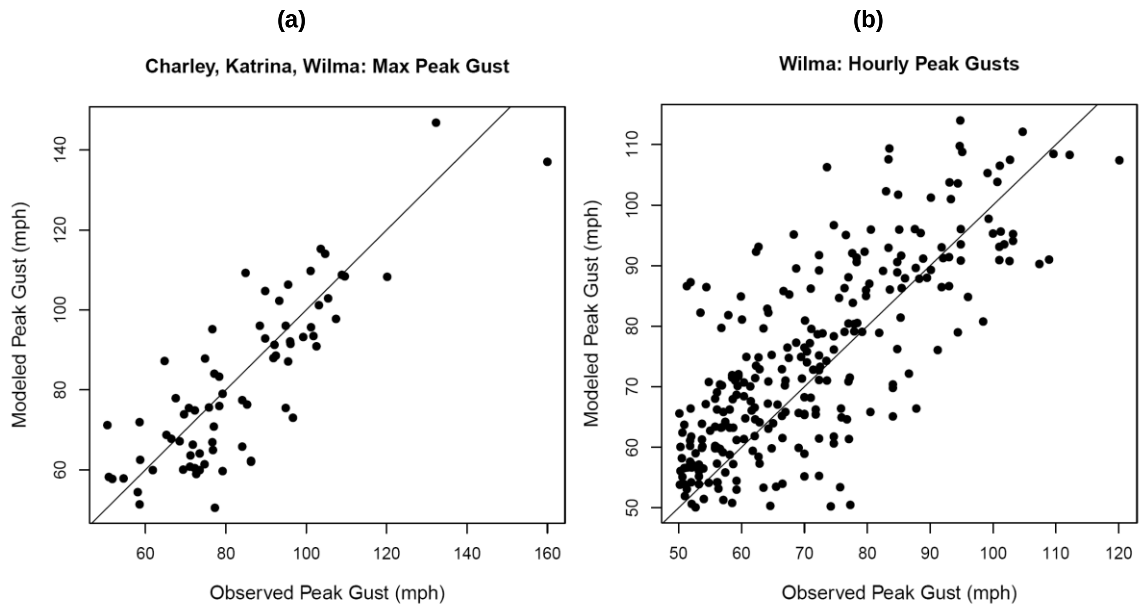
Table 10: Portion of Modeled Wind Speeds within 10%, 20%, 30%, and 40% of the Observed Value

Difference Range	Proportion of Data Points	
	Footprints	Snapshots
± 10%	55%	58%
± 20%	81%	85%
± 30%	93%	95%
± 40%	99%	98%

Several graphical validations of observed versus modeled wind speeds are shown in Standard M-4, including footprints with overlaid observations, as well as example modeled and observed time series at several stations.

Additional graphical comparisons are shown in Figure 30. Figure 30(a) is a scatterplot of modeled versus observed wind speeds for the footprints of Charley (2004), Katrina (2005), and Wilma (2005). Observed and modeled snapshot data are compared in Figure 30(b) for Hurricane Wilma (2005). Both scatterplots demonstrate a reasonable agreement between modeled and observed wind speeds.

Figure 30: Modeled versus Observed Wind Speeds (3-second peak gust)



S-1.3 Provide the date of loss of the insurance claims data used for validation and verification of the model.

The year of the loss is given below:

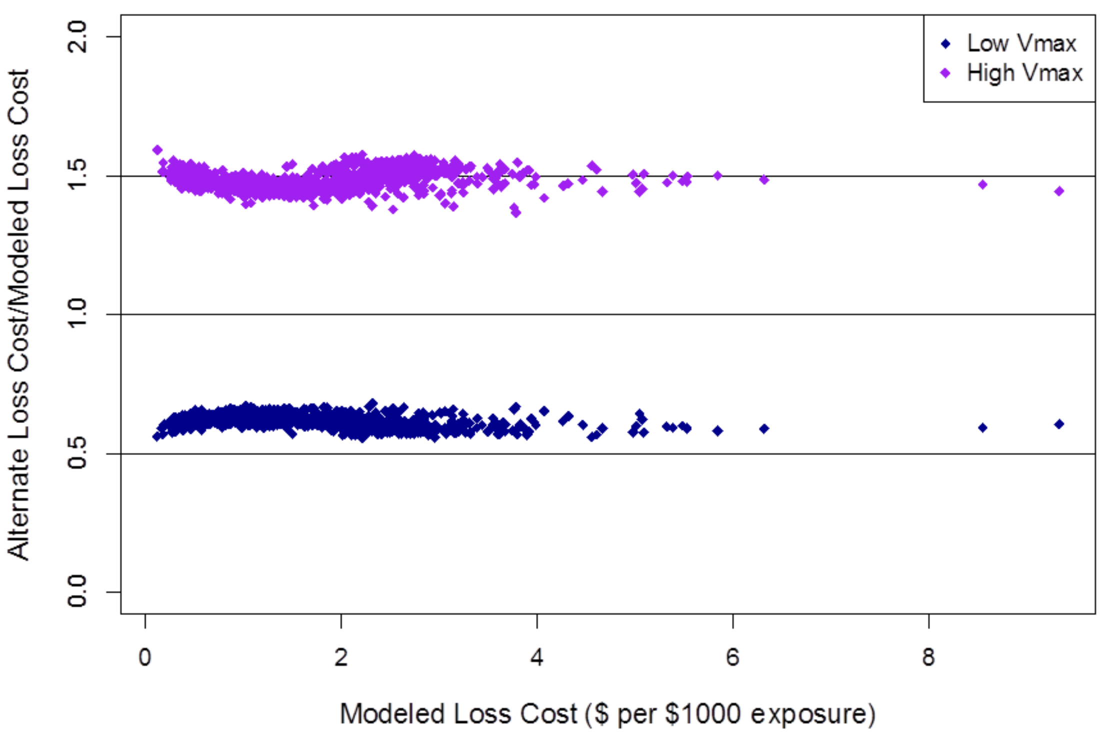
- Hugo–1989
- Bob–1991
- Andrew–1992
- Erin–1995
- Opal–1995
- Fran–1996
- Georges–1998
- Charley–2004
- Frances–2004
- Ivan–2004
- Jeanne–2004
- Dennis–2005
- Katrina–2005
- Rita–2005
- Wilma–2005
- Ike–2008
- Irene–2011
- Isaac–2012
- Sandy–2012

S-1.4 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.

The uncertainty analysis presented in the RiskLink 11.0.SP2c submission in Form S-6 identified far field pressure (FFP) and central pressure (CP) as the main contributors to the uncertainty in loss costs, followed by the radius to maximum winds (Rmax). Further analysis of the uncertainty in loss cost for output ranges focuses on intensity and size, as previous submissions have shown the other parameters to contribute considerably less to the total uncertainty. Since the maximum sustained wind (Vmax) depends on both FFP and CP, this one parameter is used in this disclosure to assess the uncertainty in loss cost due to uncertainty in intensity.

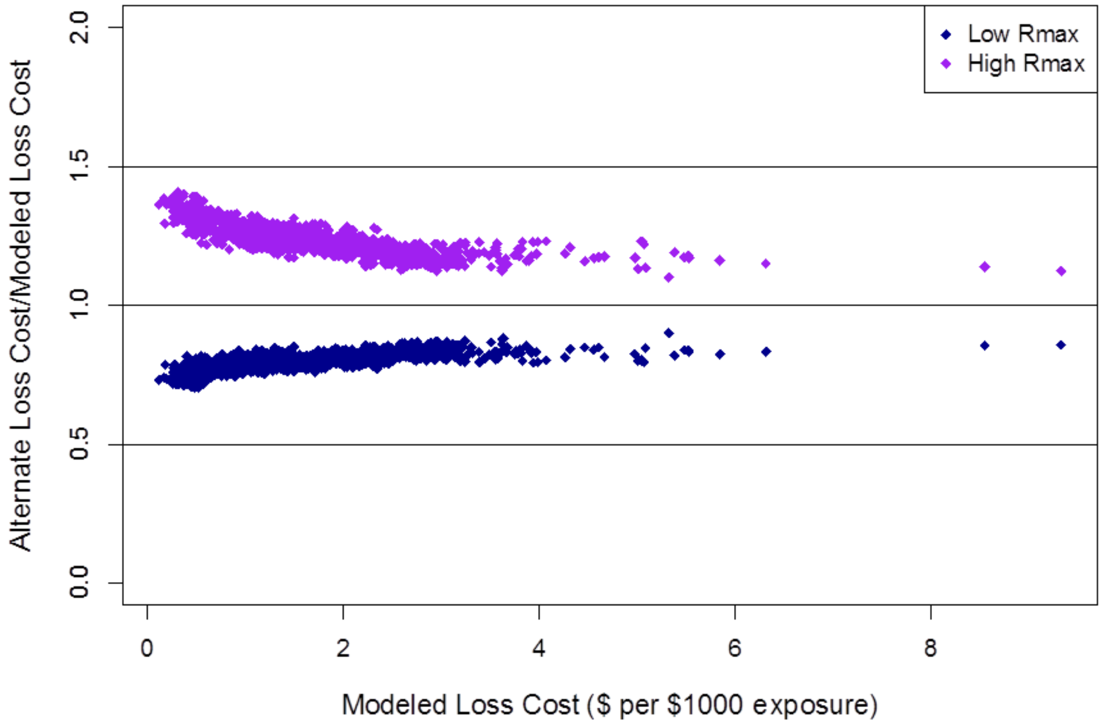
Figure 31 shows the uncertainty in loss costs for output ranges due to the uncertainty in Vmax. In the figure, each point represents the average annual loss per $1,000 of exposure for a ZIP Code. Vmax is set to "low" and "high" values to obtain alternate loss costs, which are compared to the original losses. The 5% and 95% confidence bounds on the Vmax CDF are used to set the "low" and "high" limits (the 99% confidence bounds are shown in Figure 36). The blue (purple) points show the ratio of alternate to original loss costs when Vmax is set to "low" ("high") versus the loss cost resulting from the original modeled Vmax.

Figure 31: Uncertainty in Loss Costs due to Vmax



The uncertainty in the loss costs for output ranges due to the uncertainty in the Rmax cumulative distribution function is shown in Figure 32. Each point represents the average annual loss per $1,000 of exposure for a ZIP Code. Rmax is set to "low" and "high" values to obtain alternate loss costs for comparison with the original losses. The 5% and 95% confidence bounds on the Rmax CDF are used to set the "low" and "high" limits (the 99% confidence bounds are shown in Figure 39). The blue (purple) points show the ratio of alternate to original loss costs when Rmax is set to "low" ("high") versus the loss costs corresponding to the original modeled Rmax.

Figure 32: Uncertainty in Loss Costs due to Rmax



Similar analyses were performed for several return level losses at the high end of the distribution. Figure 33 and Figure 34 show the effect of uncertainties in Vmax and Rmax on 100-year ZIP Code losses. Comparison of Figure 31 and Figure 33 demonstrates that the effect of the uncertainty in Vmax is fairly similar for 100-year losses to the effect for the loss costs. The uncertainty in Rmax impacts the 100-year loss (Figure 34) less than the loss cost (Figure 32) for the majority of ZIP Codes, although with a greater variability across ZIP Codes.

Figure 33: Uncertainty in 100-Year Loss due to Vmax

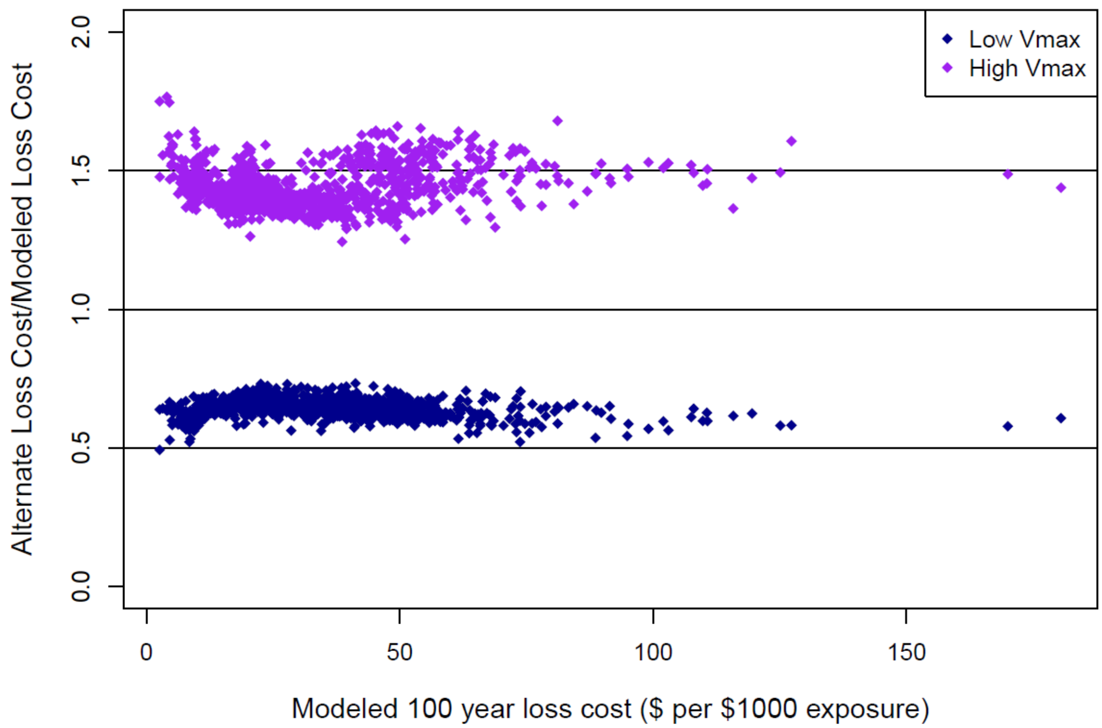
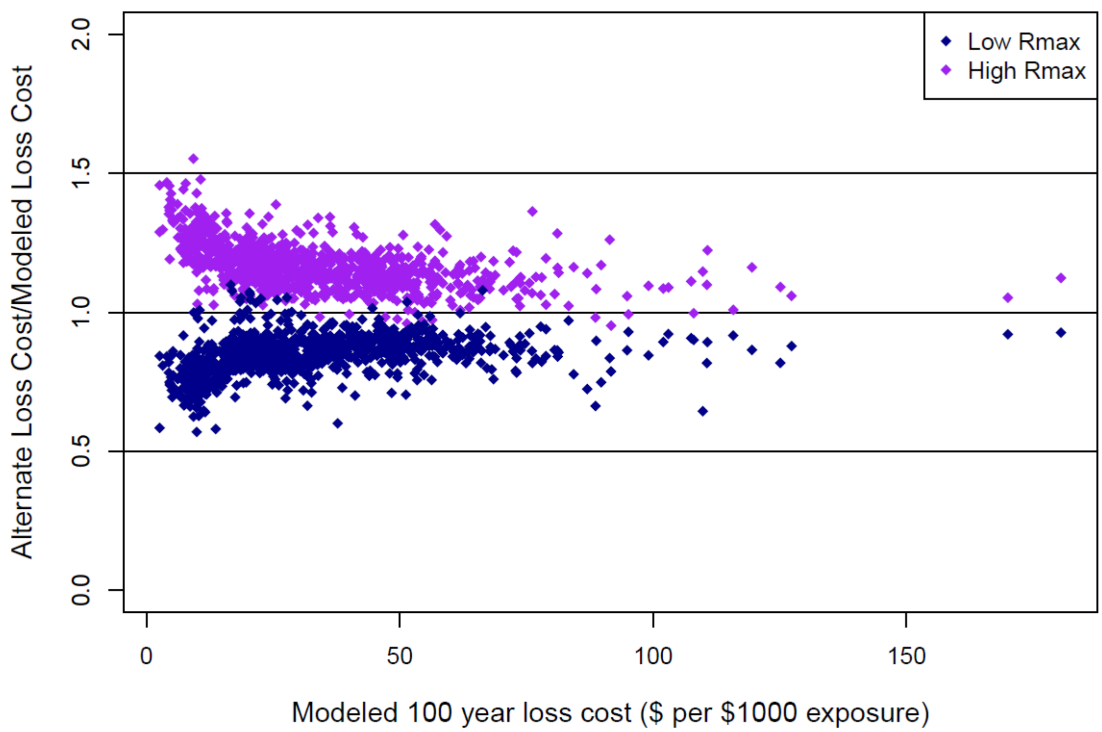


Figure 34: Uncertainty in 100-Year Loss due to Rmax



S-1.5 Justify any differences between the historical and modeled results using currently accepted scientific and statistical methods in the appropriate disciplines.

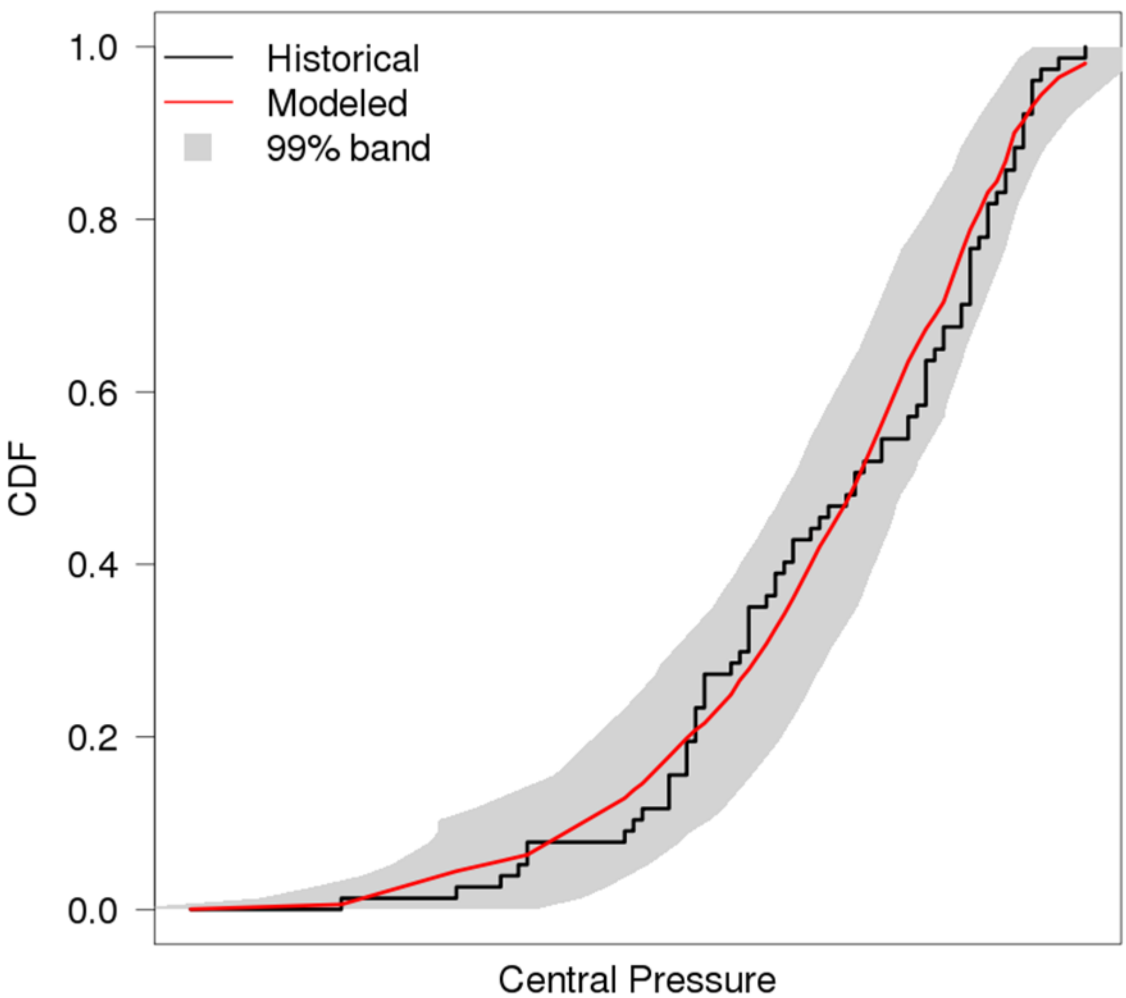
Historical and modeled results are in agreement according to currently accepted statistical methods.

S-1.6 Provide graphical comparisons of modeled and historical data and goodness-of-fit tests. Examples include hurricane frequencies, tracks, intensities, and physical damage.

<u>Intensity—Central Pressure, Vmax and Inland Filling Rate</u>

Figure 35 shows a comparison of stochastic and observed central pressure distributions in Florida and neighboring states. The observed and modeled cumulative distribution functions (CDFs) are shown in black and red respectively. The gray area represents a pointwise 99% band around the modeled CDF.

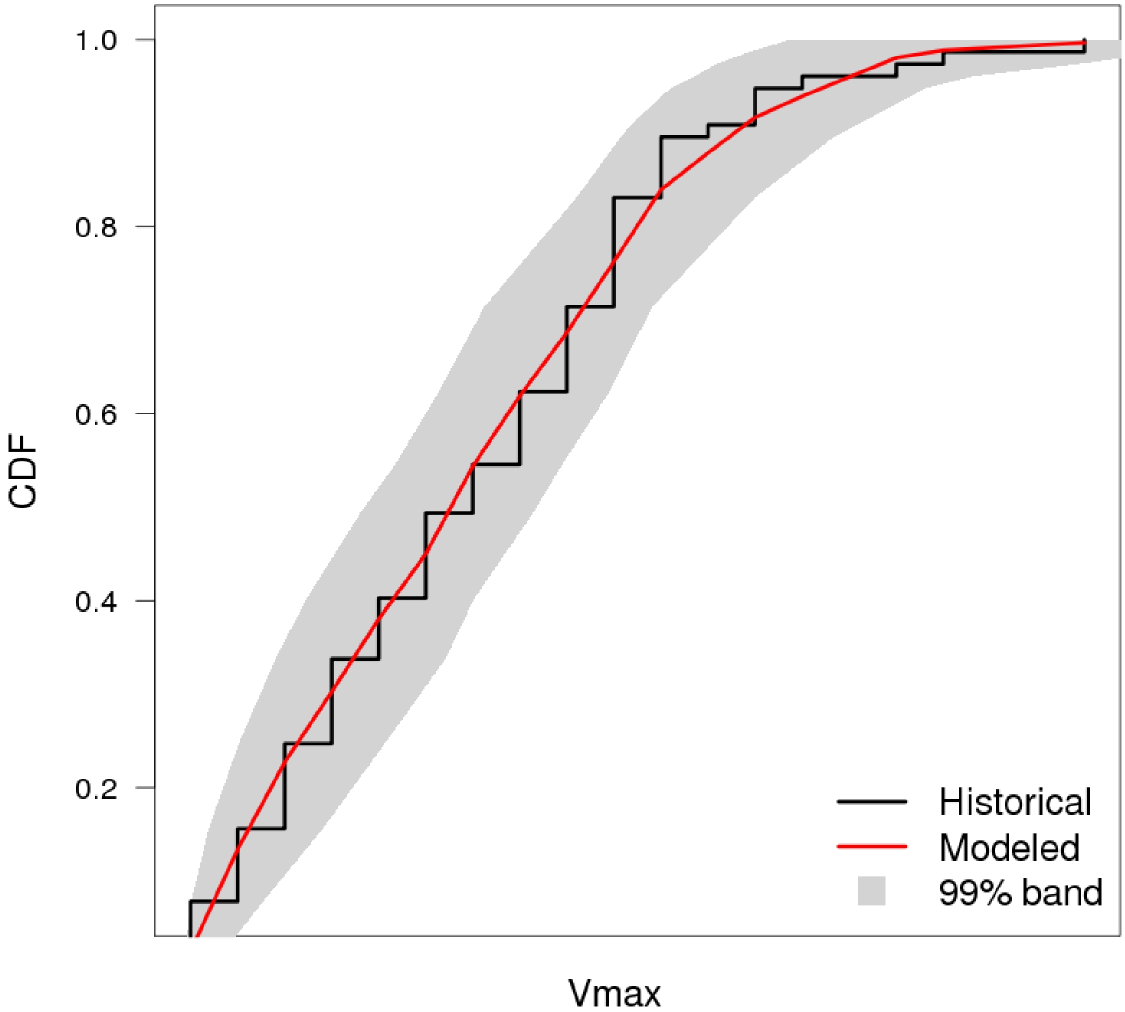
Figure 35: Central Pressure Cumulative Distribution Function (CDF)



The Kolmogorov-Smirnov test corresponding to the CDFs in the figure above produces a p-value of 54%. A chi-square test with eight cells produces a p-value of 7%. The historical data used for comparison is from the HURDAT2 database landfall summary, as of September, 2015.

Figure 36 shows a similar comparison for Vmax.

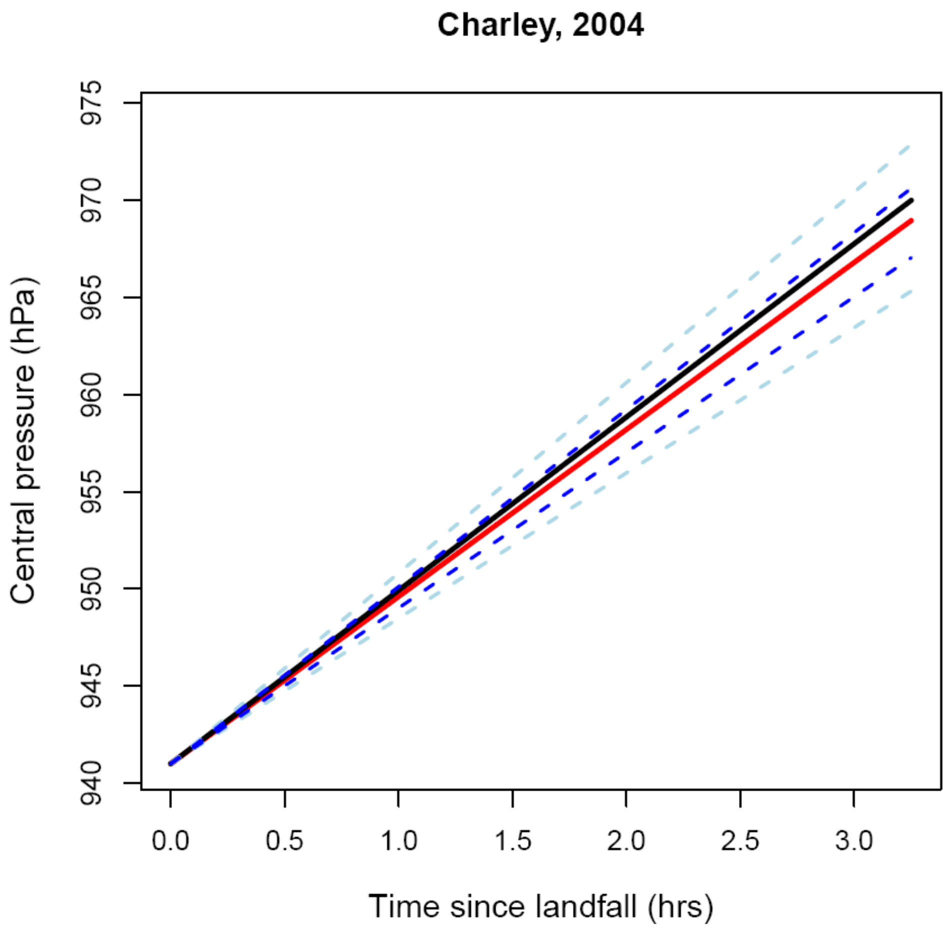
Figure 36: Vmax Cumulative Distribution Function (CDF)



The Kolmogorov-Smirnov test corresponding to the CDFs in the figure above produces a p-value of 78%. A chi-square test with eight cells produces a p-value of 52%. The historical data used for comparison is from the HURDAT2 6-hourly database as of September, 2015.

A graphical comparison for the inland filling rate is shown in Standard M-5, where the central pressure series over land, normalized by the corresponding landfall pressures, are plotted for fast and slow modeled filling in Florida, together with several historical cases. In addition, Figure 37 shows the historical pressure series over Florida for Charley (2004; black line), together with the pressures corresponding to the predicted filling rate (red), the middle 50% (dark blue), and 90% (light blue) simulated filling rates for this storm.

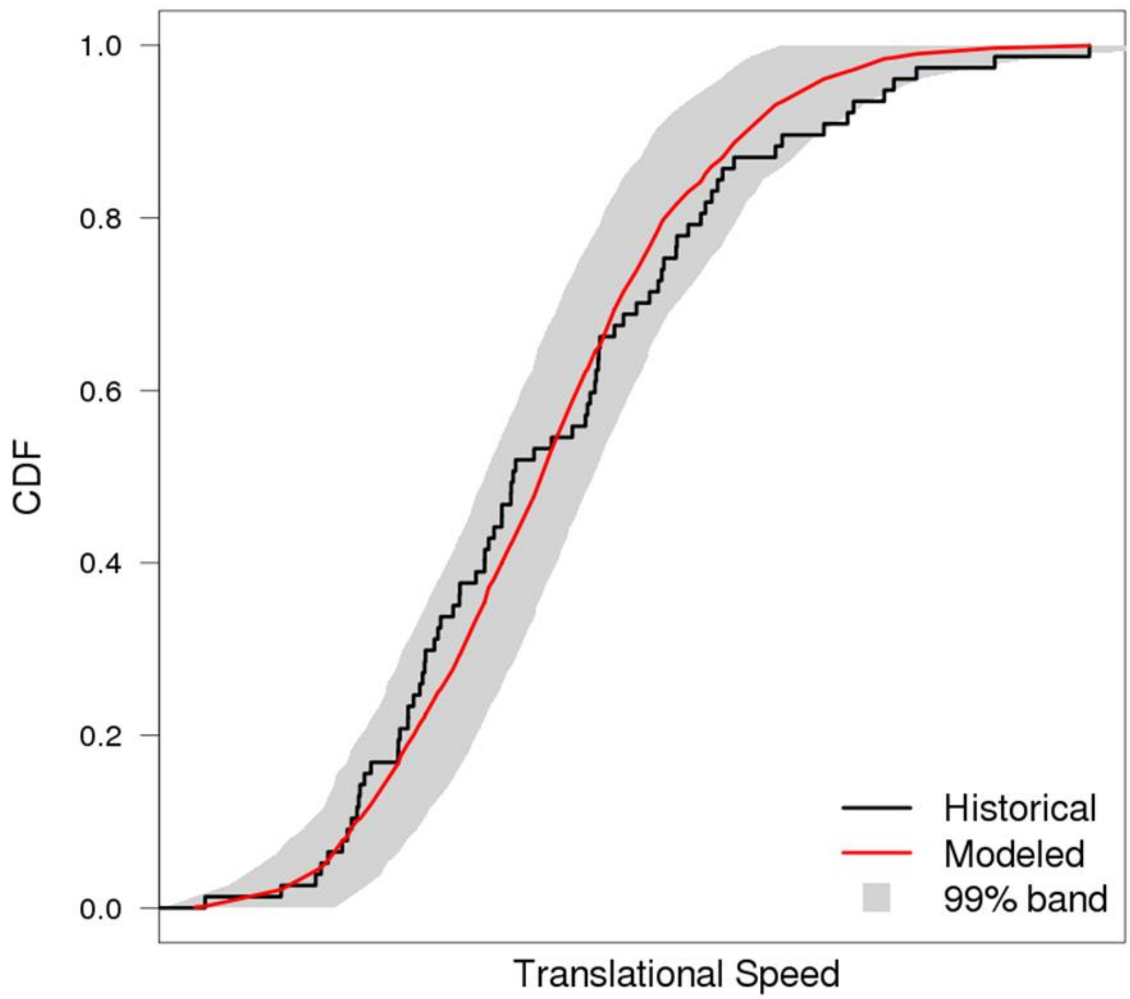
Figure 37: Pressure Time Series Over Land with Observed (black), Predicted (red), and Simulated (dark blue for 50% and light blue for 90% bands) Filling Rate



Translational Speed and Heading

Figure 38 compares historical and modeled distributions of translational speed.

Figure 38: Translational Speed (Forward Speed) Cumulative Distribution Function (CDF)



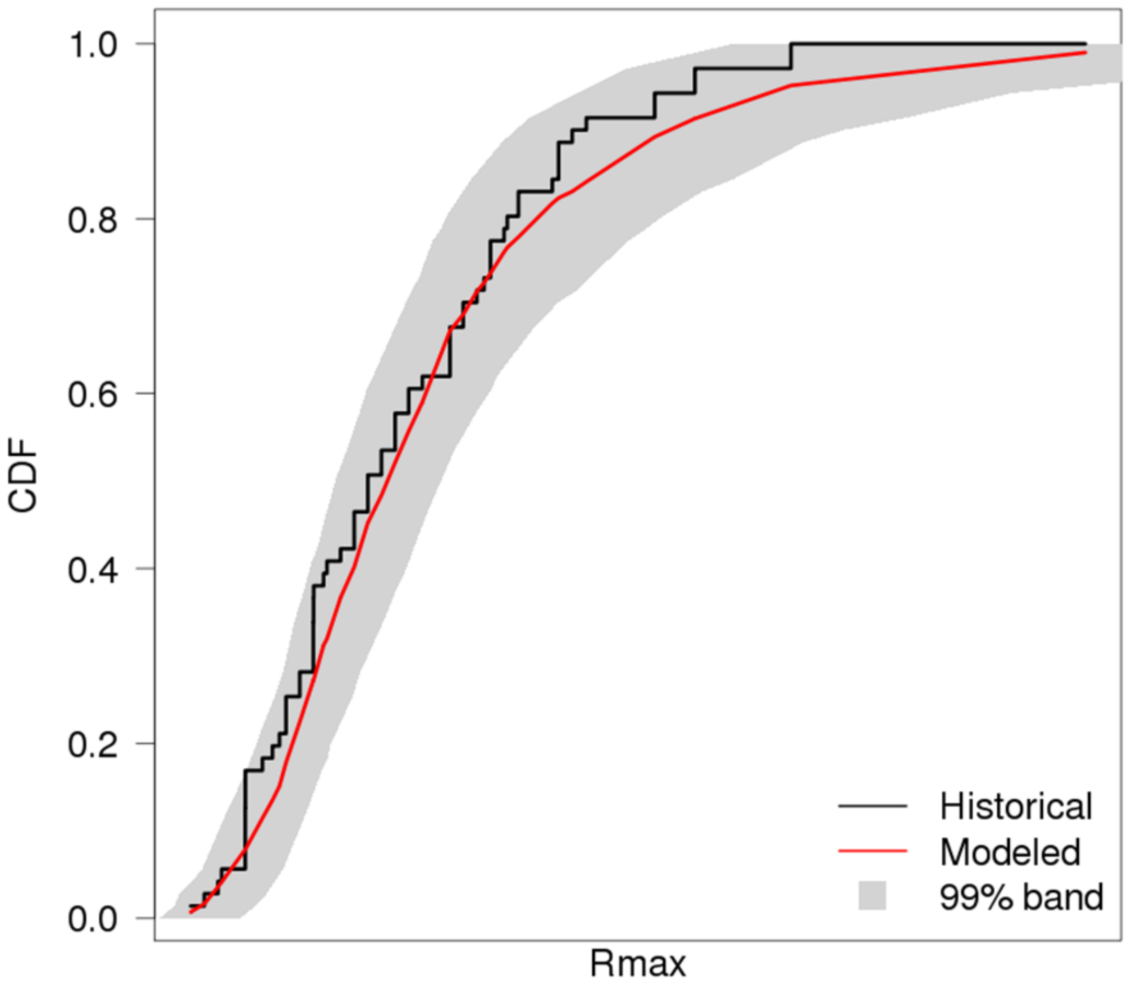
The Kolmogorov-Smirnov test on the translational speed produces a p-value of 58%, and a chi-square test with eight equal cells produces a p-value of 48%. The historical data used for comparison is from the HURDAT2 6-hourly database as of September, 2015.

Histograms of historical and modeled storm heading for different coastal segments in Florida and neighboring states are shown in Standard M-3.

Radius to Maximum Winds

Figure 39 shows a comparison of the observed and modeled Rmax distributions in Florida and neighboring states.

Figure 39: Rmax Cumulative Distribution Function (CDF)

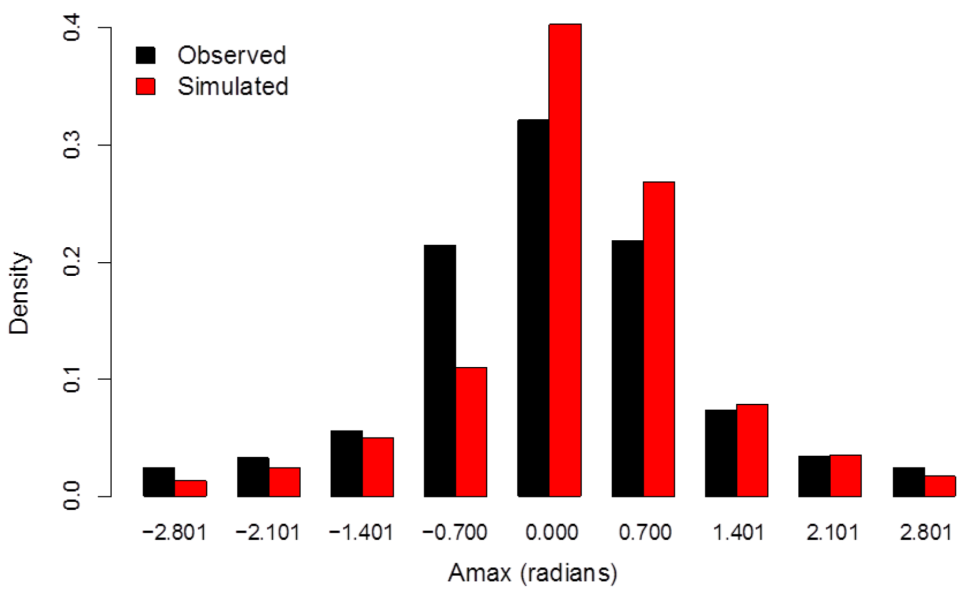


The reasonable agreement suggested by the figure above is confirmed by the goodness-of-fit test results. The Kolmogorov-Smirnov test on the radius of maximum winds produces a p-value of 36%, and a chi-square test with eight equal cells produces a p-value of 57%. The historical data used for the comparison covers the 1900 to 2014 period.

Wind Profile Parameters

The optimized Willoughby profile (see Disclosure M-4.1) prescribes the shape of the wind field outside and inside the eye of the hurricane through parameters X1 (decay length parameter) and N (power law parameter), respectively. X1 and N determine the modeled wind radii, which are validated against the historical values from the extended best track dataset. Standard M-6 contains a graphical comparison of observed and modeled histograms for radii of hurricane force winds. Figure 40 compares observed (black) and modeled (red) distributions of Amax, the wind profile parameter that describes the angle between track and location of Vmax. The comparison is shown for the whole basin, rather than Florida only, and uses RMS HWind snapshots to derive the historical values.

Figure 40: Angle to Maximum Winds Histogram



The figure above shows the histograms of observed (black) and modeled (red) Amax. A value of 0 radians corresponds to the location of Vmax being 90 degrees clockwise from the direction of storm movement. A chi-square test with four cells produces a p-value of 0.63. This is based on 43 storms within a restricted domain around Florida. A single observation was included for each storm, to ensure independence.

Storm Frequency

The Poisson assumption for the distribution of storm frequency was tested using a conditional chi-square test (p-value=11%) and Neyman-Scott test (p-value=11%). The chi-square goodness-of-fit test was used to compare historical and modeled annual storm frequencies over the different sub-regions and categories. The corresponding p-value is 76%. These tests show that the modeled storm frequency distribution is in reasonable agreement with historical data.

S-1.7 Provide a completed Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year. Provide a link to the location of the form [Form S-1].

S-1.8 Provide a completed Form S-2, Examples of Loss Exceedance Estimates. Provide a link to the location of the form [Form S-2].

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.

RMS 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.

S-2.1 Identify the most sensitive aspect of the model and the basis for making this determination.

The most sensitive aspects of the model are the intensity and size of the hurricane at landfall, specifically the far field pressure (FFP), central pressure (CP) and radius to maximum winds (Rmax) at landfall. This determination was based on the results of the sensitivity analyses described in the RiskLink 11.0.SP2c submission, in Form S-6. The standardized regression coefficients showed that for Category 1 and 3 storms, losses are most sensitive to variations in FFP and CP. For Category 5 hurricanes, losses are mostly affected by changes in Rmax.

S-2.2 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.

The filling rate (Alpha) has a significant impact on the sensitivities in output results, especially for more intense storms. Translational speed and wind profile parameters have a lesser impact on the output. This determination is based on the standardized regression coefficients presented in the RiskLink 11.0.SP2c submission.

S-2.3 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 output results are sensitive to the exact value of the maximum winds, given a central pressure and far field pressure. Variations in the land use land cover (LULC) also have an impact on the loss output. This determination is based on the changes in loss costs resulting from LULC updates in the previous and current submissions.

S-2.4 Describe and justify action or inaction as a result of the sensitivity analyses performed.

The results of the sensitivity analyses confirmed previous RMS research. Additionally, the sensitivity study highlighted the importance of the filling rate, which is a model component that has been extensively researched and revised prior to the RiskLink 11.0.SP2c submission. No action was necessary after review of the sensitivity results.

S-2.5 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 [N/A].

RMS has submitted Form S-6 in the RiskLink 11.0.SP2c submission, in compliance with the 2009 Standards.

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.

RMS 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.

S-3.1 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 major contributors to the uncertainty in model outputs are the intensity and size of the hurricane at landfall, specifically far field pressure (FFP), central pressure (CP) and radius to maximum winds (Rmax). FFP and CP are the main contributors to the uncertainty in loss costs for Category 1 and Category 3 storms. For Category 5 hurricanes, the input with the most impact on the uncertainty in the model outputs is Rmax. This determination is based on the analyses described in the RiskLink 11.0.SP2c submission, in Form S-6.

The large contributions of intensity and size of the storms at landfall on the uncertainty in the loss costs is confirmed by Figure 31 and Figure 32. These figures summarize the changes in the loss costs by ZIP that result from setting the maximum 1-minute sustained winds (Vmax) and Rmax to the 5% and 95% limits on the respective cumulative distribution functions.

S-3.2 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.

The filling rate (Alpha) has a significant impact on the uncertainties in the output results, especially for intense hurricanes. The basis for this determination are the expected percentage reductions (EPRs) presented in the RiskLink 11.0.SP2c submission. Translational speed and wind profile parameters have a much smaller impact on the uncertainties.

S-3.3 Describe and justify action or inaction as a result of the uncertainty analyses performed.

No action was necessary after reviewing the results of the uncertainty analyses. The results of these analyses confirmed results described in previous submissions. Additionally, the uncertainty analyses highlighted the importance of the filling rate, which is a model component that has been extensively researched and revised prior to the RiskLink 11.0.SP2c Form S-6 preparation.

S-3.4 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.

RMS has submitted Form S-6 in the RiskLink 11.0.SP2c submission, in compliance with the 2009 Standards.

S-4 County Level Aggregation

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

The RMS North Atlantic hurricane stochastic track set is based on approximately 100,000 years of simulated time. The track paths and associated parameters are simulated and calibrated according to the methods described in Standards M-2 and S-1. The number of storms is then reduced to a representative sub-sample through a selection process described below. Loss convergence testing verified that the county level error in loss cost estimates induced by the sampling process is negligible.

S-4.1 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.

The target for the storm selection process is the county level average annual loss, with additional constraints to ensure that other loss criteria are met and the landfall distributions of the main physical parameters are preserved. The procedure is iterative and can be described by the following steps:

1. Group storms according to their loss in different regions and their landfall parameters
2. Eliminate each storm in turn
    a. Redistribute rate within appropriate bin
    b. Calculate maximum percentage change in average annual loss over all counties
3. Choose storm that minimizes the cost function in 2b for deletion
4. Repeat steps 2 and 3 as long as the target remains in a satisfactory range

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.

The RMS model is able to reliably and without significant bias reproduce incurred losses on a large body of past hurricanes, both for personal residential and commercial residential. Validations of known storm losses have been performed in several ways, including:

For recent events, on an industry basis. The RMS model is able to reasonably reproduce aggregate incurred industry losses in recent events.

For recent events, on a company-specific basis. The RMS model is able to reasonably reproduce aggregate incurred losses for a diverse set of insurers.

For recent events, on a geographic and demographic basis. The RMS model is able to reasonably reproduce the geographic spread of company specific losses, and the spread of losses between various lines of business and between various types of coverages.

For less recent events, on an industry basis. The RMS model is able to reasonably reproduce industry losses for less recent hurricanes, both in aggregate and on a broad geographic basis, for which some level of industry loss data is available.[3]

S-5.1 Describe the nature and results of the analyses performed to validate the loss projections generated for personal and commercial residential losses separately. Include analyses for the 2004 and 2005 hurricane seasons.

RMS has compiled reported loss information from industry sources at the time of key historical events. The reported losses are normalized to the year 2011 with a methodology that accounts for increases in cost of construction, growth of the building population, the change in building quality over time, and the change in average living area per house from the time of the event until 2011. Comparisons are made to modeled losses based on the RMS industry exposure model.

In addition, insurance companies have supplied RMS with datasets containing the locations and building types associated with coverage and loss amounts. These datasets have been run against historical storms and the computed losses have been compared to the actual losses.

Figure 41 and Figure 42 show the results of representative samples of the comparative analyses that have been performed.

3 From 1950 onwards, Property Claims Services (PCS) has tracked the aggregate industry losses from hurricanes. While these estimates, particularly the older ones, are potentially unreliable and must be adjusted to reflect current demographic and economic conditions, these older events do provide a means for checking potential bias in the model.

Figure 41: Florida Industry Loss Estimates (Residential) for Recent Storms[4]

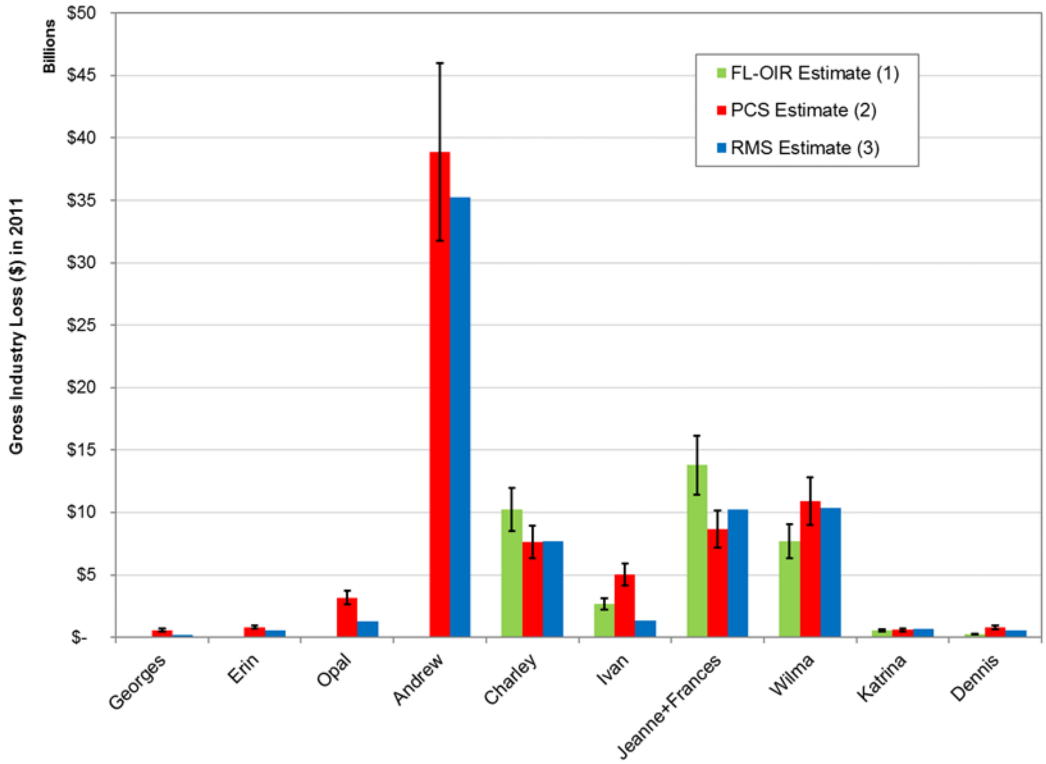


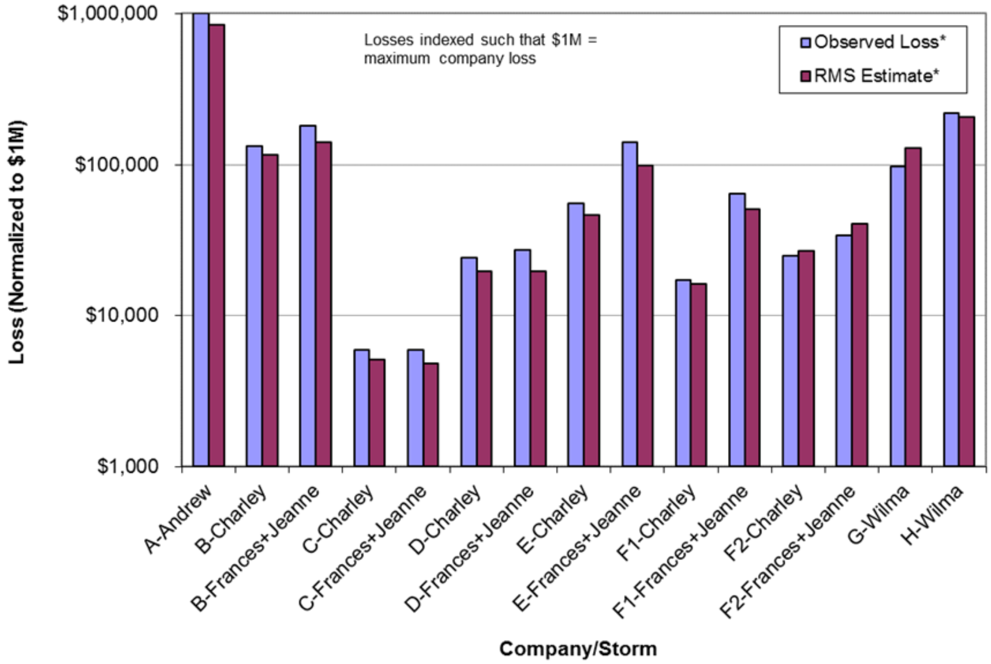
Table 11: Comparison of Actual and Estimated Industry Loss ($ million)

Storm	Year	PCS Estimate (2)	FL-OIR Estimate (1)	RMS Estimate (3)
Andrew	1992	38,883	-	35,252
Erin	1995	815	-	559
Opal	1995	3,168	-	1,303
Georges	1998	570	-	158
Charley	2004	7,646	10,238	7,717
Ivan	2004	5,039	2,659	1,315
Jeanne+Frances	2004	8,688	13,780	10,211
Wilma	2005	10,908	7,703	10,357
Katrina	2005	594	564	689
Dennis	2005	794	241	543

*See notes for Figure 41

4 Notes on Figure and Table:
(1) Estimates from Florida Office of Insurance Regulation report, "Hurricane Summary Data: CY 2004 and CY 2005" from August 2006. Losses are normalized to 2011 values, represent residential lines, include demand surge and underreporting estimates, and exclude loss adjustment expense.
(2) Property Claims Services estimate of losses. Losses for Florida are normalized to 2011 values, represent residential lines and includes demand surge and excludes loss adjustment expense.
(3) RMS estimates for residential lines and are based on RMS Industry Exposure for 2011. Losses include demand surge and exclude loss adjustment expenses.
Industry feedback indicates that Hurricanes Frances and Jeanne have been treated as one event from a claims and adjusting standpoint due to the inability of claims and adjusters to differentiate loss between the two events

Figure 42: Company Specific Loss Comparisons for Residential (RES) Structure Types



*Loss includes demand surge but does not include loss adjustment expense.

The following table shows a sampling of aggregated loss comparisons by company.

Table 12: Sample Client Loss Data Comparison

(Losses normalized such that maximum actual loss = $1,000,000)

Comparison	Storm	TIV*	Actual Loss**	Predicted Loss **	Ratio
A	Andrew	17,496,000	1,000,000	848,670	0.85
B	Charley	7,962,000	131,670	115,546	0.88
B	Frances+Jeanne	68,468,000	180,632	140,009	0.78
C	Charley	347,000	5,948	5,124	0.86
C	Frances+Jeanne	2,352,000	5,896	4,838	0.82
D	Charley	928,000	24,050	19,694	0.82
D	Frances+Jeanne	7,451,000	27,321	19,615	0.72
E	Charley	1,693,000	54,949	46,377	0.84
E	Frances+Jeanne	48,269,000	140,340	98,521	0.70
F1	Charley	1,749,000	17,114	16,241	0.95
F1	Frances+Jeanne	16,097,000	64,280	50,658	0.79
F2	Charley	3,108,000	24,955	26,869	1.08
F2	Frances+Jeanne	21,448,000	33,876	40,351	1.19
G	Wilma	9,491,000	97,056	128,781	1.33
H	Wilma	22,652,000	219,822	207,873	0.95

*Abbreviation: Total Insured Value (TIV) **Includes demand surge

S-5.2 Provide a completed Form S-4, Validation Comparisons. Provide a link to the location of the form [Form S-4].

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 difference between historical and modeled annual average statewide loss costs provided in this year's submission is statistically reasonable, given the body of data, by established statistical expectations and norms.

S-6.1 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.

The losses produced by the set of stochastic storms have been compared to losses produced by historical storms impacting Florida.

RMS has validated estimates by first comparing the modeled frequency of various storm characteristics with the historic record. The number of modeled storms of various intensities making landfall in each of the segments was compared to the historical record. For most region/category combinations, we found a reasonable agreement.

The losses produced by the set of stochastic storms have been compared to losses produced by historical storms impacting Florida. For example, historical and stochastic storm sets were compared in terms of exceedance probability curves for industry level losses. In addition, the geographic progression of loss costs by ZIP Code was reviewed for smoothness, consistency, and logical relation to risk.

The RMS model contains 20,239 hurricanes that cause damaging winds in Florida. In order to ensure that the set of stochastic storms is sufficient and converges, the county level standard errors for the average annual loss have been checked to verify that the error in loss costs estimates induced by the sampling process is negligible.

S-6.2 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.

Available observed track paths, central pressure series, and over-water Vmax values are used to model historical events. Other storm parameters are realizations of the same model used for the stochastic set, with additional constraints derived from added wind field data, if available. Historical gusts over land are consistent with the urban exposures of the 2004 and 2005 seasons, while stochastic storm gusts reflect later changes in urbanization. Vulnerability and financial modeling functions are identical for both stochastic and historic storms.

S-6.3 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 [Form S-5].

VULNERABILITY STANDARDS

V-1 Derivation of Building Vulnerability Functions

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 development of vulnerability functions for residential classes of construction in Florida (including mobile/manufactured homes) for building coverages, is primarily based upon well-supported structural and wind engineering principles and detailed analyses of historical claims data. This has been supplemented by post-storm site inspections and an extensive review of published literature on building damage assessment.

As outlined in Disclosure G-2.2 and Appendix B the individuals within RMS involved in the development of vulnerability functions have extensive experience in the field of structural and wind engineering and data analysis.

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

The methods used by RMS to derive the vulnerability functions and associated uncertainties are theoretically sound and consistent with fundamental engineering principles. Details of the methodology are provided in Disclosure V-1.4.

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

The schema used to classify buildings and assign appropriate vulnerability curves to each risk is able to representative all typical types of Florida construction for personal and commercial residential buildings.

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.

Unique vulnerability functions are defined based on a combination of the construction material, building occupancy, building height, year built and location as explained in Disclosure V-1.6. The effects of different building code changes are accounted for by the combination of year built and region of state. Floor area can also have an impact for single-family construction.

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

Damage curves for all classes of construction, including mobile/manufactured homes, are developed separately. The model contains separate functions for commercial residential, and personal residential building structures. RMS has derived separate functions to explicitly deal with residential and commercial appurtenant structures, such as fences, carports, and screen enclosures.

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

Damage associated with a declared hurricane includes damage incurred for wind speeds above and below the hurricane threshold of 74 mph (1-minute sustained). The minimum peak gust wind speed that generates damage is consistent with fundamental engineering principles.

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 include damage caused by wind speed and pressure, water infiltration (from rain water entering through breaches in the building envelope) and missile impact. The wind vulnerability functions exclude damages due to flooding, storm surge and wave action. Damage caused by storm surge and wave action can be modeled, if desired; however, to do so, the model uses a separate set of storm surge and wave vulnerability functions that are not applied for wind-only analyses.

V-1.1 Describe any modifications to the building vulnerability component in the model since the previously accepted model.

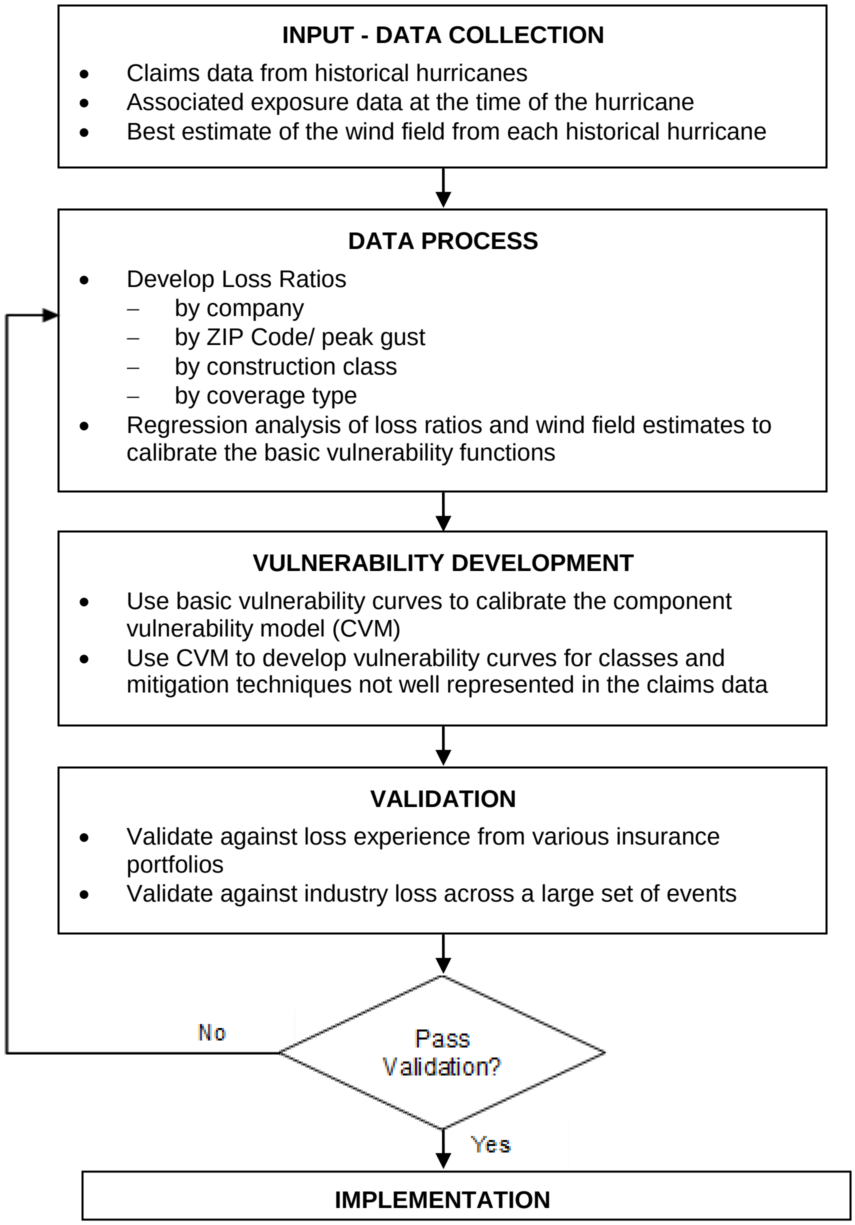
The following items listed in Disclosure G-1.5.A describe the changes related to building vulnerability.

- Improvement of mobile home vulnerability modeling, including consideration of U.S. Housing and Urban Development (HUD) zone and a new year band for post-2008 structures, supported by installation standard changes, recent IBHS research, and claims data analyses.
- Recalibration of multi-family dwelling (MFD) vulnerability, including updates to condominium (association and unit owner) lines and inventory distributions, reflecting MFD component research, regional variation, and claims data analyses.
- Introduction of unique damage curves for unreinforced masonry (URM) and reinforced masonry (RM) construction classes, based on recent IBHS research highlighting the differences in vulnerability between these construction types.

V-1.2 Provide a flowchart documenting the process by which the building vulnerability functions are derived and implemented.

The general procedure used to process such data is diagrammed in Figure 43.

Figure 43: Process for Deriving and Implementing Vulnerability Functions



The implementation of vulnerability functions is described in the response to Disclosure V-1.6.

V-1.3 ***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.***

RMS has collected loss data from its clients for the purpose of developing and calibrating the model's vulnerability functions. Construction characteristics and insured value information of the associated exposure is supplied directly to us by our clients. This information is assumed to be correct, but is also subjected to checks by RMS. Summaries of exposure and loss data sets and their use in the development of vulnerability functions will be available for on-site review by the professional team.

Overall, RMS has used over $11 billion of hurricane loss data from the U.S. and over $1.4 trillion in corresponding exposure data in the development and calibration of damage functions. This includes the following amounts of loss data by line of business: $10.4 billion for residential, $399 million for mobile/manufactured homes, $20 million for condo unit owners, $161 million for homeowners association, and $152 million for multi-family dwelling. A sample of the datasets is shown in the following table.

RMS additional claims data from some of its clients. Details of the new data will be shared with the professional team at the on-site audit.

Table 13: Sample of Residential Datasets used for Development and Calibration of Vulnerability Functions

LOB*	Storm	Company	Data Resolution
RES	Andrew	A	ZIP/Coverage/Construction Class
RES	Andrew	B	ZIP/Coverage
RES	Andrew	C	ZIP/Construction Class
RES	Bob	A	ZIP/Coverage/Construction Class
RES	Erin	A	ZIP/Coverage/Construction Class
RES	Fran	A	ZIP/Coverage/Construction Class
RES	Fran	B	ZIP/Coverage
RES	Hugo	A	ZIP/Coverage/Construction Class
RES	Hugo	B	ZIP/Coverage
RES	Opal	A	ZIP/Coverage/Construction Class
RES	Georges	D	ZIP/Coverage/Construction Class
MH	Fran	E	ZIP/Coverage/Construction Class
MH	Hugo	F	ZIP/Coverage/Construction Class
MH	Charley/ Frances/ Jeanne 2004	H	Location/Construction Class
MH	Charley/ Frances/ Jeanne 2004	I	Location/Construction Class
RES	Charley/Frances/Jeanne/Ivan 2004	J	Location/Coverage/Construction Class
MH	Charley/Frances/Jeanne/Ivan 2004	J	Location/Coverage/Construction Class
MFD	Charley/Frances/Jeanne/Ivan 2004	J	Location/Coverage/Construction Class
RES	Charley/Frances/Jeanne/Ivan 2004	K	Location/Construction Class
RES	Charley/Frances/Jeanne/Ivan 2004	L	Location/Coverage/Construction Class
RES	Charley/Frances/Jeanne/Ivan 2004	M	Location/Coverage/Construction Class
MH	Charley/Frances/Jeanne/Ivan 2004	M	Location/Coverage/Construction Class
RES	Charley/Frances/Jeanne/Ivan 2004	N	Location/Coverage/Construction Class
RES	Charley/Frances/Jeanne/Ivan 2004	O	Location/Coverage/Construction Class
RES	Charley/Frances/Jeanne/Ivan 2004	P	Location/Coverage/Construction Class
RES	Charley/Frances/Jeanne/Ivan 2004	Q	Location/Coverage/Construction Class
MH	Charley/Frances/Jeanne/Ivan 2004	V	Location/Coverage/Construction Class
RES	Wilma 2005	J	Location/Coverage/Construction Class
RES	Wilma 2005	K	Location/Coverage/Construction Class
RES	Wilma 2005	R	Location/Coverage/Construction Class
HOA	Wilma 2005	J	Location/Coverage/Construction Class
CO	Wilma 2005	J	Location/Coverage/Construction Class
MH	Wilma 2005	K	Location/Coverage/Construction Class
RES	Ike 2008	B	Location/Coverage/Construction Class
RES	Ike 2008	L	Location/Coverage/Construction Class

LOB*	Storm	Company	Data Resolution
RES	Ike 2008	S	Location/Coverage/Construction Class
RES	Ike 2008	T	Location/Coverage/Construction Class
RES	Ike 2008	U	Location/Coverage/Construction Class
MH	Ike 2008	B	Location/Coverage/Construction Class
RES	Dennis 2005	N	Location/Coverage/Construction Class
RES	Wilma 2005	N	Location/Coverage/Construction Class
MFD	Wilma 2005	N	Location/Coverage/Construction Class
MH	Sandy 2012	V	Location/Coverage/Construction Class

*RES–Residential; MH–Mobile/Manufactured Homes; MFD–Multi-Family; CO–Condo Owners; HOA–Condo Association

V-1.4 Describe the assumptions, data (including insurance claims data), methods, and processes used for the development of the building vulnerability functions.

The data used in the development of the building vulnerability functions is described in Disclosure V-1.3. The data sets vary in resolution and are used for different validation purposes. To adequately use loss data for development of vulnerability functions, the data must contain several types of information including: loss per coverage (A, B, C, and D), line of business, exposure value per coverage, description of structures (construction type, etc.), and actual location of structures.

The underlying assumption is that future claims practices will be the same as the claims practices that were in effect at the time that the historical losses used in the model development and validation were paid. Where this assumption is known or thought to be false, actions are taken to minimize the possibility of the data introducing bias into the development process such as partitioning of data, or setting contaminated data aside.

Best estimate wind fields are prepared for all the storms for which there is insurance data sets. Then the insurance data sets are geocoded and plotted on the wind fields, thus assigning a hazard parameter to each point in the insurance data set. Vulnerability functions are developed through a regression analysis of the loss ratios and estimated wind speed data.

The vulnerability functions are based on analyses of historical building loss data and engineering principles using the component vulnerability y model (CVM) as documented in the process shown in Disclosure V-1.2. The RMS Component Vulnerability Model is based on the methodology outlined by Professors Dale Perry and Norris Stubbs of Texas A&M University (Stubbs et al., 1995). This methodology has been augmented by internal research by RMS staff, and has been published by RMS staff (Khanduri 2003). The CVM enables an engineering-based approach to assess the reasonableness of the vulnerability functions derived from the analysis of historical building loss data, especially for higher wind speed ranges or building classes for which historical loss data is sparse or incomplete. Additionally, the CVM is used to gain insights into the potential reduction of losses associated with building features and hurricane mitigation measures.

References used by RMS for developing the vulnerability functions include references listed in Disclosure G-1.4 including: Davenport et al. (1989), Hart (1976), Liu et al. (1989), McDonald (1986, 1990), Mehta (1983, 1992), Minor (1979), Cook (1985), Sparks (1988, 1990, 1993), Stubbs (1993), Zollo (1993), Skerlj (2004), FEMA (2005a, 2005b, 2006a, 2006b, 2009), IBHS (2007, 2009, 2010), and Gurley (2006).

The uncertainties associated with the vulnerability functions are derived from statistical analyses of historical building loss data for different building classes and coverage types. These statistical analyses indicate that the uncertainty, as measured by the coefficient of variation (CV), is a function of the MDR.

The MDR-CV relationship derived for a vulnerability function is used to compute the uncertainty to associate with the computed MDR.

The process and method of developing the building curves relevant to renter and condo-unit owners follows the same process as for other residential risks and is outlined in Disclosure V-1.2. The claims data used in this process is described in Disclosure V-1.3.

Renter and condo-unit owner are assumed to be related to commercial residential risks as follows:

1. It is assumed that two unrelated entities have insurable interests in commercial residential properties. The nature of the insured interests held by these entities depends on the type of commercial residential property as follows:
    a. For condominium or townhouse complexes in which the units are owned by different individuals, the home owner's association holds title to the building envelope and common areas and contents while the unit owners hold title to the interior space of their units and any personal belongings.
    b. For apartment buildings in which the units are rented from the building owner, the building owner holds title to the structure and any contents in the common areas of the building, while the renters hold title to their personal belongings.
2. The building and contents vulnerability functions for the insured interests of the entities identified above are derived under the assumption that the building envelope must be breached before the interior spaces or contents contained within are damaged.
3. It is assumed that the contents vulnerability functions for all entities identified above are the same, reflecting the fact that the contents held by these different entities are similar in nature.

V-1.5 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.

RMS has conducted post-event reconnaissance missions for the hurricanes listed in Table 14. Typically, immediately after a hurricane makes landfall, teams of two or three wind and/or structural engineers are deployed to areas affected by the storm to collect information necessary to assess the extent and nature of the damage and to provide qualitative insights into the overall performance of the building stock.

The primary objective of the reconnaissance teams deployed immediately after a storm makes landfall is to provide a real-time, first-hand assessment of the severity of the damage in different areas and to different building types, and to identify the primary causes of the damage. It is critical that the reconnaissance teams conduct these initial field inspections quickly and thoroughly immediately after the storm makes landfall in order to document the damage before it is cleaned up or concealed. For example, building owners typically start cleaning up their properties within days of an event and once the debris is removed, any evidence of poor construction practices is lost. Similarly, once tarps are placed on leaking roofs, it is difficult to assess the true extent of the roof damage caused by a storm.

The data collected during these reconnaissance missions is used by RMS in two ways. First, it is provided to the RMS catastrophe response team, who uses this information, in conjunction with modeled loss estimates based on reported wind speeds for the storm, to develop an estimate of the overall industry loss and its geographic extent. This estimate is then provided to RMS clients to help them better manage their response to the event (e.g., to help them set appropriate reserve amounts and manage the deployment of their claims adjusters). The second use of the data collected during these reconnaissance missions is to suggest and guide any modifications to the vulnerability functions for the affected region. For example, the severity of the roof damage caused by Hurricane Ike noted by the RMS reconnaissance teams, was greater than expected for the wind speeds recorded during the storm. In response to this observation, RMS convened a workshop of roof engineers to better understand the reasons for the poor performance of the roofs in Texas and whether or not similar problems exist elsewhere in the U.S. The conclusions drawn from this workshop were incorporated into the 2011 U.S. Hurricane Model.

Table 14: Post-Storm Reconnaissance Missions Conducted by RMS

Hurricane/Typhoon	Year	Region
Opal	1995	Florida
Erin	1995	Florida
Marilyn	1995	Virgin Islands, Puerto Rico
Fran	1996	North Carolina
Bonnie	1998	North Carolina
Georges	1998	U.S. Gulf Coast, Puerto Rico
Floyd	1999	North Carolina
T. Paka	1997	Guam
Fabian	2003	Bermuda
Isabel	2003	North Carolina, Virginia
Charley	2004	Florida
Frances	2004	Florida
Ivan	2004	Mississippi, Alabama, Florida, Louisiana
Jeanne	2004	Florida
Dennis	2005	Florida
Katrina	2005	Mississippi, Alabama, Florida, Louisiana
Rita	2005	Texas
Wilma	2005	Florida
Gustav	2008	Louisiana
Ike	2008	Texas
Irene	2011	North Carolina, Mid-Atlantic, Northeast U.S.
Sandy	2012	Northeast U.S.
Matthew	2016	Florida, Georgia, North & South Carolina, Bahamas

V-1.6 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.

There are a total of 1,753 building vulnerability classes per vulnerability region. Each class has both building and contents damage functions. The vulnerability classes depend on a combination of:

- Construction Material
- Building Height (number of stories)
- Building Occupancy
- Year Built
- Floor Area (single-family residential and low-rise commercial only)
- Region of State (vulnerability region)

Many of these functions are applicable to commercial building classes. Of the 1,753 per region, 493 are applicable to the residential lines (including multi-family and manufactured homes). The state of Florida is divided into six vulnerability regions that have their own unique set of functions. The possible classifications for each of the six primary characteristics are listed in the following table.

The various vulnerability classes were defined to allow for the grouping together of structures with similar performance under wind loads.

Table 15: RMS Hurricane Primary Building Classification Options

Construction Class
Unknown
Wood Frame
Masonry
Reinforced Concrete
Unreinforced Masonry
Reinforced Masonry
Mobile/Manufactured Home w/o Tie-Downs
Mobile/Manufactured Home with Tie-Downs

Number of Stories
Unknown
1
2–3
4–7
8–14
15+

Occupancy
Unknown
Single Family
Multiple Family
Condo Unit Owner
Condo Association
Non-Residential[1]

Year Band (non-MH)
Unknown
Pre 1995
1995–2001
2002–2008
2009 + later
(For MH only)
Pre 1976
1976–1994
1995–2008
2009 + later

Region
South FL inland (≥0.5 miles from coast)
South FL coastal (<0.5 miles from coast)
Central FL inland (≥0.5 miles from coast)
Central FL coastal (<0.5 miles from coast)
North FL inland (≥0.5 miles from coast)
North FL coastal (<0.5 miles from coast)

Floor Area (Single Family)
≤ 1,500 sq ft (≤139 m2)
1,500–2,500 sq ft (140–232 m2)
2,500–5,000 sq ft (233–464 m^2)
5,000–10,000 sq ft (465–929 m^2)
≥ 10,000 sq ft(≥930 m^2)

[1]There are multiple sub-categories of Non-Residential occupancy in the model that are not listed in detail here.

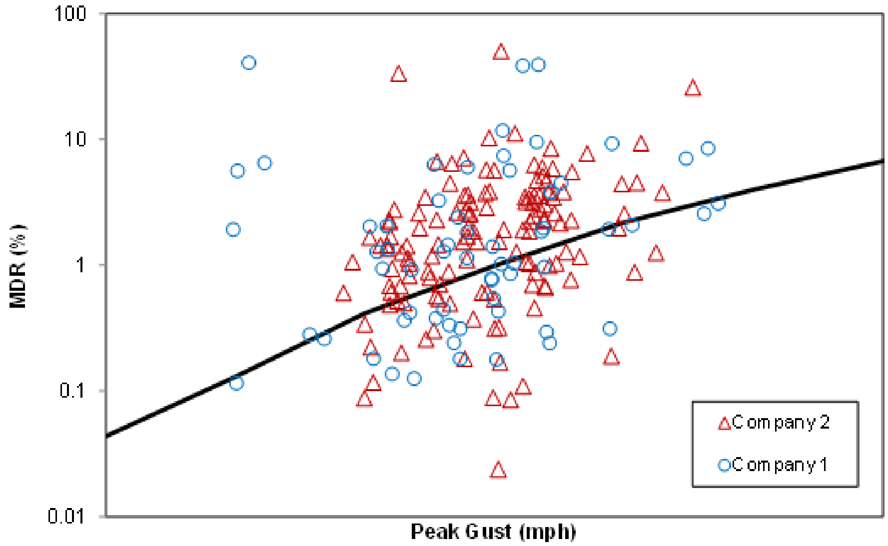
V-1.7 Describe the process by which local construction practices and building code adoption and enforcement are considered in the development of the building vulnerability functions.

The changes in local construction practices, building code adoption, and enforcement, are modeled through vulnerability functions that vary by year of construction of the building, and also region of the state (vulnerability regions). The vulnerability functions for different year bands and different regions are reasonable and theoretically sound based on RMS research on the changes of building code provisions and construction practices in Florida and across the U.S., as well as the region's experience with natural catastrophes.

V-1.8 Describe the relationship between building structure and appurtenant structure vulnerability functions and their consistency with insurance claims data.

Appurtenant structures are modeled separately using the same vulnerability functions as buildings. RMS has used actual insurance data to validate the vulnerability functions used to represent appurtenant structure losses. The following figure illustrates the model's consistency with insurance claims data through a representative comparison using two company data sets.

Figure 44: Observed Damage Ratios (dots and triangles) and Modeled Mean Damage Ratios (MDR) (solid line) versus Peak Gust Wind Speed for Appurtenant Structure Losses



V-1.9 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.

For a specified occupancy type (e.g., single-family dwelling or commercial residential), the loss cost for an unknown residential construction type is computed using a composite vulnerability function that is a weighted average of the vulnerability functions corresponding to unique combinations of height, year built, and construction class for the specified occupancy type. The weight applied to each vulnerability function included in the composite curve is specified by the inventory distribution for the location of the building and is dependent on the occupancy type. The Florida inventory distributions implemented in RiskLink are specified by ZIP Code and are based on an extensive industry database compiled by RMS from third party data sources and RMS in-house research, aggregate insurance exposure data, and studying aerial and satellite imagery.

V-1.10 Describe how vulnerability functions are selected when input data are missing, incomplete, or conflicting.

When one or more of the primary characteristics (construction, year built, number of stories or occupancy) are unknown, the software will build a composite vulnerability function that is a weighted average of the appropriate subset of vulnerability functions corresponding to unique combinations of height, year built, construction class, and occupancy type associated with the unknown characteristics.

For single-family occupancy, when floor area is unknown, the model defaults to the vulnerability function for the 1500–2500 square foot floor area band.

When input data are conflicting, the software includes logic to pick up the most appropriate vulnerability curve. For instance, if the user specifies manufactured homes (MH) construction with commercial occupancy class, the model ignores the occupancy input as MH vulnerability is independent of occupancy. Similarly, if the user specifies 20-story wood frame single-family building, the software ignores the height, and assumes the highest wood frame curve for that occupancy class which is a 2–3 story.

V-1.11 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 losses at 1-minute sustained wind speeds at 10 m (33 ft) above 42 mph.

V-1.12 Describe how the duration of windspeeds at a particular location over the life of a hurricane is considered.

The model does not explicitly consider the duration of wind speed at a particular location over the life of a hurricane. There is a general consensus among experts that for extreme wind conditions generated by hurricanes, damage should be correlated to peak gust. However, RMS vulnerability functions are based on observed losses during hurricanes. These observed losses include a variety of factors, including duration of wind speeds above a certain threshold at which damage occurs due to fatigue under repeated loading, and thus implicitly include wind duration effects.

V-1.13 Describe how the model addresses wind borne missile impact damage and water infiltration.

Wind borne debris impacts and water infiltration following breaches in the building envelope are key causes of damage that are implicitly part of all claims data. As the model is validated against claims data, the model implicitly includes losses associated with wind borne debris and water infiltration.

The model includes secondary modifier options to reduce/increase the vulnerability of structures that are protected/not protected from wind borne debris.

The model includes secondary modifier options to alter the likelihood of building envelope breaches and thus control water infiltration. It also includes options specifically designed to alter/eliminate water infiltration when the roof cover fails (secondary water resistance).

V-1.14 Provide a completed Form V-1, One Hypothetical Event. Provide a link to the location of the form [Form V-1].

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 development of content vulnerability functions is primarily based primarily on detailed analyses of historical claims data. Separate vulnerability functions have been derived for damage to building contents for each of the hurricane building classes.

As outlined in Disclosure G-2.2 and Appendix B the individuals within RMS involved in the development of vulnerability functions have extensive experience in the field of structural and wind engineering and data analysis.

Time element vulnerability functions were derived separately and exist for each occupancy class supported by the model. Time element vulnerability is related to the building damage state. Time element losses consider only direct losses (i.e., expense paid to a policy holder while the house is being repaired). RMS has used historical loss data to calibrate time element vulnerability functions.

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

RMS develops and calibrates relationships between modeled building and content vulnerability functions from actual loss data and as such the relationship between functions and historical losses is reasonable.

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

The time required to repair or replace a property used in the derivation of the time element vulnerability functions is inferred from the ratio of the time element claims and exposure values reported by insurance companies.

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

In a manner similar to contents, losses to time element coverages are dependent on the damage to the structure. Time element loss ratios will be relatively small compared to structure loss ratios up to the point where the structure is severely damaged resulting in the building being uninhabitable. In the RMS hurricane model, the time element vulnerability functions have been validated against actual coverage specific loss data ensuring that the relationships between these vulnerability functions is consistent with loss 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.

Since the time element model is calibrated with actual historic loss data, it implicitly includes claims arising from damage to the infrastructure, to the degree to which they are included in the historic loss data.

Direct flood damage to infrastructure is not calculated in the model; however, the impact on time element losses due to storm surge damage to infrastructure was not excluded in calibrating time element loss functions.

V-2.1 Describe any modifications to the contents and time element vulnerability component in the model since the previously accepted model.

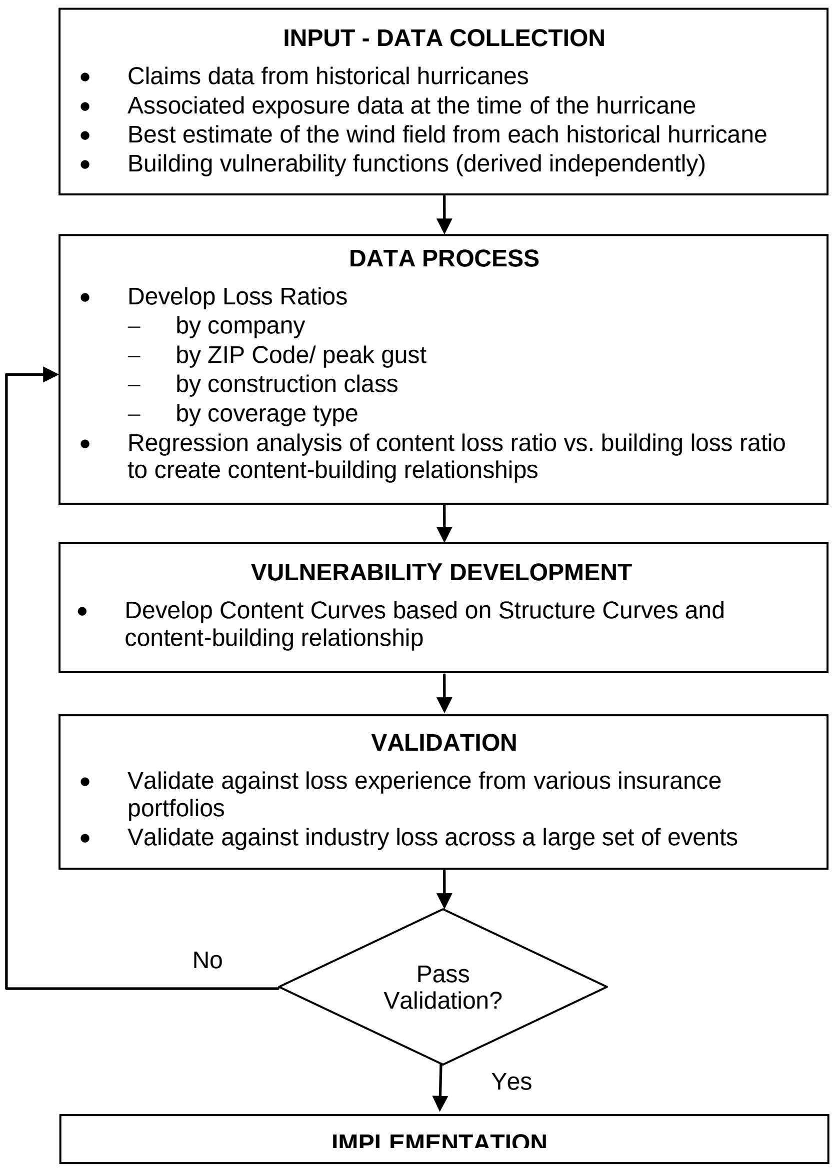
Because damage to contents is a function of the amount of damage to the building structure changes made to the structure curves also affect the corresponding contents curves. Time element losses are also a function of the building damage state.

The list of modifications to the building curves described in in Disclosure V-1.1 is also applicable to content and time element vulnerability components.

V-2.2 Provide a flowchart documenting the process by which the contents vulnerability functions are derived and implemented.

The general procedure used to process such data is diagrammed in Figure 45.

Figure 45: Process for Deriving and Implementing Contents Vulnerability Functions



V-2.3 Describe the assumptions, data (including insurance claims data), methods, and processes used to develop and validate the contents vulnerability functions.

The damage to contents is a function of the amount of damage to the building structure and in particular damage to the roof, openings (i.e., windows and doors) and envelope (i.e., cladding). This function depends on the building class and establishes the rate at which damage to contents accumulates as a function of damage to the building structure. Content curves are derived from structure curves for each of the hurricane building classes and are stored as separate vulnerability functions. The development of stand-alone contents damage curves provides a separate mathematical representation of damage to contents in order to provide reasonable representations of contents only policies.

The data used by RMS to develop and validated the contents vulnerability functions is described in Disclosure V-1.3. To adequately use loss data for development of vulnerability functions, the data must contain several types of information including: loss per coverage (A, B, C, and D), line of business, exposure value per coverage, description of structures (construction type, etc.), and actual location of structures.

The underlying assumption is that future claims practices will be the same as the claims practices that were in effect at the time that the historical losses used in the model development and validation were paid. Where this assumption is known, or thought, to be false, actions are taken to minimize the possibility of the data introducing bias into the development process such as partitioning of data, or setting contaminated data aside.

RMS has used actual insurance data to validate the vulnerability functions used to represent contents losses.

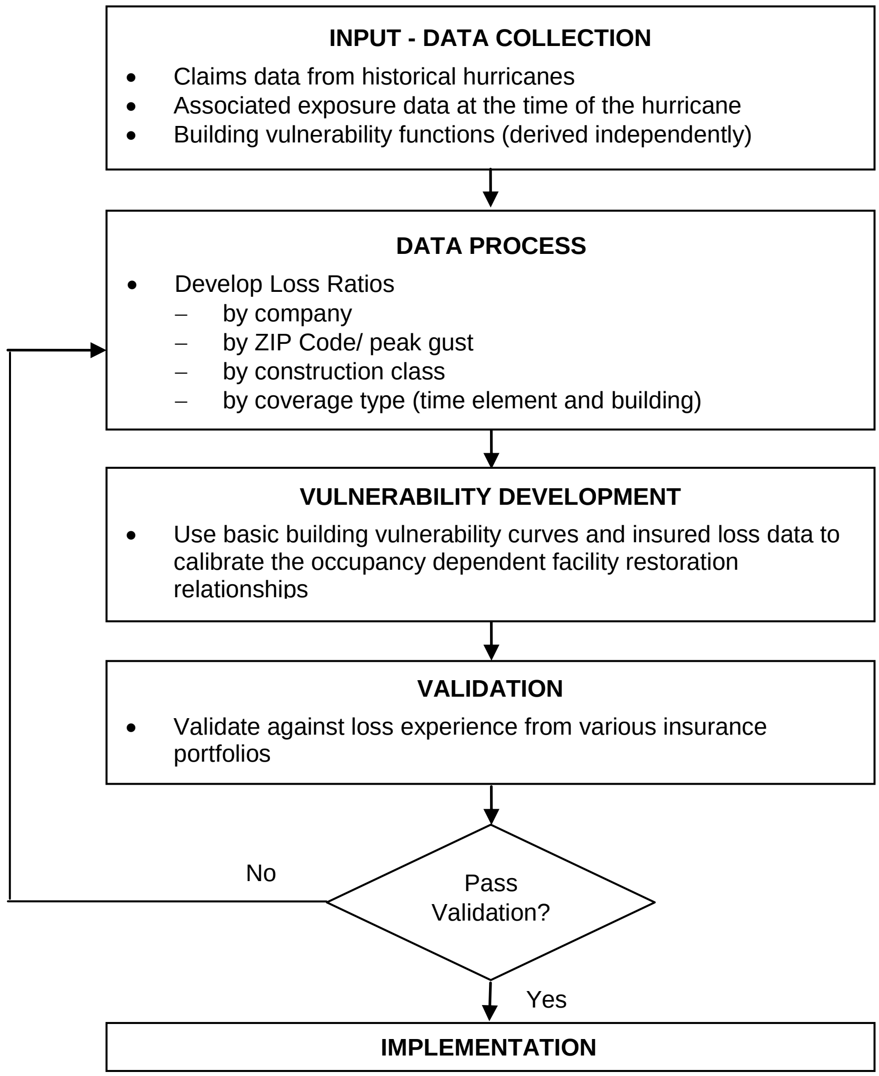
V-2.4 Provide the total number of contents vulnerability functions. Describe whether different contents vulnerability functions are used for personal residential, commercial residential, manufactured home, unit location for condo owners and apartment renters, and various building classes.

For every building vulnerability function, there is a separately derived content vulnerability function. Therefore, the number of functions is the same as that listed in Disclosure V-1.6. Different vulnerability relationships are used for personal residential, commercial residential, mobile/manufactured homes, condo unit owners, apartment renter unit locations and also commercial and industrial properties.

V-2.5 Provide a flowchart documenting the process by which the time element vulnerability functions are derived and implemented.

The general procedure used to process such data is diagrammed in Figure 46.

Figure 46: Process for Deriving and Implementing Time Element Vulnerability Functions



V-2.6 Describe the assumptions, data (including insurance claims data,) methods, and processes used to develop and validate the time element vulnerability functions.

The hurricane model has separate time element vulnerability functions. There is a time element function for each occupancy class supported by the model. Time element vulnerability is related to the building damage state. Time element losses consider only direct losses (i.e., expense paid to a policy holder while the house is being repaired).

RMS has used actual loss data to develop and validate the time element vulnerability functions. Indirect losses are not separated from the actual loss data and therefore the modeled functions include both direct and indirect loss to the building.

Calculated time element losses are dependent on the structure damage, starting at the same threshold as building damage. Claims data has been used to verify the approach of starting time element loss at the threshold of building damage. From claims data reviewed from Hurricane Andrew less than 0.1% of time element claims were associated with no structure coverage claim.

V-2.7 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.

Modeled time element loss costs include direct losses only—expense paid to a policyholder while the house is being repaired. However, the impact of storm surge damage to infrastructure on time element losses was not excluded in calibrating wind-based time element loss functions. Local and regional infrastructure damage is also considered in the RMS post-event loss amplification (PLA) methodology (see Disclosure A-4.3).

V-2.8 Describe the relationship between building structure and contents vulnerability functions.

Losses to contents are dependent on the damage to the structure. From an engineering standpoint, losses to contents will be relatively small in comparison to structure losses until the envelope of the structure is breached. At that point, both structure and contents damage will quickly escalate with increasing wind speeds with the contents damage curve approaching that of the structure as wind speeds increase.

V-2.9 Describe the relationship between building structure and time element vulnerability functions.

Time element functions are proportional to the effective down time (EDT) of a structure, which is computed as a function the physical damage state of the structure. The ratio of time element mean damage ratios to structure mean damage ratios is small at low building damage ratios and increases with increasing building damage ratio.

V-2.10 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.

For a specified occupancy type (e.g., single-family dwelling or commercial residential), the loss cost for an unknown residential construction type is computed using a composite vulnerability function that is a weighted average of the vulnerability functions corresponding to unique combinations of height, year built, and construction class for the specified occupancy type. The weight applied to each vulnerability function included in the composite curve is specified by the inventory distribution for the location of the building and is dependent on the occupancy type. The Florida inventory distributions implemented in RiskLink are specified by ZIP Code and are based on an extensive industry database compiled by RMS from third party data sources and RMS in-house research, aggregate insurance exposure data, and studying aerial and satellite imagery.

Similar to above, when one or more of the primary characteristics (construction, year built, number of stories or occupancy) are unknown, the software will build a composite vulnerability function that is a weighted average of the appropriate subset of vulnerability functions corresponding to unique combinations of height, year built, construction class, and occupancy type associated with the unknown characteristics.

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 North Atlantic Hurricane Models supports modification of the base vulnerability functions through the application of secondary modifiers developed using the component vulnerability model. The modifiers can be building-characteristic specific (e.g., improved roof sheathing or anchors) or external (e.g., storm shutters). These characteristics must be specifically selected by the user. The default case is to not include any modifiers. If modifiers are selected, they are clearly identified in the input files and output reports. The secondary modifiers available in the model include the fixtures or construction techniques required in the standard and are listed in Table 16.

In addition to affecting the mean vulnerability, the secondary modifiers also affect the associated uncertainty in a manner that is theoretically sound and consistent with engineering principles as described in Disclosure V-3.7 below.

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.

Mitigation measures impact both the mean damage ratio (MDR) and the coefficient of variation (CV) of the damage ratio. The application of mitigation measures is reasonable when applied both individually and in combination.

V-3.1 Describe any modifications to mitigation measures in the model since the previously accepted model.

As described in Disclosure G-1.5, the following options have been modified or added:

- Activation of the construction quality secondary characteristic for mobile homes, enabling the ability to model enhancements to tie down systems or signs of structural deterioration.
- New values for secondary characteristics, including roof covering, roof equipment hurricane bracing, photovoltaic solar panels, wall cladding type, and screen enclosures, to reflect RMS research on the impact of specific building attributes on wind vulnerability.

V-3.2 Provide a completed Form V-2, Mitigation Measures, Range of Changes in Damage. Provide a link to the location of the form [Form V-2].

Form V-2 has been calculated using zero deductible structural losses only on $100,000 base structure wood frame and masonry buildings as described in Form V-1.

V-3.3 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.

RMS has added two additional mitigation options to Form V-2.

- Using 10d nails at a high wind schedule (HWS) to tie the wood deck down at spacing of 6” edge and 6” field nailing on a typical piece of plywood.
- Using 8d nails at a high wind schedule (HWS), which is using a spacing of 6” edge and 6” field nailing on a typical piece of plywood. (Note: we have assumed that the given 8d nails option corresponds to 8d nails at the standard 6”/12” pattern.)

In addition to the mitigation measures listed in Form V-2, the RMS model also provides other mitigation measures which have not been included in Form V-2:

- Options for the Fortified for Safer Living Program, and the Fortified for Existing Homes program as defined by the Institute for Business and Home Safety (IBHS)
- Options for retrofitting flashing and coping

The following table lists all the secondary modifier options available in the model. Only modifiers relevant to wind hazard for residential occupancy are presented here; option numbers within a modifier are not necessarily consecutive as a result.

Table 16: RMS Secondary Characteristic Options in North Atlantic Hurricane Models

Characteristic	Options	Notes
2–Construction Quality	0-Unknown	Buildings with poor construction quality will suffer more losses than buildings with certified design and construction. New options are introduced to account for the Institute for Business and Home Safety (IBHS) hurricane risk mitigation programs. *Certified Design & Construction and obvious signs of duress are applicable to mobile homes to reflect the enhancements or deterioration of tie-down systems.
	1-Obvious signs of duress or distress	
	2-Wind Only - Fortified for Existing Homes, Bronze, Option 1 (US Only)	
	3-Wind Only - Fortified for Existing Homes, Bronze, Option 2 (US Only)	
	4-Wind Only - Fortified for Existing Homes, Silver, Option 1 (US Only)	
	5-Wind Only - Fortified for Existing Homes, Silver, Option 2 (US Only)	
	6-Wind Only - Fortified for Existing Homes, Gold, Option 1 (US Only)	
	7-Wind Only - Fortified for Existing Homes, Gold, Option 2 (US Only)	
	8-Wind Only - Fortified for Safer Buildings/Commercial – [Post 2001] (US Only)	
	9-Certified design & construction	
	10-Hail&Wind - Fortified for Existing Homes, Bronze, Option 1 (US Only)	
	11-Hail&Wind - Fortified for Existing Homes, Bronze, Option 2 (US Only)	
	12-Hail&Wind - Fortified for Existing Homes, Silver, Option 1 (US Only)	
	13-Hail&Wind - Fortified for Existing Homes, Silver, Option 2 (US Only)	
	14-Hail&Wind - Fortified for Existing Homes, Gold, Option 1 (US Only)	

Characteristic	Options	Notes
	15-Hail&Wind - Fortified for Existing Homes, Gold, Option 2 (US Only)	
	16-Hail&Wind - Fortified for Safer Buildings/Commercial – [Post 2001] (US Only)	
4–Roof Covering	0-Unknown	Damage is directly correlated to the type of roof covering material used on the building.
	1-Metal sheathing with exposed fasteners	
	2-Metal sheathing with concealed fasteners	
	3-Built-up roof or single-ply membrane roof with the presence of gutters	
	4-Built-up roof or single-ply membrane roof without the presence of gutters	
	5-Concrete / clay tiles	
	6-Wood shakes	
	7-Normal shingle	
	8-Normal shingle with Secondary Water Resistance (SWR)	
	9-Shingle rated for high wind speeds	
	10-Shingle rated for high wind with SWR	
	11-Concrete roof	
	12-Bermuda-style roof	
6–Roof Age / Condition	Unknown	Older roofs will suffer more loss than newer roofs.
	0–5 years	
	6–10 years	
	11 years or more	
	Obvious signs of duress and distress	
7–Roof Geometry	0-Unknown	Roof geometry directly impacts the type of wind forces a roof is likely to experience. Flat roofs are more likely to experience more loading than hipped or high-pitched roofs.
	1-Flat roof with parapets	
	2-Flat roof without parapets	
	3-Hip roof with slope less than or equal to 6:12 (26.5 degrees)	
	4-Hip roof with slope greater than 6:12 (26.5 degrees)	
	5-Gable roof with slope less than or equal to 6:12 (26.5 degrees)	
	6-Gable roof with slope greater than 6:12 (26.5 degrees)	
	7-Braced gable roof with slope less than or equal to 6:12 (26.5 degrees)	
	8-Braced gable roof with slope greater than 6:12 (26.5 degrees)	
9–Roof Anchor	0-Unknown	The strength of roof anchorage has a direct impact on the damageability of the building envelope. Stronger roof anchors provide more resistance against wind forces.
	1-Toe nailing / No anchorage	
	2-Clips	
	3-Single wraps	
	4-Double wraps	
	5-Structural	

Characteristic	Options	Notes
10–Roof Equipment Hurricane Bracing	0-Unknown	If the equipment anchorage is not adequate it can compromise the roof's integrity.
	1-Properly installed with adequate anchorage	
	2-Obvious signs of deficiencies in the installation	
	3-No equipment present	
12–Commercial Appurtenant Structures	0-Unknown	Commercial appurtenant structures do not refer to standalone garages or buildings, typically covered under Coverage B, but instead to large signs, extensive ornamentation, and solar panels. These features can shake loose from either the roof or structural elements of a building.
	1-Large signs	
	2-Extensive ornamentation	
	3-None	
	4-Roof-mounted ballasted PV array	
	5-Roof-mounted mechanically attached PV array	
	6-Large signs and roof-mounted ballasted PV array	
	7-Large signs and roof-mounted mechanically attached PV array	
	8-Extensive Ornamentation and roof-mounted ballasted PV array	
	9-Extensive Ornamentation and roof-mounted mechanically attached PV array	
13–Cladding Type	0-Unknown	Various types of claddings provide various degrees of resistance against wind loads. If there is a combination of two or more cladding types used on the structure, select the one of dominant use.
	1-Brick veneer	
	2-Metal sheathing	
	3-Wood	
	4-EIFS	
	5-Designed for impact	
	6-Not designed for impact with gravel rooftop on building or adjacent buildings within 1000 ft	
	7-Not designed for impact without gravel rooftop on building or adjacent buildings within 1000 ft	
	8-Vinyl siding / Hardboard	
	9-Stucco	
	10-None	
14–Roof Sheathing Attachment	0-Unknown	Roof sheathing is one of the main components of a building. It helps keep the integrity of the building and is a major line of defense against losses to building and contents due to both wind and rain. The strength of sheathing depends on the way it is attached to the roof rafters. This option accounts for nail size and spacing.
	1-Batten decking / Skipped sheathing	
	2-6d nails – Any nail schedule	
	3-8d Nails – Minimum nail schedule	
	4-8d Nails – High wind nail schedule	
	5-10d Nails – High wind nail schedule	
	6-Dimensional lumber / Tongue & groove decking with a minimum of 2 nails per board	

Characteristic	Options	Notes
15–Frame-Foundation Connection	0-Unknown	A building properly connected to its foundation can resist wind loads more effectively, especially at high wind speeds.
	1-Bolted	
	2-Unbolted	
16–Residential Appurtenant Structures	0-Unknown	Residential appurtenant structures do not refer to standalone garages or buildings, typically covered under Coverage B, but instead to carports, screen enclosures, and solar panels. The presence of these features may cause increased wind damage to the structure.
	1-None	
	2-Fences / Carport	
	3-Attached Screen enclosure / Lanai	
	4-Detached Screen enclosure / Lanai	
	7-Roof mounted ballasted PV array	
	8-Roof mounted mechanically attached PV array	
	9-Fences / Carport and Roof mounted ballasted PV array	
	10-Fences / Carport and Roof mounted mechanically attached PV array	
	11-Attached screen enclosure and Roof mounted ballasted PV array	
	12 -Attached screen enclosure and Roof mounted mechanically attached PV array	
	13-Detached screen enclosure and Roof mounted ballasted PV array	
	14-Detached screen enclosure and Roof mounted mechanically attached PV array	
19–Opening Protection	0-Unknown	Openings with poor wind resistance can expose interior building components and contents to more wind and water hazards than those with good wind resistance. In general, “glazed openings” refers to windows, and “all openings” refers to both doors and windows. Doors designed for pressure only can refer to existing garage doors retrofitted with braces to strengthen resistance to wind pressure.
	1-All openings designed for large missiles	
	2-All openings designed for medium missiles	
	3-All openings designed for small missiles	
	4-All glazed openings designed for large missiles	
	5-All glazed openings designed for medium missiles	
	6-All glazed openings designed for small missiles	
	7-All glazed openings covered with plywood / oriented strand board (OSB)	
	8-At least one glazed exterior opening does not have wind-borne debris protection	
	9-No glazed exterior openings have wind-borne debris protection	
	10-All glazed openings designed for large missiles & doors designed for pressure only	
	11-All glazed openings designed for medium missiles & doors designed for pressure only	
	12-All glazed openings designed for small missiles & doors designed for pressure only	

Characteristic	Options	Notes
	13-All glazed openings covered with plywood / oriented strand board (OSB) & doors designed for pressure & missile impact	
	14-All glazed openings covered with plywood / oriented strand board (OSB) & doors designed for pressure only	
	15-No glazed exterior openings have wind-borne debris protection but doors designed for pressure & missile impact	
	16-No glazed exterior openings have wind-borne debris protection but doors designed for pressure only	
26–Flashing and Coping Quality	0-Unknown	Roof covering failures are often attributed to initial failure of roof flashing and coping.
	1-Compliant with ES1	
	2-Not compliant with ES1	

Note that modifiers related to surge are not shown in this list.

V-3.4 Describe how mitigation measures are implemented in the model. Identify any assumptions.

A series of modifiers and options for each modifier are available for the user to select. The base (unmodified) vulnerability curves are adjusted based on modifier selections chosen by the user. The modifier values vary by base vulnerability curve, modifier option, and wind speed. The modifier values can decrease or increase the base vulnerability curves, depending on the modifier. The default setting for each of the modifiers is "unknown." Therefore, if no modifier options are chosen the base (average) vulnerability curve is utilized.

V-3.5 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.

Users may change one or more mitigation factors from the unknown state based on specific attributes for the modeled structure. The individual impact of single mitigation factors are combined together with a multiplicative methodology to reflect the combined effect of different attributes which may increase or decrease the loss. In addition, caps are placed on the maximum change evoked through the application of many modifiers to prevent unrealistic values from being returned from the model. RMS has validated the impact of multiple features through a variety of tests and comparisons to external publications (i.e., FEMA 2009b, ARA 2008). RMS also considers how additional information changes the CV of the loss estimates, and uses a probabilistic methodology to quantify the contribution of each of the mitigation measures to the CV.

V-3.6 Describe how building and contents damage are affected by performance of mitigation measures. Identify any assumptions.

As described in Disclosure V-3.4, modifier values can scale (increase or decrease) the base vulnerability functions for building and contents damage. The amount of increase or decrease in building and contents damage for each modifier option varies by wind speed and building attributes such as year built, construction class, etc. For instance, the impact of a good mitigation measure on the mean damage ratio (MDR) is typically larger for older year built structure and lower (in a relative sense) for newer year built structure, all else being equal.

The model requires the input for all primary building characteristics to be specified before the impact of mitigation measures are applied. Therefore, if any of the primary characteristics are unknown, the mitigation measure input is ignored.

The impact of multiple mitigation measures on building and contents damage are also capped (upper and lower bound) in the model.

V-3.7 Describe how mitigation measures affect the uncertainty of the vulnerability. Identify any assumptions.

Similar to the impacts on mean damage ratio described in Disclosures V-3.4 and V-3.6, modifier values impact the uncertainty of building and contents vulnerability as well.

1. As mitigation measures provide more information about the building to evaluate its performance when subject to wind loads, the epistemic uncertainty in vulnerability is always reduced. In the model, this is achieved through CV reduction factors that vary for each modifier
2. As vulnerability uncertainty (CV) is modeled a function of MDR, any increase or decrease in MDR due to mitigation measures leads to a change (corresponding reduction or increase) in CV value

Thus, the cumulative impact of the above two changes determines the total impact of mitigation measures on the uncertainty of vulnerability.

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 to insurance company input used for model verification are based upon accepted actuarial, underwriting, and statistical procedures, and are documented in writing.

Insurance company input data used in the modeling process contains information provided by the company and RMS does not make any adjustments, edits, inclusions, or deletions to the input data.

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.

Input data to the RMS hurricane model is explicitly provided by the user for each particular analysis. The model assumes that inputs provided by the user reflect actual exposures. Specifically:

Insurance to Value

The model does not make any assumptions regarding insurance to value. The location value and insurance limits are provided as separate inputs. No adjustments are made to these values within the model.

Primary Characteristics

The model itself does not make adjustments for exposure characteristics unless the user is unable to specify any of the primary characteristics or the specific location of the policy. If any of the primary characteristics are unknown, the model defaults to an average mix of the unknown characteristic(s).

Appurtenant Structures

Limits and values of appurtenant structures for each location are a user input. The model does not make assumptions regarding the value of appurtenant structures.

Contents

Contents limits and values are part of the user input. No assumptions are made within the model.

Time Element Coverage

Time element coverage limits and values are part of the user input. The model assumes that the value represents one year of potential expenses.

Insurer Exposures by ZIP Code

As part of the analysis process, each location analyzed is “geocoded” (i.e., geographically positioned). If the location does not geocode (for example, if a ZIP Code is invalid), the location is excluded from the analysis. All locations that are not included in the analysis are easily identified. If the analysis is run at ZIP Code level, the exposure is assumed to be distributed across the ZIP Code. Given that all exposure information is provided as part of the user analysis input, this information can be summarized and clearly identified as part of any rate filing submission. See the Analysis Summary Report in Appendix F.

A-1.1 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.

RiskLink assumes that the value input into it is the true property value. Any assumptions regarding insurance to value must be made by the user prior to running RiskLink.

RiskLink has separate inputs for values and limits. This provides the flexibility to estimate policies with or without guaranteed replacement cost coverage. For example, assume an insurer has a policy on its books for a building with an insured value of $100,000. If the insurer assumes that this building is 10% underinsured, the value input is $100,000 / (1-0.1) = $111,111. If the policy has guaranteed replacement cost coverage, the limit input will also be $111,111. If the policy does not have guaranteed replacement cost coverage, the limit input will be $100,000.

A-1.2 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.

RiskLink contains no assumptions regarding depreciation. To model actual cash value provisions, the user must input the actual cash values instead of the replacement cost values into RiskLink. Depreciation assumptions are made by the user prior to running RiskLink.

For example, if it is determined that a $100,000 valued home has depreciated 10% and the coverage dictates this depreciation should be reflected in the loss payment, the value input would be $100,000 and the limit input would be $90,000 ($100,000 times .90). Any expected loss payment would be capped at $90,000.

Neither RMS nor RiskLink performs any depreciation calculations, including the type given in the example. Any depreciation calculations are done by the user before inputting information into RiskLink.

A-1.3 Describe the methods used to distinguish among policy form types (e.g., homeowners, dwelling property, manufactured home, tenants, condo unit owners).

Policy forms vary in their terms and conditions, and RiskLink can model these variable terms. The modeling capabilities include variability in construction (several types of construction classes including mobile/manufactured homes), occupancy, coverages for building, contents and time element, or A, B, C, and D. Given these variables as input, any combination or policy form can be modeled for either commercial or personal lines.

A-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.

Appendix E includes screen shots of the RiskLink user interface showing the location level user inputs. All valid data input in this form is directly used in generating model output. The model name and version number are accessible in the RiskLink user interface via the About RiskLink option under the help menu. The screen shot of this is also available in the Appendix E. All items in the RiskLink model input forms are clearly labeled and defined.

A-1.5 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 should be clearly labeled and defined.

All required input needed to derive loss projections from the model are clearly labeled and defined in the Post Import Summary. All variables that a model user is authorized to set are clearly labeled and defined in the Analysis Summary Report. See Appendix F for an example of both output reports.

The RiskLink model contains several optional features that are not part of the FCHLPM approval, such as alternative rate sets reflecting “medium term” versus “historical” perspectives, and settings related to storm surge modeling. All user modifiable model options are described in sets of model option profiles called “DLM (Detailed Loss Model) profiles”—to ensure that results from the certified version of the model are clearly labeled, RMS provides a specified DLM profile, with approved settings, labeled “FCHLPM Certified Hurricane Losses.” Regulators may audit that FCHLPM approved model settings were used by verifying that the field “DLM Profile Name” is set to “FCHLPM Certified Hurricane Losses” in the Analysis Summary Report (Appendix F). The model settings corresponding to this certified profile are shown in Table 17 below:

Table 17: Model Settings Corresponding to the DLM Profile called “FCHLPM Certified Hurricane Losses”

Analysis Option	Approved Setting	Notes
Peril	Windstorm	
Region	North Atlantic (including Hawaii)	Florida is included in this region.
Analysis Mode / Type	Distributed / Exceedance Probability	
Event Rate Set	RMS 2017 Historical Event Rates	
Vulnerability Curves	Vulnerability - Default	Alternate vulnerability curves should be used only for sensitivity analyses only.
Assume 2% Deductible when UNKNOWN	Selected	This option will cause any residential locations within the state of Florida, with an unknown deductible, to default to 2% of the structure value.
Calculate Losses from:	Wind	The storm surge option should NOT be selected for ratemaking purposes in the state of Florida.
Calculated loss amplification factors for:	Building and Appurtenant Structures, Contents, and Business Interruption / Time Element	
Scale Exposure Factors:	Equal to 1.0	No exposure modification

Post analysis, users must apply annual deductible factors to model output in order to convert average annual loss and return period loss using occurrence-deductibles to average annual and return period loss using annual-deductibles, as required by Florida Statute 627.701. The table of relevant annual deductible factors is provided with each software version. In order to demonstrate these factors have been applied post analysis, users should complete a copy of the form included in Table 52 of Appendix F.

A-1.6 Describe actions performed to ensure the validity of insurer or other input data used for model inputs or validation/verification.

The following validations are done during the import or while entering the data:

- Any location that does not geocode to a county level or more geographically detailed resolution will not have any expected loss associated with it. If the user is unable to specify the ZIP Code, but is able to specify the county, the model allocates the exposure to ZIP Codes within the county in proportion to the appropriate exposure for the line of business under consideration. RMS does not perform loss costs analyses for ratemaking purposes at the county level, and strongly advises its clients not to do so. Limits and deductibles must be greater than or equal to 0. The limits are defaulted to the total value and deductibles default to 2% of Coverage A, respectively, if they are not specified.
- The construction and occupancy classes default to unknown if the data is not present or is invalid or if the scheme is not present or is invalid.
- A location must have a building, appurtenant structure, contents, or time element coverage specified or the location will be excluded from the analysis.
- The percentage completion for all the locations must be between 0 and 100. The default value for percentage completion is 100%.
- A location can have only one combined coverage (building plus contents).
- The value of the insured asset defaults to zero if not specified. If the currency type is not specified, all monetary units are defaulted to the RiskLink system currency.
- All primary characteristics must be coded in order for secondary modifiers to be invoked.
- All hurricane secondary modifiers are defaulted to unknown if not specified.
- All policies must have a valid peril specified.
- All percentage entries in the user interface must be between 0 and 100.
- The number of buildings at a location defaults to 1.
- The square-footage of a building is defaulted to a weighted average of the four square-foot bands when specified as unknown, based on an average square footage of 1,950 sq ft for single-family residential structures.

The following additional validations are done to user-input addresses during geocoding:

- Street address locations are standardized according to U.S. postal service formats, then confidence scored against a reference database comprised of validated street addresses, postcodes, cities, counties and states using a variety of matching algorithms that have been designed to minimize incorrect output. The highest confidence matching address is selected, and coordinates and other valid address elements are returned.
- Address input, including coordinate and ZIP Code level addresses, are validated against the reference database, including county and state, insuring that matches are constrained to the proper geographic region.

A-1.7 Disclose if changing the order of the model input exposure data produces different model output or results.

Changing the order of the model exposure data does not produce difference model output or results.

A-1.8 Disclose if removing and adding policies from the model input file affects the output or results for the remaining policies.

Each original policy (policies remaining or policies that existed before additions) will have the same AAL after removing or adding policies.

A-2 Event Definition

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.

The track and pressure of each tropical cyclone are modeled throughout its lifetime in the Atlantic Basin from genesis to decay. For the purposes of calculating losses, a storm is first considered when maximum winds reach hurricane strength and damage is caused in Florida. From that point on, wind speeds and losses are calculated regardless of whether maximum winds are greater than or less than hurricane strength.

A-2.1 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 stochastic database contains events making landfall in the U.S. and by-passing storms. Losses from by-passing storms are considered only once the storm reaches hurricane strength wind speeds and causes loss in Florida. The wind speeds causing damage for that hurricane could be greater than or less than hurricane strength, but the hurricane's maximum winds must correspond to at least hurricane strength for the storm to be considered.

A-2.2 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.

Loss due to coastal flood or storm surge is not included in the calculations of loss costs or probable maximum loss levels for structure or contents coverages.

A-3 Coverages

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

The methods used in the development of building loss costs are actuarially sound. The vulnerability relationships are developed using structural and wind engineering principles coupled with the analysis of historical storm loss data, building codes, published studies, and RMS internal engineering developments in consultation with wind engineering experts. In addition, RMS has reviewed research and data contained in numerous technical reports, special publications, and books related to wind engineering and damage to structures due to wind. RMS engineers have also participated in several reconnaissance missions. The knowledge and data gathered during these site visits have been used to guide the calibration and validation of the vulnerability functions. The final calibration of the vulnerability functions has been made using billions of dollars of loss data, with corresponding exposure information.

The model calculates loss distributions using damage ratios for each stochastic event and the rates for each event. These loss distributions are used to determine expected loss, which is divided by exposure to express the information in a loss cost. The methods are actuarially sound.

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

The methods used in the development of appurtenant structure loss costs are similar to the methods used for building loss costs and are actuarially sound.

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

The North Atlantic Hurricane Models' treatment of contents damage is derived from and reflects the relationships apparent in the data and is actuarially sound.

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

In the RMS hurricane model, time element losses include only factors that are hurricane related, are theoretically sound, and consider the time to repair the structure. Time element losses are determined based upon the estimated damage to the structure. Additionally, time element loss functions have been calibrated / validated with actual hurricane event time element coverage losses. The methods are actuarially sound.

A-3.1 Describe the methods used in the model to calculate loss costs for building coverage associated with personal and commercial residential properties.

To calculate losses, the damage ratio for each stochastic event derived in the Vulnerability Module is translated into dollar loss by multiplying the building damage ratio (including loss amplification as appropriate) by the building coverage value of the property. This is done at each location. Using the mean and coefficient of variation, a beta distribution is fit to represent the loss distribution. From the loss distribution one can find the expected loss.

RiskLink uses the loss distribution to estimate the portion of loss carried by each participant within a financial structure (insured, insurer, re-insurer). This distribution is used to calculate the expected loss net of any deductibles and limits.

The loss cost is equal to the expected loss divided by the exposure.

A-3.2 Describe the methods used in the model to calculate loss costs for appurtenant structure coverage associated with personal and commercial residential properties.

To calculate losses, the damage ratio for each stochastic event derived in the Vulnerability Module is translated into dollar loss by multiplying the appurtenant damage ratio (including loss amplification as appropriate) by the appurtenant coverage value of the property. This is done at each location. Using the mean and coefficient of variation, a beta distribution is fit to represent the loss distribution. From the loss distribution one can find the expected loss.

RiskLink uses the loss distribution to estimate the portion of loss carried by each participant within a financial structure (insured, insurer, re-insurer). This distribution is used to calculate the expected loss net of any deductibles and limits.

The loss cost is equal to the expected loss divided by the exposure.

A-3.3 Describe the methods used in the model to calculate loss costs for contents coverage associated with personal and commercial residential properties.

To calculate losses, the damage ratio for each stochastic event derived in the Vulnerability Module is translated into dollar loss by multiplying the contents damage ratio (including loss amplification as appropriate) by the content coverage value of the property. This is done at each location. Using the mean and coefficient of variation, a beta distribution is fit to represent the loss distribution. From the loss distribution one can find the expected loss.

RiskLink uses the loss distribution to estimate the portion of loss carried by each participant within a financial structure (insured, insurer, re-insurer). This distribution is used to calculate the expected loss net of any deductibles and limits.

The loss cost is equal to the expected loss divided by the exposure.

A-3.4 Describe the methods used in the model to calculate loss costs for time element coverage associated with personal and commercial residential properties.

The hurricane model has separate time element vulnerability functions. There is a time element function for each occupancy class supported by the model. Time element vulnerability is related to the building damage state. Time element losses consider only direct losses (i.e., expense paid to a policy holder while the house is being repaired). RMS has used actual loss data to calibrate time element vulnerability functions. Indirect losses are not separated from the actual loss data and therefore the modeled functions include both direct and indirect loss to the building.

To calculate losses, the damage ratio for each stochastic event derived in the Vulnerability Module is translated into dollar loss by multiplying the time element damage ratio (including loss amplification as appropriate) by the time element coverage value of the property. This is done at each location. Using the mean and coefficient of variation, a beta distribution is fit to represent the loss distribution. From the loss distribution one can find the expected loss.

RiskLink uses the loss distribution to estimate the portion of loss carried by each participant within a financial structure (insured, insurer, re-insurer). This distribution is used to calculate the expected loss net of any deductibles and limits.

The loss cost is equal to the expected loss divided by the 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.

Neither loss cost projections nor probable maximum loss levels include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin.

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

Neither loss cost projections nor probable maximum loss levels include any prospective provision for economic inflation. Vulnerability functions project losses as a percentage of coverage values. Coverage values are input by the user and no modifications are made within the program to account for economic inflation.

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

Loss cost projections and probable maximum loss levels do not include any 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.

RiskLink is capable of calculating loss cost projections and probable maximum loss levels at a geocode (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.

Following a major catastrophic event, claims costs can exceed the normal cost of settlement due to a unique set of economic, social, and operational factors. Commonly called demand surge, these factors are quantified using a methodology that RMS calls post-event loss amplification (PLA). These factors are included in the software, its loss costs, and its probable maximum loss levels.

A-4.1 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.

Expected losses associated with each stochastic storm are multiplied by the annual rate of occurrence for the corresponding storm. These are summed over all storms to determine the average annual loss.

Probable maximum loss levels are associated with exceedance probability (EP) curves. Occurrence exceedance probability (OEP) curves provide information on the largest loss from a single occurrence in a year and are generated from the event frequency distribution and the event severity distribution. Aggregate exceedance probability (AEP) curves provide information on losses from the accumulation of all events in a year and are generated using the Fast Fourier Transform methodology described in Robertson (Proceedings of the Casualty Actuarial Society, Vol. LXXIX, 1992).

As explained in the response to Disclosure G-1.2, beta distributions are fitted to each stochastic event which are used to obtain the severity distribution that describes the distribution of the size of losses, given that an event has occurred. A Poisson distribution is used for event frequency with the mean frequency obtained as the sum of all the event rates. The OEP curve is calculated on an occurrence basis and is obtained from the severity distribution along with the overall mean frequency. The AEP curve is calculated on an aggregate basis, showing the probability that aggregate losses in a year (the sum of losses from all occurrences in a year) will be greater than a given loss threshold. Thus, multiple occurrences in a year are considered for which the severity distribution is convolved as many times as occurrences may happen in a year.

Model output statistics are provided for various financial perspectives. Gross losses are net of primary company deductibles, as demonstrated in the response to Disclosure A-5.1. In addition to these perspectives, the model includes the capability for the model user to include reinsurance terms that form the basis of information such as pure premium and variability for treaty layers, which can be seen from either the ceding or assuming company perspective.

A-4.2 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.

Table 7 shown in the response to Disclosure G-3.3 shows the possible resolutions.

A-4.3 Describe how the model incorporates demand surge in the calculation of loss costs and probable maximum loss levels.

The North Atlantic Hurricane Models component that quantifies demand surge is called post-event loss amplification (PLA). The PLA model has three major components that escalate loss following major catastrophic events:

- **"Economic" demand surge (EDS)**—Increase in the costs of building materials and labor costs as demand exceeds supply. This factor has the biggest overall impact.
- **Claims Inflation (CI)**—Cost inflation due to the difficulties in fully adjusting claims following a catastrophic event. For example, shortcuts such as setting a threshold loss amount under which claims are simply paid with little to no investigation is a practice historically taken by insurers that are overloaded with claims following a catastrophic event. Intuitively, the impact of this factor varies with the estimated number of claims occurring for an event. Overall CI has a minor impact compared to the other two PLA components.
- **Super Catastrophe Scenarios**—Coverage and loss expansion due to a complex collection of factors such as containment failures, evacuation effects, and systemic economic downturns in selected urban areas. This factor has an impact for high return period events striking earthquake and hurricane exposed metropolitan areas. Primary escalation for super catastrophe events occurs with respect to BI losses.

Each of these PLA components has a different type of trigger and a unique loss escalation function that quantifies actual aspects of loss amplification noted in historical catastrophe events. PLA factors are quantified uniquely by coverage (building, contents, and time element) and are applied uniformly to all ground up loss estimates on a per-storm basis before the application of any financial structures such as deductibles, or limits.

A-4.4 Provide citations to published papers, if any, or modeling organization studies that were used to develop how the model estimates demand surge.

There are references that address in very general terms economic theories of demand and supply with applications to demand surge (for example, Dacy and Kunreuther, 1969). However, because of the lack of research specific to this area, RMS is not aware of publicly published papers that specifically address the topic of quantification of demand surge following natural disasters and therefore none have been referenced.

A-4.5 Describe how economic inflation has been applied to past insurance experience to develop and validate loss costs and probable maximum loss levels.

As described in Disclosure S-5.1, in order to create replications of known hurricane losses, RMS uses a normalization process on past reported historical losses to trend them to the date of the exposure used in the loss validation exercises. This process accounts for increases in cost of construction, growth of the building population, the change in building quality over time, and the change in average living area per house from the time of the event until the 2011. These normalization factors are only used for validation of the model, and are not incorporated into loss cost or probable maximum loss level outputs.

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, policy limits, and coinsurance are actuarially sound.

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

The relationship among the modeled deductible loss costs is reasonable.

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

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

A-5.1 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.

RiskLink uses a distributed approach for estimating losses net of deductibles and limits for each event. When projecting losses, RiskLink considers not only the mean damage ratio, but also the loss distribution around the mean. It does this by fitting a beta distribution by way of matching the first two moments of the distribution. The loss net of deductible and limit is calculated considering the pdf of the loss distribution between these two quantities as indicated in the example below.

Loss net of deductible and limit = $\int_{D}^{D+L}(x-D)f(x)dx + L[1-F(D+L)]$

Where:

- x = ground-up loss
- D = deductible
- L = limit
- f(x) = pdf of the ground-up loss
- F(x) = cdf of the ground-up loss

RiskLink computes the loss as a percentage of the property values, which are input parameters. The insured value is assumed to be the same as the property value unless a different insured value is input. If the insured value is lower than the property value, the insured value is treated as a limit to the insurer's liability.

RiskLink assumes that the property value input into it is the true property value. Any assumptions regarding insurance to value must be made by the user prior to running RiskLink.

RiskLink has separate inputs for values and limits. This gives it the flexibility to estimate policies with or without guaranteed replacement cost coverage. For example, assume an insurer has a policy on its books with an insured value of $100,000. If the insurer assumes that this policy is 10% underinsured, the value input is $100,000 / (1 – 0.1) = $111,111. If the policy has guaranteed replacement cost coverage, the limit input will also be $111,111. If the policy does not have guaranteed replacement cost coverage, the limit input will be $100,000.

A-5.2 Describe whether, and if so how, the model treats policy exclusions and loss settlement provisions.

The model quantifies expected damage arising from hurricanes. Perils other than wind are not included (unless the user explicitly selects surge). No other peril exclusions can be made by the user. RMS publishes a list of potential financial impacts that are not included in expected loss. Examples of these are loss assessments and inland flooding.

The users can input the specific coverages (building, contents, additional living/business interruption) to be modeled, and the values and limits for each coverage. The model does not make any adjustments to these inputs.

Damage functions are based on claimed experience, and assumes the treatment of loss settlement at the time of the loss will prevail in the future.

A-5.3 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.

Table 18: Example of Insurer Loss Calculation

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)=(A)*(D)	(I)
Building Value	**Policy Limit**	**Deductible**	**Mean Damage Ratio**	**Coefficient of Variation**	**α**	**β**	**Ground-Up Loss**	**Loss Net of Deductible and Limit**
100,000	90,000	2%	1.5%	4.184	0.041	2.716	$1,497.57	$1,224.68

In Table 18 α and β are the parameters of a beta distribution with a mean of 1.5% and a coefficient of variation of 4.184.

The calculation of the loss net of deductibles as shown in the formula in Disclosure A-5.1 is based on actuarial theory of deductibles and limits. See Hogg and Klugman, 1984. The distributions of the losses given that an event has occurred are validated using engineering studies and claims data.

Additional refinements to insurer gross loss due to deductibles and/or limits may be effective when more than one limit and/or deductible is applicable, such as when there are limits on individual locations as well as a policy limit in a multi-location policy.

A-5.4 Describe how the model treats annual deductibles.

The approach is to estimate the loss net of the deductible for each event in the year times the probability that there are that many occurrences.

Let N_k = loss net of the deductible for the k^{th} event in the year.

And let $p(k)$ = probability that there are exactly k events in the year.

Then the projected loss cost net of the deductible is $\sum_{k\geq 1} N_k\, p(k)$.

The values of the N_k's depend on k. For example, if $k = 1$, then N_k is calculated using the full deductible amount. If $k = 2$, then N_k is calculated using the amount of the deductible left over after the first occurrence.

A-6 Loss Outputs 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 methods, data, and assumptions used in the estimation of probable maximum loss levels are actuarially sound.

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.

Loss costs generated by RMS do not show an illogical relation to risk nor do they exhibit a significant change when the underlying risk does not change significantly.

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

Loss costs produced by the model are positive and non-zero for all ZIP Codes, including Florida ZIP Codes.

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 type, materials and workmanship increases, all other factors held constant.

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 other factors held constant. The model incorporates information related to fixtures and construction techniques designed for hazard mitigation as secondary modifiers as explained in Standard V-3. Details regarding these fixtures and construction techniques are input by the user.

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

Loss costs do not increase as wind resistant design increases, meaning if all other factors are held constant, more recent buildings are less vulnerable than corresponding older buildings. The model addresses wind resistant design provisions implicitly through vulnerability functions that vary with different year bands and vulnerability regions of the state.

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

Loss costs do not increase as code enforcement increases, meaning if all other factors are held constant, more recent buildings are less vulnerable than corresponding older buildings. The model addresses building code enforcement implicitly through vulnerability functions that vary with different year bands and vulnerability regions of the state.

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

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

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 loss costs for individual coverages is consistent with the coverages provided.

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

Output ranges provided by RMS are logical and without apparent deviations.

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 derived from RMS' model reflect lower loss costs for masonry construction compared to frame construction, all other factors held constant.

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

Output ranges derived from RMS' model reflect lower loss costs for the residential risk exposure compared to mobile/manufactured home risk exposure, all other factors held constant.

3. inland counties versus coastal counties, and

Output ranges derived from the RMS model reflect lower loss costs for inland counties compared to coastal counties in general, all other factors held constant.

4. northern counties versus southern counties.

Output ranges derived from the RMS model reflect generally lower loss costs for northern counties compared to southern counties, all other factors held constant.

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.

As noted in Disclosures V-1.2 and V-1.3, historical loss information is used in the development of the RMS vulnerability functions. This information, including construction type, line of business, policy structure, insured value, coinsurance and certain contractual provisions, is supplied directly to us by our clients as part of the exposure information provided with claim information. The information is reviewed by RMS and any peculiarities are clarified directly with the client. Underwriting practices, and contractual provisions not explicitly described in the exposure data are assumed to be representative of residential insurance underwriting in general; that is, the vulnerability of property observed in historical events is assumed to be indicative of vulnerability of such property types in future events where the property is subjected to similar wind loads.

A-6.1 Provide a completed Form A-1, Zero Deductible Personal Residential Loss Costs by ZIP Code. Provide a link to the location of the form [Form A-1].

A-6.2 Provide a completed Form A-2, Base Hurricane Storm Set Statewide Losses. Provide a link to the location of the form [Form A-2].

A-6.3 Provide a completed Form A-3, 2004 Hurricane Season Losses. Provide a link to the location of the form [Form A-3].

A-6.4 Provide a completed Form A-4, Output Ranges. Provide a link to the location of the form [Form A-4].

A-6.5 Provide a completed Form A-5, Percentage Change in Output Ranges. Provide a link to the location of the form [Form A-5].

A-6.6 Provide a completed Form A-7, Percentage Change in Logical Relationship to Risk. Provide a link to the location of the form [Form A-7].

A-6.7 Provide a completed Form A-8, Probable Maximum Loss for Florida. Provide a link to the location of the form [Form A-8].

A-6.8 Describe how the model produces probable maximum loss levels.

See the response to Disclosure A-4.1.

A-6.9 Provide citations to published papers, if any, or modeling organization studies that were used to estimate probable maximum loss levels.

See the response to Disclosure A-4.1.

A-6.10 Describe how the probable maximum loss levels produced by the model include the effects of personal and commercial residential insurance coverage.

Probable maximum loss levels produced by the model are based on exposure and coverage information is input by the user. This input includes identification of personal or commercial residential coverage.

A-6.11 Explain any differences 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.

A-6.12 Provide an explanation for all anomalies in the loss costs that are not consistent with the requirements of this standard.

Loss costs are consistent with the requirements of this Standard with no anomalies.

A-6.13 Provide an explanation of the differences in output ranges between the previously accepted model and the current model.

The differences are due to factors described in Disclosure G-1.5, where the impact of each component change is also given.

Consistent with the component changes described, the vulnerability module is responsible for the majority of the changes seen in the output ranges.

A-6.14 Identify the assumptions used to account for the effects of coinsurance on commercial residential loss costs.

The underlying assumption is that the exposure information received with claims data accurately represents the coinsurance provisions. The RiskLink financial model has specific logic to calculate coinsurance provisions.

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.

Model functionality and technical descriptions are documented for our users through a series of user guides, reference manuals, and white papers available from a limited-access portion of a website maintained by RMS.

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.

A Computer/Information Standards primary document binder in electronic form has been prepared by RMS and is available for on-site review by the professional team. The primary document binder contains an index that links each subsequent Computer/Information Standard to one or more sections within the binder and, where appropriate, to other more detailed documents such as the RiskLink System Administration Guide. All documentation is easily accessible from a central location. This collection of material specifies the model structure, detailed software description, and functionality. This material is indicative of the accepted software engineering practices that are followed by the RiskLink development 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.

Through the use of various techniques such as documentation templates and development standards, the RiskLink software and model development tools are documented and dated in a consistent manner. Appropriate personnel for software, data preparation and validation, as well as internal users of the software, will be available to the professional team when the Computer/Information Standards are being audited.

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.

A table containing items listed in Standard G-1, Disclosure 5 has been prepared. The table contains an item number in the first column, and the remaining columns contain specific document or file references for affected components or data relating to Computer/Information Standards CI-2, CI-3, CI-4, CI-5, and CI-6.

E. Documentation shall be created separately from the source code.

Modeling and software documentation has been created separately from and is maintained consistently with the source code. This external documentation is augmented by detailed technical documentation that is integrated with the source code.

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.

RMS maintains a complete set of requirements for each component, database, and data file accessed by a component that is relevant to this submission. These requirements are updated whenever changes are to be made to the model. This documentation, which is described in the response to Standard CI-2, is available for on-site review by the professional team.

CI-2.1 Provide a description of the documentation for interface, human factors, functionality, documentation, data, human and material resources, security, and quality assurance.

RMS maintains documentation of user interface/human factors requirements, functional specifications, documentation requirements, data specifications, human and material resource requirements, security measures, and quality assurance requirements.

Requirements documentation available for on-site review by the professional team includes:

- RiskLink System Administration Guide—detailed user-level documentation of product configuration and platform considerations, setup and installation, database maintenance, and advanced configuration settings
- RiskLink System Recommendations—material resource requirements in the form of computer system recommendations, certified platforms, and possible deployment configurations for RiskLink
- Database Schema Guide—database schema changes summary, and documentation of database schema tables
- RiskLink DLM User Guide—product reference guide that describes detailed steps on getting started with RiskLink DLM, importing data, managing exposure data, running analyses, viewing results, administering databases, and understanding the financial model
- RiskLink DLM Reference Guide—reference material necessary to use RiskLink effectively, including import file structures, construction classes and occupancy types, country-specific information, and a glossary
- Coding Standards—a collection of documents listing standards for software coding, database development, development environment setup, component design, file versioning, and source control system usage
- Market Requirements Documents—a collection of documents, typically generated by the RMS model management or product management groups, describing the business need for major feature or product changes, along with a summary of what the feature/change is intended to do (versus how it is to be implemented)
- Functional Specifications—a collection of documents, typically generated by RMS product management or senior modeling personnel, describing how a feature or product change is to be implemented, covering all aspects that have impact on the product end user (for example, user interface, loss calculations, database schema, data validity checking, documentation, and testing recommendations)
- Project Management Documents—a collection of Microsoft Project files, Microsoft Excel spreadsheets, and Microsoft Word documents that track the human resource requirements of project tasks
- Microsoft Team Foundation Server (TFS) and Visual Studio—documentation of the version control management systems used by RMS to provide secure access, auditing, and backup facilities for source code

- Information Technology Security Documents—a collection of documents explaining RMS requirements related to password protection, data backup, and other security policies and procedures
- Quality Assurance Test Plans—documents that outline testing requirements for product components, and are used to guide test case development

CI-3 Model Architecture and Component Design

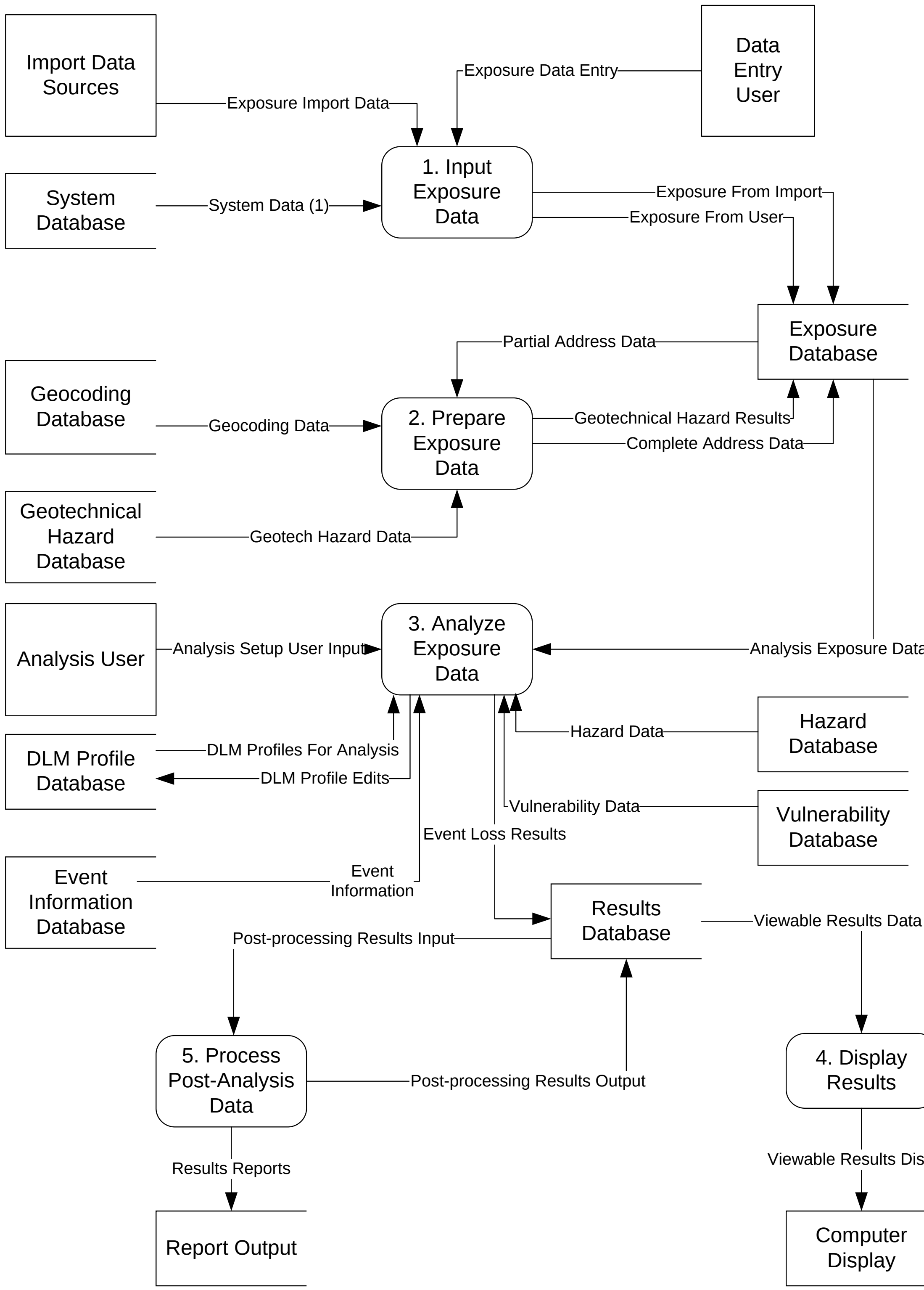
The modeling organization shall maintain and document (1) detailed control and data flowcharts and interface specifications for each software component, (2) schema definitions for each database and data file, (3) flowcharts illustrating model-related flow of information and its processing by modeling 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.

RMS maintains documentation of detailed control and data flow, interface specifications, and the schema definitions for all data files and database tables. Data flow diagrams are used to illustrate the relationship between software components and data using a network representation consisting of labeled component processes connected by data arcs, with components expanded into more detailed sub-component diagrams where appropriate. The top-level data flow diagram for the RMS RiskLink software is shown in the following figure.

The architecture for the hurricane model involves breaking the basic components into smaller modules and sub-modules, such as the wind hazard module and the vulnerability module. This structure is carried over into the software architecture. This internal model architecture and component design documentation, as well as the developers or modelers responsible for each component, are available for on-site review by the professional team.

RMS maintains diagrams illustrating flow of information and processing by modeling personnel for items such as form generation for this submission.

Figure 47: RiskLink Top Level Data Flow



RiskLink Top Level Data Flow

CI-4 Implementation

A. The modeling organization shall maintain a complete procedure of coding guidelines consistent with accepted software engineering practices.

RMS has developed and maintained a set of coding guideline documents, consistent with accepted software engineering practices. These documents contain standards for software coding, database development, development environment setup, component design, file versioning, and source control system usage. Compliance with these standards are monitored through peer and management review.

B. The modeling organization shall maintain a complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components.

RMS maintains a complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components. This procedure includes extensive validation procedures designed to guarantee that data integrity is maintained throughout the product development process.

C. All components shall be traceable, through explicit component identification in the model representations (e.g., flowcharts) down to the code level.

The software is fully traceable from the flow diagrams to the code level. Detailed data flow diagrams of the model components will be available for review by the professional team. The data flow diagrams are organized hierarchically, with highest design level components incrementally translated into a larger number of subcomponents. A data dictionary provides a textual description of each data flow component in addition to documenting the linkage of those components to the source code.

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.

RMS maintains a table of all software components affecting loss costs and probably maximum loss levels, with the table columns providing the information required by this standard.

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.

As outlined in the RMS coding guidelines, software components are commented with a statement of purpose (requirements summary), input and output description (interface specification), summary of important changes, and “tactical comments” explaining any potentially confusing software code. These comments allow a software engineer unfamiliar with the code to comprehend the component logic at a reasonable level of abstraction.

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 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.***
2. ***A cross-referenced list of implementation source code terms and variable names corresponding to items within F.1 above.***

For all components and data modified by items identified in Standard G-1, Disclosure 5, RMS maintains a list of all equations and formulas used in documentation of the model modifications, with definitions of all terms and variables, along with a cross-referenced list of implementation source code terms and variable names corresponding to those equations and formulas.

CI-4.1 Specify the hardware, operating system, other software, and all computer languages required to use the model.

The following are required to use the RMS model:

- Operating system options:
  - Microsoft Windows 2012 R2 64-bit operating system for desktop installations and client (remote database) installations
  - Microsoft Windows 7 Enterprise, or Windows 10 64-bit operating system for desktop installations and client installations
  - Microsoft Windows Server 2012 R2 64-bit operating system for analysis and job server
  - Microsoft Windows Server 2012 R2 64-bit operating system for database server installations
  - Microsoft Windows HPC Server 2012 R2 for Enterprise Grid Computing (EGC) 64-bit compute nodes (analysis servers)
  - Microsoft Windows HPC Server 2012 R2 for EGC 64-bit head nodes (job servers)
  - Microsoft Windows Server 2012 R2 for EGC database installations
- Any hardware capable of running one of the Microsoft operating systems listed above, with a recommended minimum of 8 processor cores, 16 GB RAM, 1024 x 768 display, one available USB connector, and at least 500 GB disk space
- Database options:
  - Microsoft SQL Server 2012 Standard/Enterprise or SQL Server 2014 Standard/Enterprise for EGC database server installations
- Microsoft .NET 3.5 and .NET 4.6.1
- SQL Native Client 12.0
- SQL Server 2014 Server Management Objects (SMO)
- Visual C++ 2008 and 2015 Redistributable
- Microsoft XML Core Services (MSXML)
- Microsoft Enterprise Library
- Microsoft HPC Class Library (for EGC installations)
- Crystal Reports report display software
- Group 1 (Sagent) geocoding software
- ESRI ArcGIS software
- Objective Grid display software
- Objective Toolkit display software
- Olectra Chart display software
- Rogue Wave C++ class libraries

The primary language for the development of RiskLink is C#. C++ code is being incrementally replaced by code written in the C# language.

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.

Modifications or additions to the model are typically designed and prototyped by engineers. Prototypes are coded, for example, in spreadsheets or in programs written in C, C++, C#, or FORTRAN. Once the concept has been proven in the prototype, a written specification is prepared to describe the purpose of the change and to provide a detailed description of the algorithm to be introduced to the production software. This description typically takes the form of narrative, "pseudo-code" (similar to computer code but stripped of computer language details for the sake of readability), control flowcharts, or data flow diagrams. This description is sometimes augmented by actual computer code from the prototype. The specification is peer-reviewed by other engineers and by senior software developers. Once the specification is approved, the changes are then made to the production software.

RMS model development and quality assurance (QA) departments rigorously check output generated from the model. Calculations are performed outside the model and compared to the software-generated results to ensure that they are correct. A series of test cases are run to ensure that the computer program generates consistent and reasonable results on a wide variety of client data. Data sets include end-condition test cases using very large and very small values, large-data-volume test datasets of many locations spread across multiple ZIP Codes, and data sets focused on testing specific areas of the model.

Code inspections, reviews, and walkthroughs are performed on a regular basis to verify code correctness. Both software management and model development engineers participate in this process. Reviewers check code both during and after initial development. Code changes are often isolated and inspected using the features of our source code management system. Reviewers also use source-code debugging tools to verify run time behavior.

The software source code contains numerous logical assertions, exception-handling mechanisms, and flag-triggered output statements that are used to test the values of key variables for correctness.

Verification procedures for each component include tests performed by modeler personnel other than the original component developers. The RMS QA department has primary responsibility for independent verification. In addition, peer review of model changes typically includes testing by development staff other than the original component developers.

B. Component Testing

1. ***The modeling organization shall use testing software to assist in documenting and analyzing all components.***

The IBM/Rational Enterprise Suite is the primary software development toolkit used at RMS for analyzing and testing all components. This suite contains several tools that assist in component testing. Both software developers and quality assurance personnel use Rational Robot, Rational Functional Tester, and Rational Test Manager for test plan development, test case generation, and test case execution.

Microsoft Visual Studio is the primary software development toolkit used at RMS. It contains an extensive collection of debugging tools that allows developers to "walk through" software components on a line-by-line basis, and at any point, view the control stack, the value of all variables, debug trace statement output, etc.

For key “lower-level” components, a custom test driver is developed to execute the methods of the components using a range of input values, and to test the resulting outputs of the methods. For “higher-level” components that depend upon a large collection of other components or significant amount of state information (for example, those that implement the RiskLink user interface) custom test drivers are not practical. Instead, we develop automated test suites using IBM/Rational tools to check, for example, for specific property values of user interface objects.

2. Unit tests shall be performed and documented for each component.

All software components are unit tested as they are developed or modified. The results of the unit tests are summarized in technical specification documents that are written by software developers while implementing and testing software components, or in the JIRA incident database.

3. Regression tests shall be performed and documented on incremental builds.

A large suite of regression tests are performed and documented on incremental builds of the RiskLink software. The majority of the regression tests are implemented using automated tools, including Rational Robot and Rational Functional Tester test scripts, though some additional manual testing is always performed. The automated regression tests are split into two sets. The first set is a broad but shallow set of tests that are executed by the software development team before passing the build to the quality assurance department. The QA department then executes an extensive, broad and deep set to check for stability of results in all areas of the software.

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 to ensure correctness of all components and data defining the model. Most of the aggregation testing is done by executing the product as a complete package, using a comprehensive suite of test scripts supplemented with additional manual tests, to ensure that component interactions that would escape unit testing are checked. These tests cover the complete start-to-finish workflow of the user of the software, and contain a wide range of possible inputs, thus ensuring that all components relevant to this submission are executed at least once.

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.

RMS uses a range of testing software to assist in documenting and analyzing all databases and data files accessed by components. In many cases, this involves the use of Excel, Access, or other generic data manipulation packages. Commercial mapping software (e.g., MapInfo or ArcInfo) is used to check the spatial distribution of data. In some cases, special-purpose test programs are written to automate data validation. In addition, database and data file values are validated indirectly via the regression test scripts described above.

2. The modeling organization shall perform and document integrity, consistency, and correctness checks on all databases and data files accessed by the components.

RMS performs and documents data integrity, consistency, and correctness checks on all databases and data files accessed by components. Tools such as Excel and Access are used to perform cross checks, run statistical tests, or generate data visualization output (e.g., graphs and charts) from datasets. Visual inspection of geographic data displayed as maps is another key testing methodology used to check the spatial distribution of data. All data that is packaged as binary files are checked via software that converts data from text to binary, binary to text, then performs a comparison of the input and output text files.

CI-5.1 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.

The model produces the same loss costs and probable maximum loss levels if run with the same information more than once. A random number generator is not used during model execution. Repeatability of results is tested as part of our standard testing suite.

CI-5.2 Provide an overview of the component testing procedures.

The component testing procedures can be grouped in the following categories:

Unit Tests

- Manual unit tests are run when components are created or changed. Actual results are compared against expected results documented within specification documents or test cases.
- Automated unit tests are written to test key components that are added or modified. These tests are run periodically throughout the product development cycle.

Aggregation Tests

- Manual aggregation tests are developed and run for features added with the current product release cycle.
- Automated aggregation tests are developed and run for each new feature once it has been integrated into the product and manually tested. Each automated test script is added to the overall product test suite.

Performance Tests

- A suite of performance regression tests are run at specific time intervals within the product development cycle.
- Memory checking tools and code performance profilers are run periodically during the product release cycle, either as a regression test or to diagnose known or suspected performance problems.

These testing procedures are described in more detail in the responses to Sections A, B, and C of this standard.

CI-5.3 Provide a description of verification approaches used for externally acquired data, software, and models.

When RMS receives data, software, or models from third party sources, our developers use a variety of methods and approaches to verify that the material is appropriate for use in the hurricane model.

Verification approaches will depend on what data/software/models are being reviewed, but may include:

- Checks for quality and consistency
- Comparisons to previous versions, and logical explanations
- Benchmarking against other sources
- Geospatial analysis, if appropriate

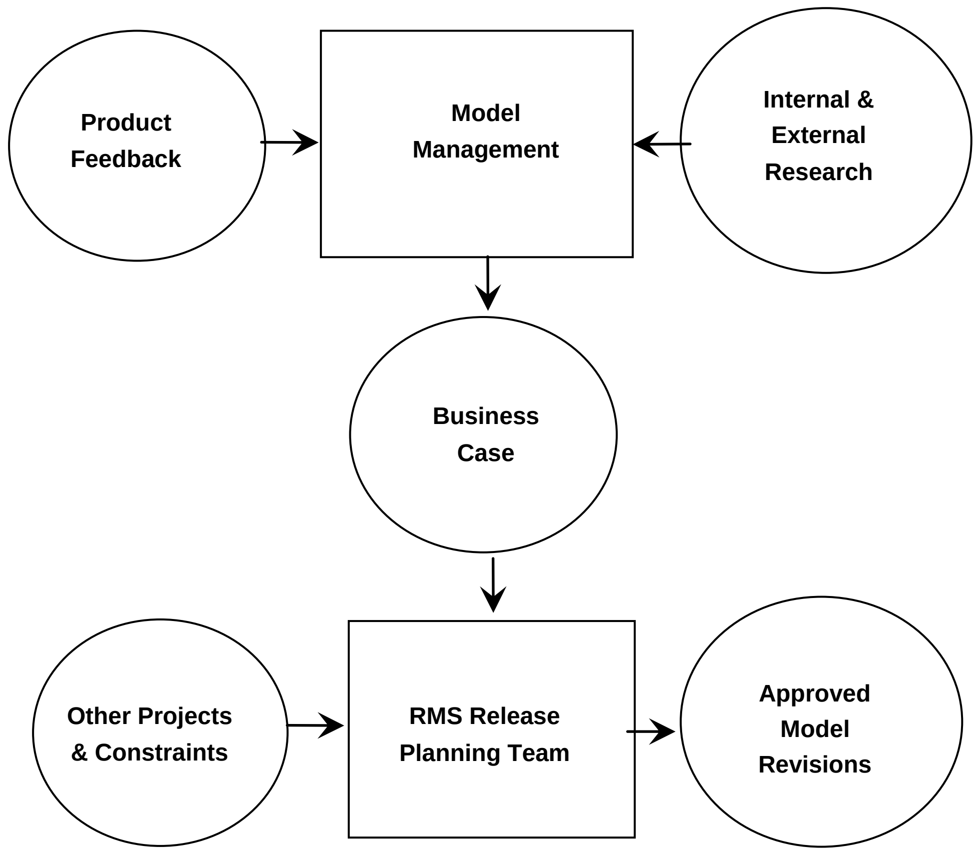
CI-6 Model Maintenance and Revision

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.

The general policy of RMS has been to upgrade its North Atlantic Hurricane Models whenever new data or research becomes available that results in a non-trivial improvement in the loss modeling methodology.

The following figure illustrates, at a high level, the process for deciding on the content of model revisions.

Figure 48: High-Level Description of Model-Revision Policy



The process of model revision and release is rigorous and well-documented. The figures in Disclosure CI-6.1 illustrate the model-revision process in more detail.

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.

The North Atlantic Hurricane Models is periodically enhanced to reflect advances in our knowledge of hurricanes and the consequences of hurricanes. Whenever RMS releases a new model with a revision to any portion of the model that results in a change in any Florida residential hurricane loss cost or probable maximum loss, a new model version number is used to designate that release.

C. The modeling organization shall use tracking software to identify and describe all errors, as well as modifications to code, data, and documentation.

Microsoft Team Foundation Server is used to track modifications to all source code. These tools provide, for each file, the date of each change, the author of the change, file version, and a detailed comparison of the file before and after the change. In addition, documentation in our JIRA incident database summarizes changes made to the source code and data.

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.

RMS will maintain a list of all model versions since the initial submission for this year, with unique version identification and a list of additions, deletions, and changes that define that version.

CI-6.1 Identify procedures used to review and maintain code, data, and documentation.

The following two figures depict the process and procedures used to maintain code, data, and documentation.

Figure 49: Detailed Description of Model-Revision Policy

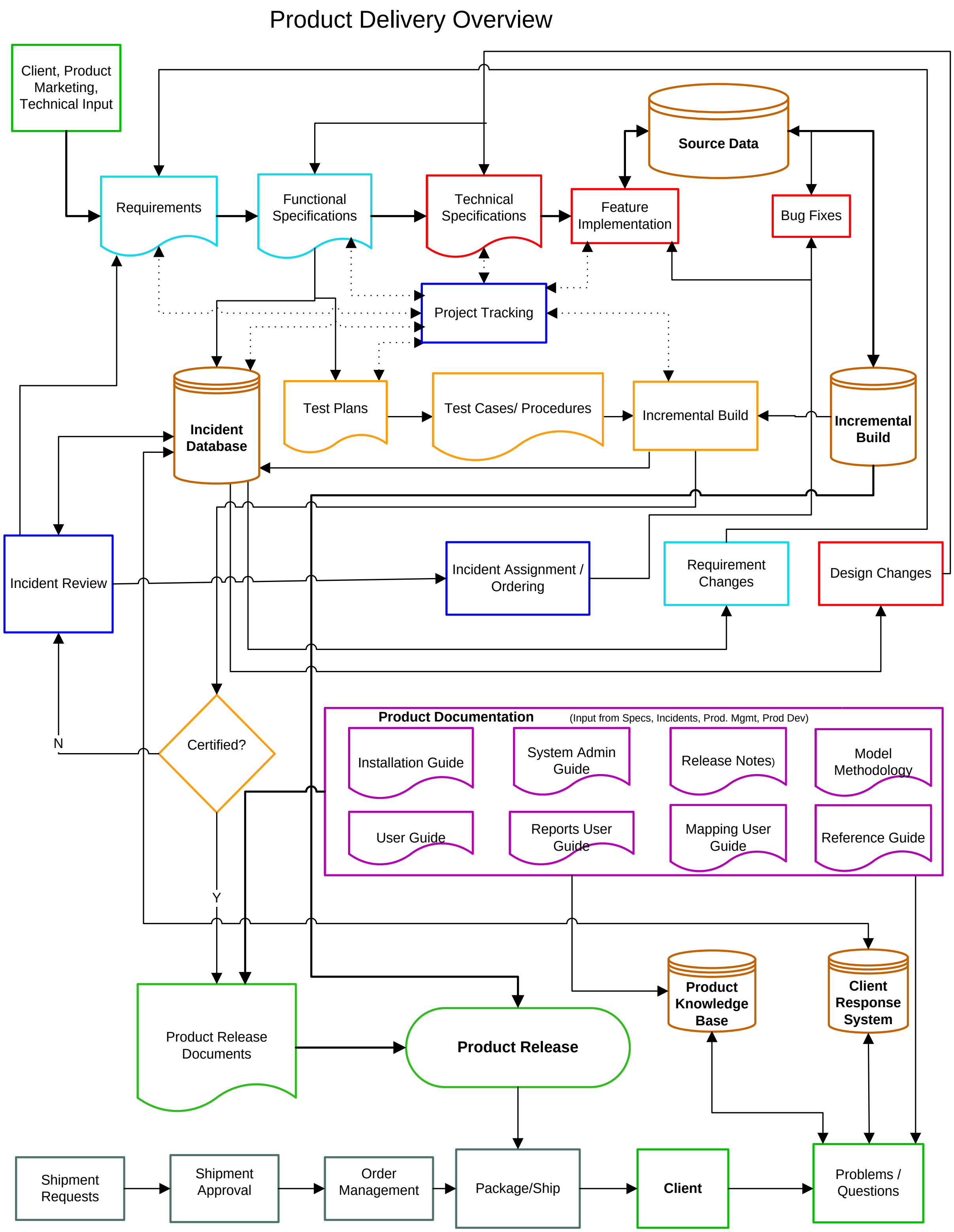
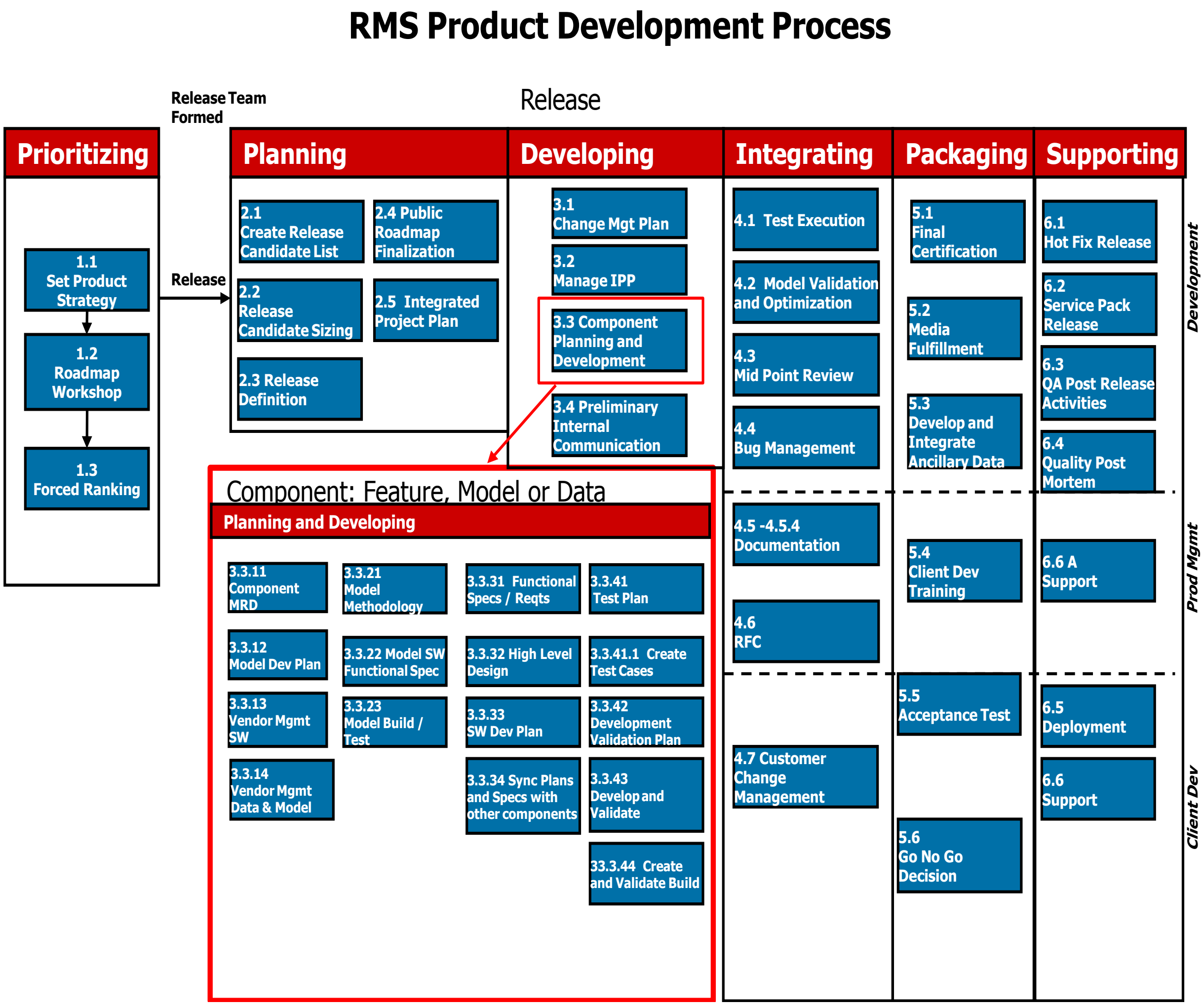


Figure 50: RMS Product Development Process Diagram



Input from clients, technical resources, product marketing, product management, and other internal and external sources drives the creation of marketing requirements documents, which describe the key goals and constraints of planned upgrades. Those requirements are translated into functional specifications, which map out how those requirements are to be met within the model implementation. Software design specifications (technical specifications) are created to detail the planned implementation.

As implementation proceeds, the need for design changes and, sometimes, requirement changes become apparent. Once approved, these changes are reflected as updates to the documents described in the previous paragraph.

The development process is carefully monitored by numerous individuals within RMS, using several project tracking tools and procedures. For example, an incident record is created using the JIRA incident tracking system for each requested model change. This is done whether the change is viewed as a new feature or a bug fix. Each incident record is maintained throughout the life cycle of that incident, including resolution and re-testing.

Documentation is developed for proposed engineering enhancements to the model, and this documentation, including the software specification, is used in the development of new or updated test plans and test cases for that release.

When a release is certified by quality assurance management, a product release document, extensive user-level product documentation, and the software and data that comprise the released product are packaged and shipped to clients. Various cross-checks and tests in this final fulfillment step assure that clients are provided a complete and correct package.

Standard test cases are shipped with the release, to allow post-installation verification. All post-installation questions or problems are tracked within the RMS Client Response System. A product Knowledge Base is being maintained and enhanced to assist RMS client development teams in supporting RMS client needs.

CI-6.2 Describe the rules underlying the model and code revision identification systems.

RMS products that implement specific models are comprised of two parts:

- Model infrastructure, i.e., the software code and data that implements the generic processes that underlie a model implementation. This includes not only the computational aspects of a model, but also the features that are a part of model workflow, such as exposure data import, and results viewing.
- Model data which, when used by the model infrastructure, generates modeled loss results.

RMS uses a four-part revision numbering system to precisely identify a model version in the format [*MajorRevision*].[*MinorRevision*]. SP [*PatchRevision*] Build ([*BuildNumber*])
where:

- *MajorRevision* signifies a significant revision to the infrastructure.
- *MinorRevision* indicates a smaller update, but one that still includes a change in product functionality.
- *PatchRevision* (and the SP designation) is an optional portion of the numbering scheme that signifies a revision that fixes model infrastructure functionality or model data that has been previously released to RMS clients. It is not shown when the PatchRevision is zero.
- *BuildNumber* identifies a particular snapshot or iteration of the model infrastructure and data during a release development cycle.

RMS typically bundles revisions to model data with revisions to model infrastructure; in other words, infrastructure and data updates are released in one package with one revision number, reflected in the MajorRevision number. For the sake of simplicity, revisions are typically communicated externally in a simplified manner. For example, 17.0.SP0 Build (1825) may simply be referred to externally with clients as version 17.0.

If the model is updated and released outside of the primary product release cycle, RMS will increment either the MinorRevision or the PatchRevision depending on the type and magnitude of the change. The criteria regarding which part of the revision numbering is incremented depends on whether the update can be distributed to clients as an incremental software download (PatchRevision) or requires a new installation package (MinorRevision).

Software component (DLL files or binaries files) and analysis results are tagged with an identifier in the format [MajorRevision].[MinorRevision].[BuildNumber].[PatchRevision].

For this submission, the model designation is RiskLink 17.0 (Build 1825), which has software components identified as “17.0.1825.0.” All analysis results generated by the software will contain a field called EngineVersion which contains the identified “17.0.1825.0.”

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 components and data are being accessed, and (4) secure access to documentation, software, and data in the event of a catastrophe.

RMS has implemented security procedures for access to code, data, and documentation in accordance with standard industry practices. These procedures are described in the disclosure for this standard.

CI-7.1 Describe methods used to ensure the security and integrity of the code, data, and documentation.

The following is a summary of key aspects of RMS security procedures:

- Security requirements are documented and enforced by the RMS legal and information technology departments
- All company personnel are trained in security requirements and procedures
- All company personnel are required to sign a non-disclosure agreement as a condition of their employment
- Physical security is maintained using locked doors, key-card access, video cameras, and security patrols
- The RMS network is protected via hardware firewalls
- All servers and desktops are protected with McAfee Antivirus software
- All servers and desktops are remotely audited for security compliance
- Microsoft Visual Studio and Microsoft Team Foundation Server are used to track modifications to all source code. These source control systems maintain source code in an encrypted form. A login is required to access source code. The nature and author of all changes are recorded
- All servers are backed up nightly. Off-site backups are maintained at a secure commercial facility.

Password and authorized personnel access provisions also apply for client data held on site at RMS for processing and analysis.

Security for RMS software licensed for use at the customer premises is primarily controlled by the use of compiled binary files, which are not readily modifiable without access to the original source code (which is not available). An additional measure of protection is provided by our software licensing provisions, which provide legal obstacles to manipulation or unauthorized use of RMS software.

APPENDIX A—FCHLPM FORMS

Form G-1: General Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models in RiskLink 17.0 (Build 1825*)* *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.*

Michael Young
Name

MSc, Engineering Science
Professional Credentials (Area of Expertise)

Signature (original submission)

October 31, 2016
Date

Signature (response to deficiencies, if any)

January 3, 2017
Date

Signature (revisions to submission, if any)

April 12, 2017
Date

Signature (final submission)

April 12, 2017
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.

Form G-2: Meteorological Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models in RiskLink 17.0 (Build 1825) *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.*

Paul Wilson	PhD, Atmospheric Physics
Name	*Professional Credentials (Area of Expertise)*
	October 31, 2016
Signature (original submission)	*Date*
Signature (response to deficiencies, if any)	*Date*
	April 12, 2017
Signature (revisions to submission, if any)	*Date*
	April 12, 2017
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.

Form G-3: Statistical Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models in RiskLink 17.0 (Build 1825) *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.*

Enrica Bellone *Name*	PhD, Statistics *Professional Credentials (Area of Expertise)*
Enrica Bellone *Signature (original submission)*	October 31, 2016 *Date*
Enrica Bellone *Signature (response to deficiencies, if any)*	January 3, 2017 *Date*
Enrica Bellone *Signature (revisions to submission, if any)*	April 12, 2017 *Date*
Enrica Bellone *Signature (final submission)*	April 12, 2017 *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.

Form G-4: Vulnerability Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models in RiskLink 17.0 (Build 1825) *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.*

Rajkiran Vojjala
Name

MS, Civil Engineering
Professional Credentials (Area of Expertise)

Signature (original submission)

October 31, 2016
Date

Signature (response to deficiencies, if any)

January 3, 2017
Date

Signature (revisions to submission, if any)

April 12, 2017
Date

Signature (final submission)

April 12, 2017
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.

Form G-5: Actuarial Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models in RiskLink 17.0 (Build 1825) *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.*

Kay Cleary	FCAS, MAAA
Name	*Professional Credentials (Area of Expertise)*
Kay A. Cleary	October 31, 2016
Signature (original submission)	*Date*
Kay A. Cleary	January 3, 2017
Signature (response to deficiencies, if any)	*Date*
Kay A. Cleary	April 12, 2017
Signature (revisions to submission, if any)	*Date*
Kay A. Cleary	April 12, 2017
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.

Form G-6: Computer/Information Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models in RiskLink 17.0 (Build 1825) *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 (CI1 – CI7),*
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.*

Yogesh Vani
Name

MS, Computing Technologies
Professional Credentials (Area of Expertise)

Signature (original submission)

October 31, 2016
Date

Signature (response to deficiencies, if any)

Date

Signature (revisions to submission, if any)

April 12, 2017
Date

Signature (final submission)

April 12, 2017
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.

Form G-7: Editorial Review Expert Certification

I/We hereby certify that I/we have reviewed the current submission of North Atlantic Hurricane Models in RiskLink 17.0 (Build 1825) *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.*

Beth Stamann
Name

Senior Documentation Specialist
Professional Credentials (Area of Expertise)

Signature (original submission)

October 31, 2016
Date

Signature (response to deficiencies, if any)

January 3, 2017
Date

Signature (revisions to submission, if any)

April 12, 2017
Date

Signature (final submission)

April 12, 2017
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.

Form M-1: Annual Occurrence Rates

A. Provide a table of annual occurrence rates for landfall from the dataset 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).

A table providing annual occurrence rates for the model is provided in Table 19. Note that the Category 1 historical number and rate for Florida by-passing hurricanes have been updated to include NONAME-05 1935 (HURDAT2 storm number AL051935).

B. Describe model variations from the historical frequencies.

The agreement between modeled and observed frequencies—both by intensity and by region—is reasonable given the limited historical record.

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.

Histograms comparing modeled and observed landfall frequencies by region are given on Figure 51 which denotes the regions of Florida corresponding to Figure 3 of the ROA.

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 partitioned or modified.

E. List all hurricanes added, removed, or modified from the previously accepted model version of the Base Hurricane Storm Set.

In agreement with the HURDAT2 reanalysis as of September 2015, one storm has been removed (Fox 1952, HURDAT2 storm number AL071952), one storm has been added (Hazel 1953, HURDAT2 storm number AL121953), and track parameters of 10 hurricanes have been modified in the 1946–1955 time frame.

The 12 storms changed since the last submission are listed below, and shown in (Figure 52 to Figure 57):

Name	Original HURDAT	HURDAT2	Added/Removed/Modified
NoName-06 1946	AL051946	AL061946	Modified
NoName-04 1947	AL041947	AL041947	Modified
NoName-09 1947	AL081947	AL091947	Modified
NoName-08 1948	AL071948	AL081948	Modified
NoName-09 1948	AL081948	AL091948	Modified
NoName-02 1949	AL021949	AL021949	Modified
Baker 1950	AL021950	AL021950	Modified
Easy 1950	AL051950	AL051950	Modified

Name		Original HURDAT	HURDAT2	Added/Removed/Modified
King	1950	AL111950	AL111950	Modified
Fox	1952	AL071952	AL101952	Removed
Florence	1953	AL081953	AL091953	Modified
Hazel	1953	AL121953	AL121953	Added

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 information is provided in Excel format in the file RMS15FormM1.xlsx at the link provided to the FCHLPM.

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.

Table 19: Annual Occurrence Rates

	Entire State				Region A – NW Florida			
	Historical		Modeled		Historical		Modeled	
Category	Number	Rate	Number	Rate	Number	Rate	Number	Rate
1	23	0.20	21	0.18	14	0.12	14	0.12
2	16	0.14	14	0.12	5	0.04	4	0.04
3	15	0.13	13	0.12	6	0.05	5	0.04
4	10	0.09	10	0.09	0	0.00	1	0.01
5	2	0.02	2	0.02	0	0.00	0	0.00

	Region B – SW Florida				Region C – SE Florida			
	Historical		Modeled		Historical		Modeled	
Category	Number	Rate	Number	Rate	Number	Rate	Number	Rate
1	7	0.06	6	0.05	6	0.05	6	0.05
2	4	0.03	4	0.03	6	0.05	6	0.05
3	5	0.04	6	0.05	6	0.05	5	0.04
4	4	0.03	2	0.02	6	0.05	7	0.06
5	1	0.01	0	0.00	1	0.01	1	0.01

	Region D – NE Florida				Florida By-Passing Hurricanes			
	Historical		Modeled		Historical		Modeled	
Category	Number	Rate	Number	Rate	Number	Rate	Number	Rate
1	1	0.01	1	0.01	5	0.04	8	0.07
2	2	0.02	1	0.01	4	0.03	2	0.02
3	0	0.00	1	0.01	4	0.03	2	0.02
4	0	0.00	0	0.00	1	0.01	1	0.00
5	0	0.00	0	0.00	0	0.00	0	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	1	0.01	6	0.05	6	0.05
2	1	0.01	2	0.01	3	0.03	3	0.02
3	0	0.00	1	0.01	5	0.04	3	0.02
4	0	0.00	1	0.01	1	0.01	1	0.01
5	0	0.00	0	0.00	1	0.01	0	0.00

*All values rounded to 2 decimal places

Figure 51: Comparison of Historical and Modeled Multiple Landfall Occurrences by Region as Defined in Figure 3 on Page 119 of the ROA

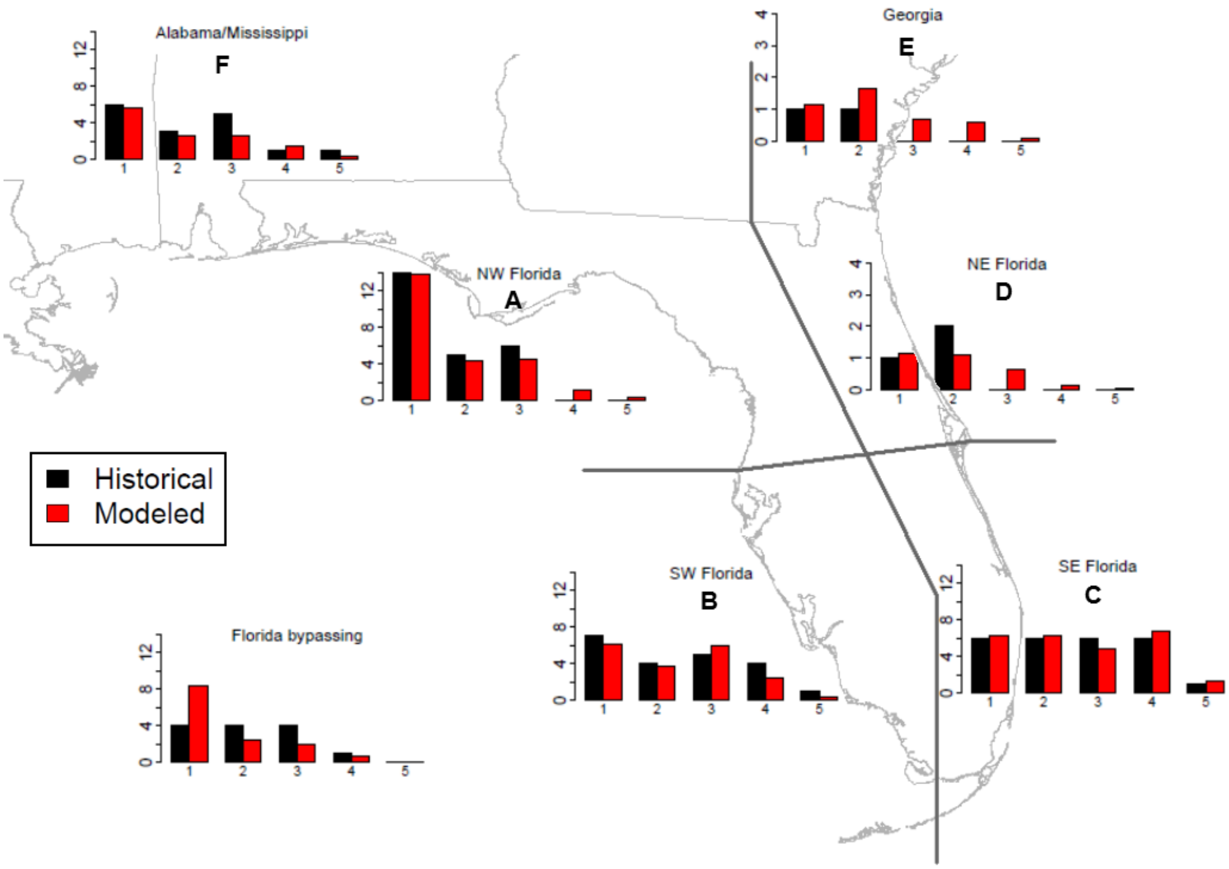


Figure 52: Change in Track Parameters for the 2 of 12 Modified Hurricanes—Part (a) Left: Previous Submission, Right: Current Submission

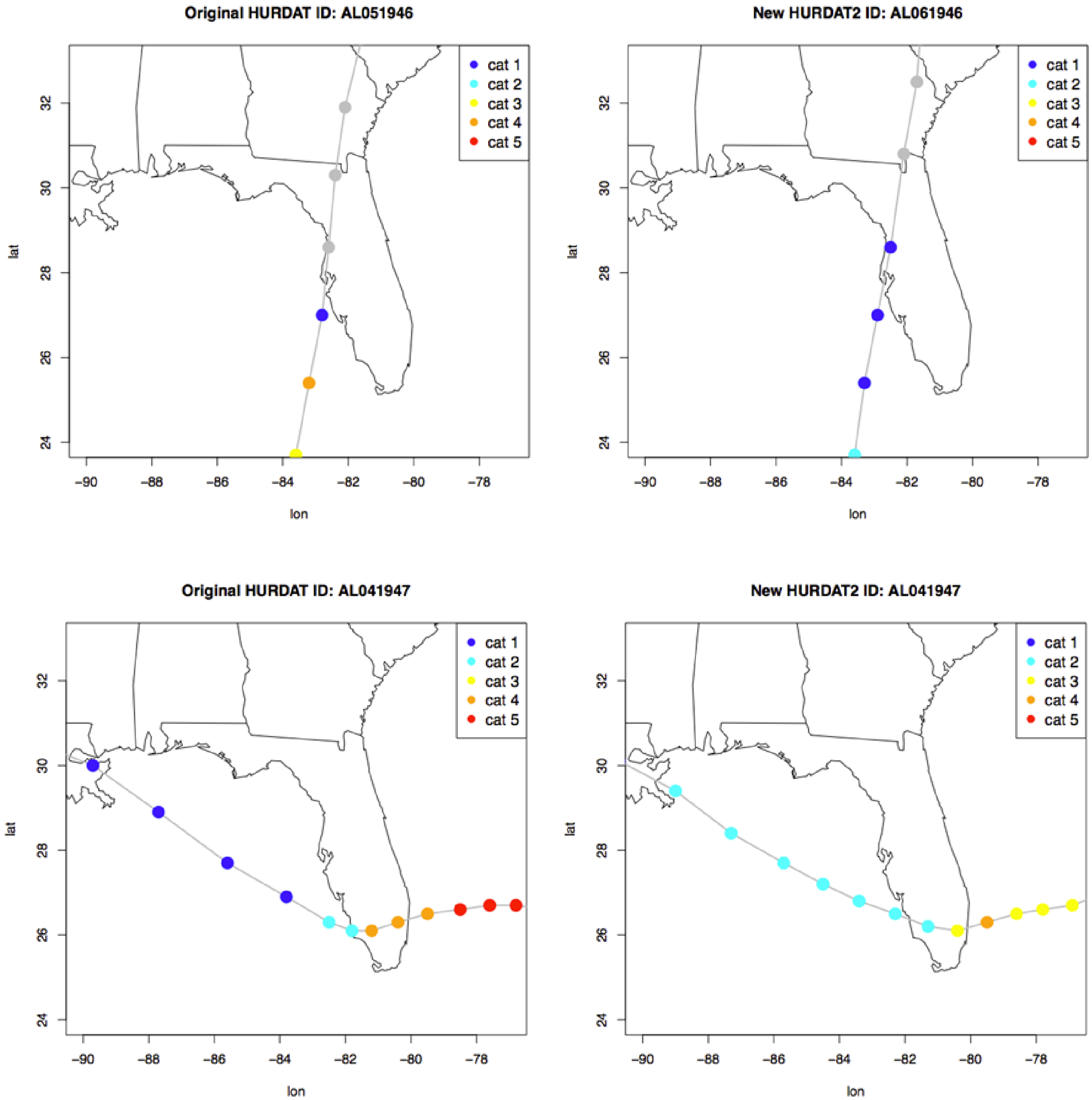


Figure 53: Change in Track Parameters for 2 of the 12 Modified Hurricanes—Part (b) Left: Previous Submission, Right: Current Submission

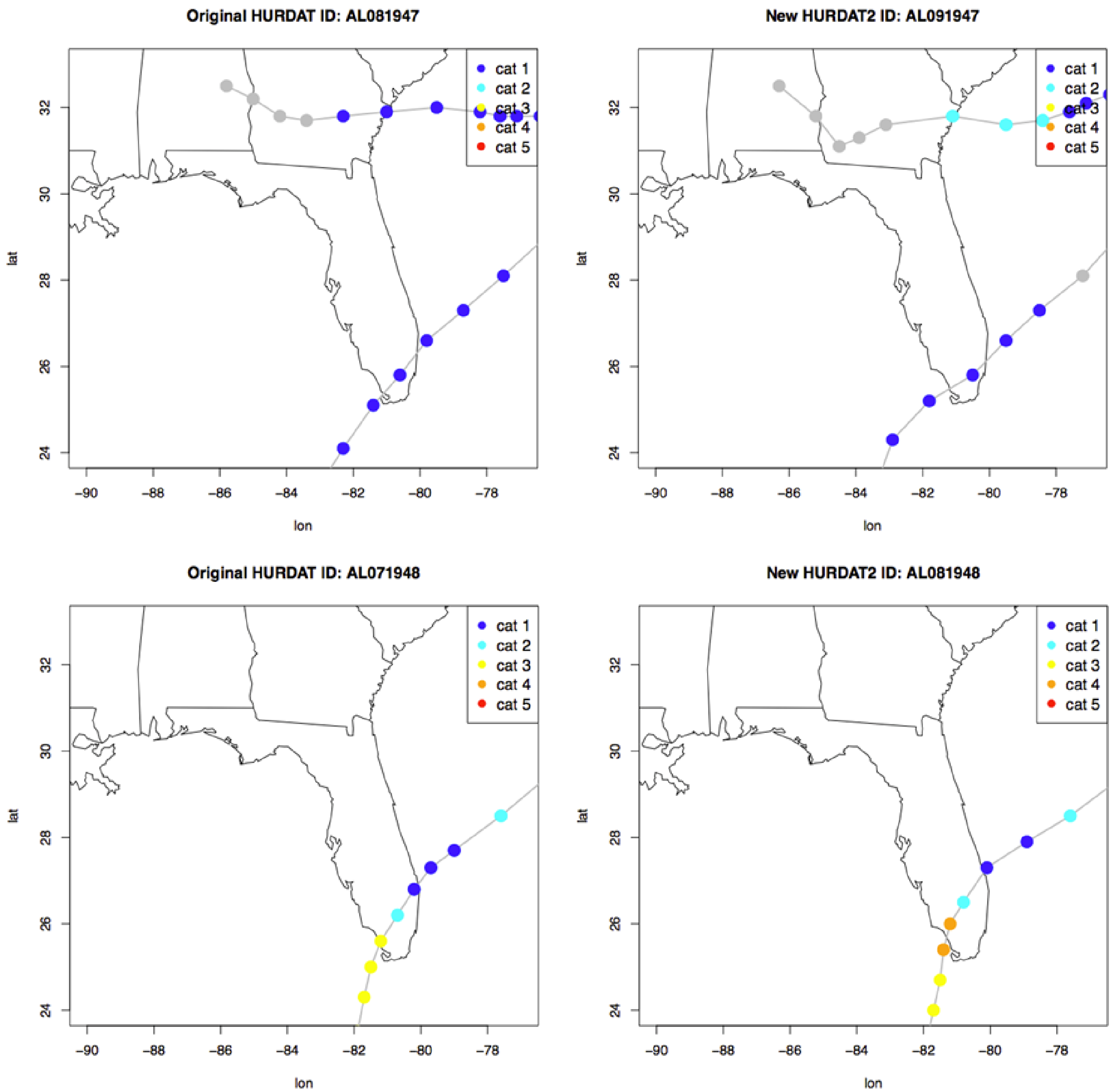


Figure 54: Change in Track Parameters for 2 of the 12 Modified Hurricanes—Part (c) Left: Previous Submission, Right: Current Submission

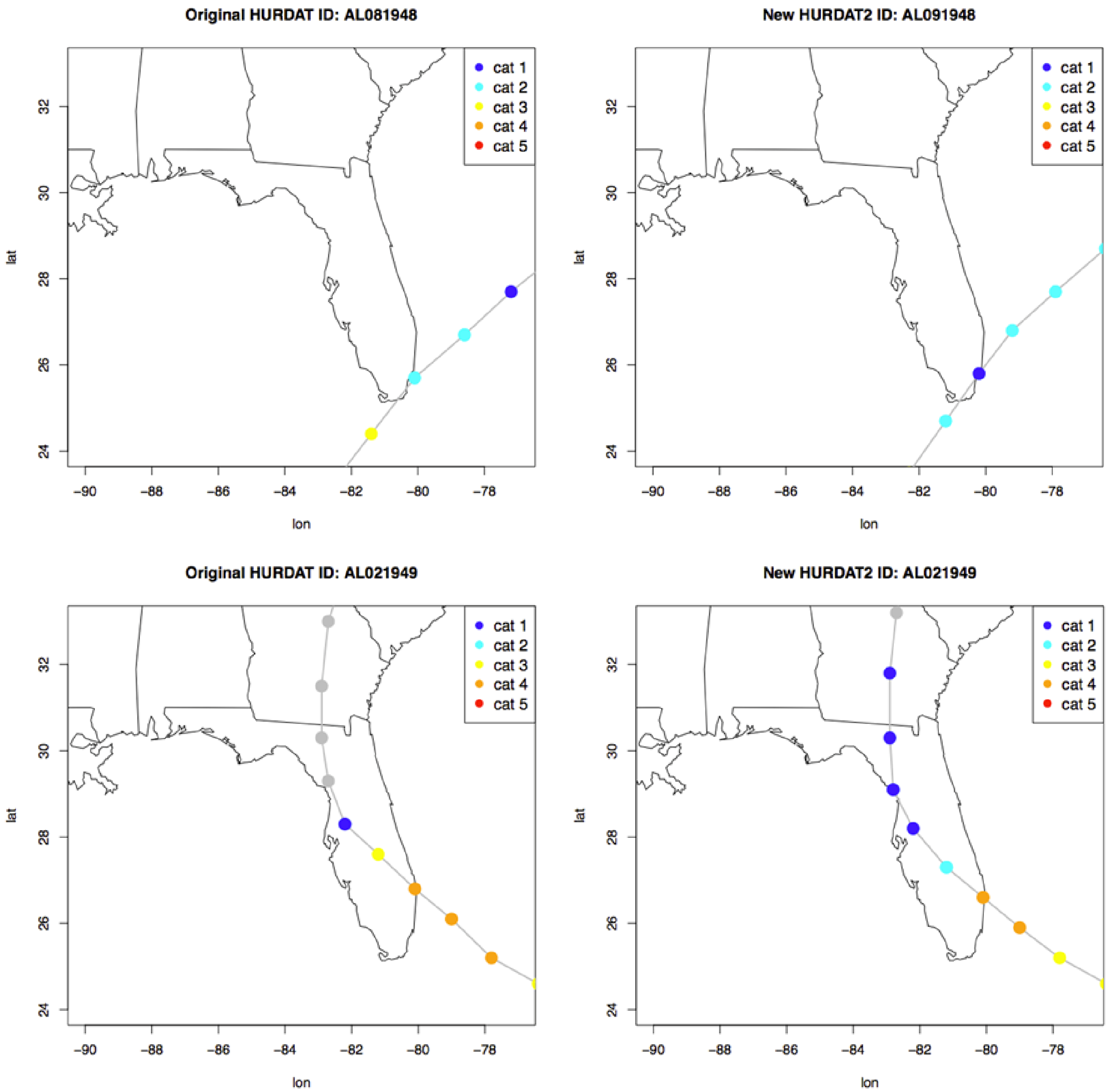


Figure 55: Change in Track Parameters for 2 of the 12 Modified Hurricanes—Part (d) Left: Previous Submission, Right: Current Submission

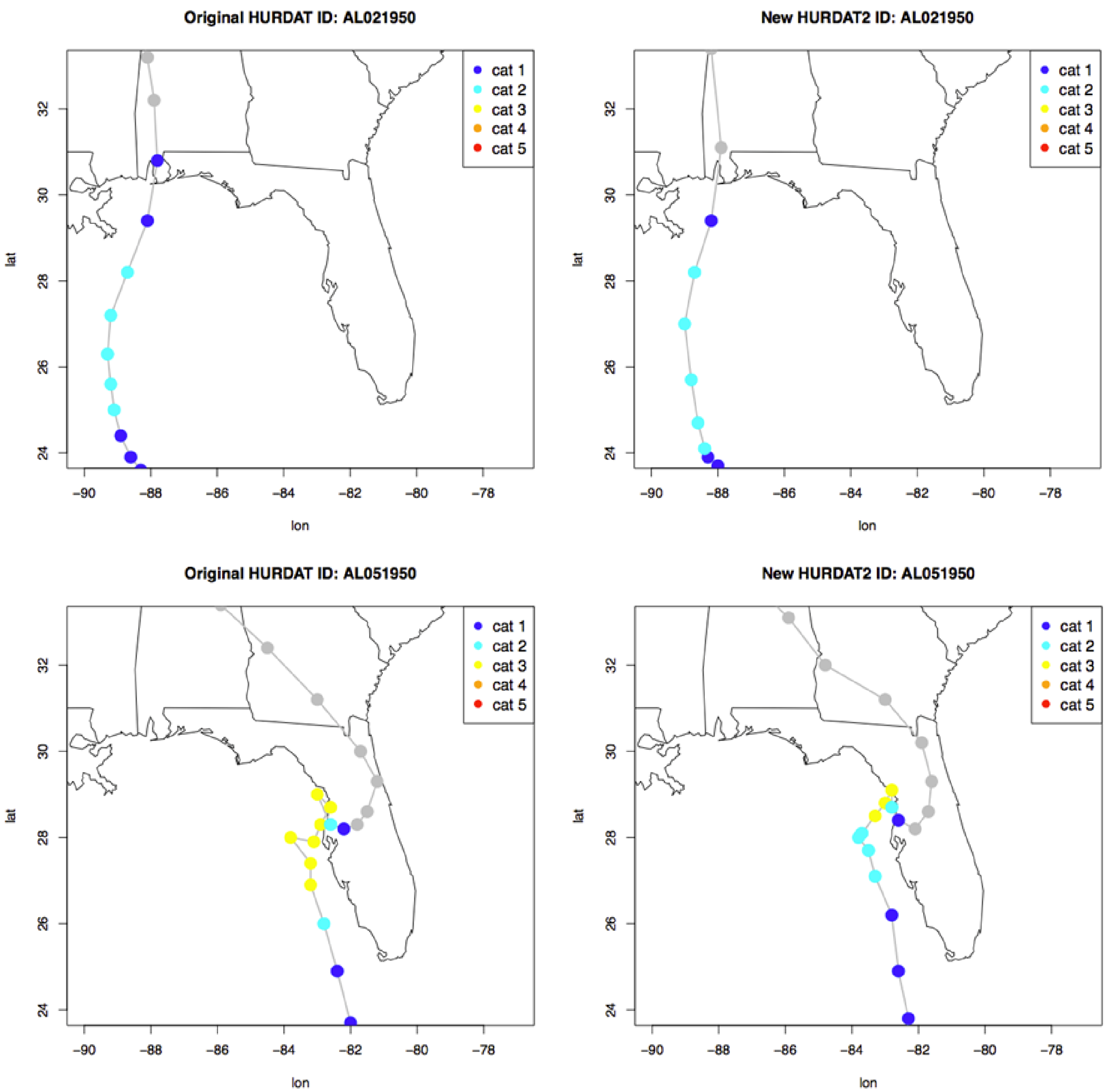


Figure 56: Change in Track Parameters for 2 of the 12 Modified Hurricanes—Part (e) Left: Previous Submission, Right: Current Submission

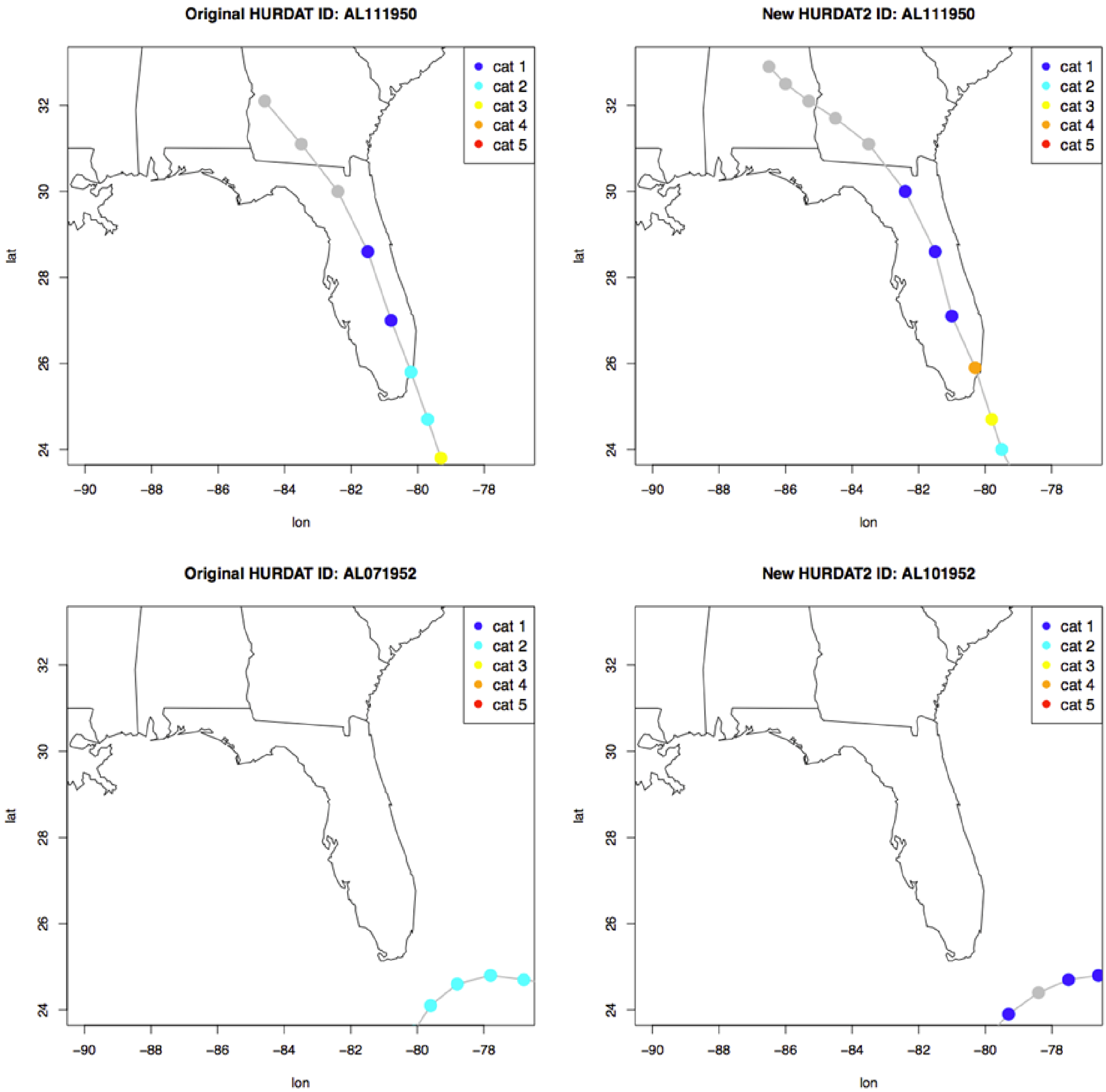
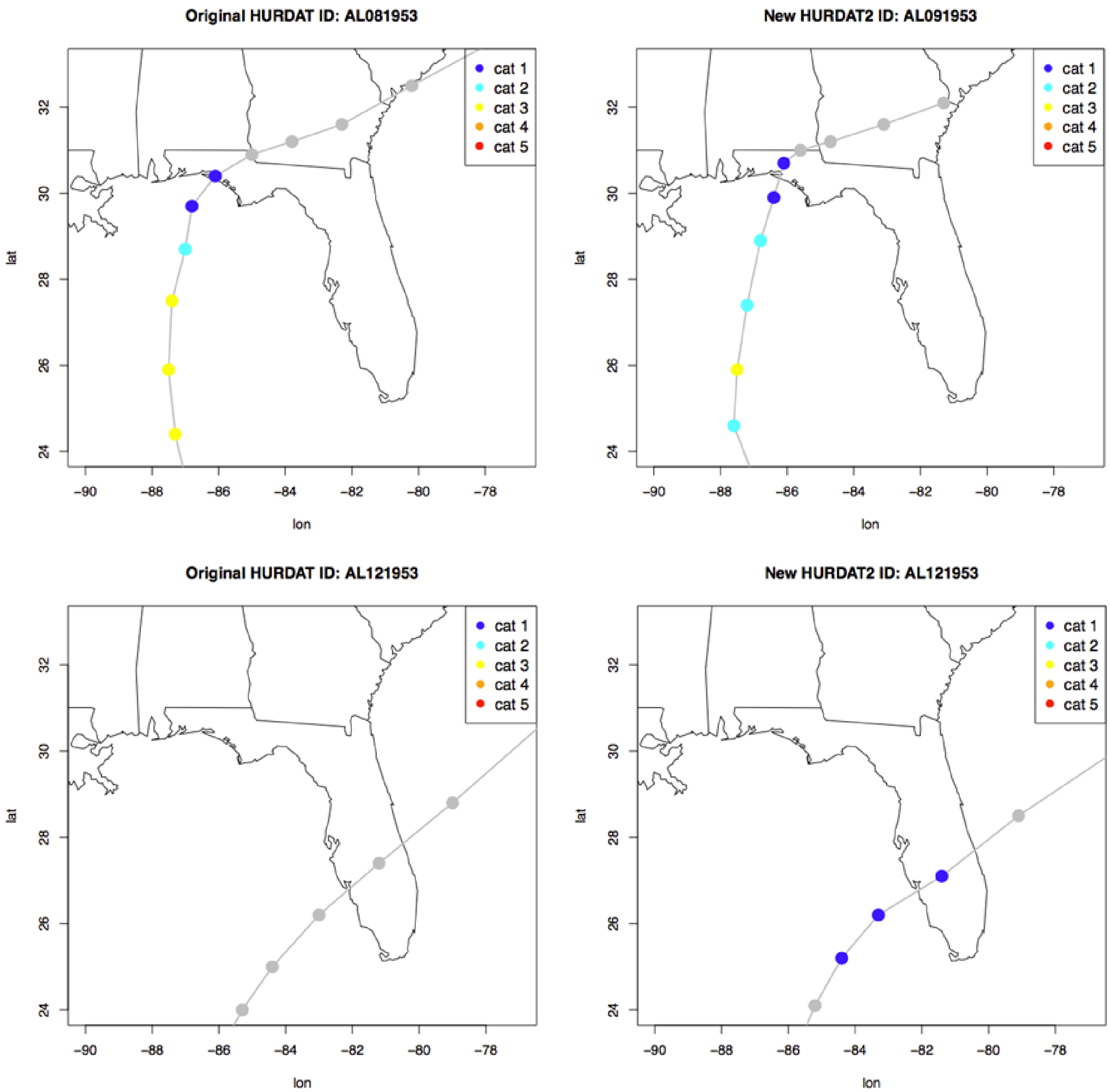


Figure 57: Change in Track Parameters for 2 of the 12 Modified Hurricanes—Part (f) Left: Previous Submission, Right: Current Submission



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.

See Figure 58 and Figure 59.

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.

See maps from Figure 60 through Figure 63.

Table 20: Maximum Wind Speeds

	Open Terrain	Real Terrain
Max Historical	155mph	153mph
Max 100y Return Period	129mph	124mph
Max 250y Return Period	140mph	135mph

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.

Figure 58: Maximum 1-Minute Mean Wind Speed (mph) at ZIP Code Level—Historical Set (1900–2014) Open Terrain

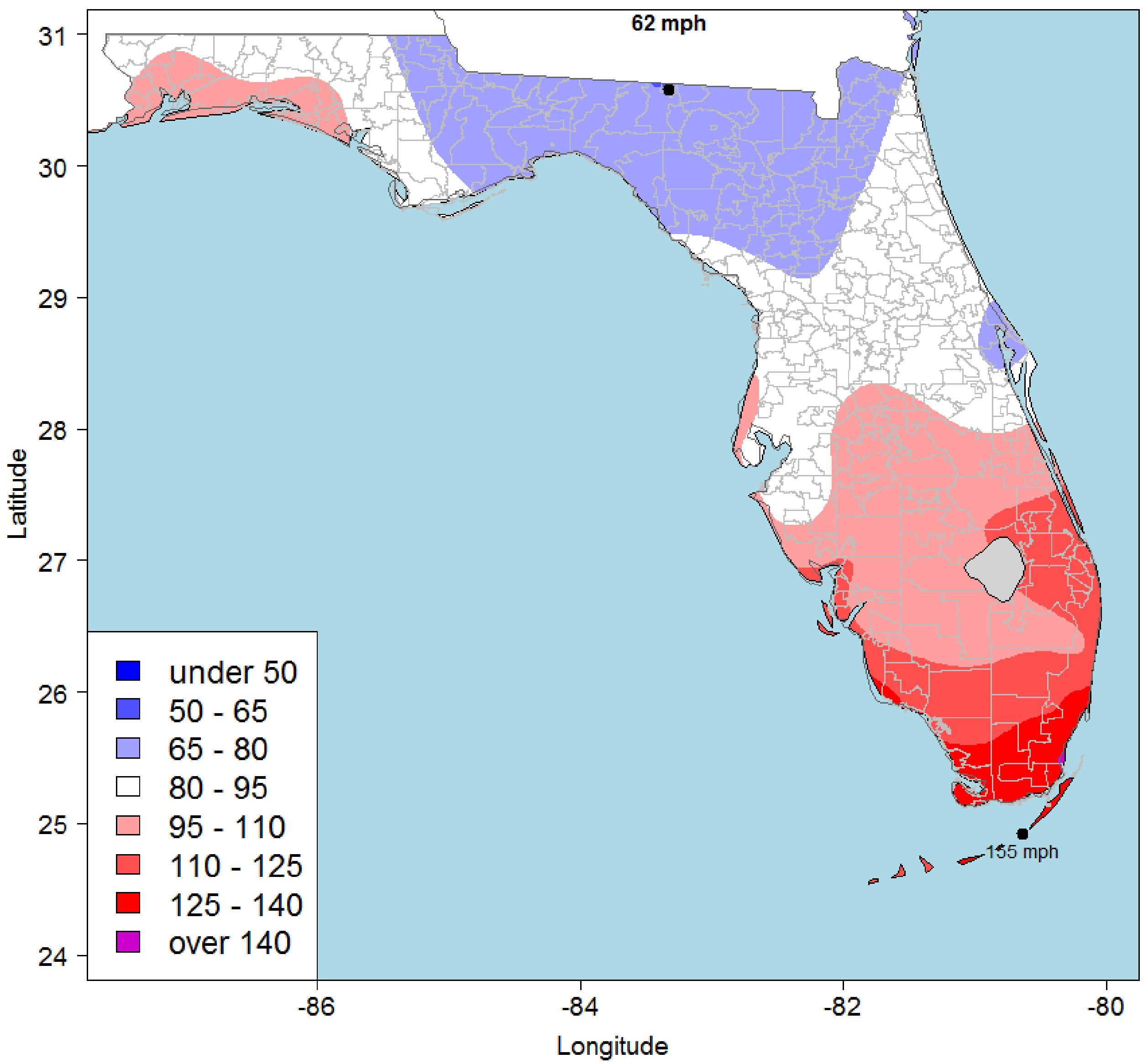


Figure 59: Maximum 1-Minute Mean Wind Speed (mph) at ZIP Code Level—Historical Set (1900–2014) Real Terrain

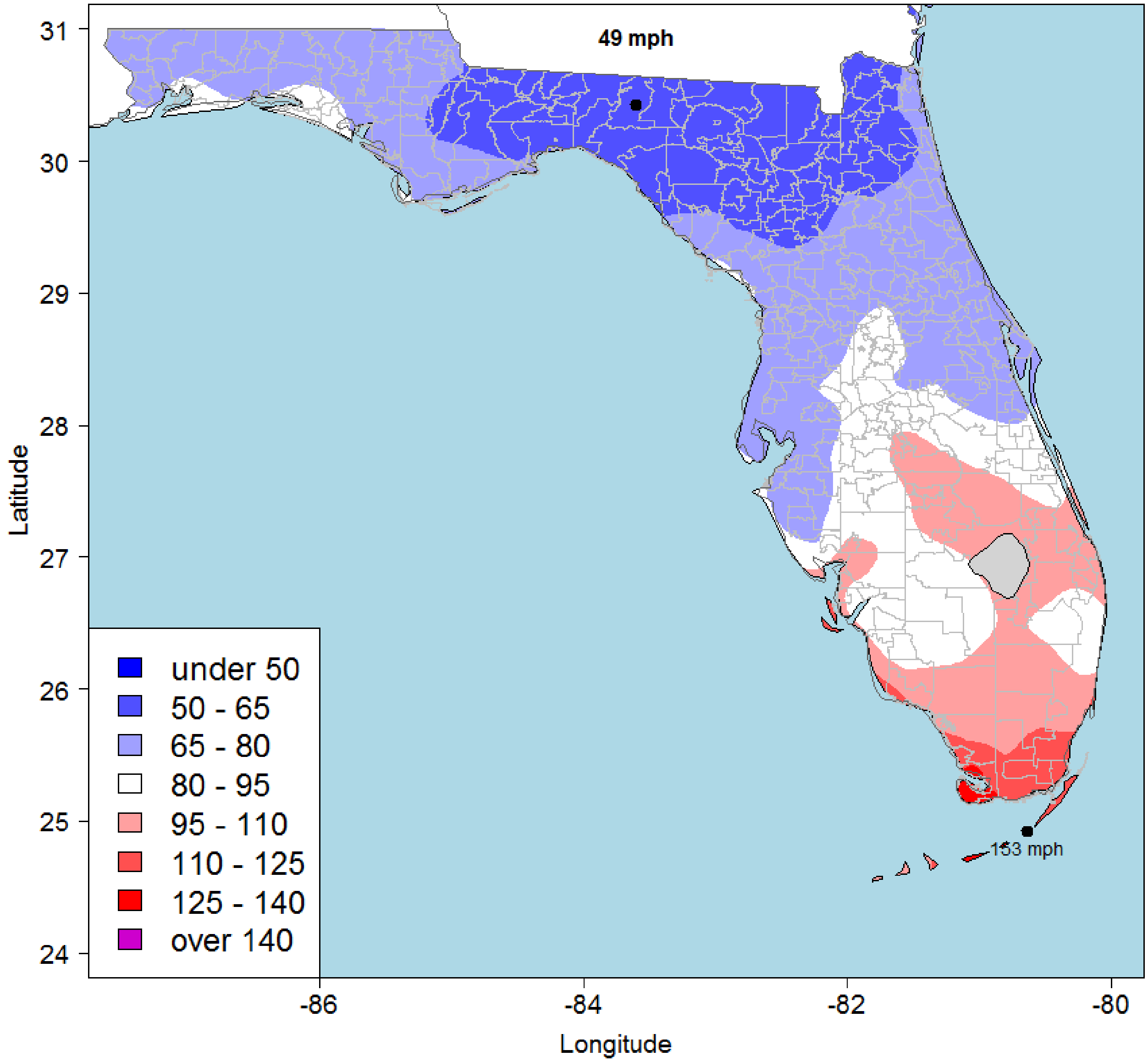


Figure 60: 100-Year Return Period 1-Minute Mean Wind Speed (mph) at ZIP Code Level—Stochastic Set Open Terrain

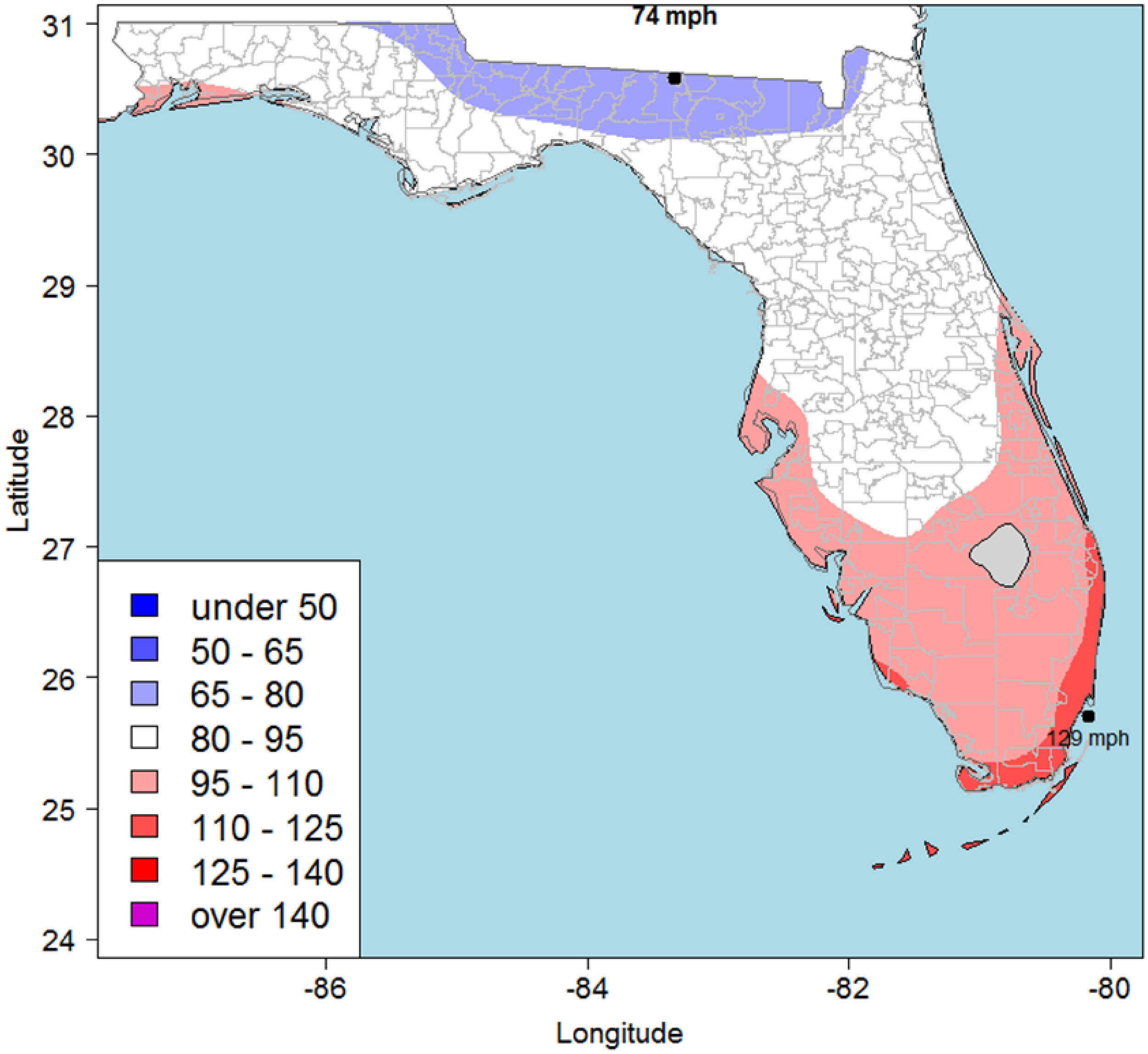


Figure 61: 100-Year Return Period 1-Minute Mean Wind Speed (mph) at ZIP Code Level—Stochastic Set Real Terrain

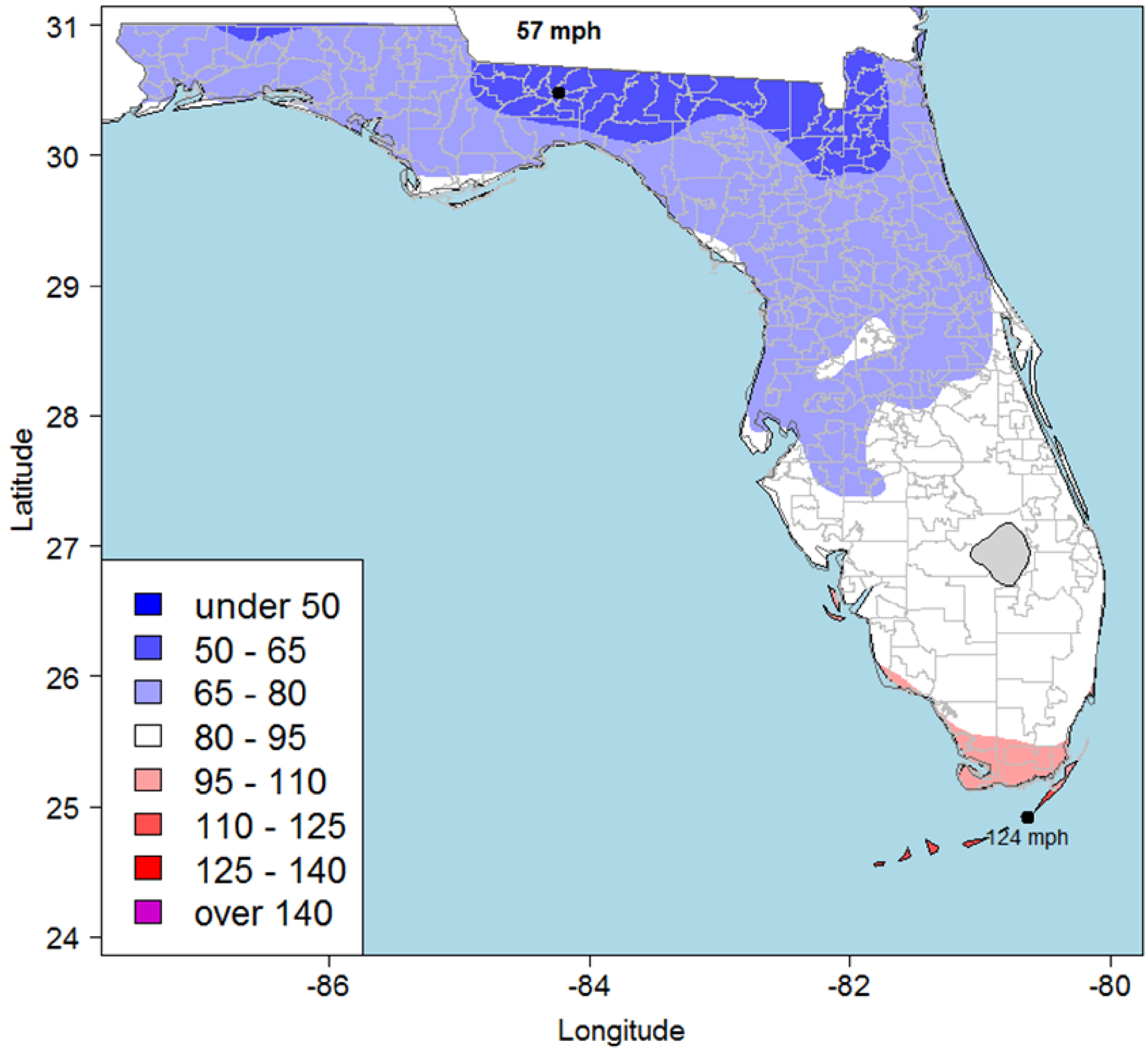


Figure 62: 250-Year Return Period 1-Minute Mean Wind Speed (mph) at ZIP Code Level—Stochastic Set Open Terrain

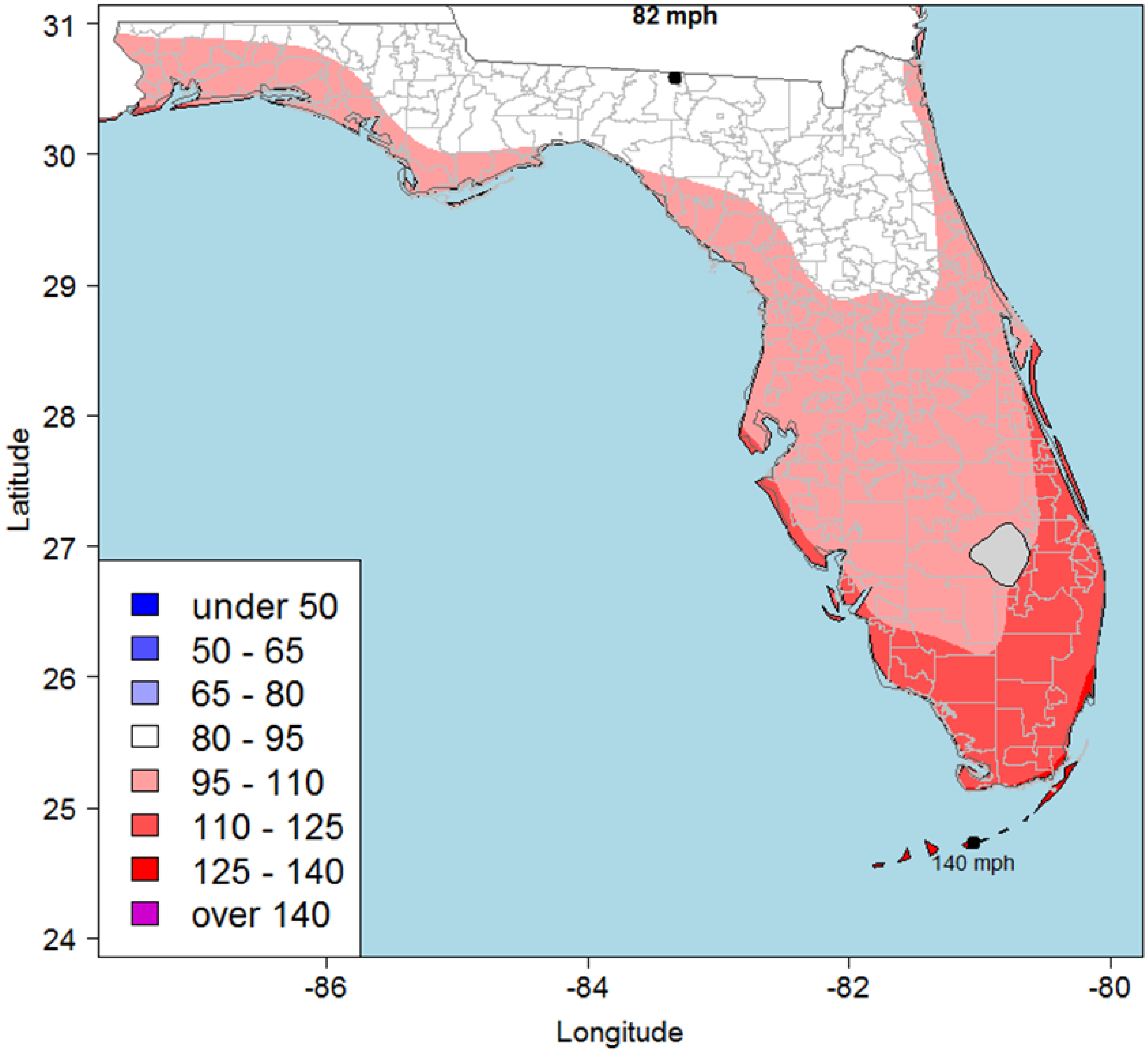
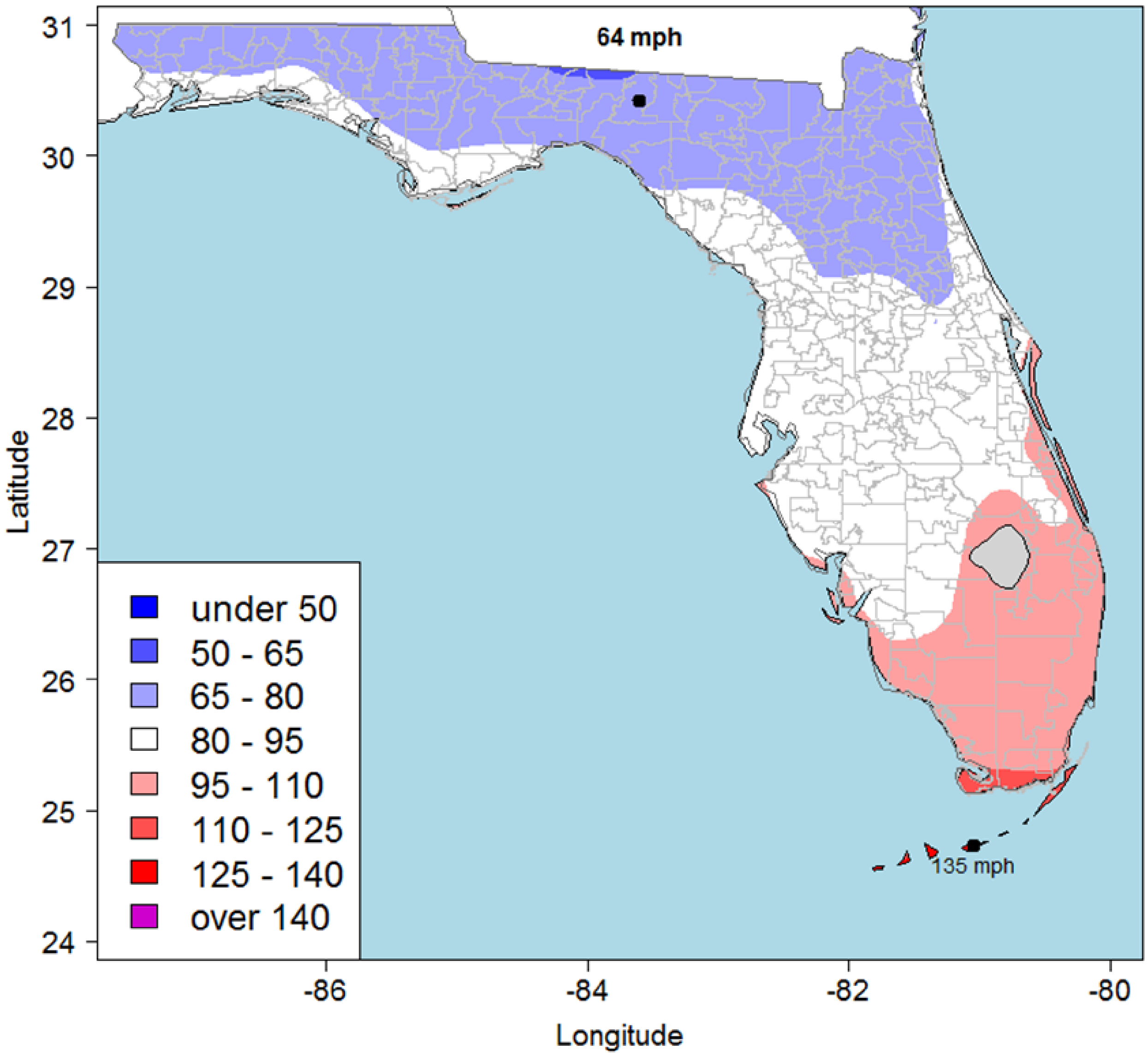


Figure 63: 250-Year Return Period 1-Minute Mean Wind Speed (mph) at ZIP Code Level—Stochastic Set Real Terrain



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 21: Ranges of Rmax used in Model's Stochastic Storm Set

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	26	36	49	NA	NA	NA	29	41	58	61	87	123
980	22	31	43	20	31	40	29	42	58	75	112	157
970	20	28	41	24	36	52	33	49	70	92	135	196
960	17	24	34	21	31	43	34	50	74	95	135	195
950	16	22	30	22	31	43	40	59	83	100	144	208
940	13	19	27	20	28	41	40	58	81	96	139	198
930	12	16	24	19	28	43	39	57	85	90	132	190
920	10	14	20	18	27	40	38	55	79	85	122	175
910	9	12	17	18	26	38	36	52	74	76	112	160
900	8	11	16	17	25	37	34	48	69	71	101	141

B. Describe the procedure used to complete this form.

The radii provided on Table 21 are computed by running the stochastic model on 10 sets of 100 tracks. Within each set, all tracks have the same length, the same central pressure (as given by the first column), the same translational speed (15mph Westward) and the same latitude (28N). The thresholds were applied to 1-minute mean wind speeds at the coast. Radii are defined as the maximum radius over the full azimuthal range.

C. Identify other variables that influence Rmax.

Rmax is a function of central pressure and latitude.

D. Specify any truncations applied to Rmax distributions in the model, and if and how these truncations vary with other variables.

The distribution of Rmax is truncated on the right. The truncation points vary by central pressure bin, and are derived from a large set of in-house numerical simulations.

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 64: Box Plot of Rmax (miles) as a Function of Central Pressure (hPa) using a 10 hPa Central Pressure Increment

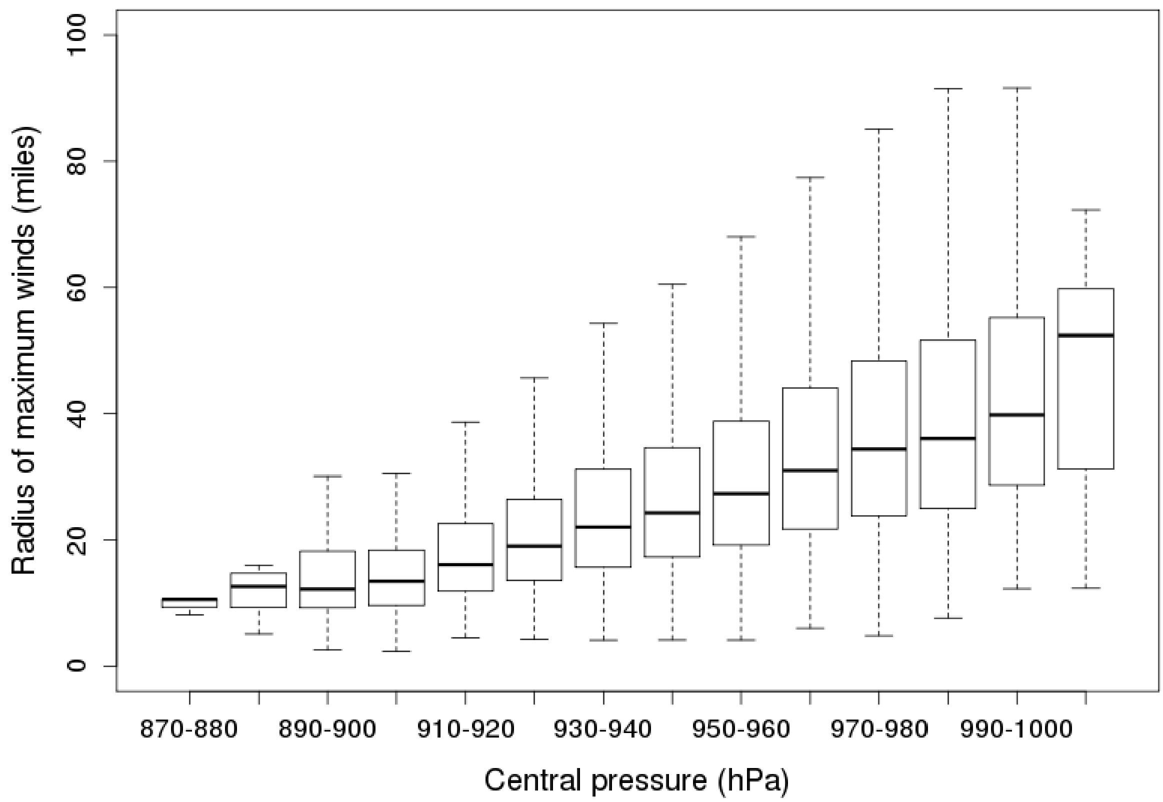


Figure 65: Frequency Histogram of the Radius of Maximum Winds (miles)

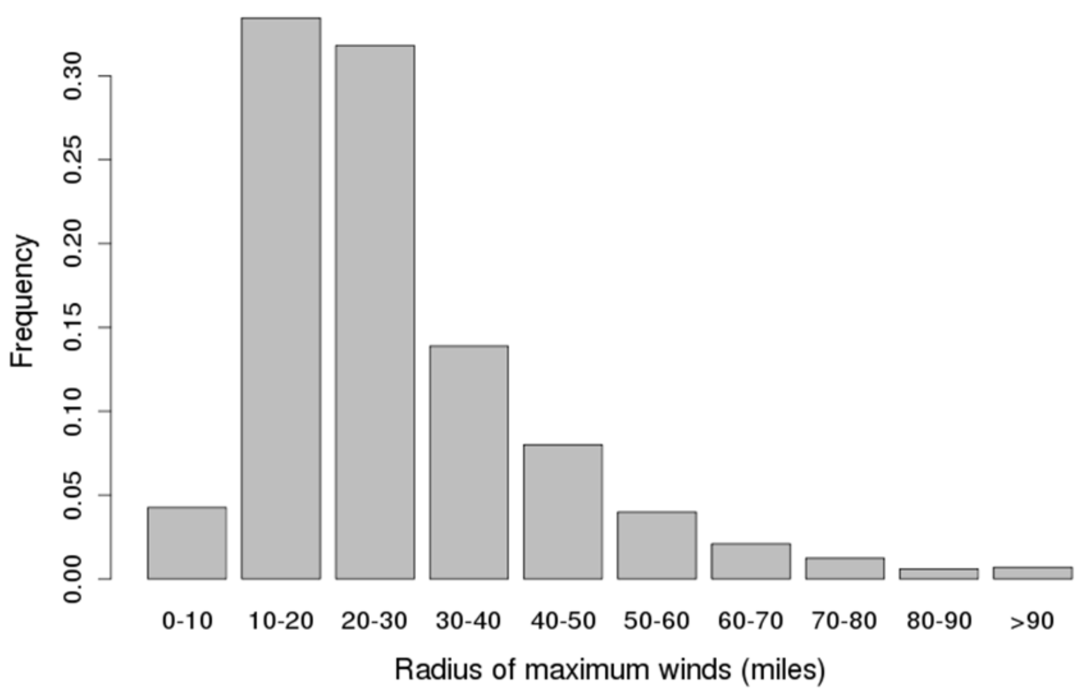
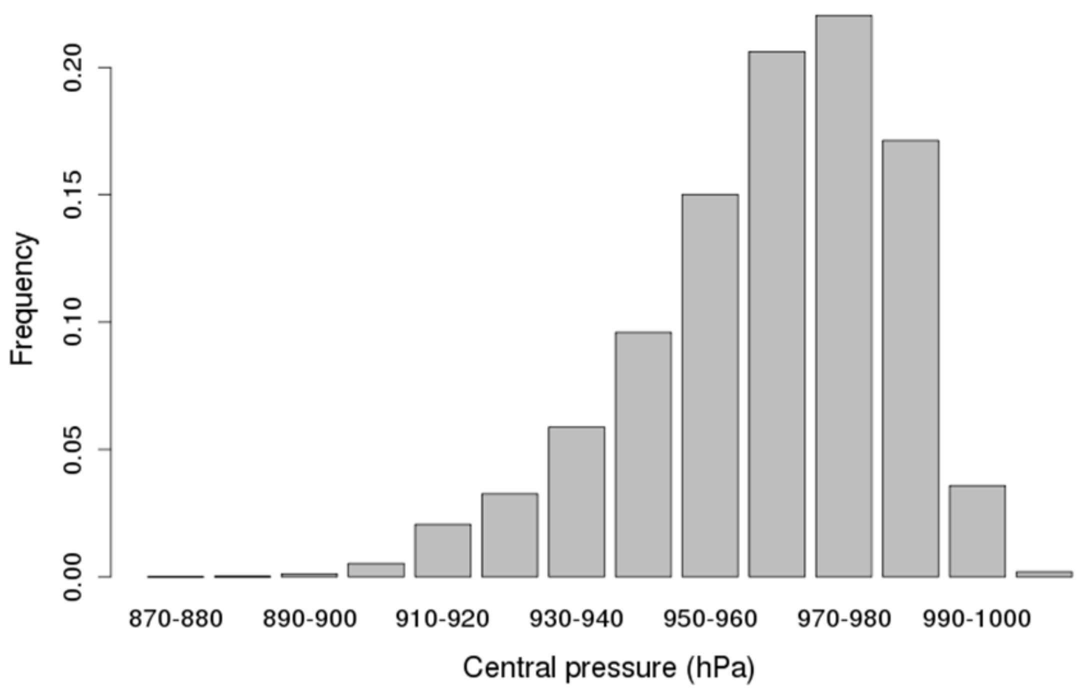


Figure 66: Frequency Histogram Central Pressure (hPa)



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.***

This information is provided in Excel format in the file RMS15FormM3.xlsx at the link provided to the FCHLPM.

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.

The table below provides the probability and frequency of landfalling Florida hurricanes per year, for the period 1900 to 2014.

Table 22: Model Results—Probability and Frequency of Florida Landfalling Hurricanes per Year

Number Of Hurricanes Per Year	Historical Probabilities	Modeled Probabilities	Historical Frequencies	Modeled Frequencies
0	0.5913	0.5953	68	68
1	0.2609	0.3088	30	36
2	0.1217	0.0801	14	9
3	0.0261	0.0138	3	2
4	0.0000	0.0018	0	0
5	0.0000	0.0002	0	0
6	0.0000	0.0000	0	0
7	0.0000	0.0000	0	0
8	0.0000	0.0000	0	0
9	0.0000	0.0000	0	0
10 or more	0.0000	0.0000	0	0

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 dataset 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 deductible exposure 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.

Part A

Table 23: Examples of Loss Exceedance Estimates

Return Period (years)	Probability of Exceedance	Estimated Loss Notional Risk Dataset	Estimated Personal and Commercial Residential Loss FHCF Dataset
Top Event	N/A	227,522,487	596,874,795,022
10,000	0.01%	115,535,691	301,882,269,376
5,000	0.02%	97,321,668	250,709,325,168
2,000	0.05%	74,705,706	187,228,065,734
1,000	0.10%	59,212,127	144,607,139,793
500	0.20%	46,311,195	108,873,250,497
250	0.40%	35,863,431	80,657,364,652
100	1.00%	24,875,402	52,862,651,563
50	2.00%	18,005,217	36,692,314,869
20	5.00%	10,508,473	20,028,501,480
10	10.00%	5,927,776	10,450,521,444
5	20.00%	2,302,040	3,584,887,877

Part B

Table 24: Average Annual Loss for Loss Exceedance Distribution

Mean (Total Average Annual Loss)	1,981,688	3,780,544,900
Median	22,809	31,256,989
Standard Deviation	5,485,411	12,272,160,640
Interquartile Range	1,393,657	1,984,442,803
Sample Size	100,000 Years of Simulated Events	100,000 Years of Simulated Events

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 25: Distributions of Hurricane Parameters

Stochastic Hurricane Parameter (Function or Variable)	Functional Form of Distribution	Data Source	Year Range Used	Justification for Functional Form
Storm Frequency	Poisson	HURDAT2	1900–2014	The Poisson assumption is supported by historical data.
Central Pressure at Landfall	Smoothed empirical distribution by landfall region	HURDAT	1900–2008	The distribution of central pressure at landfall is calibrated to match historical data.
Inland Filling Rate	Gaussian, with mean that depends on intensity, size, and proportion of the storm over different types of terrain.	HURDAT NHC Reports Numerical simulations	1988–2008	The distribution of the filling rate is in good agreement with historical data. The methods used to estimate, select and validate the model are described in Colette et al. (2010).
Vmax	Log-normal with mean that depends on central pressure, far field pressure, and latitude.	HURDAT2	1900–2014	The dependence of Vmax on central pressure, far field pressure and latitude is documented in scientific literature (e.g., Knaff and Zher 2007). The form of the relationship has been chosen to match historical data. Vmax is further calibrated at landfall to ensure the historical distribution is reproduced well.
Translational Speed and Heading	Translational speed and heading follow empirical distributions that derive from the modeling of zonal and meridional track steps.	HURDAT	1950–2007	The model for the zonal and meridional track steps is based on Hall and Jewson (2007). The resulting distribution of translational speed and heading agree with the historical data.

Stochastic Hurricane Parameter (Function or Variable)	**Functional Form of Distribution**	**Data Source**	**Year Range Used**	**Justification for Functional Form**
Rmax	Truncated log-normal. The mean depends on pressure and latitude.	Extended Best Track	1988–2008	The distribution is fitted to historical data. Truncation is necessary to avoid unrealistic values of Rmax in simulations, especially when extrapolating beyond the range of observed data.
Wind Profile Parameters	Shape parameters X1 and N: gamma distribution Angle to maximum winds (Amax): truncated Gaussian	RMS HWind	1998–2008	The distributions are chosen to match historical data. Truncation of Amax ensures that the simulated values are between 0 and 2π.

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.

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.

C. Provide scatter plot(s) of modeled versus 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.)

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.

Example A1: Comparison of a Company's Personal Residential Modeled and Actual Loss as a Percent of Total Exposure

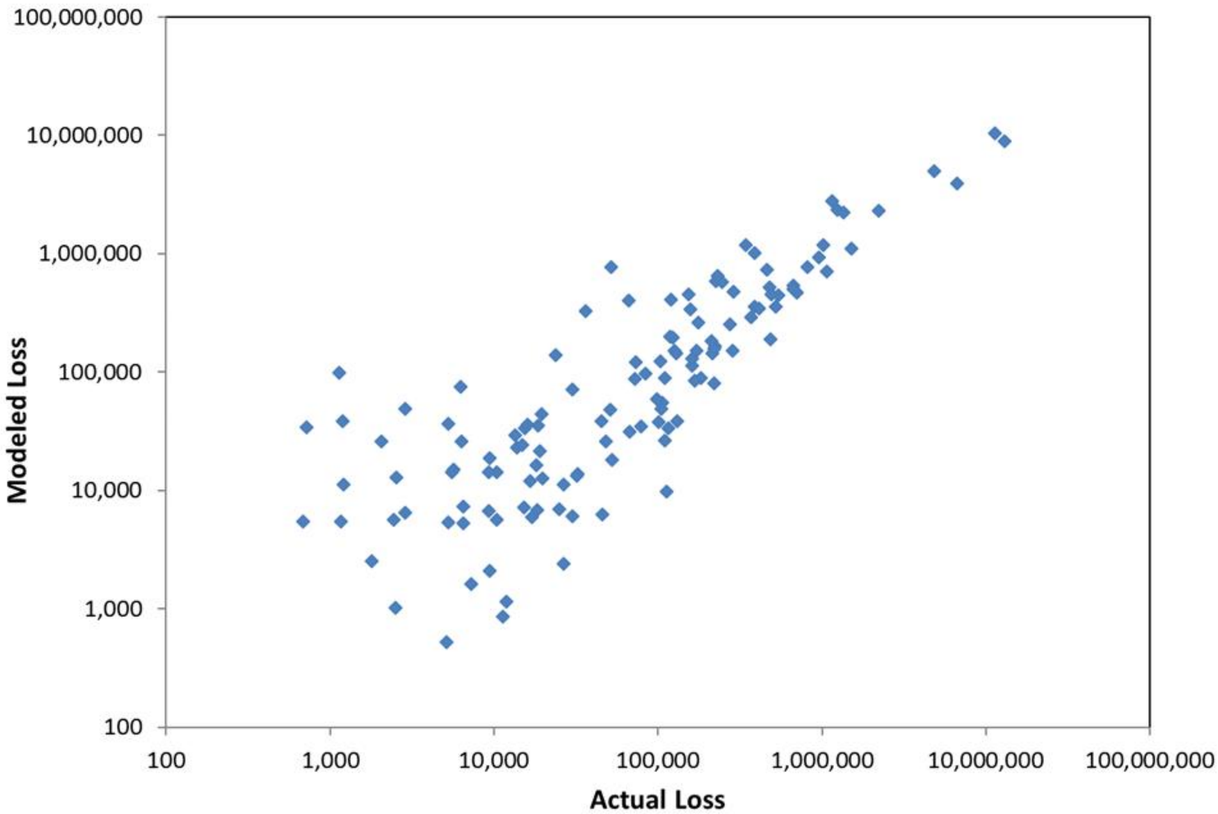
Hurricane = Charley (2004)

Exposure = Manufactured Homes—Total exposure (modeled and actual losses include demand surge)

Table 26: Example A1 Portfolio Comparison of Modeled and Actual Loss

Construction	Company Actual Loss / Exposure	Modeled Loss / Exposure	Difference
Manufactured Home	6.25%	6.18%	0.06%

Figure 67: Example A1 Comparison of Modeled and Actual Losses by ZIP Code



Example A2: Comparison of a Company's Personal Residential Modeled and Actual Loss as a Percent of Total Exposure

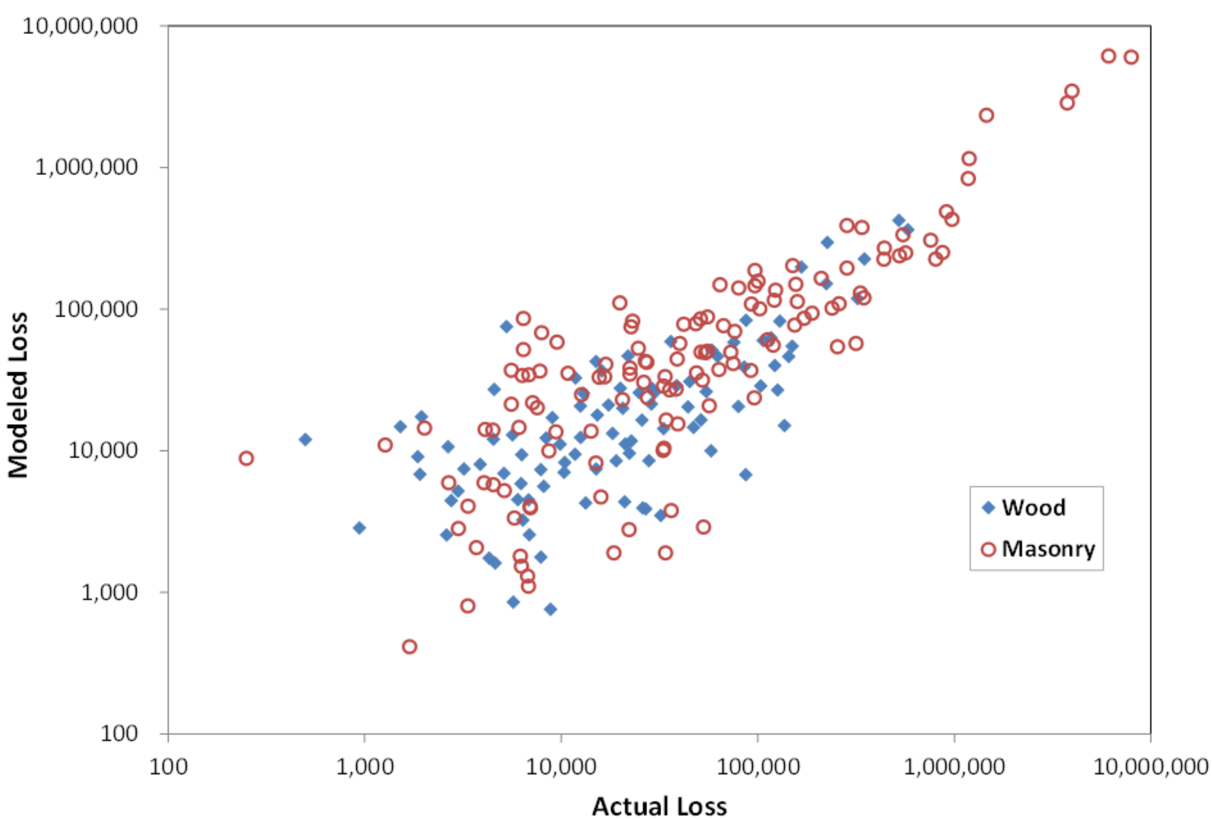
Hurricane = <u>Charley (2004)</u>

Exposure = <u>Single-Family Residential—Total exposure (modeled and actual losses include demand surge)</u>

Table 27: Example A2 Portfolio Comparison of Modeled and Actual Loss

Construction	Company Actual Loss / Exposure	Modeled Loss / Exposure	Difference
Wood Frame	1.73%	1.31%	0.42%
Masonry	2.77%	2.29%	0.48%
Total	2.59%	2.12%	0.47%

Figure 68: Example A2 Comparison of Modeled and Actual Losses by ZIP Code



Example A3: Comparison of a Company's Personal Residential Modeled and Actual Loss as a Percent of Total Exposure

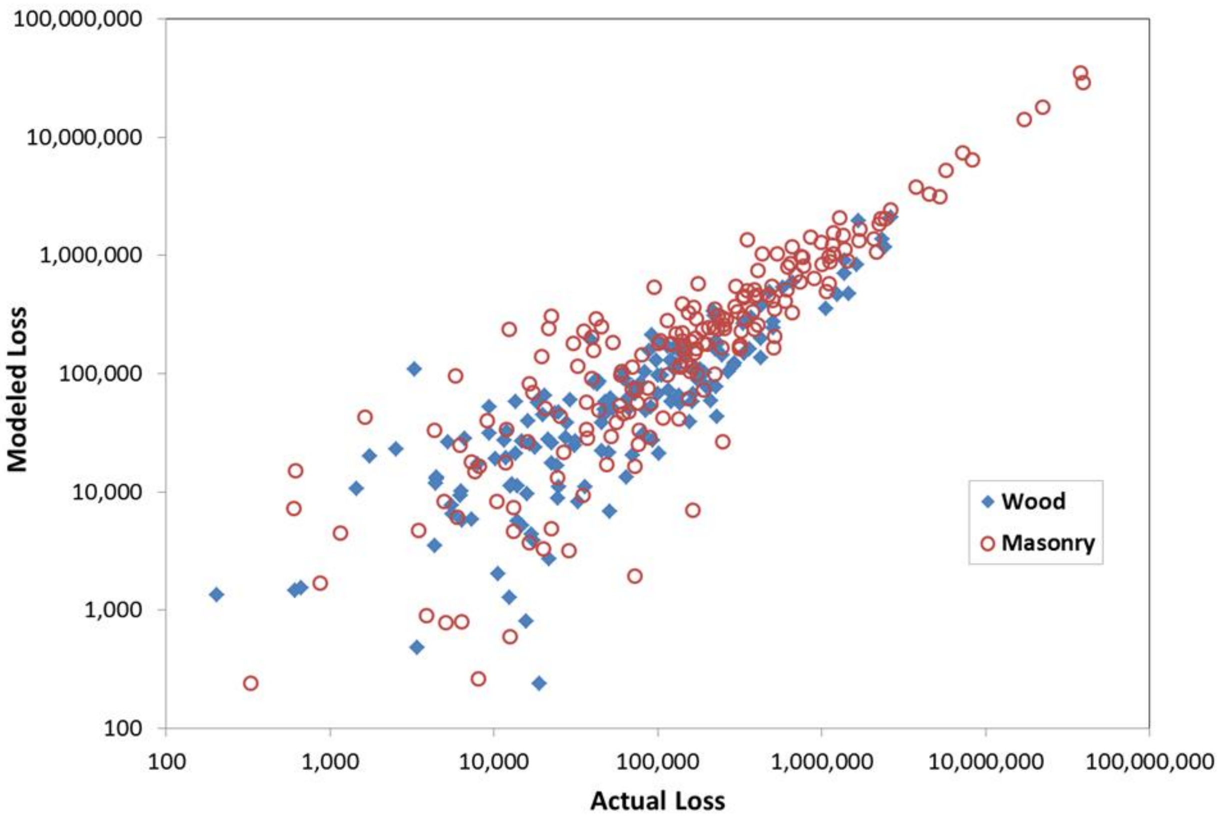
Hurricane = Charley (2004)

Exposure = Single-Family Residential—Total exposure (modeled and actual losses include demand surge)

Table 28: Example A3 Portfolio Comparison of Modeled and Actual Loss

Construction	Company Actual Loss / Exposure	Modeled Loss / Exposure	Difference
Wood Frame	1.64%	1.16%	0.48%
Masonry	1.66%	1.49%	0.16%
Total	1.65%	1.45%	0.20%

Figure 69: Example A3 Comparison of Modeled and Actual Losses by ZIP Code



Example A4: Comparison of a Company's Personal Residential Modeled and Actual Loss as a Percent of Total Exposure

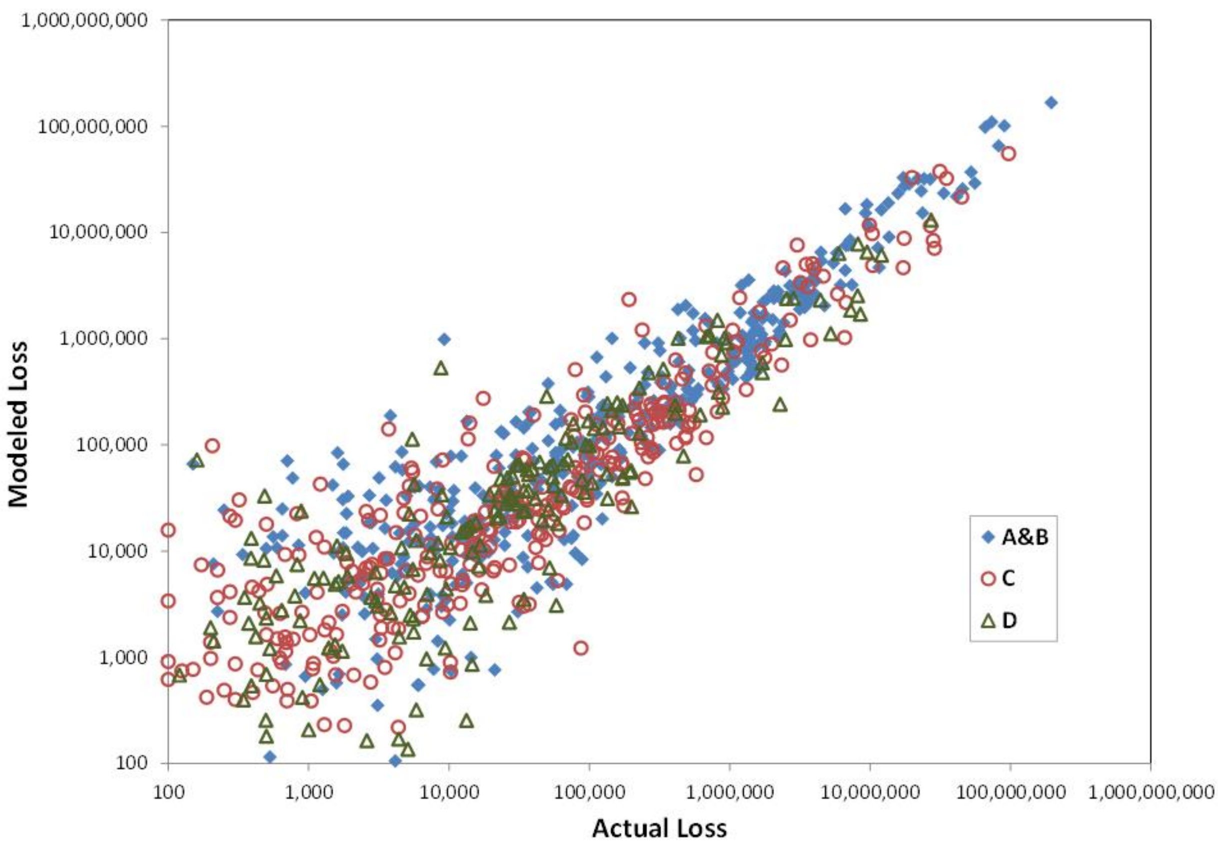
Hurricane = Andrew (1992)

Exposure = Total exposure (modeled and actual losses include demand surge)

Table 29: Example A4 Portfolio Comparison of Modeled and Actual Loss

Coverage	Company Actual Loss / Exposure	Modeled Loss / Exposure	Difference
A & B	6.91%	6.91%	0.00%
C	4.46%	3.08%	1.38%
D	3.40%	1.99%	1.42%
Total	5.72%	5.11%	0.61%

Figure 70: Example A4 Comparison of Modeled and Actual Losses by ZIP Code



Example A5: Comparison of a Company's Personal Residential Modeled and Actual Loss as a Percent of Total Exposure

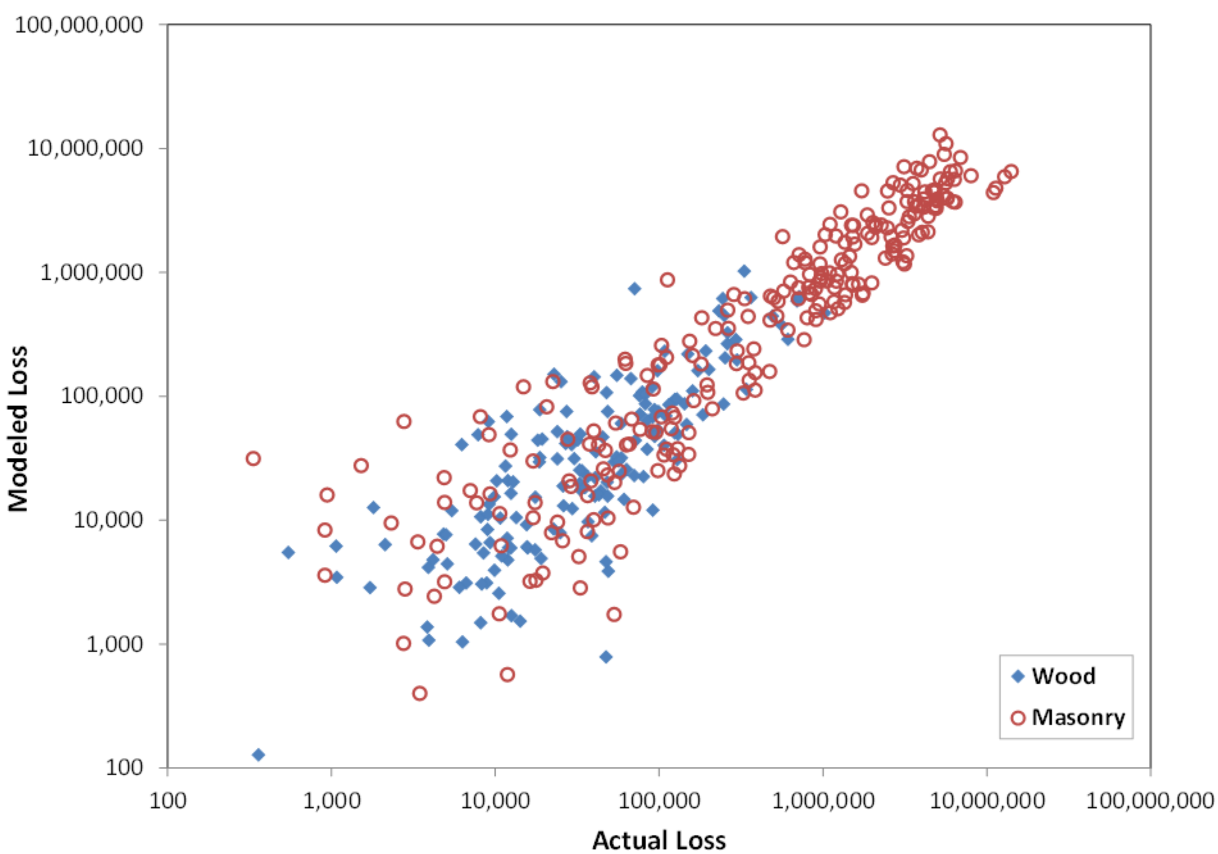
Hurricane = Wilma (2005)

Exposure = Single-Family Residential—Total exposure (modeled and actual losses include demand surge)

Table 30: Example A5 Portfolio Comparison of Modeled and Actual Loss

Construction	Company Actual Loss / Exposure	Modeled Loss / Exposure	Difference
Wood	0.70%	0.79%	-0.09%
Masonry	0.98%	0.92%	0.06%
Total	0.97%	0.92%	0.05%

Figure 71: Example A5 Comparison of Modeled and Actual Losses by ZIP Code



Example B1: Comparison of a Company's Commercial Residential Modeled and Actual Loss as a Percent of Total Exposure

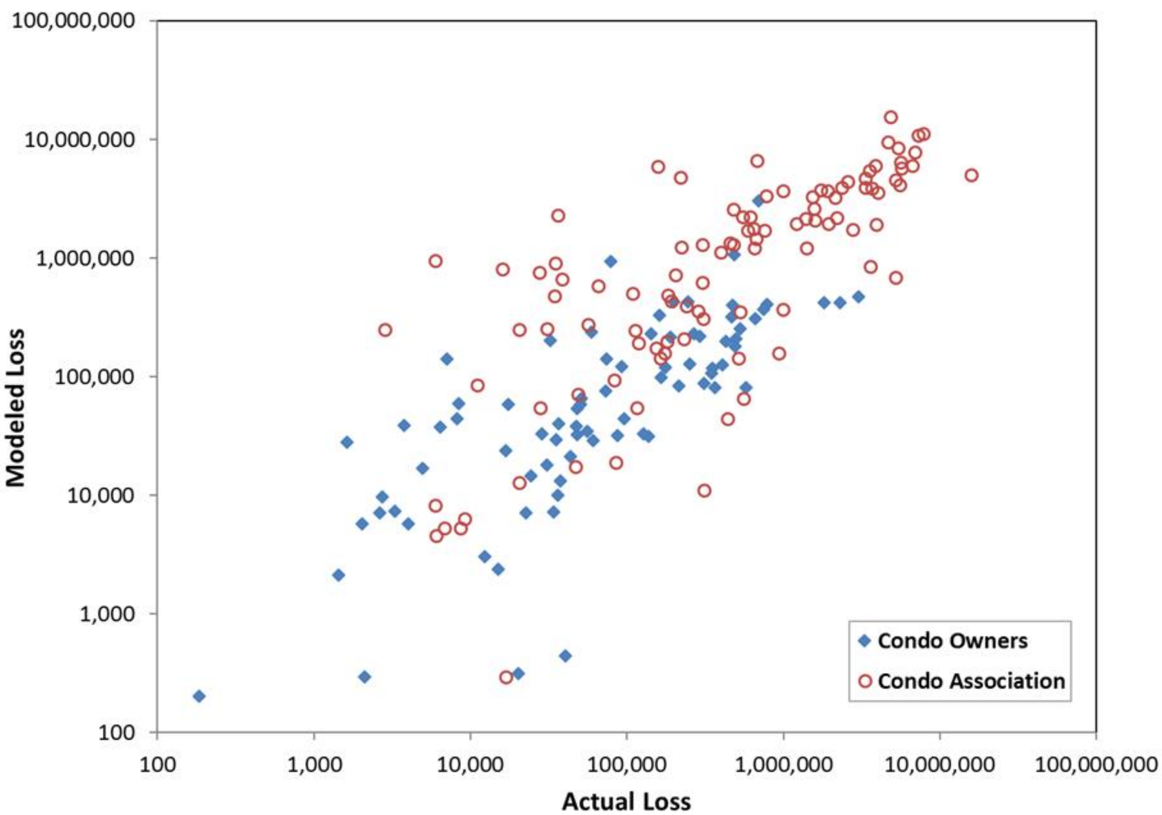
Hurricane = Wilma (2005)

Exposure = Condominium—Total exposure (modeled and actual losses include demand surge)

Table 31: Example B1 Portfolio Comparison of Modeled and Actual Loss

Line of Business	Company Actual Loss / Exposure	Modeled Loss / Exposure	Difference
Condo Unit Owner	0.57%	0.43%	0.14%
Condo Association	1.13%	1.58%	-0.45%
Total	1.02%	1.36%	-0.33%

Figure 72: Example B1 Comparison of Modeled and Actual Losses by ZIP Code



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 residential zero deductible exposure data found in the file named "hlpm2012c.exe."

Average Annual Zero Deductible Statewide Personal and Commercial Residential Loss Costs

Table 32: Average Annual Zero Deductible Statewide Personal and Commercial Residential Loss Costs

Time Period	Historical Hurricanes	Produced by Model
Current Submission	$2.79	$3.78
Previously Accepted Model* (2013 Standards)	$2.96	$3.84
Percent Change Current Submission/ Previously Accepted Model*	-5.82%	-1.51%

*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 RMS hurricane model calculated historical annual average zero deductible loss for the 2012 Florida Hurricane Catastrophe Funds' (FHCF) personal and commercial residential aggregate exposure database is $2.79 billion per year. The RMS hurricane model simulated annual average zero deductible loss for the same exposure database is $3.78 billion per year.

C. Provide the 95% confidence interval on the differences between the means of the historical and modeled personal and commercial residential loss.

The 95% confidence interval on the difference between the mean of the historical and the modeled loss is -$2.6 billion to +$600 million.

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.

E. Include Form S-5, Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled, in a submission appendix.

Form S-6: Hypothetical Events for Sensitivity and Uncertainty Analysis

This form was provided and found acceptable in the RiskLink 11.0.SP2c model submission in compliance with the 2009 Standards. The form will not be provided in the current submission unless requested as outlined in Disclosure S-2.5.

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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* *Constructed in 1980*

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 to complete this form are identical to the structures listed in the table above.

Part A

Table 33: Damage Ratios Summarized by Wind Speed (mph)

Windspeed (mph)	Estimated Damage/ Subject Exposure
41 – 50	0.1%
51 – 60	0.3%
61 – 70	1.3%
71 – 80	2.8%
81 – 90	5.9%
91 – 100	11.9%
101 – 110	20.2%
111 – 120	38.8%
121 – 130	52.0%
131 – 140	72.4%
141 – 150	83.9%
151 – 160	89.9%
161 – 170	93.8%

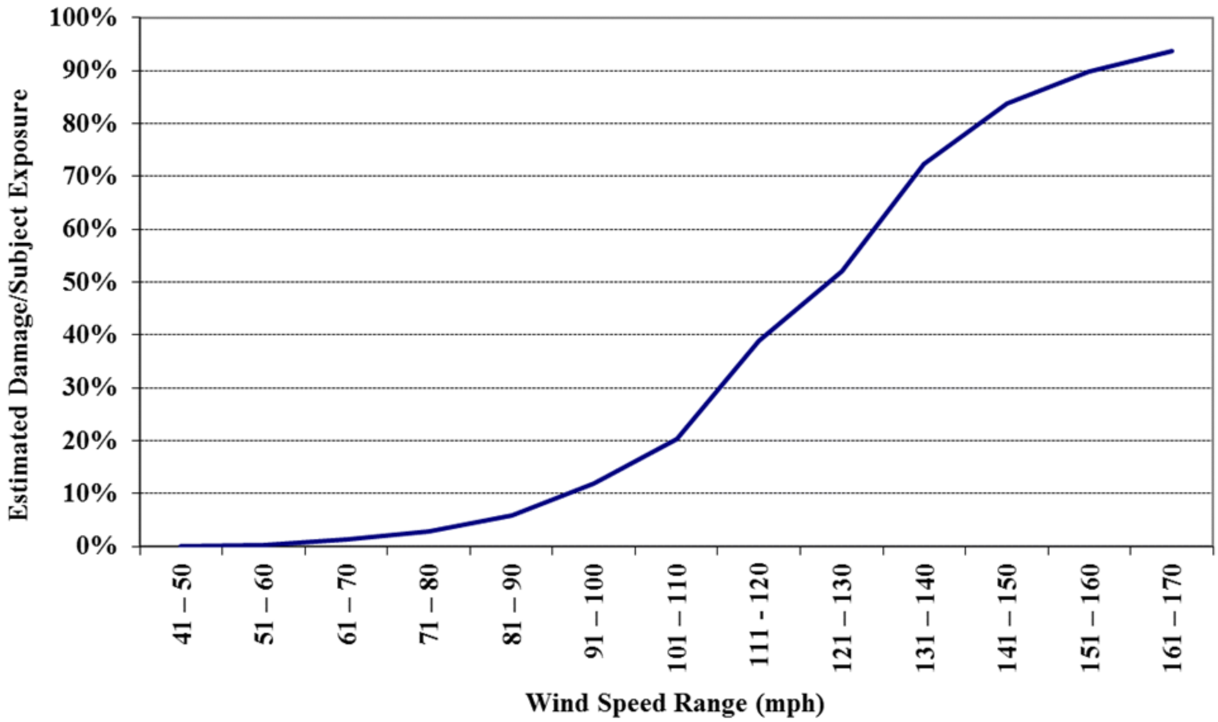
Part B

Table 34: Damage Ratios Summarized by Construction Type

Construction Type	Estimated Damage/ Subject Exposure
Wood Frame	34.2%
Masonry	32.9%
Manufactured Home	36.1%
Concrete	19.7%

C. Provide a plot of the Form V-1, One Hypothetical Event, Part A data.

Figure 73: Ratio of Estimated Damage and Subject Exposure versus 1-Minute Wind Speed



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.

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.

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.

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.

The required information is provided in the file RMS15FormV2.xlsx at the link provided to the FCHLPM and appears below.

Figure 74: Percent Change in Damage for Various Mitigation Measures

Individual Mitigation Measures			Percent Changes in Damage ((Reference Damage Rate - Mitigated Damage Rate)/ Reference Damage Rate) *100									
			Frame Building					Masonry Building				
			Wind Speed (MPH)					Wind Speed (MPH)				
			60	85	110	135	160	60	85	110	135	160
	Reference Building											
Roof Configuration	Braced Gable Ends		1.8%	1.8%	0.9%	0.0%	0.0%	1.8%	1.8%	0.9%	0.0%	0.0%
	Hip Roof		30.9%	42.5%	36.9%	16.2%	0.0%	30.9%	42.5%	36.9%	16.2%	0.0%
Roof Covering	Metal		6.8%	9.6%	9.1%	0.0%	0.0%	6.8%	9.6%	9.1%	0.0%	0.0%
	ASTM D7158 Class H Shingles (150 mph)		39.0%	25.0%	5.0%	0.0%	0.0%	39.0%	25.0%	5.0%	0.0%	0.0%
	Membrane		2.3%	2.1%	2.0%	0.0%	0.0%	2.3%	2.1%	2.0%	0.0%	0.0%
	Nailing of Deck	8d Nails	22.5%	56.2%	44.4%	17.0%	4.8%	22.5%	56.3%	44.4%	17.0%	7.5%
		8d Nails HWS	25.0%	62.5%	51.9%	22.3%	5.8%	25.0%	62.5%	51.9%	22.3%	8.5%
		10d Nails	25.0%	65.6%	55.6%	24.1%	7.7%	25.0%	65.6%	55.6%	24.1%	10.4%
Roof-Wall Strength												
	Clips		13.0%	25.0%	23.3%	20.0%	14.2%	13.0%	25.0%	23.3%	20.0%	16.7%
	Straps		17.4%	46.2%	43.3%	29.6%	14.2%	17.4%	46.3%	43.3%	29.6%	16.7%
Wall-Floor Strength												
	Ties or Clips		0.0%	0.0%	15.0%	15.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Straps		0.0%	0.0%	15.0%	15.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wall Foundation Strength												
	LargerAnchor or Closer Spacing		0.0%	0.0%	15.0%	15.0%	0.0%	-	-	-	-	-
	Straps		0.0%	0.0%	15.0%	15.0%	0.0%	-	-	-	-	-
	Vertical Reinforcing		-	-	-	-	-	0.0%	0.0%	0.0%	0.0%	0.0%
Opening Protection	Window Shutters	Structural Wood Panel	2.0%	14.2%	25.9%	15.1%	0.0%	2.0%	14.2%	25.9%	15.1%	0.0%
		Metal	5.9%	24.5%	39.8%	19.8%	0.0%	5.9%	24.5%	39.8%	19.8%	0.0%
	Door and Skylight Cover		21.6%	38.7%	44.4%	24.5%	0.0%	21.6%	38.7%	44.4%	24.5%	0.0%
Window, Door, Skylight Strength	Window s											
		Impact Rated	11.8%	32.1%	44.4%	24.5%	0.0%	11.8%	32.1%	44.4%	24.5%	0.0%
	Entry Doors	Meets Windborne Debris Requirements	2.0%	11.3%	16.7%	8.5%	0.0%	2.0%	11.3%	16.7%	8.5%	0.0%
	Garage Doors		2.0%	11.3%	16.7%	8.5%	0.0%	2.0%	11.3%	16.7%	8.5%	0.0%
	Sliding Glass Doors		2.0%	9.4%	21.3%	10.4%	0.0%	2.0%	9.4%	21.3%	10.4%	0.0%
	Skylight	Impact Rated	2.0%	9.4%	21.3%	10.4%	0.0%	2.0%	9.4%	21.3%	10.4%	0.0%

Mitigation Measures In Combination		Percent Changes in Damage ((Reference Damage Rate - Mitigated Damage Rate)/ Reference Damage Rate) *100									
		Frame Building					Masonry Building				
		Wind Speed (MPH)					Wind Speed (MPH)				
		60	85	110	135	160	60	85	110	135	160
Building	Mitigated Building	61.7%	84.9%	77.8%	50.4%	20.7%	61.7%	84.9%	77.8%	50.4%	23.0%

Form V-3: Mitigation Measures, Mean Damage Ratios and Loss Costs (Trade Secret Item)

This form will be provided during the professional team on-site review as well as the closed meeting portion of the commission meeting.

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.

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 Specifications below for additional modeling information. Explain any assumptions, deviations, and differences from the prescribed exposure information.

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.

This information is provided in Excel format in the file RMS15FormA1.xlsx and in PDF format in the file RMS15FormA1.pdf at the link provided to the FCHLPM. The three maps color-coded by ZIP Code appear below.

Notional Policy Specifications

Policy Type	Assumptions
Owners	***Coverage A = Building*** • *Replacement Cost included subject to Coverage A limit* • *Law and Ordinance not included* ***Coverage B = Appurtenant Structure*** • *Replacement Cost included subject to Coverage B limit* • *Law and Ordinance not included* ***Coverage C = Contents*** • *Replacement Cost included subject to Coverage C limit* ***Coverage D = Time Element*** • *Time Limit = 12 months* • *Per Diem = $150.00/day per policy, if used* *Loss costs per $1,000 shall be related to the Coverage A limit*
Manufactured Home	***Coverage A = Building*** • *Replacement Cost included subject to Coverage A limit* ***Coverage B = Appurtenant Structure*** • *Replacement Cost included subject to Coverage B limit* ***Coverage C = Contents*** • *Replacement Cost included subject to Coverage C limit* ***Coverage D = Time Element*** • *Time Limit = 12 months* • *Per Diem = $150.00/day per policy, if used* *Loss costs per $1,000 shall be related to the Coverage A limit*

Figure 75: Zero Deductible Loss Costs by 5-Digit ZIP Code for Frame

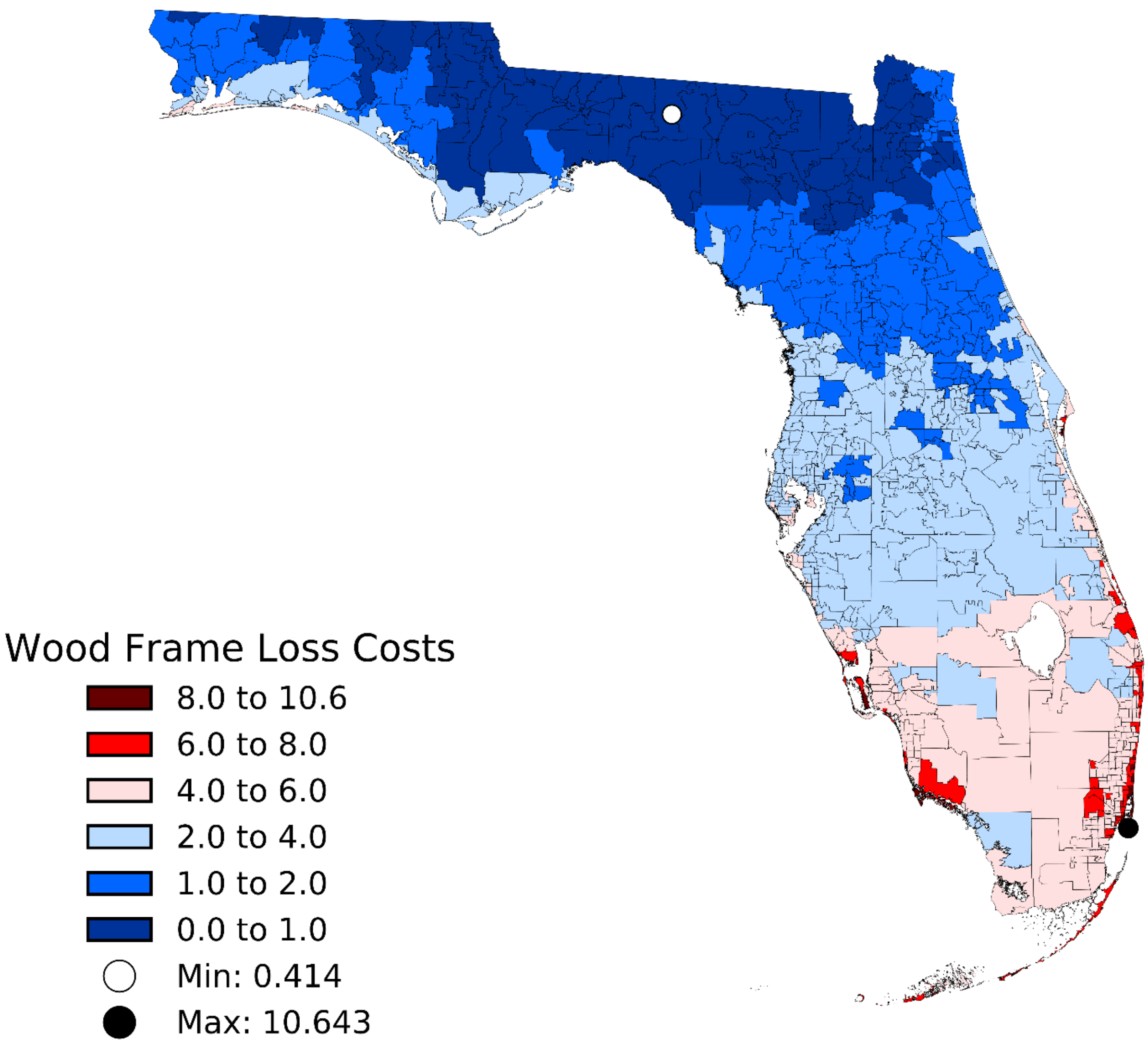


Figure 76: Zero Deductible Loss Costs by 5-Digit ZIP Code for Masonry

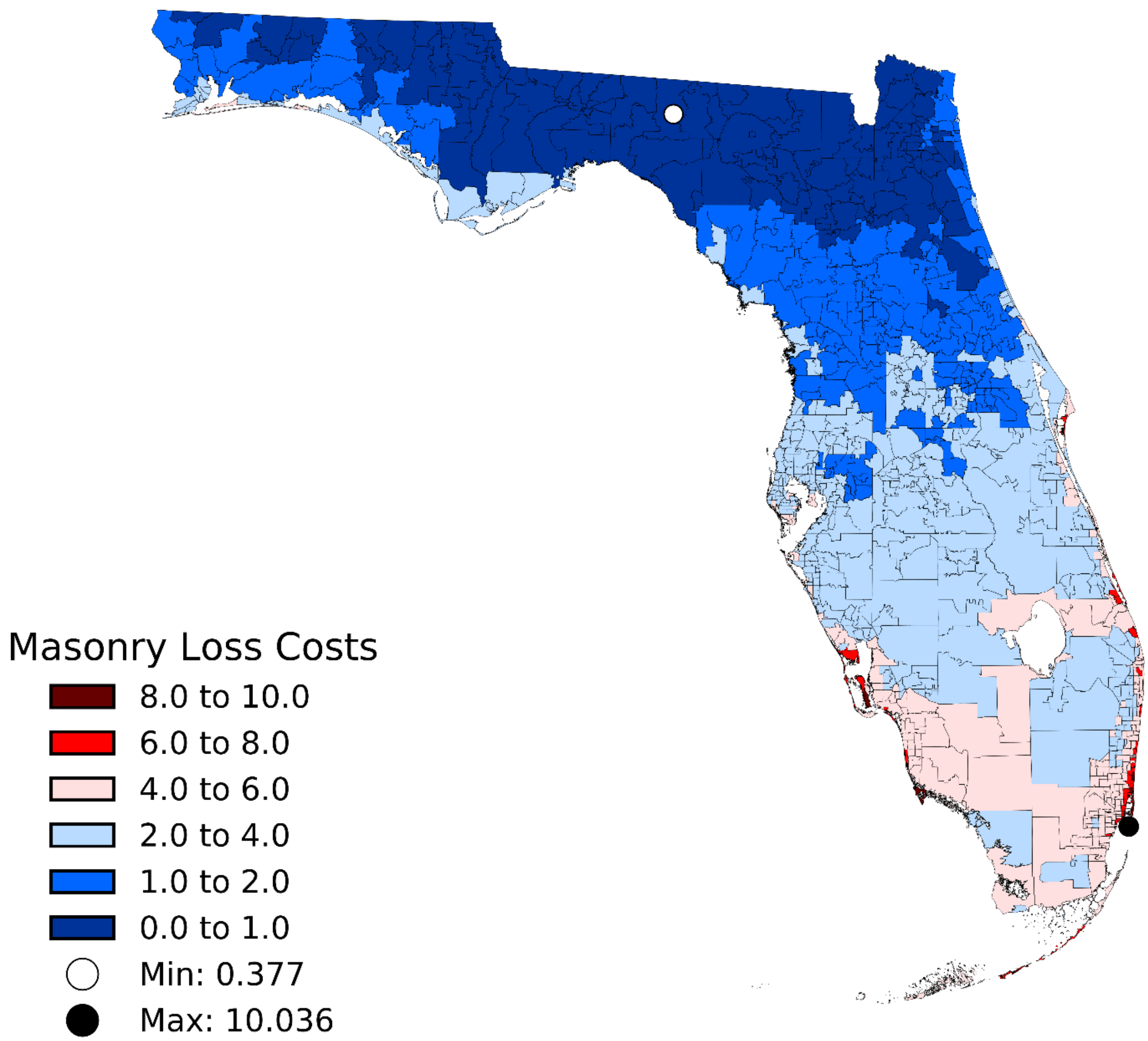
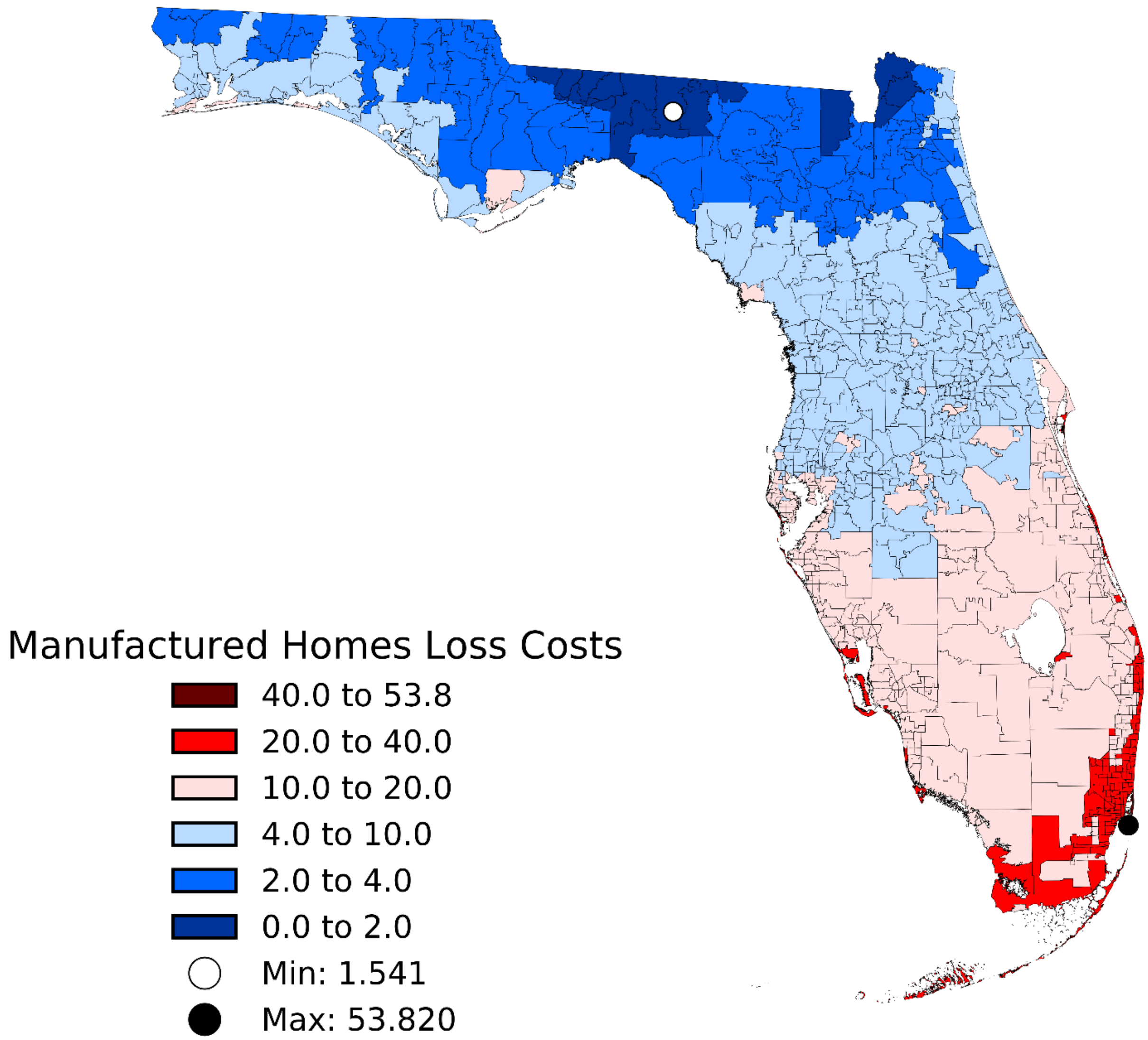


Figure 77: Zero Deductible Loss Costs by 5-Digit ZIP Code for Manufactured Home



Form A-2: Base Hurricane 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 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.

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 Set Statewide Losses, in a submission appendix.

The total insured loss and dollar contribution to the average annual loss for each storm in the Base Hurricane Storm Set is provided for personal residential and commercial residential policies from the 2012 FHCF aggregate exposure data in the file RMS15FormA2.xlsx at the link provided to the FCHLPM and appears below.

Table 35: Base Hurricane Storm Set Average Annual Zero Deductible—Statewide Loss Costs

ID	Landfall / Closest Approach Date	Year	Name	Personal and Commercial Residential Insured Losses ($)	Dollar Contribution
001	09/06/1900	1900	NotNamed-1900	57,813,186	502,723
005	08/15/1901	1901	NoName04-1901	28,484,262	247,689
010	09/11/1903	1903	NoName03-1903	1,180,184,064	10,262,470
015	10/17/1904	1904	NoName04-1904	587,295,219	5,106,915
020	06/17/1906	1906	NoName02-1906	237,863,580	2,068,379
025	09/27/1906	1906	NoName06-1906	2,313,506,064	20,117,444
030	10/18/1906	1906	NoName08-1906	6,264,705,523	54,475,700
035	10/11/1909	1909	NoName11-1909	124,077,480	1,078,935
040	10/18/1910	1910	NoName05-1910	12,569,951,576	109,303,927
045	08/11/1911	1911	NoName02-1911	93,089,838	809,477
046	08/29/1911	1911	NotNamed-1911	25,861,683	224,884
050	09/14/1912	1912	NoName04-1912	68,980,999	599,835
055	08/01/1915	1915	NoName01-1915	332,913,518	2,894,900
056	08/16/1915	1915	NotNamed-1915	20,527,337	178,499
060	09/04/1915	1915	NoName04-1915	79,290,556	689,483
065	07/05/1916	1916	NoName02-1916	371,796,240	3,233,011
070	10/18/1916	1916	NoName14-1916	989,891,191	8,607,749
075	09/29/1917	1917	NoName04-1917	1,692,939,415	14,721,212
080	09/10/1919	1919	NoName02-1919	1,627,031	14,148
085	10/25/1921	1921	TampaBay06-1921	7,709,759,911	67,041,391
086	10/17/1923	1923	NotNamed-1923	23,489,019	204,252

ID	Landfall / Closest Approach Date	Year	Name	Personal and Commercial Residential Insured Losses ($)	Dollar Contribution
090	09/15/1924	1924	NoName05-1924	59,987,920	521,634
095	10/21/1924	1924	NoName10-1924	740,228,179	6,436,767
100	07/28/1926	1926	NoName01-1926	2,324,226,742	20,210,667
105	09/18/1926	1926	GreatMiami07-1926	58,471,245,444	508,445,613
110	10/21/1926	1926	NoName10-1926	493,726,059	4,293,270
115	08/08/1928	1928	NoName01-1928	1,770,455,430	15,395,265
120	09/17/1928	1928	LakeOkeechobee04-1928	40,957,819,176	356,154,949
125	09/28/1929	1929	NoName02-1929	1,544,353,973	13,429,165
130	09/01/1932	1932	NoName03-1932	107,747,564	936,935
135	07/30/1933	1933	NoName05-1933	178,270,325	1,550,177
140	09/04/1933	1933	NoName11-1933	4,540,493,059	39,482,548
141	10/06/1933	1933	NotNamed-1933	31,167,628	271,023
145	09/03/1935	1935	LaborDay03-1935	22,349,449,848	194,343,042
146	09/29/1935	1935	NotNamed-1935	437,351,729	3,803,059
150	11/04/1935	1935	NoName07-1935	1,658,917,727	14,425,372
155	07/31/1936	1936	NoName05-1936	555,069,224	4,826,689
160	08/11/1939	1939	NoName02-1939	329,488,316	2,865,116
165	10/06/1941	1941	NoName05-1941	2,829,384,893	24,603,347
170	10/19/1944	1944	NoName13-1944	16,447,801,143	143,024,358
175	06/24/1945	1945	NoName01-1945	304,146,374	2,644,751
180	09/15/1945	1945	NoName09-1945	8,212,278,506	71,411,117
185	10/08/1946	1946	NoName06-1946	1,743,910,063	15,164,435
190	09/17/1947	1947	NoName04-1947	11,455,380,726	99,612,006
195	10/12/1947	1947	NoName09-1947	737,309,050	6,411,383
200	09/22/1948	1948	NoName08-1948	2,785,907,913	24,225,286
205	10/05/1948	1948	NoName09-1948	702,307,347	6,107,020
210	08/26/1949	1949	NoName02-1949	11,903,237,613	103,506,414
215	08/31/1950	1950	Baker-1950	63,487,157	552,062
220	09/05/1950	1950	Easy-1950	1,019,398,679	8,864,336
225	10/18/1950	1950	King-1950	6,614,085,365	57,513,786
230	09/26/1953	1953	Florence-1953	303,586,003	2,639,878
235	10/09/1953	1953	Hazel-1953	198,052,046	1,722,192
240	09/25/1956	1956	Flossy-1956	316,445,690	2,751,702
245	09/10/1960	1960	Donna-1960	6,733,754,462	58,554,387
250	08/27/1964	1964	Cleo-1964	3,191,110,674	27,748,788
255	09/10/1964	1964	Dora-1964	1,064,138,898	9,253,382
256	10/03/1964	1964	Hilda-1964	613,181	5,332
260	10/14/1964	1964	Isbell-1964	1,165,528,531	10,135,031
265	09/08/1965	1965	Betsy-1965	4,484,382,919	38,994,634
270	06/09/1966	1966	Alma-1966	685,392,614	5,959,936
275	10/04/1966	1966	Inez-1966	118,161,315	1,027,490
276	06/06/1968	1968	Abby-1968	61,984,057	538,992
280	10/19/1968	1968	Gladys-1968	255,184,274	2,218,994
285	06/19/1972	1972	Agnes-1972	3,189,240	27,733
290	09/23/1975	1975	Eloise-1975	1,265,926,592	11,008,057

ID	Landfall / Closest Approach Date	Year	Name	Personal and Commercial Residential Insured Losses ($)	Dollar Contribution
295	09/04/1979	1979	David-1979	461,867,893	4,016,243
300	09/13/1979	1979	Frederic-1979	304,138,202	2,644,680
305	09/02/1985	1985	Elena-1985	464,377,138	4,038,062
310	11/21/1985	1985	Kate-1985	175,015,011	1,521,870
315	10/12/1987	1987	Floyd-1987	18,762,366	163,151
320	08/24/1992	1992	Andrew-1992	29,205,766,757	253,963,189
325	08/03/1995	1995	Erin-1995	612,300,236	5,324,350
330	10/04/1995	1995	Opal-1995	1,335,576,331	11,613,707
335	07/19/1997	1997	Danny-1997	5,168,895	44,947
340	09/03/1998	1998	Earl-1998	148,226,737	1,288,928
345	09/25/1998	1998	Georges-1998	205,238,433	1,784,682
346	08/29/1999	1999	Dennis-1999	124	1
347	09/17/1999	1999	Floyd-1999	24,799,598	215,649
350	10/15/1999	1999	Irene-1999	524,957,639	4,564,849
351	09/19/2000	2000	Gordon-2000	5,143,775	44,728
352	11/05/2001	2001	Michelle-2001	3,177,871	27,634
355	08/13/2004	2004	Charley-2004	7,772,845,134	67,589,958
360	09/05/2004	2004	Frances-2004	3,491,088,284	30,357,289
365	09/16/2004	2004	Ivan-2004	1,356,290,407	11,793,830
370	09/26/2004	2004	Jeanne-2004	6,485,760,692	56,397,919
375	07/10/2005	2005	Dennis-2005	553,234,736	4,810,737
380	08/25/2005	2005	Katrina-2005	738,179,304	6,418,950
381	09/21/2005	2005	Rita-2005	18,312,215	159,237
385	10/24/2005	2005	Wilma-2005	10,569,324,690	91,907,171
386	09/11/2008	2008	Ike-2008	2,488,960	21,643
			Total	**320,472,172,788**	**2,786,714,546**

Note: Total dollar contribution 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.

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.

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	***Over 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	***Below 0.1%***

Plot the relevant storm track on each map.

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.

The contribution and percentage of losses from the 2004 Hurricane Season storms for each ZIP Code where losses are equal to or greater than $500,000 for personal residential and commercial residential policies from the 2012 FHCF aggregate exposure data are in RMS15FormA3.xlsx at the link provided to the FCHLPM and appear below.

Table 36: Hurricane Charley (2004) Percent of Losses using 2012 FHCF Exposure Data

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33950	1,055,194,583	13.5899%	3,117,353	0.0902%	0	0.0000%	3,264,616	0.0506%	1,061,576,552	5.5668%
33952	570,134,268	7.3428%	2,229,466	0.0645%	0	0.0000%	2,485,641	0.0385%	574,849,374	3.0144%
33983	456,582,402	5.8803%	1,252,628	0.0362%	0	0.0000%	2,064,622	0.0320%	459,899,652	2.4116%
32963	0	0.0000%	123,701,395	3.5798%	0	0.0000%	252,399,780	3.9106%	376,101,174	1.9722%
33980	307,882,584	3.9652%	944,182	0.0273%	0	0.0000%	1,130,650	0.0175%	309,957,417	1.6254%
32958	0	0.0000%	81,719,415	2.3649%	0	0.0000%	152,167,730	2.3576%	233,887,145	1.2265%
32507	0	0.0000%	0	0.0000%	227,584,869	16.8645%	0	0.0000%	227,584,869	1.1934%
33924	211,529,143	2.7243%	929,020	0.0269%	0	0.0000%	0	0.0000%	212,817,337	1.1160%
33884	130,721,416	1.6836%	8,804,587	0.2548%	0	0.0000%	52,260,692	0.8097%	191,786,695	1.0057%
33957	179,109,105	2.3068%	2,278,743	0.0659%	0	0.0000%	1,001,885	0.0155%	182,389,733	0.9564%
33948	176,640,837	2.2750%	1,324,198	0.0383%	0	0.0000%	1,287,713	0.0200%	179,252,749	0.9400%
34744	136,149,922	1.7535%	11,635,498	0.3367%	0	0.0000%	30,145,141	0.4671%	177,930,561	0.9330%
32907	0	0.0000%	31,507,061	0.9118%	0	0.0000%	143,108,906	2.2173%	174,615,967	0.9157%
34997	0	0.0000%	58,026,812	1.6792%	0	0.0000%	103,715,467	1.6069%	161,742,279	0.8482%
33982	156,676,132	2.0178%	1,007,730	0.0292%	0	0.0000%	2,253,653	0.0349%	159,937,515	0.8387%
32976	0	0.0000%	47,043,039	1.3614%	0	0.0000%	105,809,223	1.6394%	152,852,262	0.8015%
34266	138,547,109	1.7844%	1,800,589	0.0521%	0	0.0000%	11,910,958	0.1845%	152,258,656	0.7984%
34990	0	0.0000%	52,312,356	1.5139%	0	0.0000%	97,558,614	1.5115%	149,870,970	0.7859%
34952	0	0.0000%	52,804,649	1.5281%	0	0.0000%	96,748,808	1.4990%	149,553,457	0.7842%
33844	92,683,763	1.1937%	8,193,923	0.2371%	0	0.0000%	40,231,236	0.6233%	141,108,922	0.7400%
33955	136,199,524	1.7541%	918,417	0.0266%	0	0.0000%	753,131	0.0117%	137,871,071	0.7230%
33418	0	0.0000%	48,509,457	1.4038%	0	0.0000%	83,433,887	1.2927%	131,943,344	0.6919%
33480	0	0.0000%	49,657,604	1.4370%	0	0.0000%	72,711,917	1.1266%	122,369,521	0.6417%
33455	0	0.0000%	44,829,314	1.2973%	0	0.0000%	77,162,802	1.1955%	121,992,116	0.6397%
33922	121,150,742	1.5603%	570,454	0.0165%	0	0.0000%	0	0.0000%	121,975,138	0.6396%
32935	0	0.0000%	26,577,665	0.7691%	0	0.0000%	95,051,395	1.4727%	121,629,060	0.6378%
32951	0	0.0000%	31,933,162	0.9241%	0	0.0000%	89,329,574	1.3840%	121,262,736	0.6359%
32765	90,511,942	1.1657%	14,955,061	0.4328%	0	0.0000%	11,795,400	0.1828%	117,262,402	0.6149%
34957	0	0.0000%	40,669,667	1.1769%	0	0.0000%	76,570,460	1.1864%	117,240,127	0.6148%
34996	0	0.0000%	40,682,554	1.1773%	0	0.0000%	76,381,525	1.1834%	117,064,079	0.6139%
34746	83,663,534	1.0775%	8,241,582	0.2385%	0	0.0000%	24,847,693	0.3850%	116,752,810	0.6122%
34743	89,425,108	1.1517%	7,802,270	0.2258%	0	0.0000%	17,630,471	0.2732%	114,857,849	0.6023%
32506	0	0.0000%	0	0.0000%	114,296,933	8.4697%	0	0.0000%	114,296,933	0.5994%
32909	0	0.0000%	23,450,133	0.6786%	0	0.0000%	87,101,932	1.3495%	110,552,066	0.5797%
33904	105,152,562	1.3543%	3,137,227	0.0908%	0	0.0000%	0	0.0000%	108,289,790	0.5679%
32561	0	0.0000%	0	0.0000%	108,287,157	8.0243%	0	0.0000%	108,287,157	0.5678%
32960	0	0.0000%	26,557,788	0.7686%	0	0.0000%	79,244,800	1.2278%	105,802,587	0.5548%
34983	0	0.0000%	34,764,119	1.0060%	0	0.0000%	70,957,776	1.0994%	105,721,895	0.5544%
32962	0	0.0000%	24,853,996	0.7193%	0	0.0000%	80,496,865	1.2472%	105,350,861	0.5524%
33469	0	0.0000%	37,051,438	1.0722%	0	0.0000%	68,149,837	1.0559%	105,201,275	0.5517%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34953	0	0.0000%	34,663,296	1.0031%	0	0.0000%	70,140,126	1.0867%	104,803,422	0.5496%
34769	65,465,527	0.8431%	8,222,605	0.2380%	0	0.0000%	29,760,815	0.4611%	103,448,946	0.5425%
33458	0	0.0000%	35,718,082	1.0336%	0	0.0000%	64,505,305	0.9994%	100,223,387	0.5256%
32937	0	0.0000%	26,009,401	0.7527%	0	0.0000%	72,825,059	1.1283%	98,834,460	0.5183%
33898	55,005,172	0.7084%	6,802,964	0.1969%	0	0.0000%	36,534,809	0.5661%	98,342,945	0.5157%
32825	79,025,561	1.0178%	9,217,502	0.2667%	0	0.0000%	9,807,930	0.1520%	98,050,993	0.5142%
34269	96,353,322	1.2409%	0	0.0000%	0	0.0000%	796,923	0.0123%	97,480,305	0.5112%
32905	0	0.0000%	20,752,667	0.6006%	0	0.0000%	76,571,421	1.1864%	97,324,088	0.5104%
32837	67,487,961	0.8692%	8,866,140	0.2566%	0	0.0000%	18,274,637	0.2831%	94,628,738	0.4962%
34974	0	0.0000%	35,642,932	1.0315%	0	0.0000%	58,981,254	0.9138%	94,624,186	0.4962%
32967	0	0.0000%	28,879,592	0.8357%	0	0.0000%	63,583,283	0.9851%	92,462,875	0.4849%
34982	0	0.0000%	30,463,878	0.8816%	0	0.0000%	60,887,337	0.9434%	91,351,215	0.4790%
33914	88,284,670	1.1370%	2,748,051	0.0795%	0	0.0000%	0	0.0000%	91,032,721	0.4774%
33853	69,556,670	0.8958%	2,726,060	0.0789%	0	0.0000%	18,076,414	0.2801%	90,359,144	0.4738%
34759	66,428,663	0.8555%	3,374,607	0.0977%	0	0.0000%	19,892,414	0.3082%	89,695,684	0.4704%
32940	1,220,005	0.0157%	19,129,991	0.5536%	0	0.0000%	69,136,110	1.0712%	89,486,106	0.4693%
32526	0	0.0000%	0	0.0000%	88,877,175	6.5860%	0	0.0000%	88,877,175	0.4661%
32503	0	0.0000%	0	0.0000%	87,647,231	6.4949%	0	0.0000%	87,647,231	0.4596%
33410	0	0.0000%	32,961,664	0.9539%	0	0.0000%	54,394,837	0.8428%	87,356,501	0.4581%
34949	0	0.0000%	24,038,482	0.6957%	0	0.0000%	62,484,605	0.9681%	86,523,087	0.4537%
32904	0	0.0000%	16,004,385	0.4632%	0	0.0000%	69,472,289	1.0764%	85,476,675	0.4482%
33954	83,546,251	1.0760%	570,682	0.0165%	0	0.0000%	684,778	0.0106%	84,801,711	0.4447%
33908	82,135,532	1.0578%	2,611,630	0.0756%	0	0.0000%	0	0.0000%	84,747,162	0.4444%
32812	64,774,448	0.8342%	7,665,322	0.2218%	0	0.0000%	11,884,033	0.1841%	84,323,804	0.4422%
33881	38,301,319	0.4933%	7,606,107	0.2201%	0	0.0000%	34,231,314	0.5304%	80,138,739	0.4202%
32789	49,407,647	0.6363%	12,333,435	0.3569%	0	0.0000%	17,047,160	0.2641%	78,788,242	0.4132%
33921	74,381,088	0.9580%	2,905,198	0.0841%	0	0.0000%	982,476	0.0152%	78,268,763	0.4104%
32708	51,675,918	0.6655%	13,938,990	0.4034%	0	0.0000%	12,267,720	0.1901%	77,882,627	0.4084%
33411	0	0.0000%	30,169,738	0.8731%	0	0.0000%	47,686,202	0.7388%	77,855,939	0.4083%
32514	0	0.0000%	0	0.0000%	77,829,477	5.7673%	0	0.0000%	77,829,477	0.4081%
33477	0	0.0000%	27,926,032	0.8082%	0	0.0000%	49,617,963	0.7688%	77,543,995	0.4066%
32828	61,758,714	0.7954%	7,518,995	0.2176%	0	0.0000%	8,005,611	0.1240%	77,283,320	0.4053%
32966	0	0.0000%	22,082,916	0.6391%	0	0.0000%	55,182,993	0.8550%	77,265,909	0.4052%
32563	0	0.0000%	0	0.0000%	76,610,825	5.6770%	0	0.0000%	76,610,825	0.4017%
33408	0	0.0000%	27,330,407	0.7909%	0	0.0000%	46,025,130	0.7131%	73,355,538	0.3847%
32792	51,796,049	0.6671%	10,185,439	0.2948%	0	0.0000%	10,809,822	0.1675%	72,791,309	0.3817%
32903	0	0.0000%	18,205,629	0.5269%	0	0.0000%	54,369,365	0.8424%	72,574,994	0.3806%
33919	70,001,322	0.9016%	2,252,562	0.0652%	0	0.0000%	0	0.0000%	72,253,884	0.3789%
32822	56,522,018	0.7280%	6,306,464	0.1825%	0	0.0000%	9,001,936	0.1395%	71,830,418	0.3767%
34951	0	0.0000%	19,813,658	0.5734%	0	0.0000%	51,653,285	0.8003%	71,466,943	0.3748%
32504	0	0.0000%	0	0.0000%	71,106,585	5.2692%	0	0.0000%	71,106,585	0.3729%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32806	48,441,883	0.6239%	8,034,028	0.2325%	0	0.0000%	13,576,418	0.2103%	70,052,329	0.3673%
33414	0	0.0000%	28,373,457	0.8211%	0	0.0000%	40,138,484	0.6219%	68,511,941	0.3593%
32819	35,802,794	0.4611%	9,848,389	0.2850%	0	0.0000%	22,758,638	0.3526%	68,409,821	0.3587%
33880	32,377,096	0.4170%	5,996,961	0.1735%	0	0.0000%	29,553,571	0.4579%	67,927,629	0.3562%
32901	0	0.0000%	14,658,968	0.4242%	0	0.0000%	53,093,641	0.8226%	67,752,609	0.3553%
34741	50,151,294	0.6459%	4,688,492	0.1357%	0	0.0000%	11,765,145	0.1823%	66,604,931	0.3493%
34772	31,570,436	0.4066%	6,250,635	0.1809%	0	0.0000%	28,578,488	0.4428%	66,399,560	0.3482%
34758	47,632,916	0.6135%	3,750,790	0.1085%	0	0.0000%	14,356,256	0.2224%	65,739,963	0.3447%
33852	4,399,829	0.0567%	10,311,508	0.2984%	0	0.0000%	50,418,787	0.7812%	65,130,123	0.3415%
32817	50,232,252	0.6469%	7,094,084	0.2053%	0	0.0000%	6,662,608	0.1032%	63,988,944	0.3355%
32934	0	0.0000%	12,826,376	0.3712%	0	0.0000%	50,843,252	0.7877%	63,669,628	0.3339%
32824	48,249,543	0.6214%	5,185,481	0.1501%	0	0.0000%	9,485,795	0.1470%	62,920,819	0.3299%
32955	1,350,502	0.0174%	14,305,327	0.4140%	0	0.0000%	45,459,496	0.7043%	61,115,325	0.3205%
32952	1,308,979	0.0169%	16,171,901	0.4680%	0	0.0000%	43,247,296	0.6701%	60,728,176	0.3185%
33859	44,296,669	0.5705%	2,392,651	0.0692%	0	0.0000%	13,925,604	0.2158%	60,614,925	0.3179%
33825	14,773,453	0.1903%	6,653,839	0.1926%	0	0.0000%	37,361,249	0.5789%	58,788,541	0.3083%
33873	49,600,678	0.6388%	1,118,456	0.0324%	0	0.0000%	7,964,413	0.1234%	58,683,547	0.3077%
33931	56,994,894	0.7340%	1,668,821	0.0483%	0	0.0000%	0	0.0000%	58,663,715	0.3076%
34994	0	0.0000%	19,799,425	0.5730%	0	0.0000%	38,147,564	0.5910%	57,946,989	0.3039%
34986	0	0.0000%	16,879,449	0.4885%	0	0.0000%	39,213,091	0.6076%	56,092,540	0.2941%
32968	0	0.0000%	13,575,435	0.3929%	0	0.0000%	40,183,891	0.6226%	53,759,326	0.2819%
32931	1,012,601	0.0130%	14,122,096	0.4087%	0	0.0000%	38,597,585	0.5980%	53,732,282	0.2818%
32533	0	0.0000%	0	0.0000%	53,472,664	3.9624%	0	0.0000%	53,472,664	0.2804%
34786	9,765,812	0.1258%	10,837,288	0.3136%	0	0.0000%	29,614,386	0.4588%	50,217,486	0.2633%
33404	0	0.0000%	19,835,211	0.5740%	0	0.0000%	30,381,999	0.4707%	50,217,210	0.2633%
33990	47,343,170	0.6097%	1,766,921	0.0511%	0	0.0000%	1,033,622	0.0160%	50,143,714	0.2629%
32127	33,772,552	0.4350%	11,014,187	0.3187%	0	0.0000%	4,659,291	0.0722%	49,446,029	0.2593%
33872	10,377,778	0.1337%	5,816,277	0.1683%	0	0.0000%	33,235,068	0.5149%	49,429,123	0.2592%
33903	45,459,661	0.5855%	1,974,435	0.0571%	0	0.0000%	1,514,814	0.0235%	48,948,910	0.2567%
33843	24,521,229	0.3158%	3,893,216	0.1127%	0	0.0000%	19,609,228	0.3038%	48,023,672	0.2518%
32803	32,384,593	0.4171%	6,329,657	0.1832%	0	0.0000%	8,998,739	0.1394%	47,712,990	0.2502%
33870	4,813,954	0.0620%	6,456,155	0.1868%	0	0.0000%	36,323,839	0.5628%	47,593,948	0.2496%
34771	22,052,506	0.2840%	5,776,169	0.1672%	0	0.0000%	18,968,321	0.2939%	46,796,996	0.2454%
32707	29,134,988	0.3752%	8,483,281	0.2455%	0	0.0000%	8,390,705	0.1300%	46,008,974	0.2413%
33830	18,098,297	0.2331%	4,172,943	0.1208%	0	0.0000%	21,020,573	0.3257%	43,291,814	0.2270%
32950	0	0.0000%	9,457,894	0.2737%	0	0.0000%	33,575,964	0.5202%	43,033,858	0.2257%
32751	24,332,154	0.3134%	7,788,350	0.2254%	0	0.0000%	10,070,814	0.1560%	42,191,318	0.2212%
34984	0	0.0000%	14,401,426	0.4168%	0	0.0000%	27,732,080	0.4297%	42,133,506	0.2209%
32807	31,799,273	0.4095%	4,612,588	0.1335%	0	0.0000%	5,595,887	0.0867%	42,007,749	0.2203%
33993	40,464,590	0.5211%	908,323	0.0263%	0	0.0000%	576,473	0.0089%	41,949,386	0.2200%
33917	37,692,656	0.4854%	2,085,143	0.0603%	0	0.0000%	1,983,255	0.0307%	41,761,054	0.2190%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32779	11,723,802	0.1510%	13,757,852	0.3981%	0	0.0000%	16,209,560	0.2511%	41,691,213	0.2186%
32725	18,705,591	0.2409%	13,813,842	0.3998%	0	0.0000%	8,526,407	0.1321%	41,045,841	0.2152%
33956	40,004,152	0.5152%	728,232	0.0211%	0	0.0000%	0	0.0000%	41,034,728	0.2152%
32566	0	0.0000%	0	0.0000%	40,643,343	3.0118%	0	0.0000%	40,643,343	0.2131%
32809	28,109,942	0.3620%	4,376,721	0.1267%	0	0.0000%	8,042,499	0.1246%	40,529,162	0.2125%
32571	0	0.0000%	0	0.0000%	40,295,651	2.9860%	0	0.0000%	40,295,651	0.2113%
34972	0	0.0000%	14,834,429	0.4293%	0	0.0000%	25,381,040	0.3932%	40,215,469	0.2109%
33467	0	0.0000%	19,179,563	0.5550%	0	0.0000%	20,541,175	0.3183%	39,720,737	0.2083%
33837	22,696,934	0.2923%	3,906,682	0.1131%	0	0.0000%	12,009,164	0.1861%	38,612,780	0.2025%
32804	21,472,943	0.2766%	6,388,943	0.1849%	0	0.0000%	10,555,929	0.1636%	38,417,815	0.2015%
32738	22,032,467	0.2838%	10,283,231	0.2976%	0	0.0000%	5,978,829	0.0926%	38,294,528	0.2008%
32505	0	0.0000%	0	0.0000%	37,743,631	2.7969%	0	0.0000%	37,743,631	0.1979%
32746	14,669,659	0.1889%	11,864,770	0.3434%	0	0.0000%	10,673,536	0.1654%	37,207,965	0.1951%
32771	16,940,561	0.2182%	11,774,591	0.3407%	0	0.0000%	8,307,787	0.1287%	37,022,939	0.1941%
33981	35,195,112	0.4533%	789,670	0.0229%	0	0.0000%	514,516	0.0080%	36,499,299	0.1914%
32836	17,781,618	0.2290%	5,342,125	0.1546%	0	0.0000%	13,349,113	0.2068%	36,472,856	0.1913%
34748	0	0.0000%	9,016,061	0.2609%	0	0.0000%	26,971,931	0.4179%	35,987,992	0.1887%
32826	29,062,311	0.3743%	3,676,379	0.1064%	0	0.0000%	3,147,371	0.0488%	35,886,061	0.1882%
33407	0	0.0000%	13,567,073	0.3926%	0	0.0000%	21,742,018	0.3369%	35,309,091	0.1852%
32953	1,044,840	0.0135%	10,105,578	0.2924%	0	0.0000%	24,033,018	0.3724%	35,183,435	0.1845%
34950	0	0.0000%	10,397,942	0.3009%	0	0.0000%	24,412,976	0.3782%	34,810,918	0.1825%
33470	0	0.0000%	12,106,075	0.3503%	0	0.0000%	22,026,302	0.3413%	34,132,377	0.1790%
33478	0	0.0000%	11,583,721	0.3352%	0	0.0000%	21,440,226	0.3322%	33,023,947	0.1732%
32835	12,457,800	0.1604%	6,129,628	0.1774%	0	0.0000%	14,238,930	0.2206%	32,826,358	0.1721%
33417	0	0.0000%	12,767,921	0.3695%	0	0.0000%	20,034,379	0.3104%	32,802,300	0.1720%
32159	0	0.0000%	10,201,923	0.2952%	0	0.0000%	22,531,643	0.3491%	32,733,566	0.1717%
33841	24,684,757	0.3179%	1,152,207	0.0333%	0	0.0000%	6,877,629	0.1066%	32,714,593	0.1716%
32832	24,626,919	0.3172%	2,693,679	0.0780%	0	0.0000%	5,172,506	0.0801%	32,493,104	0.1704%
33401	0	0.0000%	12,823,975	0.3711%	0	0.0000%	19,626,184	0.3041%	32,450,159	0.1702%
33412	0	0.0000%	11,778,273	0.3409%	0	0.0000%	20,481,549	0.3173%	32,259,822	0.1692%
34711	0	0.0000%	7,074,036	0.2047%	0	0.0000%	25,173,184	0.3900%	32,247,221	0.1691%
32908	0	0.0000%	6,250,210	0.1809%	0	0.0000%	25,386,340	0.3933%	31,636,550	0.1659%
32174	10,664,605	0.1374%	13,704,959	0.3966%	0	0.0000%	6,823,783	0.1057%	31,193,348	0.1636%
33912	29,559,685	0.3807%	1,396,875	0.0404%	0	0.0000%	0	0.0000%	30,956,560	0.1623%
32750	15,468,785	0.1992%	7,651,387	0.2214%	0	0.0000%	7,487,549	0.1160%	30,607,722	0.1605%
33946	28,900,484	0.3722%	913,732	0.0264%	0	0.0000%	0	0.0000%	30,243,130	0.1586%
32169	14,576,484	0.1877%	11,041,566	0.3195%	0	0.0000%	4,396,647	0.0681%	30,014,697	0.1574%
34134	27,834,968	0.3585%	1,888,589	0.0547%	0	0.0000%	0	0.0000%	29,723,557	0.1559%
32766	23,078,056	0.2972%	3,609,147	0.1044%	0	0.0000%	2,462,653	0.0382%	29,149,856	0.1529%
33991	27,730,072	0.3571%	924,004	0.0267%	0	0.0000%	0	0.0000%	29,145,757	0.1528%
32168	20,134,620	0.2593%	6,276,666	0.1816%	0	0.0000%	2,603,823	0.0403%	29,015,110	0.1522%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32839	19,293,935	0.2485%	3,392,603	0.0982%	0	0.0000%	6,313,719	0.0978%	29,000,257	0.1521%
33436	0	0.0000%	14,719,041	0.4260%	0	0.0000%	13,503,359	0.2092%	28,222,400	0.1480%
33813	0	0.0000%	6,147,107	0.1779%	0	0.0000%	22,039,616	0.3415%	28,186,723	0.1478%
33827	18,799,769	0.2421%	1,264,769	0.0366%	0	0.0000%	7,543,455	0.1169%	27,607,993	0.1448%
32176	12,089,671	0.1557%	10,065,241	0.2913%	0	0.0000%	5,231,067	0.0810%	27,385,978	0.1436%
32829	21,948,969	0.2827%	2,231,075	0.0646%	0	0.0000%	3,182,787	0.0493%	27,362,831	0.1435%
33875	2,969,001	0.0382%	3,624,746	0.1049%	0	0.0000%	20,733,920	0.3212%	27,327,667	0.1433%
33823	2,020,305	0.0260%	5,625,975	0.1628%	0	0.0000%	19,675,628	0.3048%	27,321,908	0.1433%
34787	0	0.0000%	6,679,378	0.1933%	0	0.0000%	20,365,875	0.3155%	27,045,252	0.1418%
32949	0	0.0000%	5,927,946	0.1715%	0	0.0000%	20,837,046	0.3228%	26,764,992	0.1404%
32780	2,676,600	0.0345%	10,114,670	0.2927%	0	0.0000%	13,922,673	0.2157%	26,713,943	0.1401%
32541	0	0.0000%	0	0.0000%	26,677,941	1.9769%	0	0.0000%	26,677,941	0.1399%
32926	1,250,140	0.0161%	7,307,474	0.2115%	0	0.0000%	17,881,636	0.2771%	26,439,250	0.1386%
32821	16,624,916	0.2141%	2,955,929	0.0855%	0	0.0000%	6,837,666	0.1059%	26,418,511	0.1385%
34108	23,568,171	0.3035%	2,239,981	0.0648%	0	0.0000%	0	0.0000%	25,808,152	0.1353%
32808	11,038,945	0.1422%	5,013,261	0.1451%	0	0.0000%	9,611,935	0.1489%	25,664,141	0.1346%
32118	13,116,763	0.1689%	8,258,955	0.2390%	0	0.0000%	3,892,230	0.0603%	25,267,948	0.1325%
34288	24,589,670	0.3167%	0	0.0000%	0	0.0000%	0	0.0000%	25,179,266	0.1320%
32501	0	0.0000%	0	0.0000%	25,028,546	1.8547%	0	0.0000%	25,028,546	0.1312%
34135	22,865,654	0.2945%	2,066,490	0.0598%	0	0.0000%	0	0.0000%	24,932,143	0.1307%
32818	6,644,317	0.0856%	5,756,867	0.1666%	0	0.0000%	12,335,269	0.1911%	24,736,453	0.1297%
33463	0	0.0000%	11,703,509	0.3387%	0	0.0000%	12,534,668	0.1942%	24,238,177	0.1271%
32714	8,910,638	0.1148%	6,592,098	0.1908%	0	0.0000%	8,701,272	0.1348%	24,204,008	0.1269%
32548	0	0.0000%	0	0.0000%	24,124,542	1.7877%	0	0.0000%	24,124,542	0.1265%
32712	0	0.0000%	8,983,958	0.2600%	0	0.0000%	15,117,652	0.2342%	24,101,609	0.1264%
32827	19,055,499	0.2454%	1,787,419	0.0517%	0	0.0000%	3,021,387	0.0468%	23,864,305	0.1251%
32578	0	0.0000%	0	0.0000%	23,646,070	1.7522%	0	0.0000%	23,646,070	0.1240%
33437	0	0.0000%	12,567,135	0.3637%	0	0.0000%	11,073,908	0.1716%	23,641,042	0.1240%
33496	0	0.0000%	13,893,988	0.4021%	0	0.0000%	9,731,424	0.1508%	23,625,412	0.1239%
32534	0	0.0000%	0	0.0000%	23,089,771	1.7110%	0	0.0000%	23,089,771	0.1211%
33405	0	0.0000%	10,007,717	0.2896%	0	0.0000%	12,963,235	0.2008%	22,970,952	0.1205%
33462	0	0.0000%	11,232,276	0.3251%	0	0.0000%	11,540,670	0.1788%	22,772,946	0.1194%
33415	0	0.0000%	9,726,867	0.2815%	0	0.0000%	12,989,802	0.2013%	22,716,669	0.1191%
33409	0	0.0000%	9,048,679	0.2619%	0	0.0000%	13,513,896	0.2094%	22,562,576	0.1183%
32703	2,448,938	0.0315%	6,945,245	0.2010%	0	0.0000%	13,070,991	0.2025%	22,465,174	0.1178%
32119	12,939,824	0.1667%	6,374,090	0.1845%	0	0.0000%	2,844,154	0.0441%	22,158,068	0.1162%
32773	12,441,986	0.1602%	5,569,479	0.1612%	0	0.0000%	4,113,728	0.0637%	22,125,193	0.1160%
32547	0	0.0000%	0	0.0000%	22,078,315	1.6361%	0	0.0000%	22,078,315	0.1158%
33905	18,538,480	0.2388%	1,549,039	0.0448%	0	0.0000%	1,559,438	0.0242%	21,646,957	0.1135%
32570	0	0.0000%	0	0.0000%	21,503,142	1.5934%	0	0.0000%	21,503,142	0.1128%
32927	1,426,271	0.0184%	6,871,825	0.1989%	0	0.0000%	13,142,095	0.2036%	21,440,190	0.1124%

	Hurricane Charley		**Hurricane Frances**		**Hurricane Ivan**		**Hurricane Jeanne**		**Total**	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34761	1,838,007	0.0237%	5,486,317	0.1588%	0	0.0000%	13,984,865	0.2167%	21,309,189	0.1117%
33901	19,661,881	0.2532%	908,952	0.0263%	0	0.0000%	704,918	0.0109%	21,275,751	0.1116%
32810	7,844,642	0.1010%	4,822,601	0.1396%	0	0.0000%	7,786,680	0.1206%	20,453,923	0.1073%
34946	0	0.0000%	6,024,411	0.1743%	0	0.0000%	14,351,389	0.2224%	20,375,800	0.1068%
32778	0	0.0000%	6,221,263	0.1800%	0	0.0000%	13,942,578	0.2160%	20,163,841	0.1057%
34788	0	0.0000%	6,541,877	0.1893%	0	0.0000%	13,549,846	0.2099%	20,091,723	0.1054%
33907	19,362,653	0.2494%	721,349	0.0209%	0	0.0000%	0	0.0000%	20,084,002	0.1053%
33909	18,480,930	0.2380%	890,467	0.0258%	0	0.0000%	659,594	0.0102%	20,030,991	0.1050%
34747	8,921,840	0.1149%	3,100,581	0.0897%	0	0.0000%	7,550,124	0.1170%	19,572,544	0.1026%
33967	18,402,054	0.2370%	1,129,249	0.0327%	0	0.0000%	0	0.0000%	19,531,303	0.1024%
33406	0	0.0000%	8,280,171	0.2396%	0	0.0000%	11,106,841	0.1721%	19,387,012	0.1017%
34286	18,068,552	0.2327%	545,268	0.0158%	0	0.0000%	666,753	0.0103%	19,280,572	0.1011%
32162	0	0.0000%	6,205,600	0.1796%	0	0.0000%	12,460,267	0.1931%	18,665,866	0.0979%
34491	0	0.0000%	6,459,584	0.1869%	0	0.0000%	12,182,758	0.1888%	18,642,341	0.0978%
34110	16,881,272	0.2174%	1,616,343	0.0468%	0	0.0000%	0	0.0000%	18,497,615	0.0970%
32128	11,994,039	0.1545%	4,443,611	0.1286%	0	0.0000%	1,817,138	0.0282%	18,254,788	0.0957%
32757	0	0.0000%	6,251,392	0.1809%	0	0.0000%	11,986,671	0.1857%	18,238,063	0.0956%
32701	8,840,884	0.1139%	4,310,106	0.1247%	0	0.0000%	4,926,211	0.0763%	18,077,201	0.0948%
32583	0	0.0000%	0	0.0000%	17,952,323	1.3303%	0	0.0000%	17,952,323	0.0941%
32129	11,338,044	0.1460%	4,726,849	0.1368%	0	0.0000%	1,869,157	0.0290%	17,934,051	0.0940%
33403	0	0.0000%	6,792,882	0.1966%	0	0.0000%	10,571,193	0.1638%	17,364,075	0.0911%
33433	0	0.0000%	10,344,949	0.2994%	0	0.0000%	6,789,341	0.1052%	17,134,290	0.0898%
33876	1,244,877	0.0160%	2,649,183	0.0767%	0	0.0000%	13,189,391	0.2044%	17,083,451	0.0896%
33803	0	0.0000%	4,127,228	0.1194%	0	0.0000%	12,577,369	0.1949%	16,704,597	0.0876%
33461	0	0.0000%	7,865,837	0.2276%	0	0.0000%	8,765,222	0.1358%	16,631,059	0.0872%
32713	4,808,840	0.0619%	6,968,874	0.2017%	0	0.0000%	4,798,426	0.0743%	16,576,141	0.0869%
33460	0	0.0000%	7,670,296	0.2220%	0	0.0000%	8,772,551	0.1359%	16,442,847	0.0862%
34947	0	0.0000%	4,914,872	0.1422%	0	0.0000%	11,508,974	0.1783%	16,423,846	0.0861%
32141	7,364,651	0.0948%	6,587,753	0.1906%	0	0.0000%	2,423,163	0.0375%	16,375,567	0.0859%
34102	14,786,794	0.1904%	1,582,528	0.0458%	0	0.0000%	0	0.0000%	16,369,322	0.0858%
32805	9,973,199	0.1284%	2,227,311	0.0645%	0	0.0000%	4,051,308	0.0628%	16,251,818	0.0852%
33928	15,031,026	0.1936%	1,154,926	0.0334%	0	0.0000%	0	0.0000%	16,185,952	0.0849%
34471	0	0.0000%	7,334,336	0.2122%	0	0.0000%	8,688,366	0.1346%	16,022,702	0.0840%
33435	0	0.0000%	8,429,282	0.2439%	0	0.0000%	7,583,317	0.1175%	16,012,600	0.0840%
33890	11,441,225	0.1474%	584,009	0.0169%	0	0.0000%	3,776,626	0.0585%	15,801,860	0.0829%
33810	0	0.0000%	4,708,591	0.1363%	0	0.0000%	11,046,313	0.1711%	15,754,905	0.0826%
32550	0	0.0000%	0	0.0000%	15,598,173	1.1559%	0	0.0000%	15,598,173	0.0818%
32732	12,042,328	0.1551%	2,220,717	0.0643%	0	0.0000%	1,246,347	0.0193%	15,509,393	0.0813%
33801	0	0.0000%	3,763,069	0.1089%	0	0.0000%	11,595,416	0.1797%	15,358,485	0.0805%
34103	14,008,766	0.1804%	1,345,146	0.0389%	0	0.0000%	0	0.0000%	15,353,912	0.0805%
32726	0	0.0000%	5,330,276	0.1543%	0	0.0000%	9,919,966	0.1537%	15,250,242	0.0800%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32579	0	0.0000%	0	0.0000%	15,127,001	1.1209%	0	0.0000%	15,127,001	0.0793%
34945	0	0.0000%	4,506,881	0.1304%	0	0.0000%	10,562,119	0.1636%	15,069,000	0.0790%
32796	2,056,238	0.0265%	6,312,574	0.1827%	0	0.0000%	6,198,776	0.0960%	14,567,587	0.0764%
33440	0	0.0000%	4,406,032	0.1275%	0	0.0000%	9,432,539	0.1461%	14,281,672	0.0749%
33445	0	0.0000%	8,151,215	0.2359%	0	0.0000%	6,050,486	0.0937%	14,201,702	0.0745%
32920	0	0.0000%	4,199,888	0.1215%	0	0.0000%	9,588,976	0.1486%	14,186,728	0.0744%
32724	2,255,955	0.0291%	7,390,906	0.2139%	0	0.0000%	4,328,120	0.0671%	13,974,982	0.0733%
32801	9,469,743	0.1220%	1,652,744	0.0478%	0	0.0000%	2,821,344	0.0437%	13,943,831	0.0731%
33428	0	0.0000%	8,398,839	0.2431%	0	0.0000%	5,511,672	0.0854%	13,910,511	0.0729%
33838	9,592,815	0.1235%	615,867	0.0178%	0	0.0000%	3,677,609	0.0570%	13,886,292	0.0728%
32459	0	0.0000%	0	0.0000%	13,862,241	1.0272%	0	0.0000%	13,862,241	0.0727%
33446	0	0.0000%	7,888,956	0.2283%	0	0.0000%	5,740,557	0.0889%	13,629,513	0.0715%
33434	0	0.0000%	8,060,022	0.2332%	0	0.0000%	5,561,783	0.0862%	13,621,805	0.0714%
32569	0	0.0000%	0	0.0000%	13,531,044	1.0027%	0	0.0000%	13,531,044	0.0710%
33809	0	0.0000%	4,136,524	0.1197%	0	0.0000%	9,337,717	0.1447%	13,474,241	0.0707%
32137	0	0.0000%	8,536,392	0.2470%	0	0.0000%	4,790,440	0.0742%	13,326,832	0.0699%
33850	3,976,736	0.0512%	1,935,557	0.0560%	0	0.0000%	7,259,669	0.1125%	13,171,962	0.0691%
32811	6,982,907	0.0899%	2,006,756	0.0581%	0	0.0000%	4,142,159	0.0642%	13,131,822	0.0689%
32117	6,806,927	0.0877%	4,182,994	0.1211%	0	0.0000%	2,030,490	0.0315%	13,020,411	0.0683%
34145	10,701,958	0.1378%	2,233,917	0.0646%	0	0.0000%	0	0.0000%	12,935,874	0.0678%
32948	0	0.0000%	4,548,950	0.1316%	0	0.0000%	8,197,664	0.1270%	12,746,614	0.0668%
33472	0	0.0000%	6,333,406	0.1833%	0	0.0000%	6,078,396	0.0942%	12,411,802	0.0651%
34472	0	0.0000%	4,961,090	0.1436%	0	0.0000%	7,297,202	0.1131%	12,258,292	0.0643%
33484	0	0.0000%	6,900,345	0.1997%	0	0.0000%	4,986,577	0.0773%	11,886,922	0.0623%
32922	0	0.0000%	3,029,207	0.0877%	0	0.0000%	8,298,184	0.1286%	11,632,336	0.0610%
33487	0	0.0000%	6,701,108	0.1939%	0	0.0000%	4,811,607	0.0745%	11,512,715	0.0604%
34987	0	0.0000%	3,498,140	0.1012%	0	0.0000%	7,982,715	0.1237%	11,480,855	0.0602%
32082	0	0.0000%	6,797,956	0.1967%	0	0.0000%	4,651,384	0.0721%	11,449,340	0.0600%
32720	0	0.0000%	7,017,407	0.2031%	0	0.0000%	4,405,877	0.0683%	11,423,284	0.0599%
34109	10,114,268	0.1303%	1,187,955	0.0344%	0	0.0000%	0	0.0000%	11,302,223	0.0593%
34480	0	0.0000%	4,637,926	0.1342%	0	0.0000%	6,611,155	0.1024%	11,249,081	0.0590%
34731	0	0.0000%	3,150,803	0.0912%	0	0.0000%	8,058,891	0.1249%	11,209,694	0.0588%
33498	0	0.0000%	6,695,363	0.1938%	0	0.0000%	4,513,571	0.0699%	11,208,934	0.0588%
34119	9,617,377	0.1239%	1,561,436	0.0452%	0	0.0000%	0	0.0000%	11,178,813	0.0586%
34981	0	0.0000%	3,572,932	0.1034%	0	0.0000%	7,574,452	0.1174%	11,147,384	0.0585%
32114	5,972,783	0.0769%	3,471,516	0.1005%	0	0.0000%	1,597,768	0.0248%	11,042,067	0.0579%
34223	6,959,892	0.0896%	2,481,906	0.0718%	0	0.0000%	1,530,253	0.0237%	10,972,051	0.0575%
33897	1,152,903	0.0148%	2,881,391	0.0834%	0	0.0000%	6,908,964	0.1070%	10,943,258	0.0574%
34476	0	0.0000%	4,439,982	0.1285%	0	0.0000%	6,320,249	0.0979%	10,760,231	0.0564%
34956	0	0.0000%	3,788,107	0.1096%	0	0.0000%	6,940,994	0.1075%	10,729,102	0.0563%
34112	9,472,048	0.1220%	1,137,736	0.0329%	0	0.0000%	0	0.0000%	10,609,784	0.0556%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33426	0	0.0000%	5,394,712	0.1561%	0	0.0000%	4,918,844	0.0762%	10,313,556	0.0541%
33483	0	0.0000%	5,855,075	0.1694%	0	0.0000%	4,404,286	0.0682%	10,259,361	0.0538%
32833	5,360,928	0.0690%	2,132,539	0.0617%	0	0.0000%	2,681,435	0.0415%	10,174,902	0.0534%
32763	2,515,698	0.0324%	4,479,582	0.1296%	0	0.0000%	2,893,434	0.0448%	9,888,714	0.0519%
34105	8,757,455	0.1128%	1,104,149	0.0320%	0	0.0000%	0	0.0000%	9,861,604	0.0517%
33071	0	0.0000%	6,698,079	0.1938%	0	0.0000%	3,097,366	0.0480%	9,795,444	0.0514%
34224	7,174,010	0.0924%	1,649,020	0.0477%	0	0.0000%	924,417	0.0143%	9,747,447	0.0511%
34420	0	0.0000%	3,583,480	0.1037%	0	0.0000%	6,151,068	0.0953%	9,734,547	0.0510%
33860	0	0.0000%	2,188,366	0.0633%	0	0.0000%	7,525,572	0.1166%	9,713,938	0.0509%
33064	0	0.0000%	6,229,133	0.1803%	0	0.0000%	3,203,415	0.0496%	9,432,548	0.0495%
33413	0	0.0000%	3,834,214	0.1110%	0	0.0000%	5,456,786	0.0845%	9,291,000	0.0487%
33065	0	0.0000%	6,194,652	0.1793%	0	0.0000%	3,082,857	0.0478%	9,277,508	0.0486%
34698	0	0.0000%	2,554,952	0.0739%	0	0.0000%	6,708,985	0.1039%	9,263,937	0.0486%
33936	6,555,739	0.0844%	1,353,061	0.0392%	0	0.0000%	1,291,956	0.0200%	9,200,756	0.0482%
34287	6,197,209	0.0798%	1,579,882	0.0457%	0	0.0000%	1,403,122	0.0217%	9,180,213	0.0481%
33541	0	0.0000%	2,668,360	0.0772%	0	0.0000%	6,450,200	0.0999%	9,118,560	0.0478%
34785	0	0.0000%	2,438,370	0.0706%	0	0.0000%	6,631,003	0.1027%	9,069,373	0.0476%
32820	6,421,198	0.0827%	1,432,555	0.0415%	0	0.0000%	1,201,868	0.0186%	9,055,621	0.0475%
33067	0	0.0000%	5,807,615	0.1681%	0	0.0000%	3,247,856	0.0503%	9,055,471	0.0475%
33486	0	0.0000%	5,443,603	0.1575%	0	0.0000%	3,550,031	0.0550%	8,993,635	0.0472%
34293	3,833,567	0.0494%	2,981,202	0.0863%	0	0.0000%	2,142,641	0.0332%	8,957,410	0.0470%
33913	7,399,032	0.0953%	876,209	0.0254%	0	0.0000%	637,643	0.0099%	8,912,884	0.0467%
32080	0	0.0000%	5,766,302	0.1669%	0	0.0000%	2,999,802	0.0465%	8,766,104	0.0460%
33511	0	0.0000%	2,725,685	0.0789%	0	0.0000%	5,977,754	0.0926%	8,703,439	0.0456%
33706	0	0.0000%	1,935,594	0.0560%	0	0.0000%	6,705,030	0.1039%	8,640,624	0.0453%
33432	0	0.0000%	5,136,310	0.1486%	0	0.0000%	3,448,539	0.0534%	8,584,849	0.0450%
34209	0	0.0000%	3,701,735	0.1071%	0	0.0000%	4,870,200	0.0755%	8,571,935	0.0450%
32577	0	0.0000%	0	0.0000%	8,571,306	0.6352%	0	0.0000%	8,571,306	0.0449%
34470	0	0.0000%	3,931,771	0.1138%	0	0.0000%	4,636,303	0.0718%	8,568,074	0.0449%
34482	0	0.0000%	3,919,128	0.1134%	0	0.0000%	4,444,018	0.0689%	8,363,147	0.0439%
34683	0	0.0000%	2,896,887	0.0838%	0	0.0000%	5,464,195	0.0847%	8,361,082	0.0438%
34104	7,368,780	0.0949%	941,640	0.0273%	0	0.0000%	0	0.0000%	8,310,420	0.0436%
34609	0	0.0000%	2,667,627	0.0772%	0	0.0000%	5,615,682	0.0870%	8,283,309	0.0434%
33431	0	0.0000%	4,842,167	0.1401%	0	0.0000%	3,437,888	0.0533%	8,280,055	0.0434%
34465	0	0.0000%	3,199,655	0.0926%	0	0.0000%	5,060,423	0.0784%	8,260,078	0.0433%
34667	0	0.0000%	2,594,374	0.0751%	0	0.0000%	5,637,256	0.0873%	8,231,630	0.0432%
33966	7,543,086	0.0971%	0	0.0000%	0	0.0000%	0	0.0000%	8,189,081	0.0429%
34446	0	0.0000%	2,675,537	0.0774%	0	0.0000%	5,438,023	0.0843%	8,113,560	0.0425%
33430	0	0.0000%	2,593,653	0.0751%	0	0.0000%	5,508,705	0.0854%	8,102,358	0.0425%
34668	0	0.0000%	2,718,427	0.0787%	0	0.0000%	5,381,408	0.0834%	8,099,835	0.0425%
33076	0	0.0000%	4,960,903	0.1436%	0	0.0000%	3,042,580	0.0471%	8,003,482	0.0420%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34715	0	0.0000%	1,685,742	0.0488%	0	0.0000%	6,271,783	0.0972%	7,957,525	0.0417%
33542	0	0.0000%	2,341,338	0.0678%	0	0.0000%	5,600,393	0.0868%	7,941,731	0.0416%
34608	0	0.0000%	2,545,657	0.0737%	0	0.0000%	5,307,648	0.0822%	7,853,304	0.0412%
33063	0	0.0000%	5,401,064	0.1563%	0	0.0000%	2,447,429	0.0379%	7,848,493	0.0412%
34481	0	0.0000%	3,461,580	0.1002%	0	0.0000%	4,272,508	0.0662%	7,734,088	0.0406%
33953	6,894,269	0.0888%	0	0.0000%	0	0.0000%	0	0.0000%	7,716,616	0.0405%
33629	0	0.0000%	2,578,015	0.0746%	0	0.0000%	5,059,289	0.0784%	7,637,303	0.0400%
32754	2,212,371	0.0285%	3,215,394	0.0931%	0	0.0000%	2,143,300	0.0332%	7,571,065	0.0397%
34606	0	0.0000%	2,470,148	0.0715%	0	0.0000%	5,075,967	0.0786%	7,546,115	0.0396%
33756	0	0.0000%	1,843,101	0.0533%	0	0.0000%	5,656,739	0.0876%	7,499,840	0.0393%
33811	0	0.0000%	1,991,289	0.0576%	0	0.0000%	5,501,660	0.0852%	7,492,948	0.0393%
34442	0	0.0000%	2,653,791	0.0768%	0	0.0000%	4,766,409	0.0738%	7,420,199	0.0389%
33647	0	0.0000%	2,446,265	0.0708%	0	0.0000%	4,936,745	0.0765%	7,383,010	0.0387%
33710	0	0.0000%	1,801,388	0.0521%	0	0.0000%	5,437,902	0.0843%	7,239,290	0.0380%
33471	0	0.0000%	1,772,181	0.0513%	0	0.0000%	5,100,648	0.0790%	7,181,374	0.0377%
33308	0	0.0000%	4,890,628	0.1415%	0	0.0000%	2,249,192	0.0348%	7,139,820	0.0374%
33812	0	0.0000%	1,547,967	0.0448%	0	0.0000%	5,482,708	0.0849%	7,030,675	0.0369%
34736	0	0.0000%	1,701,924	0.0493%	0	0.0000%	5,312,271	0.0823%	7,014,195	0.0368%
33321	0	0.0000%	4,845,727	0.1402%	0	0.0000%	2,164,653	0.0335%	7,010,380	0.0368%
33476	0	0.0000%	2,537,779	0.0734%	0	0.0000%	4,355,496	0.0675%	6,893,275	0.0361%
32413	0	0.0000%	0	0.0000%	6,883,121	0.5101%	0	0.0000%	6,883,121	0.0361%
33449	0	0.0000%	3,215,403	0.0931%	0	0.0000%	3,627,967	0.0562%	6,843,369	0.0359%
32132	3,727,296	0.0480%	2,236,722	0.0647%	0	0.0000%	852,000	0.0132%	6,816,018	0.0357%
33594	0	0.0000%	2,116,853	0.0613%	0	0.0000%	4,693,545	0.0727%	6,810,398	0.0357%
32784	0	0.0000%	2,929,253	0.0848%	0	0.0000%	3,876,135	0.0601%	6,805,388	0.0357%
34228	0	0.0000%	2,781,141	0.0805%	0	0.0000%	3,829,195	0.0593%	6,610,336	0.0347%
33868	0	0.0000%	1,956,375	0.0566%	0	0.0000%	4,646,971	0.0720%	6,603,346	0.0346%
33916	5,971,229	0.0769%	0	0.0000%	0	0.0000%	0	0.0000%	6,563,582	0.0344%
33896	3,320,838	0.0428%	933,353	0.0270%	0	0.0000%	2,272,916	0.0352%	6,527,108	0.0342%
33442	0	0.0000%	4,081,937	0.1181%	0	0.0000%	2,427,697	0.0376%	6,509,634	0.0341%
33444	0	0.0000%	3,712,560	0.1074%	0	0.0000%	2,795,117	0.0433%	6,507,677	0.0341%
33062	0	0.0000%	4,366,672	0.1264%	0	0.0000%	1,998,328	0.0310%	6,365,000	0.0334%
34452	0	0.0000%	2,007,356	0.0581%	0	0.0000%	4,353,225	0.0674%	6,360,580	0.0334%
32502	0	0.0000%	0	0.0000%	6,356,485	0.4710%	0	0.0000%	6,356,485	0.0333%
33935	1,440,139	0.0185%	1,631,937	0.0472%	0	0.0000%	3,275,130	0.0507%	6,347,206	0.0333%
34613	0	0.0000%	1,906,841	0.0552%	0	0.0000%	4,429,279	0.0686%	6,336,120	0.0332%
34450	0	0.0000%	1,909,079	0.0552%	0	0.0000%	4,383,673	0.0679%	6,292,753	0.0330%
32225	0	0.0000%	3,336,640	0.0966%	0	0.0000%	2,940,808	0.0456%	6,277,449	0.0329%
33326	0	0.0000%	4,491,875	0.1300%	0	0.0000%	1,753,723	0.0272%	6,245,598	0.0328%
33707	0	0.0000%	1,508,747	0.0437%	0	0.0000%	4,733,145	0.0733%	6,241,893	0.0327%
34479	0	0.0000%	2,896,099	0.0838%	0	0.0000%	3,338,012	0.0517%	6,234,111	0.0327%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33525	0	0.0000%	1,790,545	0.0518%	0	0.0000%	4,436,513	0.0687%	6,227,058	0.0327%
32210	0	0.0000%	2,683,373	0.0777%	0	0.0000%	3,521,867	0.0546%	6,205,240	0.0325%
33703	0	0.0000%	1,723,134	0.0499%	0	0.0000%	4,453,963	0.0690%	6,177,098	0.0324%
32136	522,382	0.0067%	3,679,874	0.1065%	0	0.0000%	1,965,786	0.0305%	6,168,042	0.0323%
34473	0	0.0000%	2,245,453	0.0650%	0	0.0000%	3,920,223	0.0607%	6,165,676	0.0323%
33708	0	0.0000%	1,346,542	0.0390%	0	0.0000%	4,783,597	0.0741%	6,130,139	0.0321%
33596	0	0.0000%	1,954,240	0.0566%	0	0.0000%	4,175,869	0.0647%	6,130,109	0.0321%
34432	0	0.0000%	2,620,330	0.0758%	0	0.0000%	3,407,529	0.0528%	6,027,860	0.0316%
33611	0	0.0000%	1,842,278	0.0533%	0	0.0000%	4,152,169	0.0643%	5,994,447	0.0314%
32730	3,564,136	0.0459%	1,186,423	0.0343%	0	0.0000%	1,224,816	0.0190%	5,975,375	0.0313%
33624	0	0.0000%	2,122,182	0.0614%	0	0.0000%	3,824,972	0.0593%	5,947,154	0.0312%
33322	0	0.0000%	4,086,072	0.1182%	0	0.0000%	1,856,543	0.0288%	5,942,615	0.0312%
32034	0	0.0000%	2,963,949	0.0858%	0	0.0000%	2,953,616	0.0458%	5,917,565	0.0310%
33770	0	0.0000%	1,431,534	0.0414%	0	0.0000%	4,412,288	0.0684%	5,843,823	0.0306%
34113	4,940,041	0.0636%	802,949	0.0232%	0	0.0000%	0	0.0000%	5,742,990	0.0301%
33947	4,454,854	0.0574%	774,554	0.0224%	0	0.0000%	0	0.0000%	5,690,247	0.0298%
33767	0	0.0000%	1,164,353	0.0337%	0	0.0000%	4,525,681	0.0701%	5,690,034	0.0298%
33857	0	0.0000%	1,315,272	0.0381%	0	0.0000%	4,123,437	0.0639%	5,673,281	0.0297%
34655	0	0.0000%	2,143,875	0.0620%	0	0.0000%	3,498,342	0.0542%	5,642,218	0.0296%
33029	0	0.0000%	4,075,338	0.1179%	0	0.0000%	1,560,448	0.0242%	5,635,787	0.0296%
34116	4,817,499	0.0620%	804,092	0.0233%	0	0.0000%	0	0.0000%	5,621,591	0.0295%
32408	0	0.0000%	0	0.0000%	5,586,943	0.4140%	0	0.0000%	5,586,943	0.0293%
33772	0	0.0000%	1,435,842	0.0416%	0	0.0000%	4,125,332	0.0639%	5,561,174	0.0292%
33715	0	0.0000%	1,560,105	0.0451%	0	0.0000%	4,000,808	0.0620%	5,560,914	0.0292%
33573	0	0.0000%	1,508,718	0.0437%	0	0.0000%	4,029,718	0.0624%	5,538,436	0.0290%
33317	0	0.0000%	3,807,305	0.1102%	0	0.0000%	1,729,127	0.0268%	5,536,432	0.0290%
33319	0	0.0000%	3,801,226	0.1100%	0	0.0000%	1,734,263	0.0269%	5,535,490	0.0290%
33805	0	0.0000%	1,628,893	0.0471%	0	0.0000%	3,901,471	0.0604%	5,530,364	0.0290%
32179	0	0.0000%	2,259,488	0.0654%	0	0.0000%	3,168,966	0.0491%	5,428,453	0.0285%
33324	0	0.0000%	3,795,408	0.1098%	0	0.0000%	1,626,199	0.0252%	5,421,608	0.0284%
34221	0	0.0000%	2,003,105	0.0580%	0	0.0000%	3,380,494	0.0524%	5,383,599	0.0282%
34429	0	0.0000%	2,065,552	0.0598%	0	0.0000%	3,288,314	0.0509%	5,353,866	0.0281%
32605	0	0.0000%	2,405,477	0.0696%	0	0.0000%	2,910,203	0.0451%	5,315,680	0.0279%
32164	0	0.0000%	3,334,618	0.0965%	0	0.0000%	1,980,731	0.0307%	5,315,349	0.0279%
32736	0	0.0000%	2,503,793	0.0725%	0	0.0000%	2,807,544	0.0435%	5,311,337	0.0279%
33572	0	0.0000%	1,443,197	0.0418%	0	0.0000%	3,863,928	0.0599%	5,307,125	0.0278%
32565	0	0.0000%	0	0.0000%	5,280,025	0.3913%	0	0.0000%	5,280,025	0.0277%
33702	0	0.0000%	1,560,914	0.0452%	0	0.0000%	3,704,618	0.0574%	5,265,532	0.0276%
33855	685,719	0.0088%	707,912	0.0205%	0	0.0000%	3,863,084	0.0599%	5,256,715	0.0276%
33312	0	0.0000%	3,626,362	0.1049%	0	0.0000%	1,623,497	0.0252%	5,249,860	0.0275%
32073	0	0.0000%	2,354,581	0.0681%	0	0.0000%	2,886,202	0.0447%	5,240,783	0.0275%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34231	0	0.0000%	2,389,645	0.0692%	0	0.0000%	2,833,649	0.0439%	5,223,294	0.0274%
34714	0	0.0000%	1,449,238	0.0419%	0	0.0000%	3,772,203	0.0584%	5,221,441	0.0274%
33068	0	0.0000%	3,584,496	0.1037%	0	0.0000%	1,631,278	0.0253%	5,215,775	0.0274%
32608	0	0.0000%	2,264,140	0.0655%	0	0.0000%	2,895,798	0.0449%	5,159,938	0.0271%
34773	523,482	0.0067%	828,288	0.0240%	0	0.0000%	3,803,893	0.0589%	5,155,663	0.0270%
34474	0	0.0000%	2,341,413	0.0678%	0	0.0000%	2,813,129	0.0436%	5,154,542	0.0270%
32776	0	0.0000%	2,185,626	0.0632%	0	0.0000%	2,944,674	0.0456%	5,130,300	0.0269%
34601	0	0.0000%	1,553,053	0.0449%	0	0.0000%	3,575,376	0.0554%	5,128,429	0.0269%
33839	2,307,157	0.0297%	0	0.0000%	0	0.0000%	2,350,590	0.0364%	5,110,888	0.0268%
33510	0	0.0000%	1,581,000	0.0458%	0	0.0000%	3,518,213	0.0545%	5,099,213	0.0267%
33024	0	0.0000%	3,459,066	0.1001%	0	0.0000%	1,588,676	0.0246%	5,047,742	0.0265%
33325	0	0.0000%	3,589,054	0.1039%	0	0.0000%	1,449,614	0.0225%	5,038,668	0.0264%
34461	0	0.0000%	1,767,596	0.0512%	0	0.0000%	3,250,759	0.0504%	5,018,355	0.0263%
33547	0	0.0000%	1,329,928	0.0385%	0	0.0000%	3,649,769	0.0565%	4,979,697	0.0261%
32223	0	0.0000%	2,272,025	0.0658%	0	0.0000%	2,680,508	0.0415%	4,952,534	0.0260%
32735	0	0.0000%	1,876,257	0.0543%	0	0.0000%	3,069,292	0.0476%	4,945,549	0.0259%
34652	0	0.0000%	1,712,135	0.0495%	0	0.0000%	3,216,157	0.0498%	4,928,292	0.0258%
32086	0	0.0000%	3,022,329	0.0875%	0	0.0000%	1,883,949	0.0292%	4,906,279	0.0257%
33971	3,699,914	0.0477%	594,632	0.0172%	0	0.0000%	584,196	0.0091%	4,878,741	0.0256%
34448	0	0.0000%	1,635,424	0.0473%	0	0.0000%	3,232,903	0.0501%	4,868,327	0.0255%
33073	0	0.0000%	3,095,084	0.0896%	0	0.0000%	1,771,472	0.0274%	4,866,556	0.0255%
33566	0	0.0000%	1,372,450	0.0397%	0	0.0000%	3,463,193	0.0537%	4,835,643	0.0254%
34689	0	0.0000%	1,706,818	0.0494%	0	0.0000%	3,120,143	0.0483%	4,826,961	0.0253%
33615	0	0.0000%	1,728,696	0.0500%	0	0.0000%	3,097,853	0.0480%	4,826,549	0.0253%
32084	0	0.0000%	3,035,458	0.0878%	0	0.0000%	1,789,046	0.0277%	4,824,504	0.0253%
33774	0	0.0000%	1,294,053	0.0374%	0	0.0000%	3,517,794	0.0545%	4,811,847	0.0252%
33755	0	0.0000%	1,218,119	0.0353%	0	0.0000%	3,562,108	0.0552%	4,780,227	0.0251%
33569	0	0.0000%	1,497,007	0.0433%	0	0.0000%	3,236,957	0.0502%	4,733,964	0.0248%
33584	0	0.0000%	1,416,703	0.0410%	0	0.0000%	3,262,360	0.0505%	4,679,063	0.0245%
33704	0	0.0000%	1,302,403	0.0377%	0	0.0000%	3,364,791	0.0521%	4,667,194	0.0245%
34275	1,400,410	0.0180%	1,656,358	0.0479%	0	0.0000%	1,562,896	0.0242%	4,619,664	0.0242%
32250	0	0.0000%	2,636,796	0.0763%	0	0.0000%	1,978,007	0.0306%	4,614,803	0.0242%
33618	0	0.0000%	1,638,406	0.0474%	0	0.0000%	2,971,798	0.0460%	4,610,204	0.0242%
33543	0	0.0000%	1,366,981	0.0396%	0	0.0000%	3,227,394	0.0500%	4,594,375	0.0241%
33021	0	0.0000%	3,129,800	0.0906%	0	0.0000%	1,449,268	0.0225%	4,579,068	0.0240%
33441	0	0.0000%	2,907,480	0.0841%	0	0.0000%	1,671,061	0.0259%	4,578,541	0.0240%
33565	0	0.0000%	1,293,836	0.0374%	0	0.0000%	3,266,514	0.0506%	4,560,349	0.0239%
32764	3,149,293	0.0406%	885,183	0.0256%	0	0.0000%	0	0.0000%	4,532,207	0.0238%
32798	0	0.0000%	1,527,468	0.0442%	0	0.0000%	2,979,010	0.0462%	4,506,478	0.0236%
34684	0	0.0000%	1,674,471	0.0485%	0	0.0000%	2,831,205	0.0439%	4,505,676	0.0236%
33851	3,119,563	0.0402%	0	0.0000%	0	0.0000%	1,184,906	0.0184%	4,494,826	0.0236%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34453	0	0.0000%	1,444,195	0.0418%	0	0.0000%	3,036,402	0.0470%	4,480,597	0.0235%
34653	0	0.0000%	1,634,134	0.0473%	0	0.0000%	2,845,097	0.0441%	4,479,231	0.0235%
33556	0	0.0000%	1,644,296	0.0476%	0	0.0000%	2,812,231	0.0436%	4,456,527	0.0234%
32539	0	0.0000%	0	0.0000%	4,415,723	0.3272%	0	0.0000%	4,415,723	0.0232%
32404	0	0.0000%	0	0.0000%	4,394,689	0.3257%	0	0.0000%	4,394,689	0.0230%
33026	0	0.0000%	3,103,791	0.0898%	0	0.0000%	1,284,225	0.0199%	4,388,016	0.0230%
33328	0	0.0000%	3,048,092	0.0882%	0	0.0000%	1,308,729	0.0203%	4,356,822	0.0228%
33617	0	0.0000%	1,510,154	0.0437%	0	0.0000%	2,779,662	0.0431%	4,289,816	0.0225%
32068	0	0.0000%	1,730,170	0.0501%	0	0.0000%	2,545,398	0.0394%	4,275,567	0.0224%
34285	1,444,779	0.0186%	1,553,657	0.0450%	0	0.0000%	1,228,478	0.0190%	4,226,914	0.0222%
33776	0	0.0000%	1,126,098	0.0326%	0	0.0000%	3,091,802	0.0479%	4,217,900	0.0221%
32207	0	0.0000%	1,908,066	0.0552%	0	0.0000%	2,292,404	0.0355%	4,200,470	0.0220%
34739	0	0.0000%	827,704	0.0240%	0	0.0000%	3,251,405	0.0504%	4,189,067	0.0220%
32244	0	0.0000%	1,812,602	0.0525%	0	0.0000%	2,343,500	0.0363%	4,156,102	0.0218%
34428	0	0.0000%	1,865,935	0.0540%	0	0.0000%	2,289,758	0.0355%	4,155,694	0.0218%
34488	0	0.0000%	2,004,843	0.0580%	0	0.0000%	2,124,058	0.0329%	4,128,901	0.0217%
33764	0	0.0000%	1,328,034	0.0384%	0	0.0000%	2,795,325	0.0433%	4,123,359	0.0216%
34120	3,179,090	0.0409%	932,400	0.0270%	0	0.0000%	0	0.0000%	4,111,490	0.0216%
33309	0	0.0000%	2,789,041	0.0807%	0	0.0000%	1,293,593	0.0200%	4,082,633	0.0214%
32814	2,866,141	0.0369%	549,640	0.0159%	0	0.0000%	665,921	0.0103%	4,081,701	0.0214%
33323	0	0.0000%	2,829,980	0.0819%	0	0.0000%	1,228,068	0.0190%	4,058,048	0.0213%
33140	0	0.0000%	3,057,294	0.0885%	0	0.0000%	996,832	0.0154%	4,054,126	0.0213%
34639	0	0.0000%	1,267,173	0.0367%	0	0.0000%	2,726,869	0.0422%	3,994,042	0.0209%
33523	0	0.0000%	1,093,080	0.0316%	0	0.0000%	2,890,858	0.0448%	3,983,938	0.0209%
33023	0	0.0000%	2,762,443	0.0799%	0	0.0000%	1,217,959	0.0189%	3,980,403	0.0209%
32535	0	0.0000%	0	0.0000%	3,978,478	0.2948%	0	0.0000%	3,978,478	0.0209%
33331	0	0.0000%	2,813,109	0.0814%	0	0.0000%	1,156,077	0.0179%	3,969,186	0.0208%
32568	0	0.0000%	0	0.0000%	3,958,481	0.2933%	0	0.0000%	3,958,481	0.0208%
33060	0	0.0000%	2,664,487	0.0771%	0	0.0000%	1,264,480	0.0196%	3,928,968	0.0206%
34431	0	0.0000%	1,889,235	0.0547%	0	0.0000%	2,037,472	0.0316%	3,926,707	0.0206%
33351	0	0.0000%	2,699,738	0.0781%	0	0.0000%	1,223,458	0.0190%	3,923,197	0.0206%
33311	0	0.0000%	2,643,893	0.0765%	0	0.0000%	1,264,122	0.0196%	3,908,015	0.0205%
33513	0	0.0000%	1,169,207	0.0338%	0	0.0000%	2,735,181	0.0424%	3,904,388	0.0205%
33563	0	0.0000%	1,112,825	0.0322%	0	0.0000%	2,786,898	0.0432%	3,899,723	0.0204%
32257	0	0.0000%	1,840,823	0.0533%	0	0.0000%	2,040,176	0.0316%	3,880,999	0.0204%
32405	0	0.0000%	0	0.0000%	3,873,120	0.2870%	0	0.0000%	3,873,120	0.0203%
33713	0	0.0000%	1,058,673	0.0306%	0	0.0000%	2,740,573	0.0425%	3,799,246	0.0199%
34243	0	0.0000%	1,566,428	0.0453%	0	0.0000%	2,217,836	0.0344%	3,784,264	0.0198%
32205	0	0.0000%	1,614,837	0.0467%	0	0.0000%	2,168,438	0.0336%	3,783,276	0.0198%
33313	0	0.0000%	2,576,526	0.0746%	0	0.0000%	1,200,190	0.0186%	3,776,716	0.0198%
34756	0	0.0000%	866,387	0.0251%	0	0.0000%	2,904,629	0.0450%	3,771,016	0.0198%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34232	0	0.0000%	1,621,388	0.0469%	0	0.0000%	2,137,436	0.0331%	3,758,825	0.0197%
33570	0	0.0000%	968,510	0.0280%	0	0.0000%	2,781,425	0.0431%	3,749,934	0.0197%
33834	1,956,719	0.0252%	0	0.0000%	0	0.0000%	1,443,730	0.0224%	3,731,286	0.0196%
33606	0	0.0000%	1,289,097	0.0373%	0	0.0000%	2,421,819	0.0375%	3,710,916	0.0195%
33027	0	0.0000%	2,609,081	0.0755%	0	0.0000%	1,100,718	0.0171%	3,709,799	0.0195%
34242	0	0.0000%	1,620,560	0.0469%	0	0.0000%	2,077,538	0.0322%	3,698,098	0.0194%
32536	0	0.0000%	0	0.0000%	3,665,682	0.2716%	0	0.0000%	3,665,682	0.0192%
34217	0	0.0000%	1,391,044	0.0403%	0	0.0000%	2,260,891	0.0350%	3,651,935	0.0192%
34695	0	0.0000%	1,327,042	0.0384%	0	0.0000%	2,319,963	0.0359%	3,647,006	0.0191%
32003	0	0.0000%	1,738,622	0.0503%	0	0.0000%	1,897,069	0.0294%	3,635,691	0.0191%
32177	0	0.0000%	1,960,573	0.0567%	0	0.0000%	1,592,171	0.0247%	3,552,744	0.0186%
33540	0	0.0000%	1,032,986	0.0299%	0	0.0000%	2,508,770	0.0389%	3,541,756	0.0186%
33777	0	0.0000%	922,986	0.0267%	0	0.0000%	2,611,327	0.0405%	3,534,313	0.0185%
33334	0	0.0000%	2,366,962	0.0685%	0	0.0000%	1,140,364	0.0177%	3,507,326	0.0184%
32233	0	0.0000%	1,964,965	0.0569%	0	0.0000%	1,537,900	0.0238%	3,502,865	0.0184%
33705	0	0.0000%	1,014,027	0.0293%	0	0.0000%	2,481,871	0.0385%	3,495,898	0.0183%
32607	0	0.0000%	1,591,347	0.0461%	0	0.0000%	1,899,989	0.0294%	3,491,337	0.0183%
33972	2,283,243	0.0294%	561,470	0.0162%	0	0.0000%	632,142	0.0098%	3,476,855	0.0182%
32606	0	0.0000%	1,606,547	0.0465%	0	0.0000%	1,859,870	0.0288%	3,466,417	0.0182%
33771	0	0.0000%	921,578	0.0267%	0	0.0000%	2,541,830	0.0394%	3,463,408	0.0182%
33609	0	0.0000%	1,218,719	0.0353%	0	0.0000%	2,230,922	0.0346%	3,449,640	0.0181%
34436	0	0.0000%	1,091,367	0.0316%	0	0.0000%	2,357,450	0.0365%	3,448,817	0.0181%
32259	0	0.0000%	1,702,321	0.0493%	0	0.0000%	1,743,639	0.0270%	3,445,961	0.0181%
34737	0	0.0000%	785,374	0.0227%	0	0.0000%	2,643,040	0.0410%	3,428,415	0.0180%
33709	0	0.0000%	837,575	0.0242%	0	0.0000%	2,576,126	0.0399%	3,413,701	0.0179%
33160	0	0.0000%	2,424,043	0.0701%	0	0.0000%	965,620	0.0150%	3,389,663	0.0178%
34607	0	0.0000%	1,104,321	0.0320%	0	0.0000%	2,220,795	0.0344%	3,325,116	0.0174%
34734	612,842	0.0079%	759,216	0.0220%	0	0.0000%	1,943,652	0.0301%	3,315,710	0.0174%
34654	0	0.0000%	1,190,600	0.0345%	0	0.0000%	2,111,353	0.0327%	3,301,953	0.0173%
34691	0	0.0000%	1,132,209	0.0328%	0	0.0000%	2,149,430	0.0333%	3,281,639	0.0172%
34114	2,694,699	0.0347%	546,186	0.0158%	0	0.0000%	0	0.0000%	3,240,885	0.0170%
32656	0	0.0000%	1,202,502	0.0348%	0	0.0000%	2,032,417	0.0315%	3,234,919	0.0170%
32401	0	0.0000%	0	0.0000%	3,213,477	0.2381%	0	0.0000%	3,213,477	0.0169%
34677	0	0.0000%	1,175,857	0.0340%	0	0.0000%	2,020,461	0.0313%	3,196,318	0.0168%
33604	0	0.0000%	1,139,534	0.0330%	0	0.0000%	2,038,807	0.0316%	3,178,341	0.0167%
32696	0	0.0000%	1,595,902	0.0462%	0	0.0000%	1,578,881	0.0245%	3,174,783	0.0166%
34203	0	0.0000%	1,298,961	0.0376%	0	0.0000%	1,826,899	0.0283%	3,125,861	0.0164%
33761	0	0.0000%	1,124,707	0.0325%	0	0.0000%	1,981,379	0.0307%	3,106,086	0.0163%
33782	0	0.0000%	908,136	0.0263%	0	0.0000%	2,182,824	0.0338%	3,090,961	0.0162%
32224	0	0.0000%	1,696,411	0.0491%	0	0.0000%	1,365,058	0.0211%	3,061,469	0.0161%
34434	0	0.0000%	1,241,742	0.0359%	0	0.0000%	1,794,212	0.0278%	3,035,954	0.0159%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33578	0	0.0000%	949,707	0.0275%	0	0.0000%	2,082,839	0.0323%	3,032,546	0.0159%
33330	0	0.0000%	2,132,441	0.0617%	0	0.0000%	896,926	0.0139%	3,029,366	0.0159%
32816	2,492,186	0.0321%	0	0.0000%	0	0.0000%	0	0.0000%	2,997,753	0.0157%
33549	0	0.0000%	1,011,323	0.0293%	0	0.0000%	1,986,076	0.0308%	2,997,398	0.0157%
33066	0	0.0000%	2,059,898	0.0596%	0	0.0000%	930,034	0.0144%	2,989,932	0.0157%
34685	0	0.0000%	1,126,002	0.0326%	0	0.0000%	1,846,608	0.0286%	2,972,610	0.0156%
32444	0	0.0000%	0	0.0000%	2,959,987	0.2193%	0	0.0000%	2,959,987	0.0155%
34292	1,169,344	0.0151%	956,033	0.0277%	0	0.0000%	829,366	0.0128%	2,954,743	0.0155%
33612	0	0.0000%	1,058,541	0.0306%	0	0.0000%	1,884,425	0.0292%	2,942,966	0.0154%
32277	0	0.0000%	1,435,155	0.0415%	0	0.0000%	1,499,995	0.0232%	2,935,150	0.0154%
33613	0	0.0000%	1,033,760	0.0299%	0	0.0000%	1,898,440	0.0294%	2,932,200	0.0154%
33558	0	0.0000%	979,790	0.0284%	0	0.0000%	1,932,998	0.0299%	2,912,788	0.0153%
34205	0	0.0000%	1,252,101	0.0362%	0	0.0000%	1,632,409	0.0253%	2,884,510	0.0151%
33025	0	0.0000%	1,982,752	0.0574%	0	0.0000%	887,734	0.0138%	2,870,487	0.0151%
33619	0	0.0000%	898,567	0.0260%	0	0.0000%	1,939,387	0.0300%	2,837,954	0.0149%
32195	0	0.0000%	971,614	0.0281%	0	0.0000%	1,846,215	0.0286%	2,817,829	0.0148%
33316	0	0.0000%	1,954,414	0.0566%	0	0.0000%	859,468	0.0133%	2,813,882	0.0148%
32065	0	0.0000%	1,255,062	0.0363%	0	0.0000%	1,555,326	0.0241%	2,810,388	0.0147%
33009	0	0.0000%	1,972,463	0.0571%	0	0.0000%	837,195	0.0130%	2,809,658	0.0147%
32640	0	0.0000%	1,161,884	0.0336%	0	0.0000%	1,642,158	0.0254%	2,804,042	0.0147%
33139	0	0.0000%	2,133,860	0.0618%	0	0.0000%	668,567	0.0104%	2,802,427	0.0147%
33327	0	0.0000%	1,964,549	0.0569%	0	0.0000%	817,432	0.0127%	2,781,981	0.0146%
33610	0	0.0000%	924,434	0.0268%	0	0.0000%	1,836,105	0.0284%	2,760,539	0.0145%
33614	0	0.0000%	994,934	0.0288%	0	0.0000%	1,757,940	0.0272%	2,752,874	0.0144%
33781	0	0.0000%	737,833	0.0214%	0	0.0000%	2,011,366	0.0312%	2,749,199	0.0144%
33920	1,536,370	0.0198%	0	0.0000%	0	0.0000%	729,203	0.0113%	2,737,602	0.0144%
32246	0	0.0000%	1,447,518	0.0419%	0	0.0000%	1,289,748	0.0200%	2,737,266	0.0144%
32043	0	0.0000%	1,346,835	0.0390%	0	0.0000%	1,375,051	0.0213%	2,721,886	0.0143%
32709	1,185,920	0.0153%	670,800	0.0194%	0	0.0000%	861,764	0.0134%	2,718,483	0.0143%
32134	0	0.0000%	1,347,106	0.0390%	0	0.0000%	1,364,491	0.0211%	2,711,597	0.0142%
33815	0	0.0000%	723,978	0.0210%	0	0.0000%	1,975,395	0.0306%	2,699,373	0.0142%
34238	0	0.0000%	1,243,822	0.0360%	0	0.0000%	1,448,305	0.0224%	2,692,127	0.0141%
33773	0	0.0000%	762,548	0.0221%	0	0.0000%	1,919,671	0.0297%	2,682,219	0.0141%
33544	0	0.0000%	837,984	0.0243%	0	0.0000%	1,843,026	0.0286%	2,681,010	0.0141%
34433	0	0.0000%	1,145,727	0.0332%	0	0.0000%	1,532,730	0.0237%	2,678,457	0.0140%
33156	0	0.0000%	2,669,808	0.0773%	0	0.0000%	0	0.0000%	2,669,808	0.0140%
33538	0	0.0000%	769,202	0.0223%	0	0.0000%	1,898,686	0.0294%	2,667,889	0.0140%
34241	0	0.0000%	1,183,068	0.0342%	0	0.0000%	1,478,420	0.0229%	2,661,488	0.0140%
34610	0	0.0000%	827,048	0.0239%	0	0.0000%	1,826,827	0.0283%	2,653,875	0.0139%
33712	0	0.0000%	735,915	0.0213%	0	0.0000%	1,917,655	0.0297%	2,653,571	0.0139%
34239	0	0.0000%	1,187,001	0.0344%	0	0.0000%	1,466,410	0.0227%	2,653,411	0.0139%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32653	0	0.0000%	1,187,389	0.0344%	0	0.0000%	1,443,068	0.0224%	2,630,457	0.0138%
34219	0	0.0000%	979,507	0.0283%	0	0.0000%	1,650,834	0.0256%	2,630,340	0.0138%
33711	0	0.0000%	670,567	0.0194%	0	0.0000%	1,948,914	0.0302%	2,619,481	0.0137%
33069	0	0.0000%	1,804,776	0.0522%	0	0.0000%	808,423	0.0125%	2,613,199	0.0137%
33301	0	0.0000%	1,763,166	0.0510%	0	0.0000%	836,384	0.0130%	2,599,550	0.0136%
32580	0	0.0000%	0	0.0000%	2,596,720	0.1924%	0	0.0000%	2,596,720	0.0136%
33149	0	0.0000%	1,985,278	0.0575%	0	0.0000%	567,066	0.0088%	2,552,343	0.0134%
33778	0	0.0000%	687,084	0.0199%	0	0.0000%	1,848,906	0.0286%	2,535,991	0.0133%
34207	0	0.0000%	1,047,595	0.0303%	0	0.0000%	1,478,954	0.0229%	2,526,549	0.0132%
34236	0	0.0000%	1,074,192	0.0311%	0	0.0000%	1,442,757	0.0224%	2,516,949	0.0132%
34208	0	0.0000%	1,049,169	0.0304%	0	0.0000%	1,428,210	0.0221%	2,477,379	0.0130%
34202	0	0.0000%	1,049,937	0.0304%	0	0.0000%	1,408,790	0.0218%	2,458,727	0.0129%
33141	0	0.0000%	1,821,056	0.0527%	0	0.0000%	623,331	0.0097%	2,444,387	0.0128%
33625	0	0.0000%	880,847	0.0255%	0	0.0000%	1,563,517	0.0242%	2,444,364	0.0128%
33785	0	0.0000%	578,167	0.0167%	0	0.0000%	1,859,005	0.0288%	2,437,171	0.0128%
32407	0	0.0000%	0	0.0000%	2,413,739	0.1789%	0	0.0000%	2,413,739	0.0127%
34475	0	0.0000%	1,115,153	0.0323%	0	0.0000%	1,291,798	0.0200%	2,406,951	0.0126%
33019	0	0.0000%	1,662,329	0.0481%	0	0.0000%	722,774	0.0112%	2,385,104	0.0125%
33180	0	0.0000%	1,659,468	0.0480%	0	0.0000%	711,770	0.0110%	2,371,238	0.0124%
32433	0	0.0000%	0	0.0000%	2,360,955	0.1750%	0	0.0000%	2,360,955	0.0124%
32217	0	0.0000%	1,078,444	0.0312%	0	0.0000%	1,279,134	0.0198%	2,357,579	0.0124%
34117	1,889,131	0.0243%	0	0.0000%	0	0.0000%	0	0.0000%	2,353,706	0.0123%
32216	0	0.0000%	1,130,730	0.0327%	0	0.0000%	1,219,860	0.0189%	2,350,589	0.0123%
34705	0	0.0000%	612,537	0.0177%	0	0.0000%	1,735,393	0.0269%	2,347,931	0.0123%
33304	0	0.0000%	1,610,225	0.0466%	0	0.0000%	735,393	0.0114%	2,345,618	0.0123%
33527	0	0.0000%	687,680	0.0199%	0	0.0000%	1,657,608	0.0257%	2,345,288	0.0123%
32211	0	0.0000%	1,130,797	0.0327%	0	0.0000%	1,200,721	0.0186%	2,331,518	0.0122%
34797	0	0.0000%	524,698	0.0152%	0	0.0000%	1,802,356	0.0279%	2,327,054	0.0122%
33154	0	0.0000%	1,708,916	0.0495%	0	0.0000%	606,785	0.0094%	2,315,701	0.0121%
34602	0	0.0000%	710,722	0.0206%	0	0.0000%	1,603,071	0.0248%	2,313,794	0.0121%
33305	0	0.0000%	1,557,701	0.0451%	0	0.0000%	737,423	0.0114%	2,295,124	0.0120%
33186	0	0.0000%	2,259,831	0.0654%	0	0.0000%	0	0.0000%	2,259,831	0.0119%
34229	0	0.0000%	868,122	0.0251%	0	0.0000%	917,950	0.0142%	2,244,574	0.0118%
32615	0	0.0000%	1,005,732	0.0291%	0	0.0000%	1,238,779	0.0192%	2,244,512	0.0118%
33626	0	0.0000%	843,238	0.0244%	0	0.0000%	1,398,692	0.0217%	2,241,930	0.0118%
34669	0	0.0000%	721,397	0.0209%	0	0.0000%	1,468,399	0.0228%	2,189,796	0.0115%
33020	0	0.0000%	1,481,071	0.0429%	0	0.0000%	703,327	0.0109%	2,184,399	0.0115%
32744	853,743	0.0110%	843,416	0.0244%	0	0.0000%	0	0.0000%	2,177,494	0.0114%
34240	0	0.0000%	943,951	0.0273%	0	0.0000%	1,230,585	0.0191%	2,174,536	0.0114%
32256	0	0.0000%	1,137,465	0.0329%	0	0.0000%	1,033,856	0.0160%	2,171,321	0.0114%
33759	0	0.0000%	752,713	0.0218%	0	0.0000%	1,389,282	0.0215%	2,141,995	0.0112%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34210	0	0.0000%	881,165	0.0255%	0	0.0000%	1,231,787	0.0191%	2,112,951	0.0111%
33634	0	0.0000%	752,476	0.0218%	0	0.0000%	1,359,883	0.0211%	2,112,359	0.0111%
32092	0	0.0000%	1,168,148	0.0338%	0	0.0000%	935,471	0.0145%	2,103,620	0.0110%
33597	0	0.0000%	614,566	0.0178%	0	0.0000%	1,484,793	0.0230%	2,099,359	0.0110%
33157	0	0.0000%	2,093,119	0.0606%	0	0.0000%	0	0.0000%	2,093,119	0.0110%
33176	0	0.0000%	2,091,579	0.0605%	0	0.0000%	0	0.0000%	2,091,579	0.0110%
33579	0	0.0000%	661,900	0.0192%	0	0.0000%	1,419,847	0.0220%	2,081,748	0.0109%
32456	0	0.0000%	0	0.0000%	2,052,348	0.1521%	0	0.0000%	2,052,348	0.0108%
33015	0	0.0000%	2,043,245	0.0591%	0	0.0000%	0	0.0000%	2,043,245	0.0107%
32669	0	0.0000%	1,033,540	0.0299%	0	0.0000%	1,008,367	0.0156%	2,041,906	0.0107%
33473	0	0.0000%	1,082,464	0.0313%	0	0.0000%	959,170	0.0149%	2,041,634	0.0107%
33332	0	0.0000%	1,460,129	0.0423%	0	0.0000%	579,148	0.0090%	2,039,277	0.0107%
34638	0	0.0000%	672,675	0.0195%	0	0.0000%	1,339,332	0.0208%	2,012,007	0.0106%
32668	0	0.0000%	998,033	0.0289%	0	0.0000%	996,884	0.0154%	1,994,917	0.0105%
33567	0	0.0000%	542,471	0.0157%	0	0.0000%	1,441,231	0.0223%	1,983,701	0.0104%
33603	0	0.0000%	713,089	0.0206%	0	0.0000%	1,266,204	0.0196%	1,979,293	0.0104%
32024	0	0.0000%	855,549	0.0248%	0	0.0000%	1,110,084	0.0172%	1,965,633	0.0103%
33877	1,392,021	0.0179%	0	0.0000%	0	0.0000%	0	0.0000%	1,963,987	0.0103%
32686	0	0.0000%	903,486	0.0261%	0	0.0000%	1,047,260	0.0162%	1,950,746	0.0102%
33976	1,484,905	0.0191%	0	0.0000%	0	0.0000%	0	0.0000%	1,946,497	0.0102%
34233	0	0.0000%	851,987	0.0247%	0	0.0000%	1,080,668	0.0167%	1,932,655	0.0101%
32666	0	0.0000%	760,043	0.0220%	0	0.0000%	1,169,673	0.0181%	1,929,716	0.0101%
32112	0	0.0000%	1,176,153	0.0340%	0	0.0000%	740,322	0.0115%	1,916,476	0.0100%
32601	0	0.0000%	779,748	0.0226%	0	0.0000%	1,136,278	0.0176%	1,916,025	0.0100%
34690	0	0.0000%	716,362	0.0207%	0	0.0000%	1,187,440	0.0184%	1,903,801	0.0100%
33763	0	0.0000%	613,969	0.0178%	0	0.0000%	1,289,465	0.0200%	1,903,434	0.0100%
33616	0	0.0000%	534,219	0.0155%	0	0.0000%	1,368,070	0.0212%	1,902,289	0.0100%
34235	0	0.0000%	793,353	0.0230%	0	0.0000%	1,094,250	0.0170%	1,887,604	0.0099%
32759	675,970	0.0087%	869,018	0.0251%	0	0.0000%	0	0.0000%	1,869,272	0.0098%
32113	0	0.0000%	842,315	0.0244%	0	0.0000%	1,017,620	0.0158%	1,859,935	0.0098%
33559	0	0.0000%	608,523	0.0176%	0	0.0000%	1,249,769	0.0194%	1,858,292	0.0097%
34484	0	0.0000%	572,005	0.0166%	0	0.0000%	1,272,909	0.0197%	1,844,914	0.0097%
32091	0	0.0000%	671,955	0.0194%	0	0.0000%	1,167,412	0.0181%	1,839,367	0.0096%
32439	0	0.0000%	0	0.0000%	1,821,783	0.1350%	0	0.0000%	1,821,783	0.0096%
32148	0	0.0000%	821,051	0.0238%	0	0.0000%	998,151	0.0155%	1,819,202	0.0095%
33762	0	0.0000%	592,249	0.0171%	0	0.0000%	1,226,743	0.0190%	1,818,992	0.0095%
32221	0	0.0000%	693,790	0.0201%	0	0.0000%	1,115,066	0.0173%	1,808,856	0.0095%
32266	0	0.0000%	1,020,693	0.0295%	0	0.0000%	776,557	0.0120%	1,797,251	0.0094%
33545	0	0.0000%	537,500	0.0156%	0	0.0000%	1,244,706	0.0193%	1,782,206	0.0093%
33949	1,774,673	0.0229%	0	0.0000%	0	0.0000%	0	0.0000%	1,780,639	0.0093%
32609	0	0.0000%	745,197	0.0216%	0	0.0000%	1,031,561	0.0160%	1,776,758	0.0093%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33028	0	0.0000%	1,226,361	0.0355%	0	0.0000%	536,202	0.0083%	1,762,563	0.0092%
33175	0	0.0000%	1,758,874	0.0509%	0	0.0000%	0	0.0000%	1,758,874	0.0092%
32025	0	0.0000%	658,730	0.0191%	0	0.0000%	1,088,881	0.0169%	1,747,611	0.0092%
34234	0	0.0000%	722,489	0.0209%	0	0.0000%	1,008,821	0.0156%	1,731,310	0.0091%
33786	0	0.0000%	0	0.0000%	0	0.0000%	1,369,367	0.0212%	1,729,960	0.0091%
33548	0	0.0000%	553,902	0.0160%	0	0.0000%	1,147,853	0.0178%	1,701,755	0.0089%
33974	1,159,040	0.0149%	0	0.0000%	0	0.0000%	0	0.0000%	1,699,300	0.0089%
32130	0	0.0000%	1,042,630	0.0302%	0	0.0000%	639,412	0.0099%	1,682,043	0.0088%
34604	0	0.0000%	523,343	0.0151%	0	0.0000%	1,156,021	0.0179%	1,679,364	0.0088%
33607	0	0.0000%	596,077	0.0172%	0	0.0000%	1,082,281	0.0168%	1,678,358	0.0088%
34212	0	0.0000%	698,226	0.0202%	0	0.0000%	977,594	0.0151%	1,675,820	0.0088%
34688	0	0.0000%	638,441	0.0185%	0	0.0000%	1,029,737	0.0160%	1,668,178	0.0087%
32618	0	0.0000%	817,969	0.0237%	0	0.0000%	849,496	0.0132%	1,667,464	0.0087%
32258	0	0.0000%	864,959	0.0250%	0	0.0000%	802,292	0.0124%	1,667,251	0.0087%
32226	0	0.0000%	831,489	0.0241%	0	0.0000%	818,761	0.0127%	1,650,251	0.0087%
33165	0	0.0000%	1,646,043	0.0476%	0	0.0000%	0	0.0000%	1,646,043	0.0086%
33714	0	0.0000%	0	0.0000%	0	0.0000%	1,206,192	0.0187%	1,645,647	0.0086%
33143	0	0.0000%	1,638,179	0.0474%	0	0.0000%	0	0.0000%	1,638,179	0.0086%
32060	0	0.0000%	0	0.0000%	0	0.0000%	1,118,883	0.0173%	1,607,040	0.0084%
33133	0	0.0000%	1,604,832	0.0464%	0	0.0000%	0	0.0000%	1,604,832	0.0084%
32617	0	0.0000%	741,411	0.0215%	0	0.0000%	857,319	0.0133%	1,598,730	0.0084%
34222	0	0.0000%	621,243	0.0180%	0	0.0000%	940,170	0.0146%	1,561,413	0.0082%
33179	0	0.0000%	1,560,581	0.0452%	0	0.0000%	0	0.0000%	1,560,581	0.0082%
33598	0	0.0000%	0	0.0000%	0	0.0000%	1,123,831	0.0174%	1,555,274	0.0082%
33765	0	0.0000%	0	0.0000%	0	0.0000%	1,036,449	0.0161%	1,515,792	0.0079%
33134	0	0.0000%	1,512,187	0.0438%	0	0.0000%	0	0.0000%	1,512,187	0.0079%
33314	0	0.0000%	1,043,657	0.0302%	0	0.0000%	0	0.0000%	1,498,116	0.0079%
32218	0	0.0000%	0	0.0000%	0	0.0000%	1,496,488	0.0232%	1,496,488	0.0078%
33315	0	0.0000%	1,028,396	0.0298%	0	0.0000%	0	0.0000%	1,492,237	0.0078%
33635	0	0.0000%	540,683	0.0156%	0	0.0000%	934,248	0.0145%	1,474,931	0.0077%
33854	542,779	0.0070%	0	0.0000%	0	0.0000%	825,574	0.0128%	1,470,649	0.0077%
33018	0	0.0000%	1,468,186	0.0425%	0	0.0000%	0	0.0000%	1,468,186	0.0077%
33701	0	0.0000%	0	0.0000%	0	0.0000%	1,024,529	0.0159%	1,467,671	0.0077%
32702	0	0.0000%	722,278	0.0209%	0	0.0000%	703,972	0.0109%	1,426,251	0.0075%
33760	0	0.0000%	0	0.0000%	0	0.0000%	946,850	0.0147%	1,417,295	0.0074%
32641	0	0.0000%	555,127	0.0161%	0	0.0000%	861,232	0.0133%	1,416,359	0.0074%
32643	0	0.0000%	683,952	0.0198%	0	0.0000%	722,764	0.0112%	1,406,716	0.0074%
33592	0	0.0000%	0	0.0000%	0	0.0000%	974,405	0.0151%	1,403,096	0.0074%
32428	0	0.0000%	0	0.0000%	1,398,399	0.1036%	0	0.0000%	1,398,399	0.0073%
33155	0	0.0000%	1,391,351	0.0403%	0	0.0000%	0	0.0000%	1,391,351	0.0073%
33960	0	0.0000%	0	0.0000%	0	0.0000%	1,043,617	0.0162%	1,375,967	0.0072%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
33055	0	0.0000%	1,369,631	0.0396%	0	0.0000%	0	0.0000%	1,369,631	0.0072%
32531	0	0.0000%	0	0.0000%	1,361,123	0.1009%	0	0.0000%	1,361,123	0.0071%
33012	0	0.0000%	1,357,068	0.0393%	0	0.0000%	0	0.0000%	1,357,068	0.0071%
32667	0	0.0000%	592,886	0.0172%	0	0.0000%	757,804	0.0117%	1,350,690	0.0071%
33161	0	0.0000%	1,345,901	0.0389%	0	0.0000%	0	0.0000%	1,345,901	0.0071%
32102	0	0.0000%	806,897	0.0234%	0	0.0000%	530,057	0.0082%	1,336,953	0.0070%
33014	0	0.0000%	1,317,732	0.0381%	0	0.0000%	0	0.0000%	1,317,732	0.0069%
32209	0	0.0000%	500,683	0.0145%	0	0.0000%	814,203	0.0126%	1,314,886	0.0069%
33820	948,490	0.0122%	0	0.0000%	0	0.0000%	0	0.0000%	1,312,468	0.0069%
34614	0	0.0000%	0	0.0000%	0	0.0000%	904,053	0.0140%	1,310,097	0.0069%
33162	0	0.0000%	1,289,169	0.0373%	0	0.0000%	0	0.0000%	1,289,169	0.0068%
32693	0	0.0000%	683,760	0.0198%	0	0.0000%	603,163	0.0093%	1,286,924	0.0067%
32189	0	0.0000%	772,426	0.0224%	0	0.0000%	503,146	0.0078%	1,275,572	0.0067%
33637	0	0.0000%	0	0.0000%	0	0.0000%	853,312	0.0132%	1,275,259	0.0067%
33493	0	0.0000%	0	0.0000%	0	0.0000%	861,309	0.0133%	1,271,889	0.0067%
33004	0	0.0000%	876,178	0.0254%	0	0.0000%	0	0.0000%	1,263,900	0.0066%
33138	0	0.0000%	1,252,966	0.0363%	0	0.0000%	0	0.0000%	1,252,966	0.0066%
33037	0	0.0000%	1,245,353	0.0360%	0	0.0000%	0	0.0000%	1,245,353	0.0065%
32208	0	0.0000%	0	0.0000%	0	0.0000%	1,196,691	0.0185%	1,196,691	0.0063%
33605	0	0.0000%	0	0.0000%	0	0.0000%	774,748	0.0120%	1,173,159	0.0062%
32055	0	0.0000%	0	0.0000%	0	0.0000%	820,878	0.0127%	1,168,753	0.0061%
33602	0	0.0000%	0	0.0000%	0	0.0000%	750,497	0.0116%	1,165,761	0.0061%
33973	907,032	0.0117%	0	0.0000%	0	0.0000%	0	0.0000%	1,153,918	0.0061%
34289	1,061,359	0.0137%	0	0.0000%	0	0.0000%	0	0.0000%	1,148,708	0.0060%
33196	0	0.0000%	1,134,563	0.0328%	0	0.0000%	0	0.0000%	1,134,563	0.0059%
33169	0	0.0000%	1,134,182	0.0328%	0	0.0000%	0	0.0000%	1,134,182	0.0059%
32626	0	0.0000%	627,926	0.0182%	0	0.0000%	0	0.0000%	1,126,215	0.0059%
33178	0	0.0000%	1,123,731	0.0325%	0	0.0000%	0	0.0000%	1,123,731	0.0059%
33438	0	0.0000%	0	0.0000%	0	0.0000%	680,136	0.0105%	1,113,897	0.0058%
34753	0	0.0000%	0	0.0000%	0	0.0000%	806,754	0.0125%	1,112,192	0.0058%
33534	0	0.0000%	0	0.0000%	0	0.0000%	780,622	0.0121%	1,112,121	0.0058%
32767	0	0.0000%	611,207	0.0177%	0	0.0000%	0	0.0000%	1,102,894	0.0058%
34237	0	0.0000%	0	0.0000%	0	0.0000%	626,732	0.0097%	1,092,518	0.0057%
33177	0	0.0000%	1,091,707	0.0316%	0	0.0000%	0	0.0000%	1,091,707	0.0057%
33056	0	0.0000%	1,083,862	0.0314%	0	0.0000%	0	0.0000%	1,083,862	0.0057%
32328	0	0.0000%	0	0.0000%	1,070,284	0.0793%	0	0.0000%	1,070,284	0.0056%
33173	0	0.0000%	1,068,663	0.0309%	0	0.0000%	0	0.0000%	1,068,663	0.0056%
32435	0	0.0000%	0	0.0000%	1,064,271	0.0789%	0	0.0000%	1,064,271	0.0056%
32038	0	0.0000%	507,270	0.0147%	0	0.0000%	549,420	0.0085%	1,056,690	0.0055%
34760	0	0.0000%	0	0.0000%	0	0.0000%	785,944	0.0122%	1,055,188	0.0055%
32124	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	1,048,046	0.0055%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
34251	0	0.0000%	0	0.0000%	0	0.0000%	694,470	0.0108%	1,042,625	0.0055%
34216	0	0.0000%	0	0.0000%	0	0.0000%	651,116	0.0101%	1,031,811	0.0054%
32409	0	0.0000%	0	0.0000%	1,017,611	0.0754%	0	0.0000%	1,017,611	0.0053%
32206	0	0.0000%	0	0.0000%	0	0.0000%	557,850	0.0086%	1,016,525	0.0053%
32063	0	0.0000%	0	0.0000%	0	0.0000%	707,598	0.0110%	1,005,756	0.0053%
34142	503,910	0.0065%	0	0.0000%	0	0.0000%	0	0.0000%	1,002,207	0.0053%
33016	0	0.0000%	995,379	0.0288%	0	0.0000%	0	0.0000%	995,379	0.0052%
32621	0	0.0000%	512,765	0.0148%	0	0.0000%	0	0.0000%	978,536	0.0051%
33193	0	0.0000%	974,268	0.0282%	0	0.0000%	0	0.0000%	974,268	0.0051%
32110	0	0.0000%	593,866	0.0172%	0	0.0000%	0	0.0000%	946,740	0.0050%
32131	0	0.0000%	560,794	0.0162%	0	0.0000%	0	0.0000%	942,643	0.0049%
33183	0	0.0000%	935,334	0.0271%	0	0.0000%	0	0.0000%	935,334	0.0049%
34268	877,994	0.0113%	0	0.0000%	0	0.0000%	0	0.0000%	920,169	0.0048%
33576	0	0.0000%	0	0.0000%	0	0.0000%	639,390	0.0099%	899,174	0.0047%
34449	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	886,856	0.0047%
33146	0	0.0000%	850,369	0.0246%	0	0.0000%	0	0.0000%	850,369	0.0045%
32054	0	0.0000%	0	0.0000%	0	0.0000%	514,816	0.0080%	843,947	0.0044%
32180	0	0.0000%	512,520	0.0148%	0	0.0000%	0	0.0000%	811,695	0.0043%
33306	0	0.0000%	547,927	0.0159%	0	0.0000%	0	0.0000%	805,385	0.0042%
32181	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	801,052	0.0042%
33145	0	0.0000%	779,912	0.0226%	0	0.0000%	0	0.0000%	779,912	0.0041%
34291	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	773,141	0.0041%
33181	0	0.0000%	759,085	0.0220%	0	0.0000%	0	0.0000%	759,085	0.0040%
32906	0	0.0000%	0	0.0000%	0	0.0000%	639,289	0.0099%	751,038	0.0039%
33847	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	745,109	0.0039%
33185	0	0.0000%	741,031	0.0214%	0	0.0000%	0	0.0000%	741,031	0.0039%
33147	0	0.0000%	738,537	0.0214%	0	0.0000%	0	0.0000%	738,537	0.0039%
32680	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	737,338	0.0039%
32095	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	736,355	0.0039%
33013	0	0.0000%	729,528	0.0211%	0	0.0000%	0	0.0000%	729,528	0.0038%
33848	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	717,578	0.0038%
32139	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	716,803	0.0038%
33585	0	0.0000%	0	0.0000%	0	0.0000%	515,590	0.0080%	711,397	0.0037%
33168	0	0.0000%	699,273	0.0202%	0	0.0000%	0	0.0000%	699,273	0.0037%
33867	0	0.0000%	0	0.0000%	0	0.0000%	521,265	0.0081%	695,419	0.0036%
32425	0	0.0000%	0	0.0000%	683,988	0.0507%	0	0.0000%	683,988	0.0036%
32564	0	0.0000%	0	0.0000%	680,005	0.0504%	0	0.0000%	680,005	0.0036%
33166	0	0.0000%	676,161	0.0196%	0	0.0000%	0	0.0000%	676,161	0.0035%
32625	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	676,066	0.0035%
33125	0	0.0000%	662,314	0.0192%	0	0.0000%	0	0.0000%	662,314	0.0035%
34762	0	0.0000%	0	0.0000%	0	0.0000%	504,878	0.0078%	656,277	0.0034%

	Hurricane Charley		Hurricane Frances		Hurricane Ivan		Hurricane Jeanne		Total	
ZIP Code	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)	Personal & Commercial Residential Monetary Contribution ($)	Percent of Losses (%)
32204	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	653,535	0.0034%
32446	0	0.0000%	0	0.0000%	644,092	0.0477%	0	0.0000%	644,092	0.0034%
33129	0	0.0000%	641,153	0.0186%	0	0.0000%	0	0.0000%	641,153	0.0034%
33184	0	0.0000%	637,202	0.0184%	0	0.0000%	0	0.0000%	637,202	0.0033%
32033	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	631,557	0.0033%
33174	0	0.0000%	631,459	0.0183%	0	0.0000%	0	0.0000%	631,459	0.0033%
33010	0	0.0000%	631,414	0.0183%	0	0.0000%	0	0.0000%	631,414	0.0033%
34201	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	628,373	0.0033%
33142	0	0.0000%	626,770	0.0181%	0	0.0000%	0	0.0000%	626,770	0.0033%
33514	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	621,671	0.0033%
32040	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	620,213	0.0033%
33468	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	609,557	0.0032%
33144	0	0.0000%	605,358	0.0175%	0	0.0000%	0	0.0000%	605,358	0.0032%
33033	0	0.0000%	595,012	0.0172%	0	0.0000%	0	0.0000%	595,012	0.0031%
33109	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	592,709	0.0031%
32008	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	590,055	0.0031%
33865	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	580,526	0.0030%
33126	0	0.0000%	575,056	0.0166%	0	0.0000%	0	0.0000%	575,056	0.0030%
32567	0	0.0000%	0	0.0000%	569,708	0.0422%	0	0.0000%	569,708	0.0030%
34637	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	565,429	0.0030%
33054	0	0.0000%	564,088	0.0163%	0	0.0000%	0	0.0000%	564,088	0.0030%
33158	0	0.0000%	557,788	0.0161%	0	0.0000%	0	0.0000%	557,788	0.0029%
33032	0	0.0000%	552,882	0.0160%	0	0.0000%	0	0.0000%	552,882	0.0029%
32222	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	549,121	0.0029%
33187	0	0.0000%	540,234	0.0156%	0	0.0000%	0	0.0000%	540,234	0.0028%
33189	0	0.0000%	540,127	0.0156%	0	0.0000%	0	0.0000%	540,127	0.0028%
33137	0	0.0000%	537,450	0.0156%	0	0.0000%	0	0.0000%	537,450	0.0028%
34211	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	531,586	0.0028%
32145	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	528,821	0.0028%
32619	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	528,167	0.0028%
34265	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	524,111	0.0027%
32220	0	0.0000%	0	0.0000%	0	0.0000%	517,440	0.0080%	517,440	0.0027%
32957	0	0.0000%	0	0.0000%	0	0.0000%	0	0.0000%	500,490	0.0026%

Figure 78: Percentage of Residential Losses from Hurricane Charley (2004) by ZIP Code

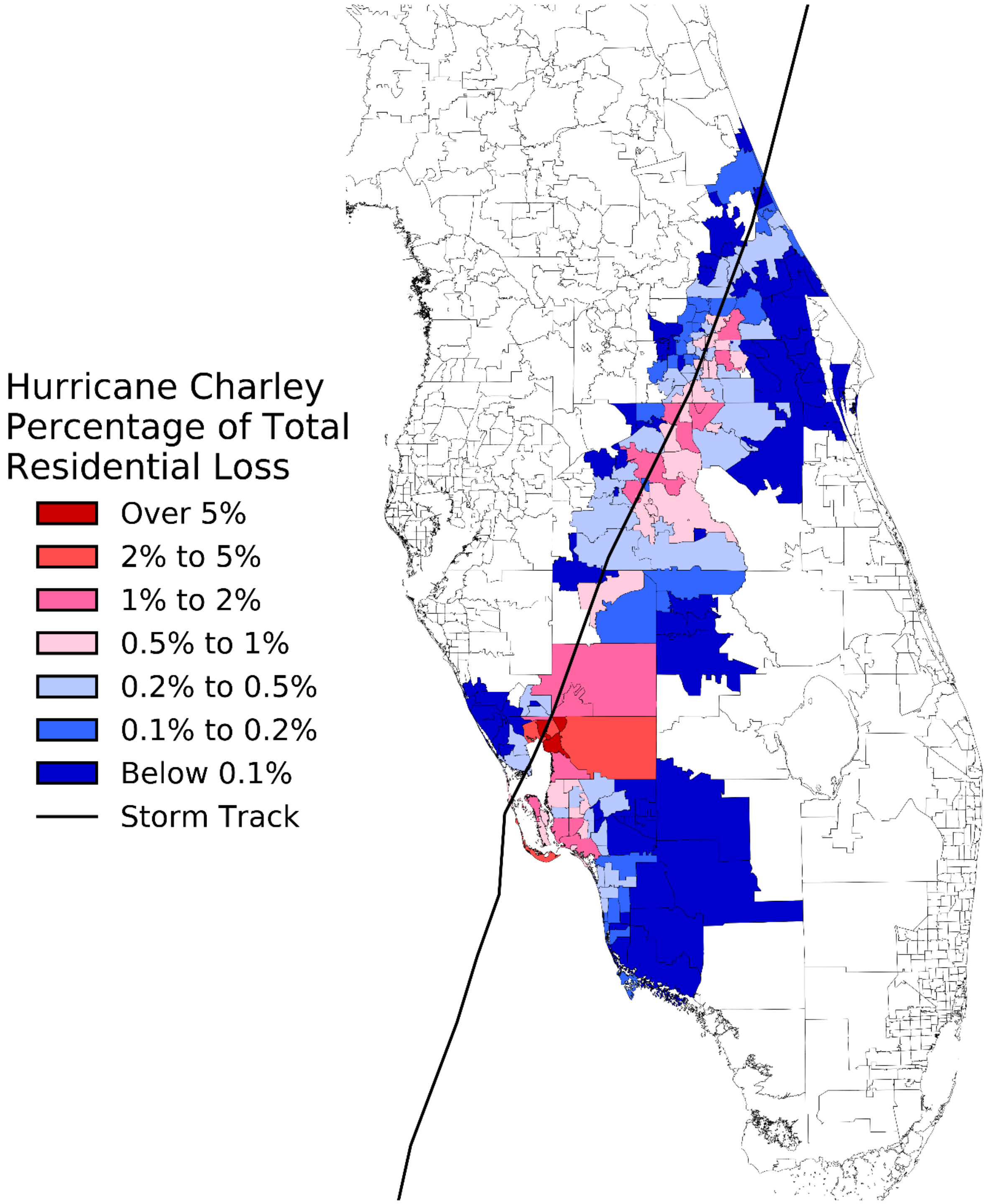


Figure 79: Percentage of Residential Losses from Hurricane Frances (2004) by ZIP Code

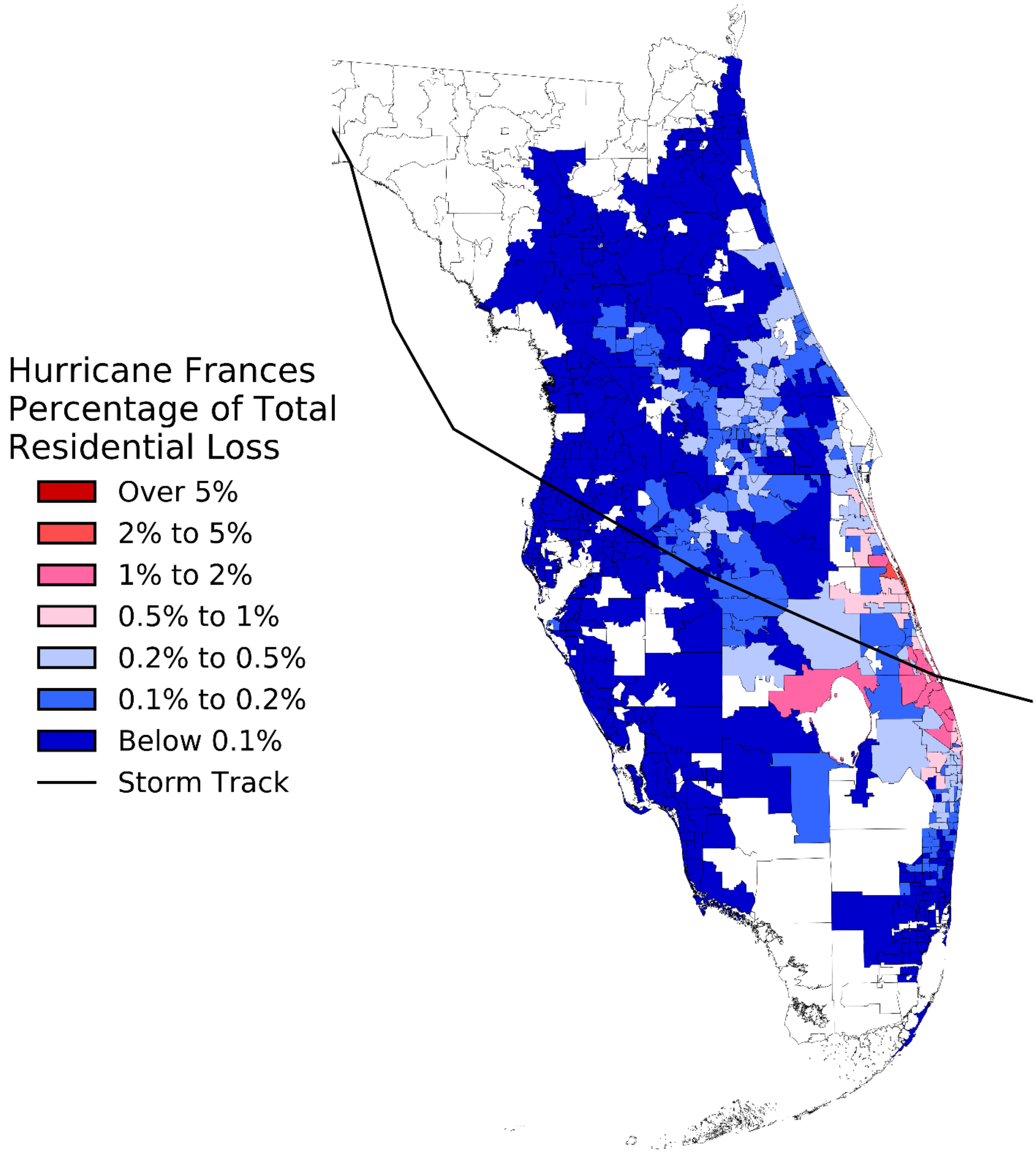


Figure 80: Percentage of Residential Losses from Hurricane Ivan (2004) by ZIP Code

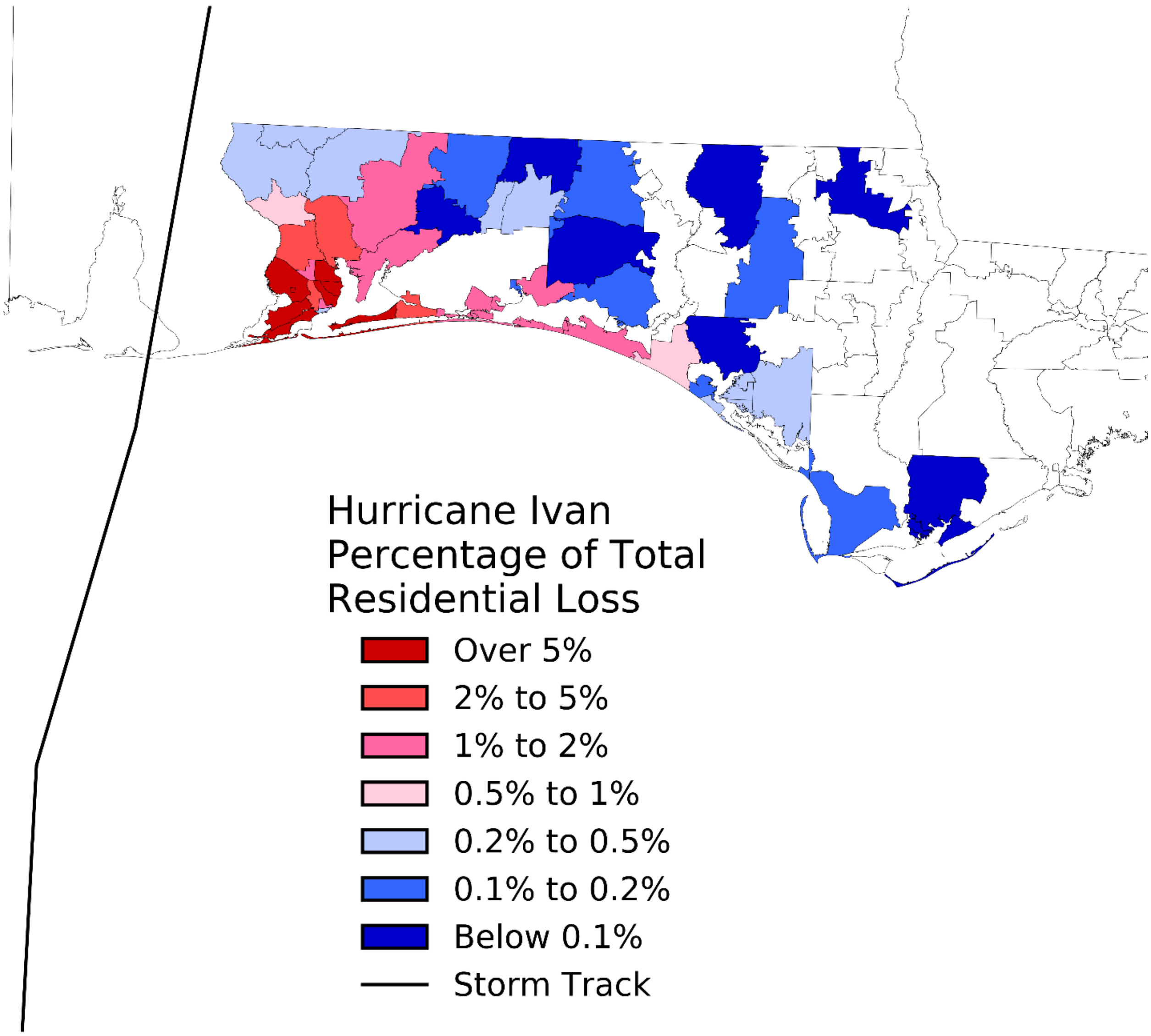


Figure 81: Percentage of Residential Losses from Hurricane Jeanne (2004) by ZIP Code

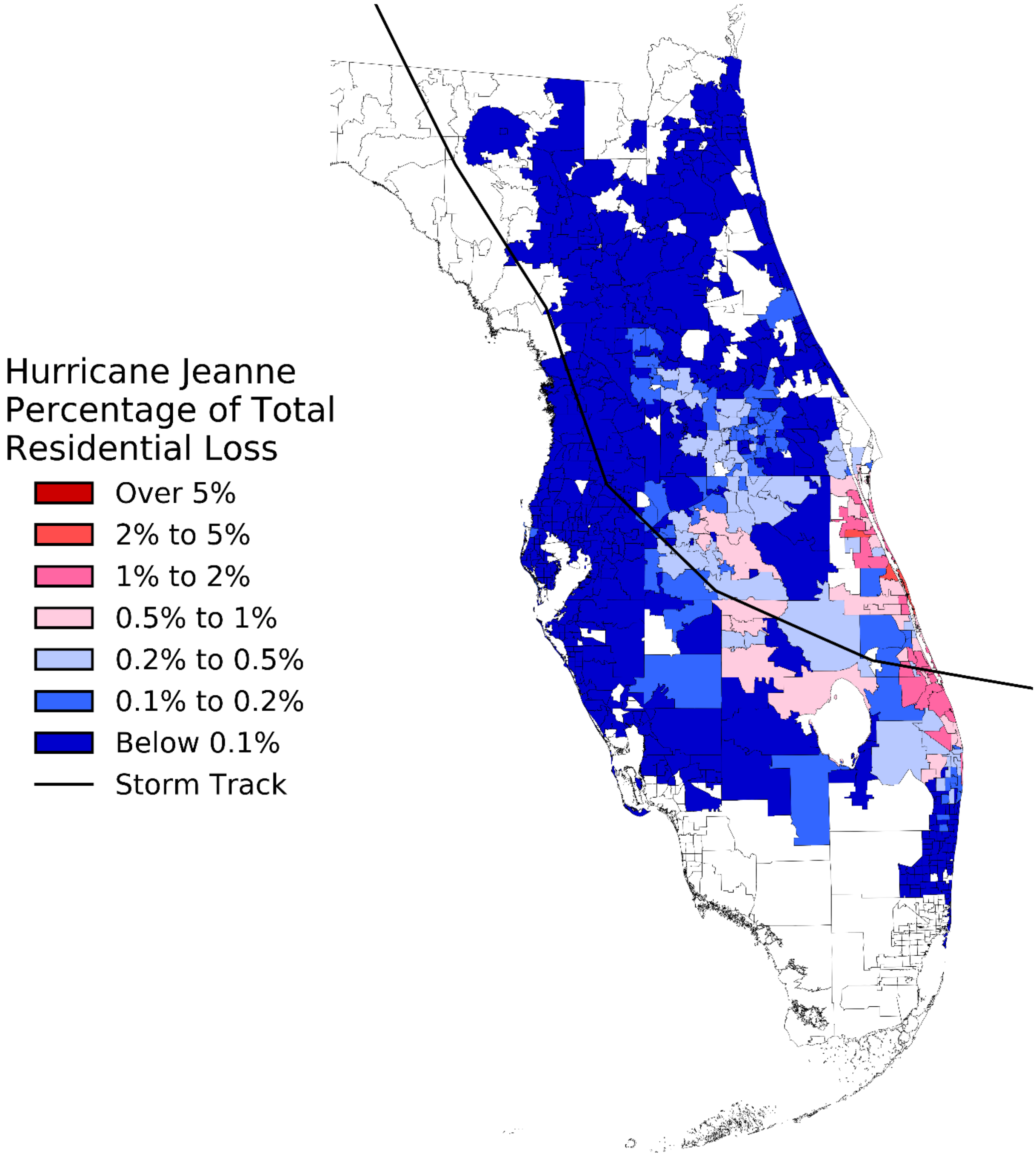
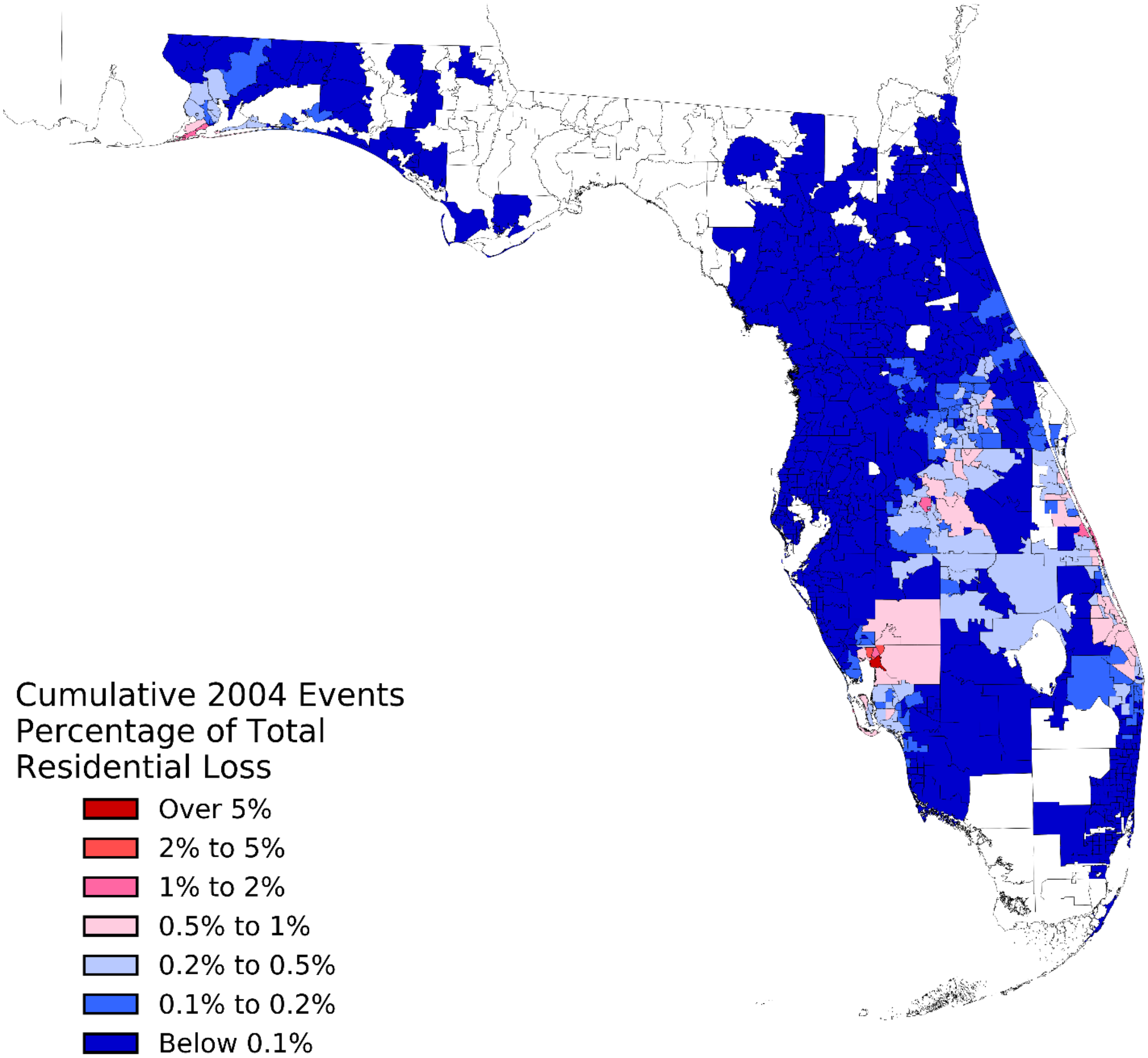


Figure 82: Percentage of Cumulative Residential Losses from 2004 Events by ZIP Code



Form A-4: Output Ranges

A. Provide personal and commercial residential output ranges in the format shown in the file named "2015FormA4.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.

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 values 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).

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.

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.

E. NA shall be 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.

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.

The required file is provided in Excel format in the file RMS15FormA4.xlsx at the link provided to the FCHLPM and appears below. There are no instances of loss costs for a ZIP Code for which there is no exposure in the submitted output ranges. The gross (non-zero deductible) loss costs have been calculated with the assumption that an insurer will not elect to apply an all other perils deductible to subsequent hurricane losses. There are no instances where we have a zero loss cost for a ZIP Code for which there is some exposure in the submitted output ranges.

Output Range Specifications

Policy Type	***Assumptions***
Owners	***Coverage A = Building*** • *Coverage A limit = $100,000* • *Replacement Cost included subject to Coverage A limit* • *Law and Ordinance not included* ***Coverage B = Appurtenant Structure*** • *Coverage B limit = 10% of Coverage A limit* • *Replacement Cost included subject to Coverage B limit* • *Law and Ordinance not included* ***Coverage C = Contents*** • *Coverage C limit = 50% of Coverage A limit* • *Replacement Cost included subject to Coverage C limit* ***Coverage D = Time Element*** • *Coverage D limit = 20% of Coverage A limit* • *Time limit = 12 months* • *Per diem = $150.00/day per policy, if used* ✧ *Dominant Coverage = A* ✧ *Loss costs per $1,000 shall be related to the Coverage A limit* ✧ *Loss costs for the various specified deductibles shall be determined based on annual deductibles* ✧ *2% Deductible of Coverage A* ✧ *All-other perils deductible = $500*
Renters	***Coverage C = Contents*** • *Coverage C limit = $25,000* • *Replacement Cost included subject to Coverage C limit* ***Coverage D = Time Element*** • *Coverage D limit = 40% of Coverage C limit* • *Time limit = 12 months* • *Per diem = $150.00/day per policy, if used* ✧ *Dominate Coverage = C* ✧ *Loss costs per $1,000 shall be related to the Coverage C limit* ✧ *Loss costs for the various specified deductibles shall be determined based on annual deductibles* ✧ *2% Deductible of Coverage C* ✧ *All-other perils deductible = $500*
Condo Unit Owners	***Coverage A = Building*** • *Coverage A limit = 10% of Coverage C limit* • *Replacement Cost included subject to Coverage A limit* ***Coverage C = Contents*** • *Coverage C limit = $50,000* • *Replacement Cost included subject to Coverage C limit* ***Coverage D = Time Element*** • *Coverage D limit = 40% of Coverage C limit* • *Time limit = 12 months* • *Per diem = $150.00/day per policy, if used* ✧ *Dominant Coverage = C* ✧ *Loss costs per $1,000 shall be related to the Coverage C limit* ✧ *Loss costs for the various specified deductibles shall be determined based on annual deductibles* ✧ *2% Deductible of Coverage C* ✧ *All-other perils deductible = $500*

Manufactured Home

Coverage A = Building

- *Coverage A limit = $50,000*
- *Replacement Cost included subject to Coverage A limit*

Coverage B = Appurtenant Structure

- *Coverage B limit = 10% of Coverage A limit*
- *Replacement Cost included subject to Coverage B limit*

Coverage C = Contents

- *Coverage C limit = 50% of Coverage A limit*
- *Replacement Cost included subject to Coverage C limit*

Coverage D = Time Element

- *Coverage D limit = 20% of Coverage A limit*
- *Time limit = 12 months*
- *Per diem = $150.00/day per policy, if used*

✧ *Dominant Coverage = A*
✧ *Loss costs per $1,000 shall be related to the Coverage A limit*
✧ *Loss costs for the various specified deductibles shall be determined based on annual deductibles*
✧ *2% Deductible of Coverage A*
✧ *All-other perils deductible = $500*

Commercial Residential

Coverage A = Building

- *Coverage A limit = $750,000*
- *Replacement Cost included subject to Coverage A limit*

Coverage C = Contents

- *Coverage C limit = 5% of Coverage A limit*
- *Replacement Cost included subject to Coverage C limit*

Coverage D = Time Element

- *Coverage D limit = 20% of Coverage A limit*
- *Time limit = 12 months*
- *Per diem = $150.00/day per policy, if used*

✧ *Dominant Coverage = A*
✧ *Loss costs per $1,000 shall be related to the Coverage A limit*
✧ *Loss costs for the various specified deductibles shall be determined based on annual deductibles*
✧ *3% Deductible of Coverage A*
✧ *All-other perils deductible = $500*

Table 37: Loss Costs per $1000 for 0% Deductible using 2012 FHCF Exposure Data

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Alachua	LOW	0.155	0.152	2.888	0.065	0.035	0.081	0.044	0.129
	AVERAGE	1.026	1.233	4.009	0.271	0.279	0.357	0.310	0.570
	HIGH	2.383	2.201	6.298	0.688	0.644	0.768	0.786	1.253
Baker	LOW	0.102	0.095	1.840	0.031	0.018	NA	NA	NA
	AVERAGE	0.555	0.611	2.179	0.166	0.183	NA	NA	NA
	HIGH	1.028	0.944	3.076	0.229	0.211	NA	NA	NA
Bay	LOW	0.215	0.223	3.519	0.144	0.134	0.230	0.096	0.221
	AVERAGE	1.880	1.969	5.521	0.574	0.590	1.442	0.717	1.865
	HIGH	3.935	3.693	10.883	1.669	1.579	1.856	1.738	2.513
Bradford	LOW	0.140	0.131	2.313	0.047	0.042	NA	NA	NA
	AVERAGE	0.988	1.061	3.059	0.285	0.243	NA	NA	NA
	HIGH	1.379	1.269	4.056	0.342	0.296	NA	NA	NA
Brevard	LOW	0.468	0.431	9.093	0.302	0.129	0.422	0.180	0.377
	AVERAGE	3.853	3.001	13.024	1.264	1.241	1.929	2.111	3.298
	HIGH	9.181	8.681	24.359	3.878	3.634	4.708	4.411	6.422
Broward	LOW	0.722	0.646	17.961	0.534	0.215	0.678	0.288	0.583
	AVERAGE	5.333	4.334	23.711	1.686	1.852	2.783	2.334	4.206
	HIGH	12.215	11.243	31.210	5.656	5.435	6.923	6.648	9.312
Calhoun	LOW	0.171	0.159	2.827	0.067	0.104	NA	NA	NA
	AVERAGE	1.127	1.108	3.280	0.350	0.298	NA	NA	NA
	HIGH	1.663	1.535	4.765	0.456	0.426	NA	NA	NA
Charlotte	LOW	0.483	0.447	11.141	0.300	0.217	0.452	0.219	0.574
	AVERAGE	4.522	3.166	14.743	1.435	1.253	2.929	1.664	3.030
	HIGH	10.091	9.545	21.047	4.197	3.966	5.131	4.847	7.246
Citrus	LOW	0.323	0.290	6.154	0.163	0.115	0.236	0.182	0.379
	AVERAGE	2.704	1.932	7.375	0.790	0.643	1.197	1.113	1.995
	HIGH	4.322	3.675	10.137	1.272	1.181	1.555	1.445	2.443
Clay	LOW	0.112	0.103	2.375	0.042	0.024	0.051	0.033	0.112
	AVERAGE	0.708	0.894	3.043	0.211	0.230	0.199	0.180	0.401
	HIGH	2.003	1.848	5.325	0.466	0.430	0.570	0.591	0.989

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Collier	LOW	0.705	0.650	14.621	0.529	0.213	0.662	0.283	0.633
	AVERAGE	4.977	3.422	17.566	2.011	1.637	3.066	2.386	4.029
	HIGH	13.860	13.194	28.936	6.915	6.552	8.524	8.056	10.213
Columbia	LOW	0.123	0.113	2.561	0.049	0.044	0.175	0.094	0.126
	AVERAGE	0.831	0.859	3.119	0.228	0.210	0.326	0.307	0.207
	HIGH	1.680	1.552	4.726	0.453	0.361	0.472	0.337	0.584
DeSoto	LOW	0.469	0.419	9.589	0.256	0.225	0.419	0.190	1.141
	AVERAGE	3.550	2.980	10.995	1.137	0.949	1.017	1.139	2.310
	HIGH	5.297	4.946	15.173	1.614	1.511	1.999	1.872	3.105
Dixie	LOW	0.286	0.259	4.089	0.136	0.207	0.168	0.146	0.622
	AVERAGE	1.834	1.445	4.395	0.565	0.613	0.481	0.391	0.858
	HIGH	3.944	3.706	9.345	0.625	1.339	0.519	0.707	2.471
Duval	LOW	0.106	0.099	2.271	0.041	0.021	0.067	0.032	0.090
	AVERAGE	1.018	1.132	3.166	0.272	0.273	0.258	0.272	0.549
	HIGH	2.635	3.075	8.483	1.236	1.151	1.043	0.970	2.190
Escambia	LOW	0.200	0.184	3.481	0.110	0.164	0.256	0.154	0.312
	AVERAGE	2.416	2.676	6.552	1.039	1.014	1.862	1.208	2.343
	HIGH	6.140	5.810	14.010	2.783	2.612	3.327	3.124	4.212
Flagler	LOW	0.220	0.199	3.962	0.104	0.055	0.287	0.058	0.200
	AVERAGE	1.811	1.031	6.052	0.488	0.321	1.141	0.490	0.963
	HIGH	4.896	4.620	10.367	1.388	1.293	2.152	1.569	2.491
Franklin	LOW	0.668	0.627	7.841	0.547	0.449	0.605	0.492	1.893
	AVERAGE	3.309	3.911	9.245	1.602	1.692	1.273	2.025	2.754
	HIGH	5.991	5.641	14.119	2.459	2.333	2.953	2.803	3.918
Gadsden	LOW	0.096	0.101	1.732	0.040	0.041	NA	0.241	0.483
	AVERAGE	0.654	0.725	2.028	0.222	0.215	NA	0.241	0.551
	HIGH	1.115	1.025	3.318	0.282	0.250	NA	0.241	0.560
Gilchrist	LOW	0.265	0.210	3.854	0.122	0.118	NA	0.632	NA
	AVERAGE	1.312	1.313	4.211	0.523	0.512	NA	0.632	NA
	HIGH	2.125	1.973	5.738	0.623	0.583	NA	0.632	NA
Glades	LOW	0.766	0.673	12.900	2.278	0.811	NA	NA	NA
	AVERAGE	5.483	3.794	14.287	2.278	1.953	NA	NA	NA
	HIGH	6.920	6.486	19.220	2.278	2.144	NA	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Gulf	LOW	0.216	0.193	3.536	0.117	0.095	0.547	0.209	0.387
	AVERAGE	2.176	2.741	5.195	1.168	1.041	0.851	0.508	1.508
	HIGH	4.566	3.938	10.570	1.571	1.484	1.899	2.228	2.594
Hamilton	LOW	0.100	0.094	1.753	0.041	0.061	NA	NA	NA
	AVERAGE	0.675	0.731	2.147	0.207	0.198	NA	NA	NA
	HIGH	1.132	1.042	3.321	0.279	0.258	NA	NA	NA
Hardee	LOW	0.404	0.343	8.440	0.188	0.166	NA	1.114	0.387
	AVERAGE	3.143	2.685	9.131	0.921	0.834	NA	1.114	0.387
	HIGH	4.601	4.285	13.563	1.321	1.237	NA	1.114	0.387
Hendry	LOW	0.625	0.555	12.095	0.371	0.322	1.628	0.365	1.268
	AVERAGE	5.507	4.452	14.796	1.944	1.802	3.344	2.353	3.841
	HIGH	8.410	7.907	22.636	2.997	2.827	3.709	3.502	5.385
Hernando	LOW	0.327	0.281	7.237	0.150	0.135	0.391	0.200	0.307
	AVERAGE	2.615	1.923	8.045	0.636	0.540	0.988	1.011	1.474
	HIGH	3.876	3.608	11.523	1.127	1.054	1.391	1.300	2.121
Highlands	LOW	0.535	0.431	10.334	0.280	0.119	0.402	0.160	0.555
	AVERAGE	3.692	3.235	11.274	1.271	1.069	1.696	1.531	2.609
	HIGH	5.960	5.788	16.715	2.054	1.930	2.322	2.181	3.741
Hillsborough	LOW	0.310	0.280	7.307	0.143	0.096	0.182	0.086	0.302
	AVERAGE	2.629	2.339	9.328	0.593	0.642	0.827	0.854	1.605
	HIGH	5.977	5.608	15.802	2.006	2.241	2.479	2.316	3.958
Holmes	LOW	0.141	0.131	2.661	0.066	0.310	0.405	NA	0.637
	AVERAGE	0.976	1.061	2.802	0.305	0.310	0.405	NA	0.654
	HIGH	1.444	1.334	4.094	0.396	0.310	0.405	NA	0.687
Indian River	LOW	0.646	0.552	10.736	0.437	0.225	0.622	0.255	0.552
	AVERAGE	4.412	2.353	13.055	1.759	1.357	2.627	2.213	3.584
	HIGH	6.343	5.974	22.610	2.886	2.777	3.526	3.394	4.951
Jackson	LOW	0.144	0.153	2.716	0.063	0.098	NA	0.198	0.124
	AVERAGE	1.033	1.091	2.954	0.300	0.303	NA	0.350	0.472
	HIGH	1.541	1.420	4.477	0.423	0.380	NA	0.438	0.708
Jefferson	LOW	0.096	0.089	1.621	0.047	0.040	0.122	NA	NA
	AVERAGE	0.554	0.552	1.789	0.205	0.180	0.122	NA	NA
	HIGH	0.983	0.911	2.617	0.274	0.256	0.122	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Lafayette	LOW	0.191	0.176	2.541	0.148	0.124	0.485	NA	NA
	AVERAGE	1.008	1.061	3.258	0.374	0.310	0.485	NA	NA
	HIGH	1.459	1.348	4.150	0.399	0.372	0.485	NA	NA
Lake	LOW	0.238	0.194	4.507	0.126	0.056	0.162	0.076	0.354
	AVERAGE	2.030	1.560	8.113	0.496	0.469	1.088	0.898	1.594
	HIGH	4.397	4.091	13.098	1.261	1.178	1.417	1.323	2.416
Lee	LOW	0.636	0.585	13.438	0.419	0.186	0.523	0.231	0.473
	AVERAGE	5.006	2.862	16.086	1.378	1.139	3.066	1.704	3.339
	HIGH	12.730	12.072	31.329	7.463	6.172	9.008	8.389	11.548
Leon	LOW	0.093	0.093	1.830	0.044	0.028	0.054	0.026	0.060
	AVERAGE	0.650	0.679	2.449	0.168	0.162	0.143	0.162	0.227
	HIGH	1.409	1.308	3.842	0.376	0.348	0.374	0.347	0.646
Levy	LOW	0.283	0.252	3.740	0.152	0.132	0.717	0.600	1.032
	AVERAGE	2.036	1.727	5.330	0.776	0.620	1.781	1.540	2.217
	HIGH	5.287	4.988	12.511	2.203	2.063	2.658	2.489	3.591
Liberty	LOW	0.177	0.165	2.616	0.075	0.354	NA	NA	NA
	AVERAGE	0.998	1.065	3.027	0.346	0.354	NA	NA	NA
	HIGH	1.437	1.324	4.188	0.380	0.354	NA	NA	NA
Madison	LOW	0.098	0.091	1.541	0.038	0.040	NA	NA	NA
	AVERAGE	0.693	0.708	2.002	0.203	0.194	NA	NA	NA
	HIGH	1.137	1.047	3.295	0.292	0.271	NA	NA	NA
Manatee	LOW	0.484	0.445	10.265	0.300	0.124	0.378	0.167	0.485
	AVERAGE	4.089	2.725	12.334	1.194	1.004	2.251	1.888	3.341
	HIGH	10.652	10.096	28.951	4.553	4.310	5.557	5.259	7.769
Marion	LOW	0.216	0.198	3.886	0.103	0.091	0.145	0.077	0.216
	AVERAGE	1.984	1.292	5.934	0.400	0.383	0.704	0.593	0.985
	HIGH	4.117	3.821	11.147	1.174	0.730	0.967	0.897	1.678
Martin	LOW	0.814	0.739	14.944	0.623	0.286	0.778	0.316	1.063
	AVERAGE	6.168	4.179	18.058	2.838	2.106	4.385	3.376	5.062
	HIGH	10.635	10.081	23.699	4.683	4.432	5.701	5.397	7.712
Miami-Dade	LOW	0.734	0.671	18.257	0.568	0.295	0.756	0.343	0.612
	AVERAGE	5.596	4.560	21.170	2.603	2.632	4.094	3.146	5.150
	HIGH	13.638	12.822	53.820	13.268	12.380	15.932	14.891	19.098

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Monroe	LOW	1.921	1.858	32.847	2.665	0.898	3.217	1.165	1.852
	AVERAGE	5.327	5.341	36.071	6.717	6.140	7.765	6.745	8.748
	HIGH	10.747	10.105	46.422	10.002	9.303	12.032	11.846	13.822
Nassau	LOW	0.092	0.092	1.815	0.033	0.030	0.261	0.096	0.226
	AVERAGE	1.135	1.056	2.919	0.515	0.430	0.716	0.664	1.048
	HIGH	3.029	2.830	7.162	0.936	0.870	1.138	1.058	1.702
Okaloosa	LOW	0.185	0.170	2.865	0.115	0.097	0.142	0.220	0.224
	AVERAGE	2.179	2.324	4.472	0.896	0.883	1.724	1.052	2.119
	HIGH	5.417	5.114	12.644	2.309	2.115	2.770	2.541	3.649
Okeechobee	LOW	0.729	0.666	13.357	0.718	0.436	0.900	0.551	1.463
	AVERAGE	5.544	4.378	15.648	2.194	1.966	2.049	3.084	3.479
	HIGH	8.068	7.593	21.458	2.966	2.800	3.659	3.458	5.236
Orange	LOW	0.300	0.275	6.963	0.134	0.063	0.172	0.086	0.198
	AVERAGE	2.094	2.012	8.257	0.482	0.470	0.622	0.606	1.114
	HIGH	6.136	5.739	11.868	1.988	1.864	1.331	1.301	2.309
Osceola	LOW	0.291	0.272	6.340	0.136	0.062	0.170	0.086	0.261
	AVERAGE	1.953	1.842	9.277	0.458	0.457	0.577	0.447	0.890
	HIGH	4.737	4.424	13.635	1.476	1.272	1.677	1.570	2.782
Palm Beach	LOW	0.584	0.541	13.531	0.477	0.207	0.601	0.252	0.643
	AVERAGE	5.043	3.397	19.802	1.903	1.683	3.083	2.316	3.988
	HIGH	10.692	10.141	29.268	5.304	5.101	6.471	6.220	8.762
Pasco	LOW	0.365	0.324	8.304	0.183	0.145	0.244	0.114	0.352
	AVERAGE	2.249	2.229	9.874	0.485	0.581	1.022	1.132	1.889
	HIGH	4.815	4.332	13.490	1.372	1.284	1.678	1.570	2.698
Pinellas	LOW	0.364	0.332	8.311	0.198	0.129	0.252	0.115	0.302
	AVERAGE	4.119	3.638	11.259	1.021	1.171	1.811	1.602	2.752
	HIGH	8.027	7.549	18.484	4.370	4.054	5.327	4.945	7.392
Polk	LOW	0.309	0.288	7.652	0.142	0.066	0.180	0.087	0.303
	AVERAGE	2.679	2.202	9.510	0.625	0.708	0.729	0.877	1.358
	HIGH	5.869	5.491	14.324	1.863	1.751	1.917	1.804	3.059
Putnam	LOW	0.179	0.155	3.139	0.076	0.072	0.104	0.050	0.832
	AVERAGE	1.524	1.486	4.485	0.425	0.389	0.554	0.358	0.985
	HIGH	2.723	2.516	7.717	0.721	0.641	0.841	0.785	1.320

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
St. Johns	LOW	0.160	0.149	3.140	0.078	0.034	0.097	0.050	0.167
	AVERAGE	1.062	1.192	4.698	0.426	0.388	0.684	0.728	1.089
	HIGH	3.361	3.137	8.734	1.140	1.061	1.383	1.288	2.058
St. Lucie	LOW	0.619	0.564	11.774	0.450	0.173	0.563	0.233	0.602
	AVERAGE	4.678	2.303	13.985	1.745	1.128	2.855	2.578	3.717
	HIGH	7.953	7.477	30.824	4.707	4.367	5.730	5.323	7.387
Santa Rosa	LOW	0.207	0.226	3.580	0.116	0.144	0.518	0.206	0.233
	AVERAGE	2.073	2.310	6.249	1.153	1.010	3.543	1.521	2.929
	HIGH	7.982	7.617	18.814	3.777	3.579	4.508	4.276	5.592
Sarasota	LOW	0.463	0.370	10.216	0.285	0.121	0.360	0.159	0.472
	AVERAGE	4.124	2.763	13.202	1.166	1.095	2.182	1.813	3.163
	HIGH	8.106	7.617	25.757	4.370	4.053	5.330	4.950	7.343
Seminole	LOW	0.264	0.240	6.893	0.112	0.064	0.142	0.069	0.193
	AVERAGE	2.174	1.942	7.367	0.520	0.469	0.662	0.633	1.094
	HIGH	5.259	4.917	10.604	0.985	1.601	1.214	1.133	2.063
Sumter	LOW	0.266	0.242	6.221	0.114	0.069	0.161	0.076	0.263
	AVERAGE	0.637	0.711	7.426	0.275	0.311	0.652	0.305	0.615
	HIGH	3.711	3.444	11.294	0.956	0.929	0.966	0.768	1.599
Suwannee	LOW	0.132	0.121	2.447	0.057	0.051	0.129	0.113	0.626
	AVERAGE	0.920	0.899	2.919	0.268	0.273	0.129	0.113	0.821
	HIGH	1.731	1.602	4.818	0.479	0.447	0.129	0.113	0.946
Taylor	LOW	0.154	0.145	1.659	0.124	0.104	0.120	0.091	0.331
	AVERAGE	1.119	1.136	3.211	0.336	0.326	0.275	0.241	0.331
	HIGH	2.187	2.037	5.705	0.732	0.689	0.881	0.331	0.331
Union	LOW	0.136	0.124	2.326	0.045	0.051	0.074	0.065	0.671
	AVERAGE	0.807	0.831	2.803	0.232	0.250	0.074	0.065	0.671
	HIGH	1.452	1.338	4.207	0.311	0.288	0.074	0.065	0.671
Volusia	LOW	0.252	0.208	4.781	0.102	0.080	0.150	0.077	0.237
	AVERAGE	2.613	1.983	7.304	0.659	0.657	1.527	1.207	1.925
	HIGH	6.525	6.151	16.908	2.603	2.461	3.154	2.983	4.415
Wakulla	LOW	0.186	0.170	2.683	0.114	0.096	0.555	1.756	0.185
	AVERAGE	0.970	1.198	3.280	0.321	0.291	0.783	1.756	1.895
	HIGH	3.955	3.713	9.646	0.951	1.457	1.851	1.756	2.526

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Walton	LOW	0.215	0.197	3.188	0.099	0.147	0.311	0.112	0.285
	AVERAGE	2.003	1.885	5.372	1.008	0.952	2.330	1.228	2.881
	HIGH	6.079	5.748	13.921	2.720	2.552	3.242	3.048	4.136
Washington	LOW	0.171	0.154	2.676	0.115	0.098	0.171	NA	0.225
	AVERAGE	1.234	1.399	3.720	0.461	0.463	0.171	NA	0.510
	HIGH	2.115	1.968	5.658	0.685	0.643	0.171	NA	0.932
Statewide	LOW	0.092	0.089	1.541	0.031	0.018	0.051	0.026	0.060
	AVERAGE	2.300	2.849	9.687	0.716	1.109	1.434	2.034	3.393
	HIGH	13.860	13.194	53.820	13.268	12.380	15.932	14.891	19.098

Table 38: Loss Costs per $1000 with Specified Deductibles using 2012 FHCF Exposure Data

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Alachua	LOW	0.096	0.095	2.500	0.044	0.021	0.056	0.028	0.085
	AVERAGE	0.844	1.023	3.515	0.223	0.229	0.299	0.258	0.460
	HIGH	2.007	1.849	5.620	0.598	0.558	0.671	0.689	1.058
Baker	LOW	0.061	0.057	1.582	0.020	0.010	NA	NA	NA
	AVERAGE	0.442	0.491	1.885	0.132	0.146	NA	NA	NA
	HIGH	0.844	0.771	2.693	0.185	0.169	NA	NA	NA
Bay	LOW	0.146	0.155	3.066	0.117	0.105	0.192	0.069	0.158
	AVERAGE	1.603	1.682	4.901	0.504	0.516	1.310	0.636	1.616
	HIGH	3.448	3.233	9.821	1.509	1.426	1.694	1.583	2.198
Bradford	LOW	0.088	0.082	2.000	0.032	0.027	NA	NA	NA
	AVERAGE	0.809	0.873	2.661	0.232	0.196	NA	NA	NA
	HIGH	1.149	1.054	3.562	0.283	0.241	NA	NA	NA
Brevard	LOW	0.336	0.307	8.165	0.248	0.099	0.352	0.137	0.284
	AVERAGE	3.324	2.572	11.845	1.124	1.104	1.743	1.915	2.893
	HIGH	8.218	7.762	22.571	3.570	3.340	4.365	4.083	5.748
Broward	LOW	0.548	0.485	16.472	0.453	0.167	0.581	0.228	0.447
	AVERAGE	4.648	3.751	21.956	1.513	1.663	2.537	2.111	3.715
	HIGH	11.077	10.173	29.146	5.268	5.055	6.487	6.222	8.463
Calhoun	LOW	0.110	0.102	2.448	0.049	0.078	NA	NA	NA
	AVERAGE	0.926	0.912	2.851	0.292	0.246	NA	NA	NA
	HIGH	1.393	1.282	4.192	0.386	0.358	NA	NA	NA
Charlotte	LOW	0.345	0.318	10.030	0.240	0.167	0.374	0.165	0.437
	AVERAGE	3.899	2.687	13.387	1.268	1.100	2.664	1.481	2.621
	HIGH	9.034	8.532	19.398	3.849	3.631	4.744	4.475	6.494
Citrus	LOW	0.227	0.199	5.463	0.123	0.085	0.186	0.136	0.285
	AVERAGE	2.299	1.623	6.570	0.684	0.552	1.057	0.979	1.703
	HIGH	3.746	3.170	9.162	1.128	1.045	1.392	1.291	2.107
Clay	LOW	0.066	0.059	2.055	0.026	0.014	0.033	0.019	0.072
	AVERAGE	0.572	0.733	2.649	0.171	0.187	0.161	0.145	0.316
	HIGH	1.680	1.545	4.692	0.394	0.363	0.489	0.502	0.816

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Collier	LOW	0.523	0.481	13.336	0.441	0.165	0.560	0.223	0.489
	AVERAGE	4.350	2.951	16.122	1.813	1.466	2.810	2.171	3.558
	HIGH	12.674	12.056	27.058	6.485	6.138	8.052	7.600	9.320
Columbia	LOW	0.075	0.067	2.221	0.035	0.030	0.140	0.069	0.086
	AVERAGE	0.677	0.703	2.724	0.186	0.170	0.272	0.254	0.154
	HIGH	1.412	1.301	4.183	0.385	0.302	0.402	0.281	0.471
DeSoto	LOW	0.335	0.293	8.563	0.201	0.172	0.343	0.140	0.929
	AVERAGE	3.015	2.516	9.865	0.989	0.820	0.883	0.995	1.966
	HIGH	4.571	4.256	13.788	1.420	1.326	1.778	1.661	2.671
Dixie	LOW	0.207	0.187	3.612	0.109	0.171	0.136	0.115	0.512
	AVERAGE	1.564	1.218	3.895	0.489	0.533	0.421	0.336	0.723
	HIGH	3.483	3.267	8.470	0.542	1.200	0.459	0.616	2.154
Duval	LOW	0.061	0.057	1.967	0.027	0.012	0.047	0.019	0.054
	AVERAGE	0.839	0.938	2.775	0.225	0.226	0.214	0.226	0.443
	HIGH	2.264	2.659	7.628	1.099	1.022	0.923	0.856	1.892
Escambia	LOW	0.134	0.121	3.044	0.086	0.132	0.215	0.123	0.237
	AVERAGE	2.074	2.315	5.874	0.933	0.907	1.703	1.088	2.049
	HIGH	5.486	5.187	12.836	2.566	2.405	3.088	2.895	3.755
Flagler	LOW	0.144	0.126	3.461	0.078	0.037	0.238	0.038	0.140
	AVERAGE	1.534	0.850	5.370	0.421	0.269	1.016	0.422	0.806
	HIGH	4.279	4.033	9.335	1.241	1.154	1.951	1.413	2.164
Franklin	LOW	0.541	0.495	7.035	0.485	0.390	0.538	0.430	1.642
	AVERAGE	2.890	3.429	8.328	1.456	1.538	1.160	1.857	2.392
	HIGH	5.308	4.993	12.863	2.252	2.134	2.722	2.582	3.465
Gadsden	LOW	0.056	0.061	1.496	0.028	0.029	NA	0.197	0.385
	AVERAGE	0.530	0.592	1.754	0.180	0.174	NA	0.197	0.439
	HIGH	0.920	0.843	2.900	0.230	0.203	NA	0.197	0.446
Gilchrist	LOW	0.192	0.144	3.392	0.098	0.094	NA	0.547	NA
	AVERAGE	1.098	1.099	3.718	0.450	0.439	NA	0.547	NA
	HIGH	1.810	1.675	5.122	0.539	0.503	NA	0.547	NA
Glades	LOW	0.581	0.500	11.637	2.038	0.695	NA	NA	NA
	AVERAGE	4.753	3.254	12.921	2.039	1.741	NA	NA	NA
	HIGH	6.043	5.652	17.570	2.039	1.916	NA	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Gulf	LOW	0.148	0.127	3.080	0.091	0.072	0.480	0.168	0.296
	AVERAGE	1.867	2.364	4.589	1.051	0.934	0.762	0.442	1.296
	HIGH	3.950	3.432	9.513	1.423	1.342	1.733	2.037	2.261
Hamilton	LOW	0.061	0.057	1.509	0.027	0.044	NA	NA	NA
	AVERAGE	0.546	0.594	1.860	0.167	0.159	NA	NA	NA
	HIGH	0.937	0.858	2.915	0.228	0.210	NA	NA	NA
Hardee	LOW	0.282	0.230	7.501	0.142	0.122	NA	0.967	0.283
	AVERAGE	2.662	2.262	8.136	0.793	0.715	NA	0.967	0.283
	HIGH	3.950	3.670	12.252	1.155	1.079	NA	0.967	0.283
Hendry	LOW	0.462	0.401	10.869	0.300	0.254	1.451	0.291	1.044
	AVERAGE	4.771	3.847	13.397	1.737	1.608	3.047	2.125	3.370
	HIGH	7.425	6.969	20.799	2.716	2.558	3.392	3.197	4.766
Hernando	LOW	0.223	0.187	6.401	0.111	0.096	0.320	0.152	0.219
	AVERAGE	2.205	1.603	7.151	0.541	0.457	0.862	0.882	1.236
	HIGH	3.314	3.076	10.358	0.987	0.920	1.231	1.148	1.802
Highlands	LOW	0.390	0.302	9.262	0.223	0.085	0.330	0.117	0.425
	AVERAGE	3.162	2.760	10.143	1.117	0.933	1.509	1.358	2.246
	HIGH	5.187	5.035	15.246	1.832	1.719	2.088	1.957	3.258
Hillsborough	LOW	0.211	0.186	6.474	0.106	0.067	0.136	0.056	0.215
	AVERAGE	2.223	1.969	8.351	0.505	0.548	0.717	0.741	1.353
	HIGH	5.225	4.890	14.414	1.793	2.009	2.237	2.085	3.465
Holmes	LOW	0.085	0.079	2.306	0.047	0.257	0.342	NA	0.514
	AVERAGE	0.796	0.872	2.434	0.253	0.257	0.342	NA	0.528
	HIGH	1.206	1.110	3.610	0.334	0.257	0.342	NA	0.556
Indian River	LOW	0.490	0.408	9.702	0.368	0.180	0.537	0.203	0.431
	AVERAGE	3.840	2.004	11.895	1.588	1.214	2.400	2.011	3.160
	HIGH	5.616	5.280	20.970	2.640	2.535	3.250	3.123	4.411
Jackson	LOW	0.086	0.096	2.351	0.045	0.073	NA	0.154	0.081
	AVERAGE	0.844	0.896	2.564	0.246	0.249	NA	0.289	0.372
	HIGH	1.284	1.179	3.934	0.356	0.314	NA	0.368	0.571
Jefferson	LOW	0.057	0.053	1.404	0.036	0.030	0.099	NA	NA
	AVERAGE	0.453	0.452	1.558	0.170	0.149	0.099	NA	NA
	HIGH	0.827	0.763	2.306	0.233	0.217	0.099	NA	NA

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Lafayette	LOW	0.130	0.119	2.212	0.118	0.097	0.416	NA	NA
	AVERAGE	0.834	0.881	2.851	0.316	0.260	0.416	NA	NA
	HIGH	1.226	1.129	3.663	0.338	0.314	0.416	NA	NA
Lake	LOW	0.156	0.118	3.927	0.090	0.034	0.118	0.048	0.255
	AVERAGE	1.687	1.282	7.184	0.412	0.389	0.946	0.774	1.335
	HIGH	3.765	3.495	11.798	1.100	1.024	1.244	1.159	2.059
Lee	LOW	0.469	0.429	12.121	0.343	0.141	0.435	0.174	0.351
	AVERAGE	4.330	2.427	14.647	1.220	0.999	2.796	1.521	2.902
	HIGH	11.482	10.872	29.190	6.963	5.733	8.455	7.862	10.510
Leon	LOW	0.054	0.054	1.593	0.033	0.017	0.039	0.017	0.036
	AVERAGE	0.533	0.559	2.147	0.138	0.132	0.117	0.132	0.175
	HIGH	1.197	1.109	3.406	0.322	0.297	0.322	0.297	0.534
Levy	LOW	0.195	0.170	3.282	0.119	0.100	0.634	0.522	0.872
	AVERAGE	1.737	1.459	4.724	0.682	0.537	1.629	1.402	1.941
	HIGH	4.703	4.432	11.439	2.014	1.883	2.449	2.290	3.192
Liberty	LOW	0.115	0.107	2.264	0.055	0.294	NA	NA	NA
	AVERAGE	0.818	0.877	2.631	0.288	0.294	NA	NA	NA
	HIGH	1.197	1.099	3.677	0.317	0.294	NA	NA	NA
Madison	LOW	0.061	0.056	1.331	0.028	0.029	NA	NA	NA
	AVERAGE	0.565	0.578	1.735	0.166	0.158	NA	NA	NA
	HIGH	0.944	0.866	2.898	0.240	0.223	NA	NA	NA
Manatee	LOW	0.349	0.320	9.209	0.245	0.091	0.311	0.125	0.370
	AVERAGE	3.524	2.320	11.176	1.055	0.881	2.040	1.699	2.919
	HIGH	9.584	9.069	27.017	4.188	3.960	5.152	4.871	6.986
Marion	LOW	0.139	0.123	3.371	0.073	0.062	0.106	0.050	0.146
	AVERAGE	1.656	1.059	5.223	0.332	0.317	0.604	0.506	0.809
	HIGH	3.517	3.257	9.991	1.024	0.631	0.843	0.785	1.411
Martin	LOW	0.631	0.569	13.635	0.536	0.232	0.677	0.255	0.872
	AVERAGE	5.424	3.638	16.616	2.593	1.909	4.061	3.103	4.506
	HIGH	9.597	9.087	21.998	4.338	4.101	5.317	5.028	6.965
Miami-Dade	LOW	0.561	0.507	16.776	0.485	0.231	0.654	0.272	0.474
	AVERAGE	4.881	3.948	19.539	2.381	2.399	3.790	2.882	4.589
	HIGH	12.268	11.520	51.116	12.561	11.706	15.154	14.149	17.665

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Monroe	LOW	1.585	1.569	30.799	2.444	0.784	3.009	1.023	1.583
	AVERAGE	4.638	4.642	33.871	6.309	5.751	7.328	6.319	7.948
	HIGH	9.640	9.055	43.906	9.449	8.775	11.426	11.262	12.710
Nassau	LOW	0.055	0.053	1.565	0.021	0.019	0.217	0.071	0.163
	AVERAGE	0.947	0.881	2.561	0.446	0.370	0.631	0.581	0.883
	HIGH	2.611	2.435	6.431	0.827	0.767	1.015	0.942	1.461
Okaloosa	LOW	0.123	0.112	2.500	0.090	0.075	0.114	0.182	0.171
	AVERAGE	1.875	2.012	3.973	0.802	0.788	1.575	0.942	1.846
	HIGH	4.807	4.534	11.544	2.116	1.933	2.556	2.338	3.231
Okeechobee	LOW	0.547	0.498	12.098	0.616	0.361	0.782	0.461	1.227
	AVERAGE	4.841	3.798	14.246	1.975	1.764	1.852	2.813	3.050
	HIGH	7.136	6.705	19.743	2.691	2.537	3.349	3.161	4.640
Orange	LOW	0.198	0.177	6.155	0.096	0.040	0.126	0.055	0.125
	AVERAGE	1.746	1.676	7.332	0.400	0.390	0.526	0.511	0.916
	HIGH	5.321	4.968	10.653	1.765	1.652	1.165	1.141	1.964
Osceola	LOW	0.188	0.174	5.582	0.097	0.038	0.124	0.055	0.177
	AVERAGE	1.630	1.532	8.278	0.379	0.380	0.486	0.370	0.723
	HIGH	4.096	3.817	12.349	1.300	1.112	1.487	1.389	2.394
Palm Beach	LOW	0.432	0.398	12.343	0.401	0.161	0.511	0.196	0.505
	AVERAGE	4.387	2.917	18.252	1.714	1.507	2.818	2.093	3.511
	HIGH	9.669	9.160	27.269	4.926	4.731	6.049	5.806	7.947
Pasco	LOW	0.255	0.223	7.361	0.139	0.109	0.191	0.079	0.258
	AVERAGE	1.889	1.872	8.835	0.408	0.494	0.893	0.994	1.604
	HIGH	4.141	3.714	12.212	1.204	1.123	1.487	1.389	2.313
Pinellas	LOW	0.257	0.232	7.416	0.156	0.092	0.201	0.081	0.216
	AVERAGE	3.550	3.120	10.181	0.896	1.032	1.628	1.430	2.383
	HIGH	7.041	6.609	17.016	4.023	3.723	4.939	4.576	6.647
Polk	LOW	0.202	0.187	6.771	0.103	0.042	0.133	0.056	0.212
	AVERAGE	2.260	1.845	8.487	0.529	0.603	0.625	0.757	1.133
	HIGH	5.096	4.757	12.971	1.653	1.550	1.712	1.608	2.644
Putnam	LOW	0.116	0.092	2.718	0.052	0.047	0.072	0.030	0.680
	AVERAGE	1.266	1.235	3.918	0.354	0.321	0.470	0.296	0.812
	HIGH	2.304	2.123	6.849	0.617	0.547	0.730	0.679	1.108

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
St. Johns	LOW	0.099	0.092	2.742	0.057	0.021	0.072	0.034	0.118
	AVERAGE	0.882	0.995	4.142	0.365	0.330	0.600	0.641	0.917
	HIGH	2.914	2.715	7.841	1.014	0.941	1.241	1.154	1.777
St. Lucie	LOW	0.466	0.422	10.682	0.379	0.135	0.482	0.184	0.473
	AVERAGE	4.068	1.963	12.773	1.572	1.005	2.620	2.360	3.295
	HIGH	7.005	6.576	28.845	4.377	4.052	5.365	4.973	6.686
Santa Rosa	LOW	0.139	0.160	3.139	0.092	0.114	0.454	0.168	0.175
	AVERAGE	1.779	2.002	5.597	1.043	0.909	3.292	1.385	2.588
	HIGH	7.176	6.843	17.345	3.499	3.312	4.203	3.982	5.014
Sarasota	LOW	0.333	0.260	9.178	0.229	0.087	0.292	0.118	0.355
	AVERAGE	3.548	2.346	11.987	1.028	0.963	1.971	1.628	2.755
	HIGH	7.099	6.658	23.948	4.025	3.725	4.944	4.583	6.595
Seminole	LOW	0.173	0.153	6.088	0.079	0.040	0.102	0.042	0.124
	AVERAGE	1.815	1.615	6.527	0.435	0.389	0.562	0.536	0.898
	HIGH	4.551	4.247	9.509	0.852	1.413	1.063	0.990	1.749
Sumter	LOW	0.173	0.153	5.462	0.080	0.044	0.118	0.048	0.182
	AVERAGE	0.492	0.556	6.563	0.219	0.251	0.553	0.245	0.486
	HIGH	3.152	2.919	10.131	0.824	0.798	0.836	0.654	1.342
Suwannee	LOW	0.081	0.072	2.125	0.040	0.035	0.101	0.086	0.504
	AVERAGE	0.755	0.738	2.549	0.220	0.224	0.101	0.086	0.676
	HIGH	1.460	1.346	4.271	0.408	0.380	0.101	0.086	0.786
Taylor	LOW	0.104	0.096	1.434	0.099	0.082	0.094	0.070	0.263
	AVERAGE	0.935	0.950	2.822	0.284	0.276	0.237	0.205	0.263
	HIGH	1.879	1.746	5.102	0.646	0.607	0.785	0.287	0.263
Union	LOW	0.087	0.077	2.012	0.031	0.035	0.052	0.044	0.546
	AVERAGE	0.656	0.678	2.436	0.188	0.204	0.052	0.044	0.546
	HIGH	1.211	1.112	3.702	0.256	0.237	0.052	0.044	0.546
Volusia	LOW	0.164	0.130	4.183	0.073	0.058	0.112	0.051	0.165
	AVERAGE	2.224	1.675	6.512	0.573	0.570	1.375	1.079	1.657
	HIGH	5.782	5.441	15.510	2.374	2.242	2.898	2.738	3.912
Wakulla	LOW	0.127	0.114	2.347	0.093	0.075	0.494	1.603	0.138
	AVERAGE	0.816	1.016	2.891	0.276	0.250	0.701	1.603	1.649
	HIGH	3.472	3.255	8.727	0.852	1.319	1.691	1.603	2.210

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Walton	LOW	0.150	0.137	2.792	0.078	0.117	0.266	0.086	0.218
	AVERAGE	1.729	1.620	4.794	0.910	0.856	2.151	1.113	2.545
	HIGH	5.420	5.120	12.739	2.505	2.348	3.006	2.822	3.681
Washington	LOW	0.116	0.101	2.327	0.089	0.073	0.140	NA	0.166
	AVERAGE	1.026	1.172	3.264	0.395	0.396	0.140	NA	0.410
	HIGH	1.810	1.679	5.040	0.599	0.562	0.140	NA	0.772
Statewide	LOW	0.054	0.053	1.331	0.020	0.010	0.033	0.017	0.036
	AVERAGE	1.961	2.431	8.729	0.625	0.982	1.291	1.838	2.978
	HIGH	12.674	12.056	51.116	12.561	11.706	15.154	14.149	17.665

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-4, 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.***

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.

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.

<u>Figure 14</u>

State of Florida by North/Central/South Regions

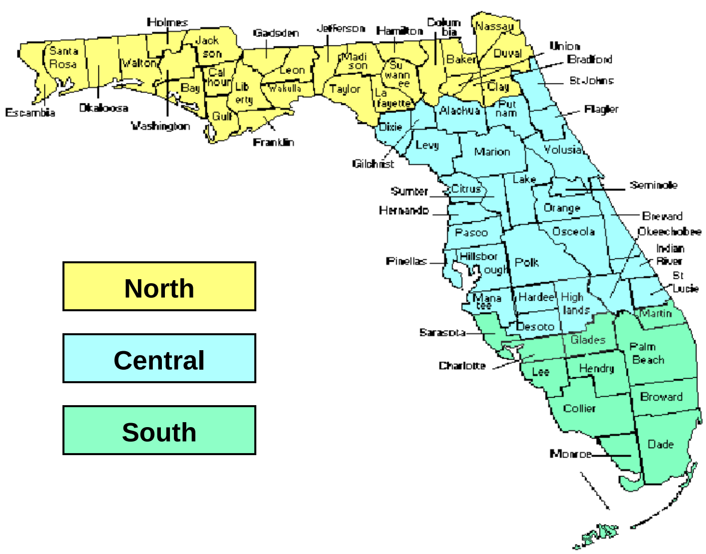
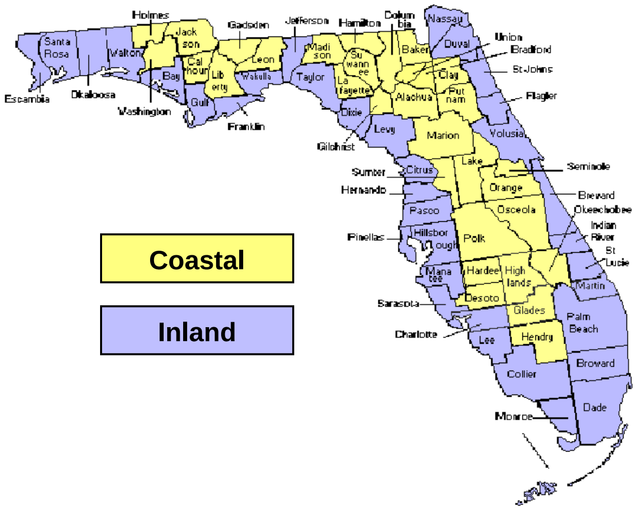


Figure 15

State of Florida by Coastal/Inland Counties



The percentage change in the weighted average loss costs from the output ranges supplied in the previously accepted model are shown in the file RMS15FormA5.xlsx at the link provided to the FCHLPM and appears below.

Table 39: 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	-1.66%	-0.91%	2.04%	-14.66%	-2.33%	-13.95%	1.68%	-9.69%
Inland	-2.98%	-2.58%	2.65%	-14.34%	-3.04%	-11.81%	1.08%	-11.15%
North	-2.33%	-2.54%	2.76%	-9.52%	9.28%	-6.85%	17.02%	-6.91%
Central	-2.48%	-2.53%	2.38%	-14.15%	-0.14%	-12.84%	5.10%	-7.81%
South	-0.20%	-0.03%	1.87%	-18.22%	-3.98%	-16.83%	0.59%	-10.29%
Statewide	-1.96%	-1.18%	2.25%	-14.56%	-2.38%	-13.77%	1.70%	-9.74%

Table 40: 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	-1.67%	-0.88%	1.79%	-14.80%	-1.40%	-14.22%	2.52%	-9.63%
Inland	-3.19%	-2.59%	2.39%	-14.11%	-1.48%	-11.55%	2.76%	-10.98%
North	-2.43%	-2.58%	2.58%	-9.15%	12.34%	-6.41%	20.14%	-6.77%
Central	-2.56%	-2.49%	2.10%	-14.26%	1.34%	-13.01%	6.29%	-7.64%
South	-0.18%	0.06%	1.64%	-18.58%	-3.26%	-17.24%	1.36%	-10.29%
Statewide	-2.00%	-1.10%	1.97%	-14.73%	-1.41%	-13.99%	2.57%	-9.68%

Figure 83: Map by County Reflecting the Percentage Changes in the Average Loss Costs with Specified Deductibles for Frame Owners from the Output Ranges from the Previously Accepted Model

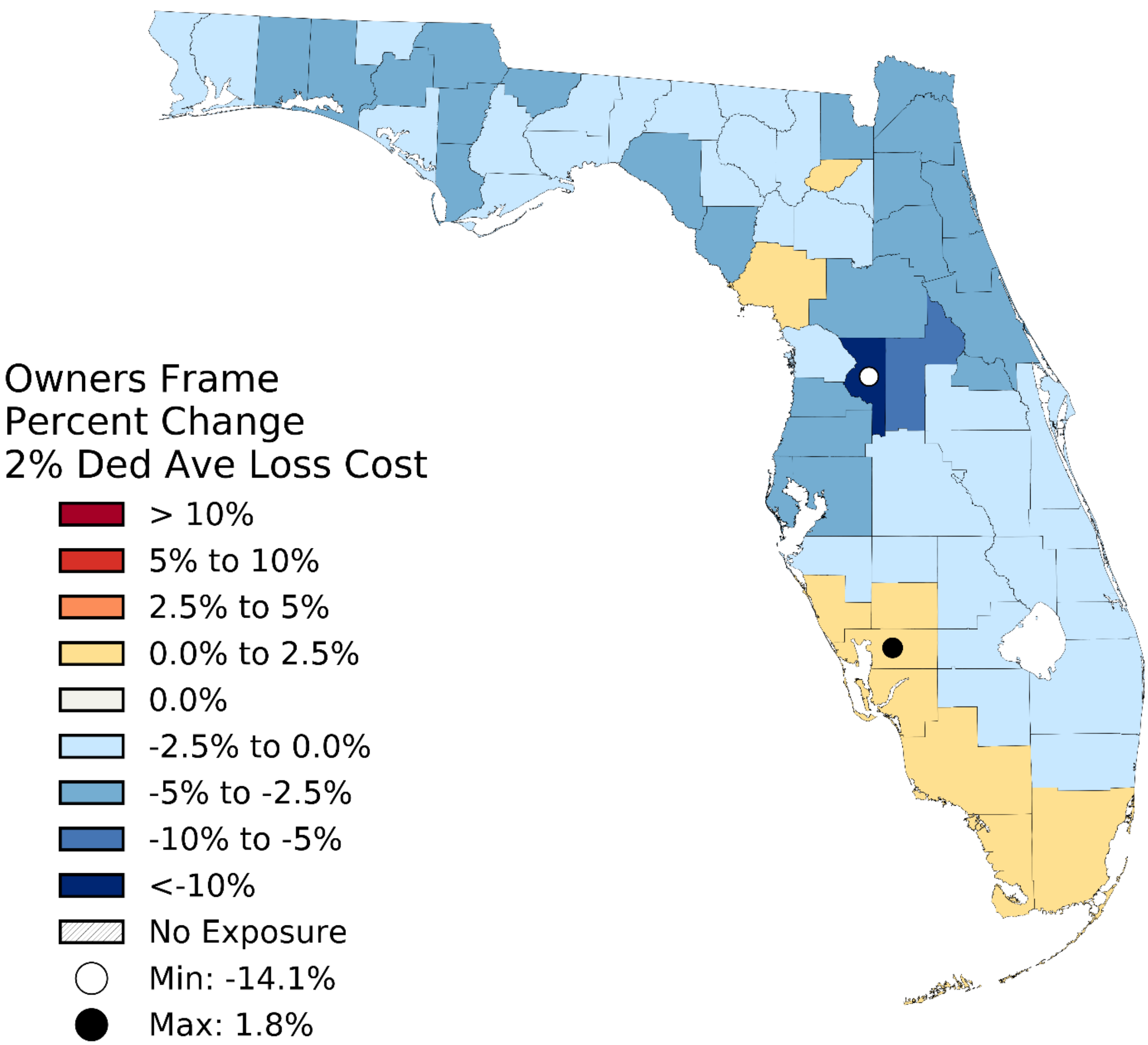


Figure 84: Map by County Reflecting the Percentage Changes in the Average Loss Costs with Specified Deductibles for Masonry Owners from the Output Ranges from the Previously Accepted Model

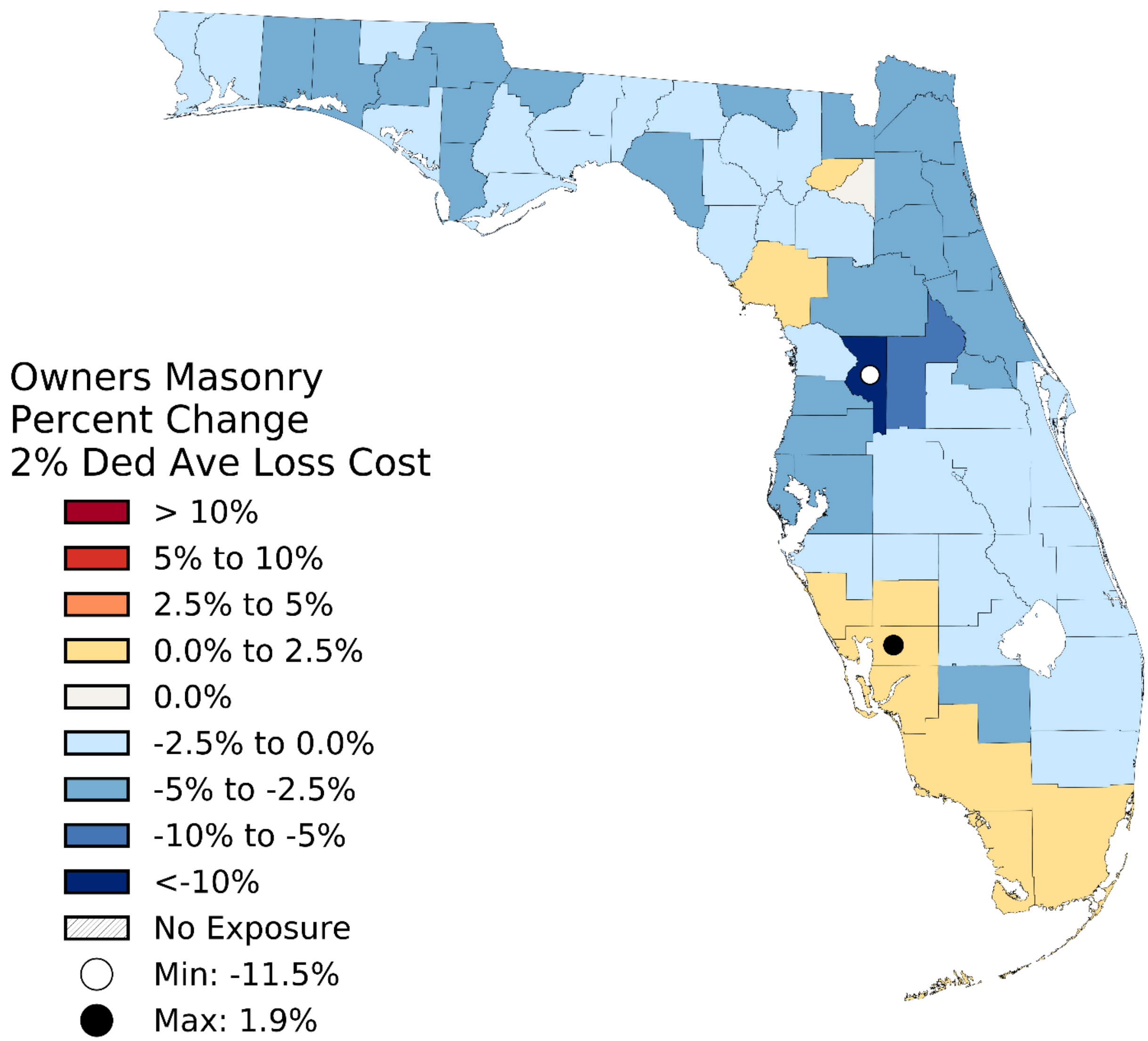


Figure 85: Map by County Reflecting the Percentage Changes in the Average Loss Costs with Specified Deductibles for Manufactured Home from the Output Ranges from the Previously Accepted Model

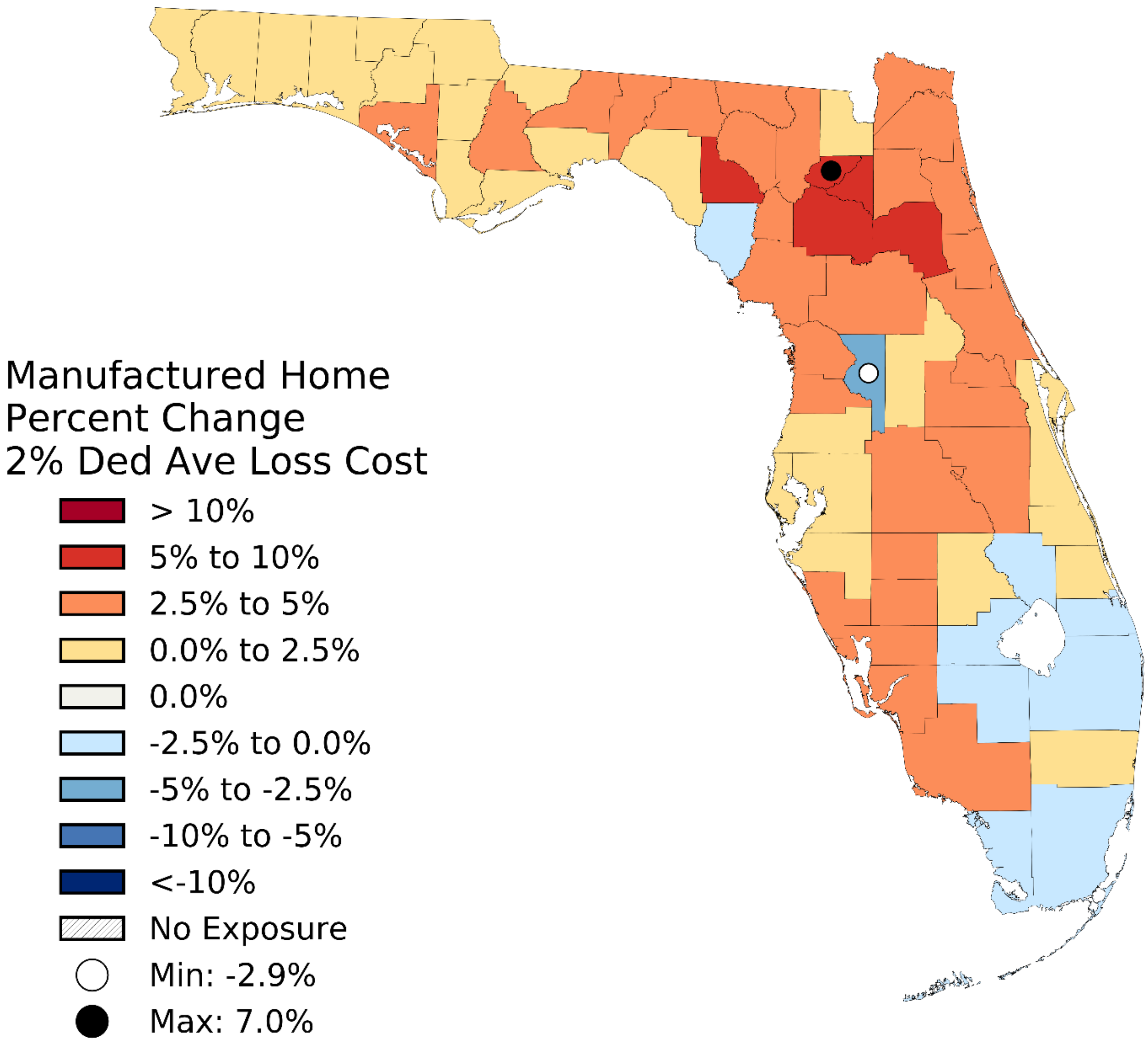


Figure 86: Map by County Reflecting the Percentage Changes in the Average Loss Costs with Specified Deductibles for Frame Renters from the Output Ranges from the Previously Accepted Model

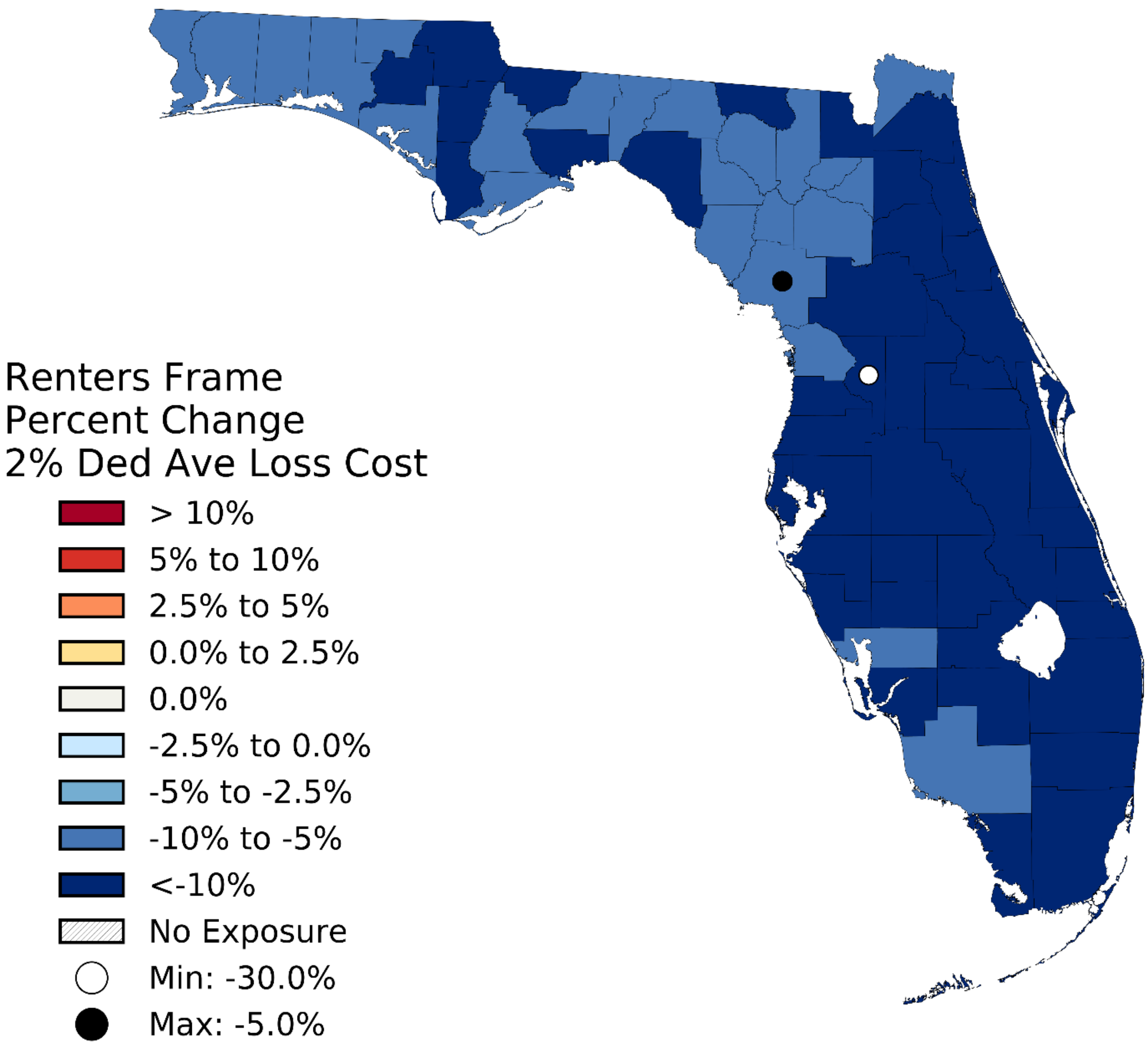


Figure 87: Map by County Reflecting the Percentage Changes in the Average Loss Costs with Specified deductibles for Masonry Renters from the Output Ranges from the Previously Accepted Model

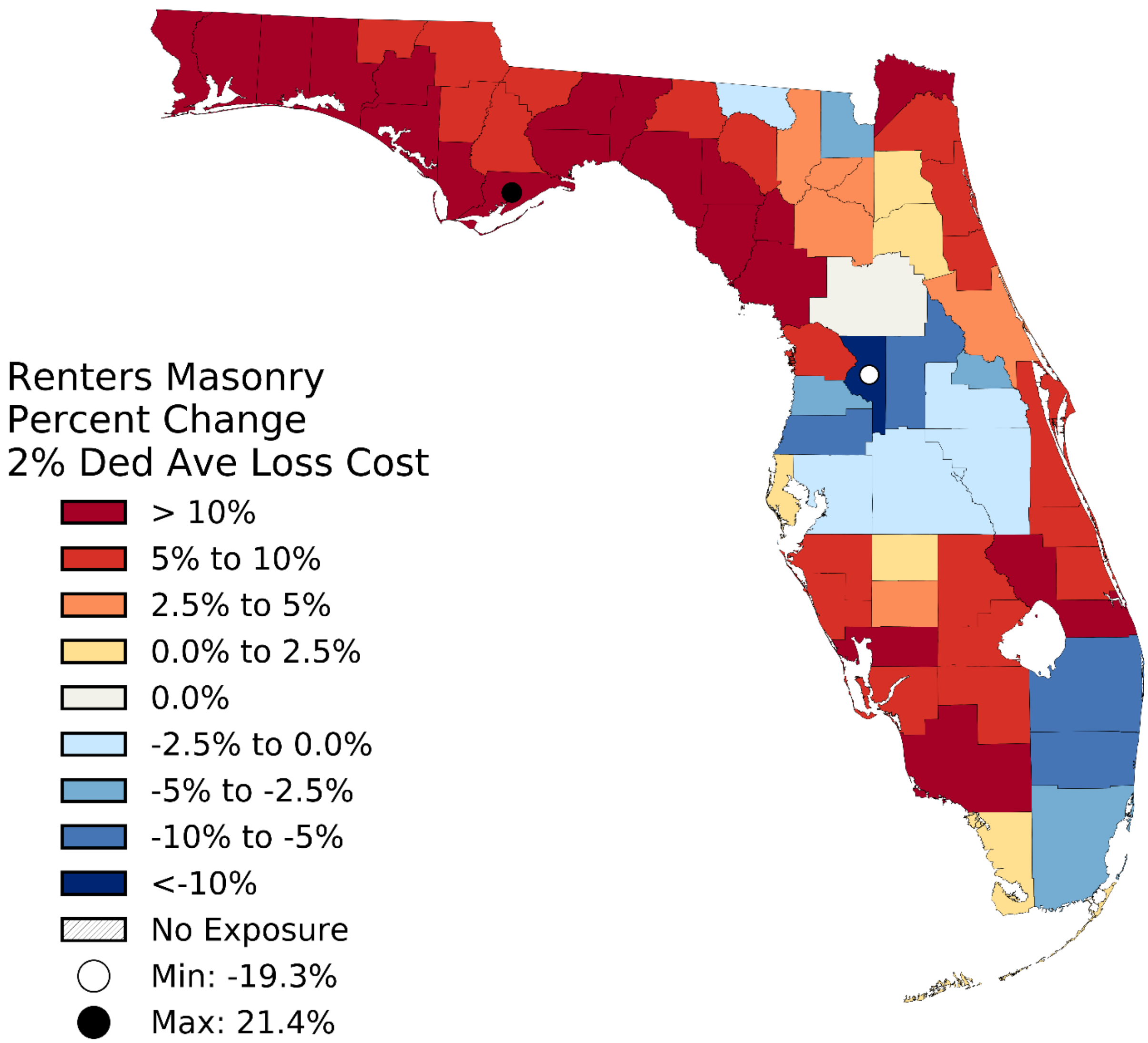


Figure 88: Map by County Reflecting the Percentage Changes in the Average Loss Costs with Specified Deductibles for Frame Condo Unit Owners from the Output Ranges from the Previously Accepted Model

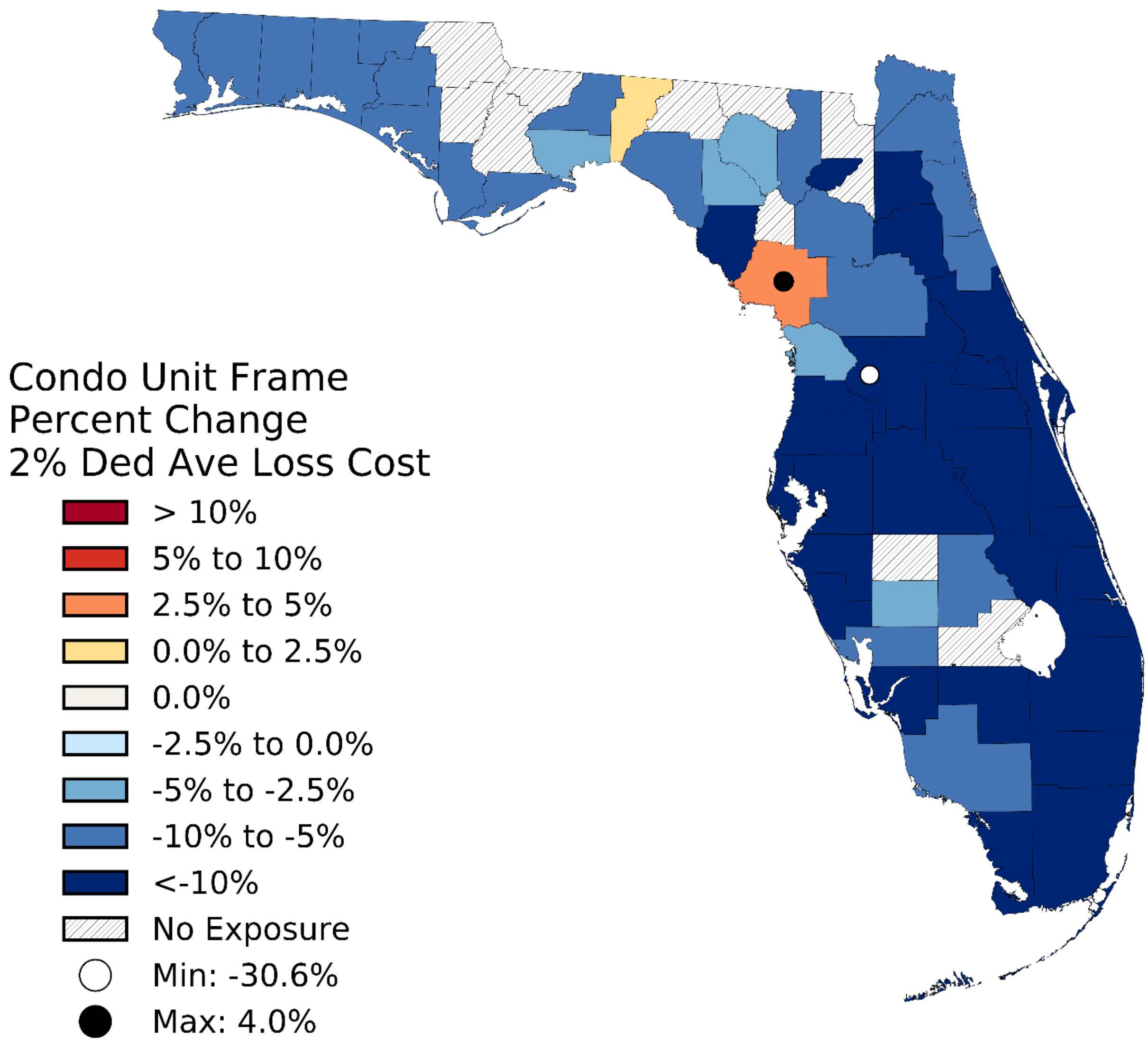


Figure 89: Map by County Reflecting the Percentage Changes in the Average Loss Costs with Specified Deductibles for Masonry Condo Unit Owners from the Output Ranges from the Previously Accepted Model

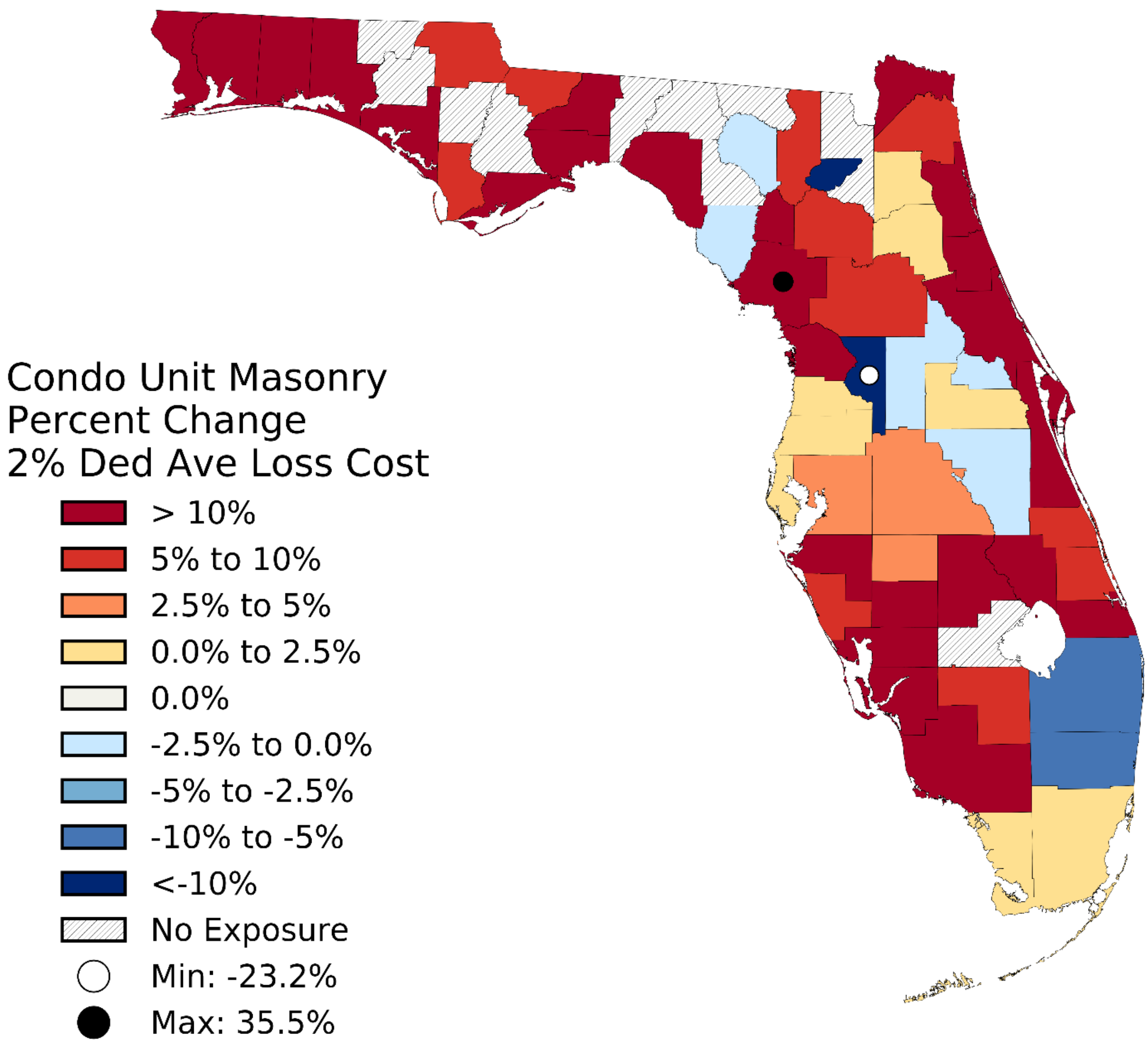
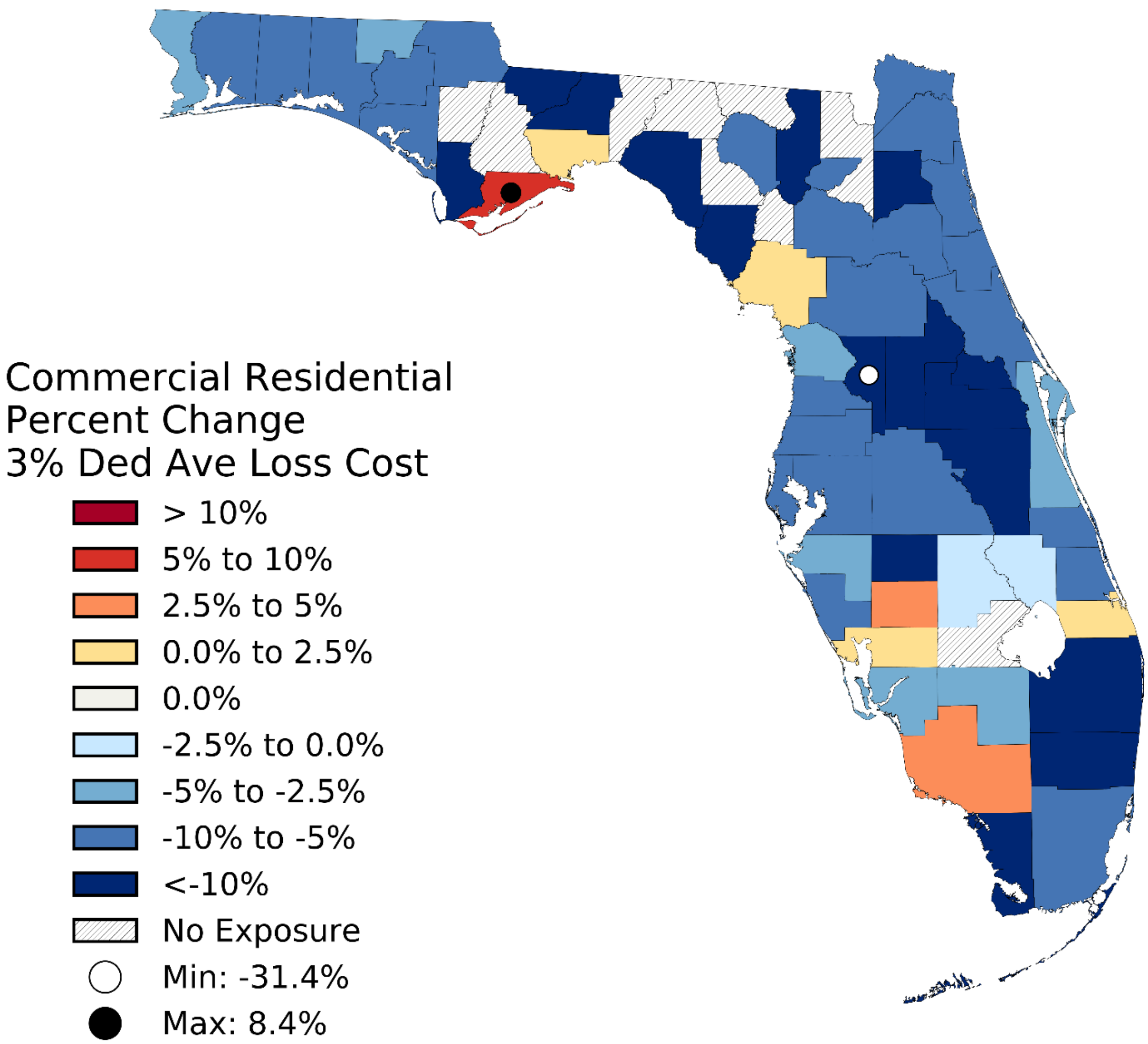


Figure 90: Map by County Reflecting the Percentage Changes in the Average Loss Costs with Specified Deductibles for Commercial Residential from the Output Ranges from the Previously Accepted Model



Form A-6: Logical Relationship to Risk (Trade Secret Item)

This form will be provided during the professional team on-site review as well as the closed meeting portion of the commission meeting.

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."

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.

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.

The results are provided in Excel format in the file RMS15FormA7.xlsx at the link provided to the FCHLPM and appears below. The gross (non-zero deductible) loss costs have been calculated with the assumption that an insurer will not elect to apply an all other perils deductible to subsequent hurricane losses. The percent changes for the Commercial Residential buildings in Table 42: Percent Change in Logical Relationship to Risk—Construction Sensitivity (notional set 2) include the model changes since the previous submission and the change in the deductible amount from 10% of Coverage A to $0 in NotionalInput13.xlsx for these buildings.

Table 41: Percent Change in Logical Relationship to Risk—Deductible Sensitivity (notional set 1)

Construction / Policy	Region	Percent Change in Loss Cost					
		$0	$500	1%	2%	5%	10%
Frame Owners	Coastal	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%
	Inland	-2.7%	-2.8%	-2.8%	-2.9%	-2.9%	-2.9%
	North	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	-2.3%
	Central	-2.4%	-2.5%	-2.5%	-2.5%	-2.5%	-2.6%
	South	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
	Statewide	-1.2%	-1.2%	-1.1%	-1.1%	-1.2%	-1.2%
Masonry Owners	Coastal	-0.9%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%
	Inland	-2.8%	-2.8%	-2.8%	-2.8%	-3.0%	-3.0%
	North	-2.3%	-2.3%	-2.3%	-2.3%	-2.4%	-2.4%
	Central	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-2.6%
	South	0.0%	0.1%	0.0%	0.1%	0.1%	0.0%
	Statewide	-1.2%	-1.2%	-1.1%	-1.2%	-1.2%	-1.2%
Manufactured Homes	Coastal	1.0%	0.9%	0.9%	0.8%	0.5%	0.0%
	Inland	2.7%	2.6%	2.6%	2.5%	2.2%	1.7%
	North	1.5%	1.4%	1.4%	1.3%	1.0%	0.6%
	Central	2.1%	1.9%	1.9%	1.8%	1.4%	0.9%
	South	0.7%	0.6%	0.6%	0.5%	0.2%	-0.2%
	Statewide	1.3%	1.1%	1.1%	1.0%	0.7%	0.2%
Frame Renters	Coastal	-18.3%	-18.7%	-18.6%	-18.7%	-18.9%	-19.1%
	Inland	-14.1%	-14.2%	-14.3%	-14.2%	-14.1%	-13.9%
	North	-10.1%	-9.5%	-10.0%	-9.5%	-9.3%	-9.2%
	Central	-15.1%	-15.3%	-15.3%	-15.3%	-15.6%	-15.6%
	South	-20.1%	-20.5%	-20.3%	-20.5%	-20.8%	-21.0%
	Statewide	-17.8%	-18.2%	-18.1%	-18.2%	-18.4%	-18.6%
Masonry Renters	Coastal	-1.7%	-0.8%	-1.2%	-0.8%	-0.1%	0.9%
	Inland	-1.8%	-0.3%	-1.0%	-0.3%	1.0%	2.4%
	North	8.9%	12.1%	11.0%	12.1%	14.3%	16.4%
	Central	-0.6%	0.7%	0.2%	0.7%	1.8%	3.1%
	South	-3.5%	-2.8%	-3.1%	-2.8%	-2.2%	-1.4%
	Statewide	-1.7%	-0.7%	-1.1%	-0.7%	0.1%	1.0%
Frame Condo Unit	Coastal	-15.1%	-15.3%	-15.3%	-15.3%	-15.4%	-15.5%
	Inland	-11.3%	-11.5%	-11.5%	-11.3%	-11.0%	-10.9%
	North	-7.4%	-7.0%	-7.0%	-6.8%	-6.2%	-5.8%
	Central	-12.1%	-12.3%	-12.3%	-12.3%	-12.1%	-12.0%
	South	-16.8%	-17.0%	-17.0%	-17.1%	-17.2%	-17.3%
	Statewide	-14.6%	-14.8%	-14.8%	-14.9%	-14.9%	-14.9%

Construction / Policy	Region	Percent Change in Loss Cost					
		$0	$500	1%	2%	5%	10%
Masonry Condo Unit	Coastal	1.6%	2.2%	2.2%	2.6%	3.6%	4.7%
	Inland	0.9%	1.9%	1.9%	2.7%	4.3%	6.1%
	North	11.5%	13.3%	13.3%	14.7%	16.8%	19.5%
	Central	2.4%	3.3%	3.3%	3.9%	5.2%	6.7%
	South	-0.1%	0.3%	0.3%	0.7%	1.5%	2.5%
	Statewide	1.6%	2.1%	2.1%	2.6%	3.6%	4.9%
Construction / Policy	**Region**	**Percent Change in Loss Cost**					
		$0	**2%**	**3%**	**5%**	**10%**	
Commercial Residential	Coastal	1.4%	1.6%	1.5%	1.6%	1.6%	
	Inland	-0.3%	0.0%	0.0%	0.0%	0.0%	
	North	-0.4%	0.0%	0.0%	-0.5%	0.0%	
	Central	0.0%	0.0%	0.0%	0.0%	0.3%	
	South	2.1%	2.1%	2.2%	2.2%	2.2%	
	Statewide	1.2%	1.4%	1.3%	1.4%	1.5%	

Table 42: Percent Change in Logical Relationship to Risk—Construction Sensitivity (notional set 2)

Policy	Region	Percent Change in Loss Cost	
		Masonry	**Frame**
Owners	Coastal	-0.9%	-0.8%
	Inland	-2.8%	-2.7%
	North	-2.3%	-2.3%
	Central	-2.5%	-2.4%
	South	0.0%	0.0%
	Statewide	-1.2%	-1.2%
Renters	Coastal	-1.7%	-18.3%
	Inland	-1.8%	-14.1%
	North	8.9%	-10.1%
	Central	-0.6%	-15.1%
	South	-3.5%	-20.1%
	Statewide	-1.7%	-17.8%
Condo Unit	Coastal	1.6%	-15.1%
	Inland	0.9%	-11.3%
	North	11.5%	-7.4%
	Central	2.4%	-12.1%
	South	-0.1%	-16.8%
	Statewide	1.6%	-14.6%
Policy	**Region**	**Percent Change in Loss Cost**	
		Concrete	
Commercial Residential	Coastal	1.4%	
	Inland	-0.3%	
	North	-0.4%	
	Central	0.0%	
	South	2.1%	
	Statewide	1.2%	

Table 43: Percent Change in Logical Relationship to Risk—Policy Form Sensitivity (notional set 3)

Region	Percent Change in Loss Cost		
	Frame Owners	Masonry Owners	Manufactured Homes
Coastal	-0.8%	-0.9%	1.0%
Inland	-2.7%	-2.8%	2.7%
North	-2.3%	-2.3%	1.5%
Central	-2.4%	-2.5%	2.1%
South	0.0%	0.0%	0.7%
Statewide	-1.2%	-1.2%	1.3%

Table 44: Percent Change in Logical Relationship to Risk—Coverage Sensitivity (notional set 4)

Construction / Policy	Region	Percent Change in Loss Cost			
		Coverage A	Coverage B	Coverage C	Coverage D
Frame Owners	Coastal	-0.8%	-0.7%	-0.8%	-1.2%
	Inland	-2.6%	-2.8%	-3.2%	-3.6%
	North	-2.3%	-1.9%	-2.1%	0.0%
	Central	-2.4%	-2.4%	-2.9%	-2.2%
	South	0.0%	0.2%	0.2%	0.0%
	Statewide	-1.1%	-1.2%	-1.2%	-1.5%
Masonry Owners	Coastal	-0.8%	-0.7%	-0.8%	-1.3%
	Inland	-2.7%	-2.3%	-3.5%	-4.0%
	North	-2.3%	-2.1%	-2.3%	-3.8%
	Central	-2.4%	-2.1%	-2.2%	-2.4%
	South	0.1%	0.0%	0.0%	-0.9%
	Statewide	-1.1%	-1.3%	-1.4%	-1.7%
Manufactured Homes	Coastal	1.1%	1.1%	1.0%	-1.3%
	Inland	2.7%	2.6%	3.5%	1.5%
	North	1.5%	1.5%	2.0%	1.0%
	Central	2.1%	2.1%	2.1%	0.0%
	South	0.8%	0.8%	0.8%	-1.7%
	Statewide	1.3%	1.3%	1.3%	-0.9%
Frame Renters	Coastal			-18.1%	-19.4%
	Inland			-14.1%	-14.1%
	North			-10.1%	-10.6%
	Central			-15.1%	-15.7%
	South			-19.8%	-21.4%
	Statewide			-17.5%	-19.1%

Construction / Policy	Region	Percent Change in Loss Cost			
		Coverage A	Coverage B	Coverage C	Coverage D
Masonry Renters	Coastal			-2.3%	2.9%
	Inland			-2.3%	1.8%
	North			7.9%	17.8%
	Central			-1.3%	4.5%
	South			-4.2%	0.7%
	Statewide			-2.4%	2.2%
Frame Condo Unit	Coastal	-6.8%		-18.1%	-8.6%
	Inland	-4.7%		-14.1%	-2.8%
	North	-1.3%		-10.1%	1.4%
	Central	-4.8%		-15.1%	-4.1%
	South	-8.4%		-19.8%	-10.6%
	Statewide	-6.7%		-17.5%	-7.7%
Masonry Condo Unit	Coastal	6.4%		-2.3%	18.8%
	Inland	5.7%		-2.3%	16.7%
	North	13.1%		7.9%	31.9%
	Central	7.4%		-1.3%	20.2%
	South	5.3%		-4.2%	16.2%
	Statewide	6.3%		-2.4%	18.2%
Commercial Residential	Coastal	1.4%		9.1%	0.0%
	Inland	-0.3%		14.3%	0.0%
	North	-0.4%		0.0%	-10.0%
	Central	-0.2%		0.0%	0.0%
	South	2.0%		5.7%	0.0%
	Statewide	1.2%		5.6%	0.0%

Table 45: Percent Change in Logical Relationship to Risk—Building Code / Enforcement (Year Built) Sensitivity (notional set 5)

Construction / Policy	Region	Percent Change in Loss Cost		
		Year Built 1980	Year Built 1998	Year Built 2004
Frame Owners	Coastal	-0.9%	-0.8%	-0.8%
	Inland	-2.7%	-3.2%	-3.0%
	North	-2.2%	-2.2%	-2.3%
	Central	-2.4%	-2.8%	-2.6%
	South	0.0%	0.1%	0.1%
	Statewide	-1.2%	-1.2%	-1.0%
Masonry Owners	Coastal	-0.9%	-0.8%	-0.7%
	Inland	-2.7%	-3.1%	-2.9%
	North	-2.3%	-2.4%	-2.4%
	Central	-2.4%	-2.7%	-2.6%
	South	0.0%	0.1%	0.1%
	Statewide	-1.2%	-1.1%	-1.0%
Construction / Policy	**Region**	**Percent Change in Loss Cost**		
		Year Built 1974	**Year Built 1992**	**Year Built 2004**
Manufactured Homes	Coastal	11.1%	7.4%	-17.3%
	Inland	13.9%	10.1%	-12.9%
	North	11.1%	9.2%	-12.9%
	Central	12.8%	8.5%	-14.1%
	South	10.7%	7.2%	-18.7%
	Statewide	11.5%	7.9%	-16.6%
Construction / Policy	**Region**	**Percent Change in Loss Cost**		
		Year Built 1980	**Year Built 1998**	**Year Built 2004**
Frame Renters	Coastal	-22.0%	-3.1%	-9.0%
	Inland	-13.6%	-11.1%	-23.9%
	North	-10.3%	-5.4%	-15.6%
	Central	-15.9%	-8.4%	-18.9%
	South	-24.9%	-1.6%	-5.7%
	Statewide	-21.0%	-4.1%	-10.8%
Masonry Renters	Coastal	-1.4%	1.5%	-5.7%
	Inland	1.0%	-3.2%	-19.3%
	North	12.4%	8.3%	-7.6%
	Central	1.0%	0.5%	-14.3%
	South	-3.9%	0.0%	-3.6%
	Statewide	-1.0%	0.9%	-7.6%

Construction / Policy	Region	Percent Change in Loss Cost		
		Year Built 1980	Year Built 1998	Year Built 2004
Frame Condo Unit	Coastal	-19.0%	1.1%	-4.6%
	Inland	-10.9%	-7.4%	-19.5%
	North	-7.8%	-1.9%	-12.0%
	Central	-13.0%	-4.5%	-15.0%
	South	-21.9%	2.7%	-1.0%
	Statewide	-18.0%	0.0%	-6.6%
Masonry Condo Unit	Coastal	1.8%	5.7%	-1.2%
	Inland	3.8%	1.0%	-15.0%
	North	14.7%	11.8%	-3.2%
	Central	4.1%	4.9%	-10.0%
	South	-0.7%	4.4%	1.1%
	Statewide	2.0%	5.0%	-2.9%
Commercial Residential	Coastal	1.7%	0.6%	0.0%
	Inland	0.0%	-0.9%	-0.7%
	North	-0.2%	-1.0%	-1.5%
	Central	0.2%	-0.6%	-0.9%
	South	2.4%	1.2%	0.6%
	Statewide	1.4%	0.4%	0.0%

Table 46: Percent Change in Logical Relationship to Risk—Building Strength Sensitivity (notional set 6)

Construction / Policy	Region	Percent Change in Loss Cost		
		Weak	Medium	Strong
Frame Owners	Coastal	-0.9%	-0.8%	-0.7%
	Inland	-3.0%	-3.1%	-2.7%
	North	-2.4%	-2.3%	-2.2%
	Central	-2.7%	-2.7%	-2.3%
	South	0.1%	0.1%	-0.2%
	Statewide	-1.3%	-1.2%	-1.1%
Masonry Owners	Coastal	-0.9%	-0.8%	-0.7%
	Inland	-3.0%	-3.2%	-2.6%
	North	-2.4%	-2.3%	-2.1%
	Central	-2.8%	-2.7%	-2.1%
	South	0.1%	0.1%	-0.1%
	Statewide	-1.3%	-1.2%	-1.2%
Manufactured Homes	Coastal	6.1%	7.4%	-17.3%
	Inland	7.3%	10.1%	-12.9%
	North	7.1%	9.2%	-12.9%
	Central	6.5%	8.5%	-14.1%
	South	6.1%	7.2%	-18.7%
	Statewide	6.3%	7.9%	-16.6%
Frame Renters	Coastal	-25.6%	-3.0%	-10.7%
	Inland	-14.3%	-9.2%	-27.3%
	North	-8.9%	-4.1%	-16.0%
	Central	-17.5%	-7.5%	-21.1%
	South	-29.4%	-2.0%	-8.3%
	Statewide	-24.2%	-3.7%	-12.9%
Masonry Renters	Coastal	-0.6%	4.4%	-5.6%
	Inland	8.0%	1.7%	-22.7%
	North	25.1%	18.1%	-3.8%
	Central	6.2%	5.4%	-13.9%
	South	-5.4%	1.6%	-4.6%
	Statewide	0.5%	4.2%	-7.9%
Frame Condo Unit	Coastal	-17.5%	0.7%	-8.1%
	Inland	-8.5%	-7.5%	-23.3%
	North	-3.6%	-1.8%	-14.6%
	Central	-11.0%	-4.6%	-18.1%
	South	-20.8%	2.2%	-4.8%
	Statewide	-16.4%	-0.4%	-10.1%

Construction / Policy	Region	Percent Change in Loss Cost		
		Weak	Medium	Strong
Masonry Condo Unit	Coastal	0.7%	4.6%	-4.8%
	Inland	7.5%	0.3%	-20.6%
	North	18.7%	12.4%	-7.1%
	Central	6.1%	4.3%	-14.5%
	South	-2.9%	3.0%	-2.5%
	Statewide	1.6%	4.1%	-6.7%
Commercial Residential	Coastal	1.7%	0.6%	0.0%
	Inland	-0.2%	-0.9%	-1.0%
	North	-0.2%	-1.0%	-2.2%
	Central	0.1%	-0.6%	-0.7%
	South	2.4%	1.2%	0.5%
	Statewide	1.4%	0.4%	-0.4%

Table 47: Percent Change in Logical Relationship to Risk—Condo Unit Floor Sensitivity (notional set 7)

Construction / Policy	Region	Percent Change in Loss Cost			
		3rd Floor	9th Floor	15th Floor	20th Floor
Condo Unit A	Coastal	8.2%	8.2%	8.2%	8.2%
	Inland	3.9%	3.9%	3.9%	3.9%
	North	3.5%	3.5%	3.5%	3.5%
	Central	5.6%	5.6%	5.6%	5.6%
	South	9.4%	9.4%	9.4%	9.4%
	Statewide	7.4%	7.4%	7.4%	7.4%
Condo Unit B	Coastal	9.4%	9.4%	9.4%	9.4%
	Inland	5.0%	5.0%	5.0%	5.0%
	North	5.3%	5.3%	5.3%	5.3%
	Central	6.4%	6.4%	6.4%	6.4%
	South	10.7%	10.7%	10.7%	10.7%
	Statewide	8.9%	8.9%	8.9%	8.9%

Table 48: Percent Change in Logical Relationship to Risk—Number of Stories Sensitivity (notional set 8)

Construction / Policy	Region	Percent Change in Loss Cost		
		1 Story	2 Story	
Frame Owners	Coastal	-0.8%	-0.8%	
	Inland	-2.7%	-2.8%	
	North	-2.3%	-2.3%	
	Central	-2.4%	-2.5%	
	South	0.0%	0.1%	
	Statewide	-1.2%	-1.2%	
Masonry Owners	Coastal	-0.9%	-0.8%	
	Inland	-2.7%	-2.9%	
	North	-2.3%	-2.3%	
	Central	-2.4%	-2.5%	
	South	0.0%	0.1%	
	Statewide	-1.2%	-1.1%	
Frame Renters	Coastal	-21.1%	-18.3%	
	Inland	-14.9%	-14.0%	
	North	-10.7%	-9.9%	
	Central	-16.4%	-15.0%	
	South	-23.4%	-20.2%	
	Statewide	-20.4%	-17.8%	
Masonry Renters	Coastal	-0.4%	-3.3%	
	Inland	1.4%	-2.4%	
	North	17.1%	9.3%	
	Central	2.6%	-1.4%	
	South	-3.6%	-5.6%	
	Statewide	-0.2%	-3.2%	
Construction / Policy	**Region**	**Percent Change in Loss Cost**		
		5 Story	**10 Story**	**20 Story**
Commercial Residential	Coastal	2.1%	1.8%	1.4%
	Inland	0.1%	0.0%	-0.3%
	North	0.2%	0.0%	-0.4%
	Central	0.4%	0.1%	0.0%
	South	2.8%	2.5%	2.1%
	Statewide	1.8%	1.5%	1.2%

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.

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.

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.

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.

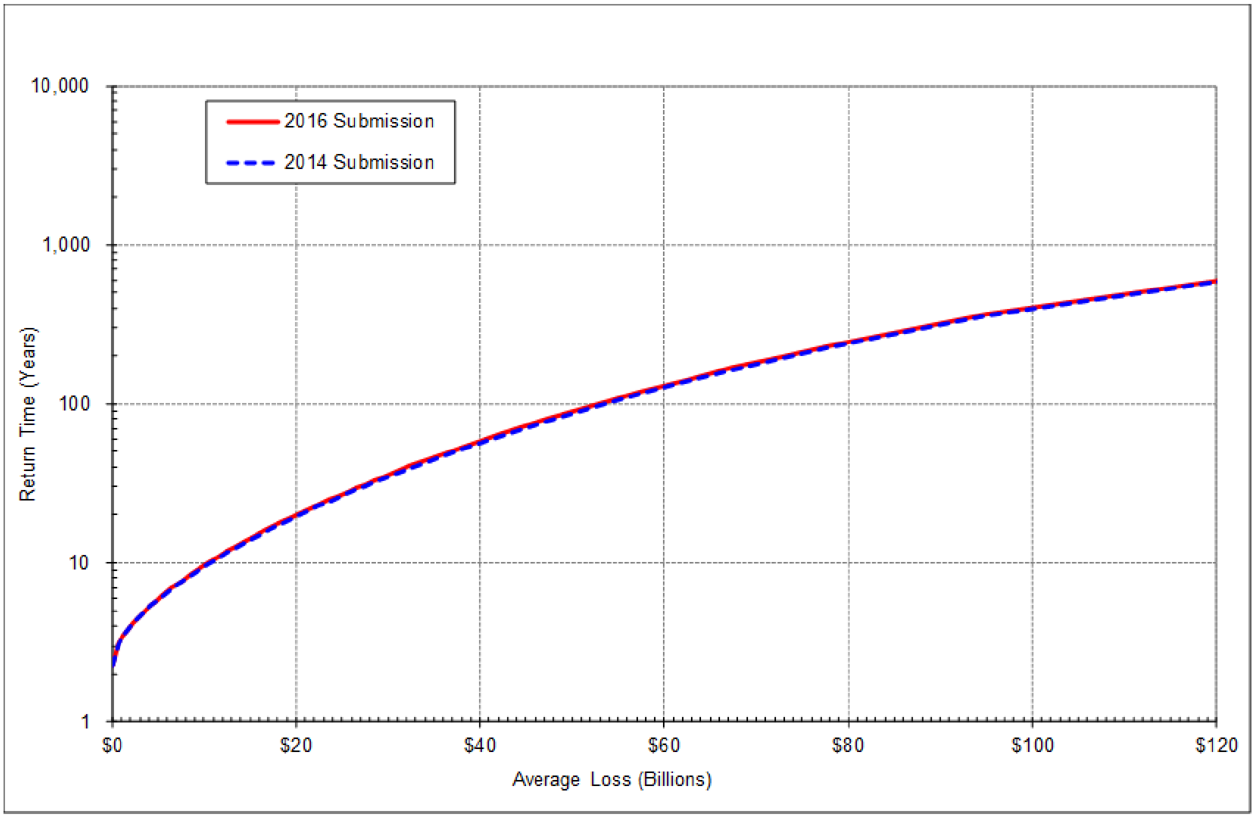
E. Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the standards year, and the form name. Also include Form A-8, Probable Maximum Loss for Florida, in a submission appendix.

To calculate the expected annual hurricane losses, the loss for each event in the range is multiplied by its annual rate of occurrence, and the products are summed across the range. The return time is calculated as the reciprocal of the exceedance probability of the average loss in each range. The return time is rounded to the nearest year.

The 5% / 95% uncertainty interval for each return period was derived from the beta distribution of the event with the mean loss closest to the "estimated loss level" for that return period.

The results of the calculations are shown in the file RMS15FormA8.xlsx at the link provided to the FCHLPM and appear in the following tables.

Figure 91: Comparison of Current Submission Return Times to the Prior Year's Submission Return Times



Part A – Personal and Commercial Residential Probable Maximum Loss for Florida

Table 49: Distribution of Hurricanes by Size of Loss for the 2012 FHCF Combined Personal and Commercial Residential Aggregate Exposure Data

LOSS RANGE (MILLIONS)			TOTAL LOSS	AVERAGE LOSS (MILLIONS)	NUMBER OF HURRICANES	EXPECTED ANNUAL HURRICANE LOSSES*	RETURN PERIOD (YEARS)
$ -	to	$ 500	$ 741,836	$ 108	6,889	$ 52,662,050	2
$ 501	to	$ 1,000	$ 910,237	$ 725	1,255	$ 66,897,812	3
$ 1,001	to	$ 1,500	$ 1,000,040	$ 1,233	811	$ 61,217,368	3
$ 1,501	to	$ 2,000	$ 1,109,284	$ 1,750	634	$ 62,225,208	4
$ 2,001	to	$ 2,500	$ 1,327,899	$ 2,243	592	$ 78,276,588	4
$ 2,501	to	$ 3,000	$ 1,568,447	$ 2,747	571	$ 65,289,894	4
$ 3,001	to	$ 3,500	$ 1,676,277	$ 3,249	516	$ 48,847,664	5
$ 3,501	to	$ 4,000	$ 1,697,712	$ 3,748	453	$ 52,531,417	5
$ 4,001	to	$ 4,500	$ 1,797,692	$ 4,240	424	$ 54,913,519	5
$ 4,501	to	$ 5,000	$ 1,767,623	$ 4,752	372	$ 44,925,930	6
$ 5,001	to	$ 6,000	$ 3,594,014	$ 5,479	656	$ 118,426,624	6
$ 6,001	to	$ 7,000	$ 3,627,731	$ 6,490	559	$ 171,301,824	7
$ 7,001	to	$ 8,000	$ 3,905,081	$ 7,495	521	$ 181,604,286	8
$ 8,001	to	$ 9,000	$ 4,062,709	$ 8,482	479	$ 107,476,232	8
$ 9,001	to	$ 10,000	$ 3,678,314	$ 9,480	388	$ 106,302,466	9
$ 10,001	to	$ 11,000	$ 3,540,939	$ 10,476	338	$ 117,117,777	10
$ 11,001	to	$ 12,000	$ 3,044,779	$ 11,490	265	$ 81,042,247	11
$ 12,001	to	$ 13,000	$ 3,052,991	$ 12,461	245	$ 67,647,283	12
$ 13,001	to	$ 14,000	$ 2,418,574	$ 13,512	179	$ 46,996,336	13
$ 14,001	to	$ 15,000	$ 3,292,612	$ 14,505	227	$ 98,132,848	14
$ 15,001	to	$ 16,000	$ 3,010,419	$ 15,518	194	$ 66,930,721	15
$ 16,001	to	$ 17,000	$ 2,905,944	$ 16,511	176	$ 66,199,723	16
$ 17,001	to	$ 18,000	$ 2,569,671	$ 17,481	147	$ 74,431,359	17
$ 18,001	to	$ 19,000	$ 3,030,965	$ 18,481	164	$ 93,405,247	18
$ 19,001	to	$ 20,000	$ 2,730,390	$ 19,503	140	$ 69,525,747	19
$ 20,001	to	$ 21,000	$ 3,017,082	$ 20,524	147	$ 82,925,046	21
$ 21,001	to	$ 22,000	$ 3,190,418	$ 21,557	148	$ 58,990,945	22
$ 22,001	to	$ 23,000	$ 2,566,750	$ 22,515	114	$ 40,501,680	23
$ 23,001	to	$ 24,000	$ 2,726,170	$ 23,501	116	$ 45,576,958	25
$ 24,001	to	$ 25,000	$ 2,866,981	$ 24,504	117	$ 56,539,899	26
$ 25,001	to	$ 26,000	$ 2,374,004	$ 25,527	93	$ 38,092,225	28
$ 26,001	to	$ 27,000	$ 2,570,704	$ 26,502	97	$ 46,372,977	29
$ 27,001	to	$ 28,000	$ 2,503,059	$ 27,506	91	$ 30,716,550	31
$ 28,001	to	$ 29,000	$ 2,479,467	$ 28,500	87	$ 32,571,043	33
$ 29,001	to	$ 30,000	$ 2,650,552	$ 29,451	90	$ 47,903,794	35
$ 30,001	to	$ 35,000	$ 11,713,757	$ 32,358	362	$ 195,005,366	40

LOSS RANGE (MILLIONS)					TOTAL LOSS		AVERAGE LOSS (MILLIONS)		NUMBER OF HURRICANES	EXPECTED ANNUAL HURRICANE LOSSES*		RETURN PERIOD (YEARS)
$	35,001	to	$	40,000	$	9,987,320	$	37,406	267	$	112,925,634	52
$	40,001	to	$	45,000	$	9,222,155	$	42,303	218	$	97,334,618	65
$	45,001	to	$	50,000	$	7,230,973	$	47,261	153	$	93,603,884	80
$	50,001	to	$	55,000	$	7,632,407	$	52,277	146	$	83,698,688	98
$	55,001	to	$	60,000	$	5,500,578	$	57,298	96	$	73,936,966	118
$	60,001	to	$	65,000	$	7,420,693	$	62,359	119	$	80,912,435	141
$	65,001	to	$	70,000	$	4,455,665	$	67,510	66	$	30,169,018	168
$	70,001	to	$	75,000	$	4,867,078	$	72,643	67	$	50,529,598	198
$	75,001	to	$	80,000	$	5,115,492	$	77,507	66	$	30,027,701	228
$	80,001	to	$	90,000	$	8,888,270	$	84,650	105	$	57,378,442	279
$	90,001	to	$	100,000	$	7,024,239	$	94,922	74	$	45,357,601	363
$	100,001	to	$	Maximum	$	57,944,741	$	162,310	357	$	295,145,669	1,350
Total					**$**	**236,010,732**	**$**	**11,574**	**20,391**	**$**	**3,780,544,907**	**11**

*Personal and commercial residential zero deductible statewide loss using 2012 FHCF personal and commercial residential exposure data—file name: hlpm2012c.exe.

Part B – Personal and Commercial Residential Probable Maximum Loss for Florida (Annual Aggregate)

Table 50: Estimated Loss for Each of the Return Periods Given for the 2012 FHCF Combined Personal and Commercial Residential Aggregate Exposure Data

Return Period (Years)	Estimated Loss Level	Uncertainty Interval			Conditional Tail Expectation
Top Event	596,874,795,022	403,847,578,782	to	811,305,453,997	---
1,000	144,607,139,793	72,414,837,081	to	236,160,372,692	211,304,839,270
500	108,873,250,497	66,905,623,350	to	159,300,107,465	167,679,176,166
250	80,657,364,652	49,124,850,094	to	118,365,091,621	130,114,154,770
100	52,862,651,563	24,865,066,853	to	89,142,164,906	90,418,829,586
50	36,692,314,869	14,767,277,910	to	66,471,484,992	66,985,982,678
20	20,028,501,480	6,730,488,389	to	39,014,523,214	42,828,034,078
10	10,450,521,444	4,446,965,862	to	18,488,108,995	28,650,275,284
5	3,584,887,877	192,586,384	to	10,666,589,497	17,533,171,089

Part C – Personal and Commercial Residential Probable Maximum Loss for Florida (Annual Occurrence)

Table 51: Estimated Loss for Each of the Return Periods Given for the 2012 FHCF Combined Personal and Commercial Residential Occurrence Exposure Data

Return Period (Years)	Estimated Loss Level	Uncertainty Interval			Conditional Tail Expectation
Top Event	596,874,795,022	403,847,578,782	to	811,305,453,997	---
1,000	139,786,332,712	67,741,288,585	to	232,416,259,434	206,463,757,015
500	104,103,187,876	41,283,303,352	to	189,232,218,403	162,871,462,102
250	76,173,841,002	45,107,667,055	to	113,611,403,583	125,382,052,368
100	49,181,311,422	25,642,542,880	to	78,883,107,782	86,103,238,265
50	33,810,414,694	14,080,479,977	to	60,362,195,845	63,204,189,013
20	18,282,290,062	5,401,603,889	to	37,280,522,575	39,976,045,349
10	9,534,779,410	2,828,222,186	to	19,427,075,773	26,584,791,442
5	3,305,589,715	1,143,098,443	to	6,374,395,815	16,236,270,767

APPENDIX B—RMS TECHNICAL STAFF

Yasuyuki Akita

Since joining RMS in April 2015, Yasu has been involved in several projects as geospatial modeling specialist. Last year, Yasu developed new methodologies to estimate the standard of protection of flood defenses for the U.S. inland flood and North Atlantic hurricane storm surge models. He was also involved in model calibration efforts for the North Atlantic Hurricane Models version 17.0 release and performed post-event field reconnaissance after Hurricane Matthew (2016) in the Carolinas. Yasuyuki has a BS and MS degree in Physics from Sophia University in Japan and PhD degree in environmental science from the University of North Carolina at Chapel Hill (UNC-CH). During this time, he conducted postdoctoral research in air pollution exposure assessment at UNC-CH and Centre for Research in Environmental Epidemiology (CREAL) in Barcelona, Spain.

Hurricane Project Responsibilities: Hurricane claims analysis; testing of the vulnerability component of software

Cathy Ansell, PhD, Manager, Model Development

Catherine joined the RMS London model development team in 2014. She leads the event response team at RMS, monitoring and evaluating events as they occur in real time and developing the processes by which RMS supports our clients in the days prior to and weeks following major storms. Prior to RMS, Catherine worked at Hiscox in London. Catherine holds an MPhys from Oxford and a PhD in atmospheric physics from Imperial College London.

Hurricane Project Responsibilities: Updating historical reconstructions

Irina Behnert, PhD, Senior Project Manager

Dr. Irina Behnert is responsible for the coordination and delivery of climate models such as: Europe windstorm, North Atlantic hurricane, Europe flood, and Japan typhoon. Prior to joining RMS, she was a senior research scientist at National Physical Laboratory, U.K. where she coordinated the calibration and validation of satellite over-land targets in Antarctica and Turkey in the framework of European Space Agency program. She worked in remote sensing and atmospheric science projects with governmental bodies and SME in the U.K., France, and Germany for more than eight years. Dr. Behnert received a PhD in physics and an MSC (DEA) in history from Pantheon Sorbonne, Paris.

Hurricane Project Responsibilities: Program management for RiskLink 15.0 release

Enrica Bellone, PhD, Senior Director, Modeling

Dr. Bellone is responsible for researching and implementing advanced modeling techniques. Prior to joining RMS, she conducted postdoctoral research in statistics as applied to the atmospheric sciences, first at the National Center for Atmospheric Research in Boulder, Colorado, and then at University College London. Dr. Bellone received a PhD in statistics from the University of Washington.

Hurricane Project Responsibilities: Lead of hazard and frequency updates, development of the stochastic tracks set, and review of the model from a statistical point of view

Suman Kumar Bhattacharya, Software Architect, Software Engineering

Suman has a diploma in electrical engineering from RK Mission Shilpamandira, Kolkata, India and has worked for many well-known software technology companies for more than 12 years. For RMS, Suman works on RiskLink performance, unit tests for improving code quality, TFS administration, and various tools and technology for the application development team. Suman's experience includes user interface, business components, and database programming.

Hurricane Project Responsibilities: RiskLink performance, unit tests for improving code quality, TFS administration, and various tools and technology for the application development team

Masha Bilyak, Quality Engineer

Masha obtained her bachelor degrees in economics and management in Ukraine from the Polytechnic University in Lvov. Masha joined RMS in 2000 in the quality assurance department. Some of her key functions have been working on RiskLink and RiskBrowser, and testing related projects.

Hurricane Project Responsibilities: Software quality assurance.

Auguste Boissonnade, PhD, CTO

Dr. Boissonnade was the original architect of the RMS hurricane catastrophe models and has over 20 years of professional experience in structural analysis and design, natural hazard modeling, and risk assessment of natural hazards in the U.S., Europe, Africa, and Asia. His expertise includes developing risk assessment models for natural hazards (earthquakes, extreme winds, floods and other weather phenomena) for applications in risk assessment of critical facilities and insurance exposures. Dr. Boissonnade has a BS degree from Ecole Superieure des Travaux Publics (France) and a PhD from Stanford University where he has been a consulting professor. While at Stanford, Dr. Boissonnade performed research on damage estimation with application to the insurance industry. Prior to joining RMS, Auguste was a project leader at Lawrence Livermore National Laboratory with responsibilities for developing probabilistic seismic hazard guidelines for the U.S. Nuclear Regulatory Commission and guidelines on natural phenomena hazards for the Department of Energy. He is a member of several organizations including the American Meteorological Society and the American Society of Civil Engineers and a reviewer for the National Science Foundation. Dr. Boissonnade has authored more than 50 publications, including one book.

Hurricane Project Responsibilities: Loss amplification modeling, and advisor on science and technical issues

Sagar Bora, PhD, Senior Modeler

Sagar holds a PhD (Dr. rer. Nat) in physics from the University of Bremen, Germany for his work in ocean/climate modeling. During his PhD, he did a three-month internship at RMS and worked on the Europe Windstorm Model. After receiving his PhD, Sagar worked as a postdoctoral fellow in Kiel working on the bio-geo-chemical part of the Kiel Climate Model. Sagar joined RMS in March 2014.

Hurricane Project Responsibilities: Historical reconstructions

Jason Bryngelson, Director, Modeling

Jason has a BS in civil engineering and an MS in structural engineering from San Jose State University. He has worked on many types of risk models including earthquake, hurricane, terrorism and wildfire, developing hazard and vulnerability functions, site hazard details and designing model implementation methods. Jason joined RMS in 1995 as a consultant and was hired full time in 1997 and during his tenure has gained significant knowledge of the core RMS software and data design.

Hurricane Project Responsibilities: Data management, manage model data check-in to TFS/build engineer, debugging, knowledge transfer, advisor on RiskLink data and implementation details, documentation support

Jordan Byk, Senior Director, Model Product Management

Jordan is responsible for the planning, acquisition, documentation, marketing and high-level support for RMS geocoding software and data. He joined RMS in 2006 to manage the RMS weather risk business, taking the role of managing geocoding in 2008. Before joining RMS, Jordan worked with several large telecom and computer firms and several start-up companies managing infrastructure and leading edge technology product lines. He is a graduate of Carnegie Mellon with a BS in computer science and administrative management science, and of Rutgers University with an MBA in marketing and finance.

Hurricane Project Responsibilities: Functional specification, data acquisition, documentation, and go-to-market responsibilities for geocoding software and data

David Carttar, Senior Director, Geospatial Modeling

Mr. Carttar has BA degrees in geography and architectural studies from the University of Kansas, and a master of city planning degree from the University of California at Berkeley. For RMS, Mr. Carttar coordinates geocoding and mapping applications for the company's core technology. Mr. Carttar's experience revolves around the application of geographic modeling at a variety of technical levels.

Hurricane Project Responsibilities: Updating geocoding capabilities for all hurricane states

Monisha Chahal, Senior Manager, Geospatial Modeling

Ms. Chahal received a bachelor’s degree in architecture and a masters in computer programming from IBM Education, New Delhi. She has over 10 years of experience in geospatial data development, including five years focused specifically on data design and development. She leads development of the base map for the RMS global location module, and has contributed to ZIP Code data updates in the U.S.

Hurricane Project Responsibilities: Updating geocoding capabilities for all hurricane states

Umesh Chander, Principal Quality Engineer

Umesh has an MS degree in computer science from Northwestern Polytechnic University, Fremont, CA. He has been with RMS for the last 10 years, in the quality assurance department working on EGC, RiskLink, DPM, and, RMS(one) testing related projects. Umesh’s main responsibilities are functional, performance/stress and automation testing.

Hurricane Project Responsibilities: QA testing of RiskLink/EGC software components

Ching-Yee Chang, PhD, Senior Engineer, Model Certification

Dr. Ching-Yee Chang received her PhD in chemical physics with specialization in atmospheric and oceanic sciences from the University of Maryland, College Park. She has over 10 years of experience in analyzing geophysical data, with her focus on addressing the topics in climate model biases, climate variability, and climate change.

Hurricane Project Responsibilities: Validating hurricane model methodology and implementation

Chethana Chidambara, Senior Software Engineer

Chethana joined RMS in February 2014. She has a bachelor’s degree in computer science and engineering from Bangalore University, India. Prior to RMS, Chethana has over 13 years of experience in the software industry.

Hurricane Project Responsibilities: Implement UI requirements and installer maintenance

Tommy Chou, Principal Solutions Consulting Manager

Tommy joined RMS in February of 2007. He received a BA in developmental studies of industrial societies from the University of California at Berkeley.

Hurricane Project Responsibilities: Certify RMS catastrophe models on EGC/HPC and RDP platform

Karen Clarke, Senior Director, Program Management

Ms. Clarke joined RMS in 2010. She received a BSE in biomedical engineering from the University of Iowa. At RMS, Ms. Clarke leads the model development project management organization. She has led various software, model, and client engagement projects at RMS. Prior to joining RMS, Ms. Clarke worked in the financial risk management software industry.

Hurricane Project Responsibilities: Leads overall program management for the RiskLink 15.0 release, coordinating tasks and milestones across the model, software, and deployment teams

Kay Cleary, Director, Regulatory Practice

Ms. Cleary joined RMS in October of 2006. She has over 25-years' experience in property/casualty insurance with a focus on personal property lines catastrophe risk. She has worked in both the public and private sectors, with stints at Florida's Office of Insurance Regulation and Florida Citizens Property Insurance Corporation. She spent 10 years with Allstate at their research and planning center and several years with Aon Re Services.

Ms. Cleary is an ex-chair of the American Academy of Actuaries' Property/Casualty Risk-Based Capital Committee, was on the Academy Task Force authoring Actuarial Standard of Practice #38 and co-authored "Reserving for Catastrophes," summarizing a proposal for pre-event tax-deferred catastrophe reserves in the Fall 2002 Forum. She served on the Florida Commission on Hurricane Loss Projection Methodology 2001–2002. Ms. Cleary is a fellow of the Casualty Actuarial Society, a member of the American Academy of Actuaries and has a bachelor of arts from Northwestern University.

Hurricane Project Responsibilities: Review of model from an actuarial viewpoint and lead contact for RMS with the Florida Commission on Hurricane Loss Projection Methodology

Peter Datin, PhD, Principal Modeler

Since joining RMS in June 2011, Peter worked on the vulnerability development for U.S. and Caribbean hurricane and U.S. severe convective storm models. He has been involved on several claims analysis projects for wind-related catastrophes, site specific risk analyses for various structures and field reconnaissance for hurricanes Irene (2011), Sandy (2012), and Matthew (2016), as well as the Moore, OK tornado outbreak (2013). Peter has taught a graduate level course (Fundamentals and Application of Wind Engineering) at Stanford University as a part-time lecturer. Prior to joining RMS, Peter received his PhD from the University of Florida in Gainesville, where he researched structural load paths in low-rise, wood-framed structures and worked on structural testing of metal roof decking, light-frame residential building components, and water ingress through windows from wind-driven rain as a post-doctoral research assistant.

Hurricane Project Responsibilities: Development & implementation of wind and storm surge vulnerability functions; research and update of secondary modifier impacts

Sushil Dhyani, Principal QA Engineer

Sushil joined RMS in March 2004, he worked on RiskLink and other RMS projects and developed several utilities for model certification. Currently he is responsible for RiskLink 15.0 model regression to ensure RiskLink generates the correct results for all models. He is a graduate of (MCA) master of computer application and master of computer science from the University of Rohtak (India).

Hurricane Project Responsibilities: Model regression of RiskLink

Mark Dixon, PhD, Principal Modeler

Mark joined RMS in February 2010, in the London model development team. He has worked on the 2011 Europe Windstorm Models; the RMS tropical cyclone rain model; and is currently responsible for historical reconstructions both for the RMS Japan Typhoon Model upgrade, and the North Atlantic Hurricane Models. Prior to RMS, Mark was at the UK Met Office for 10 years, where he developed data assimilation methods for numerical weather prediction models. Before this he performed post-doctoral research at the University of Reading (U.K.) on extra-tropical cyclones. Mark has a PhD in physics, and has numerous peer-reviewed publications in data assimilation, meteorology, and condensed-matter physics.

Hurricane Project Responsibilities: Historical reconstructions

Michael Drayton, PhD, Consultant, Model Development

Dr. Drayton holds a PhD in applied mathematics from the University of Cambridge and a first class honors degree in civil engineering from New Zealand. Dr. Drayton is primarily involved in the research and development of hazard models. Since joining the RMS London office in early 1996 he has worked on the Europe Windstorm Models, the North Atlantic Hurricane Models and the U.K. flood project. He has extensive experience of insurance-related hazard modeling and has also worked as a researcher investigating river flooding and pollution dispersion in the environment. Currently, Dr. Drayton consults to RMS full-time.

Hurricane Project Responsibilities: Review of the hazard model

Weimin Dong, PhD, Chief Risk Officer

Dr. Dong is a co-founder of RMS. He has over 30 years of industrial, teaching, and research experience specializing in seismic hazard evaluation and insurance and financial risk assessment. He is the chief architect of the RMS catastrophe models, and has overseen the company's research and development efforts since its inception. Dr. Dong is currently focusing his efforts on further developing the P&C RAROC methodologies, including the RAROC ASP development and various optimization routines. Prior to founding RMS, Dr. Dong served as the Director of Earthquake Research for the General Research Institute, Ministry of Machine Building in China. Dr. Dong received his PhD from Stanford University, and his master of engineering mechanics from Shanghai Jiao Tong University. During his career, he has published books, technical reports, and over 100 papers.

Hurricane Project Responsibilities: Advisor on science and technical issues

Laura Eads, PhD, Senior Modeler

Since joining RMS in October 2013, Laura has worked extensively on hurricane claims data analyses to support the version 15.0 North Atlantic Hurricane Models update and also leads the structural modeling efforts for the New Zealand Earthquake Model update. Prior to joining RMS, she was a research & development engineer at OpenSees, Berkeley, where she developed finite element models and nonlinear modeling techniques in structural engineering. Laura has a PhD in civil and environmental engineering from Stanford University, where her research focused on collapse risk assessment of buildings subject to lateral forces.

Hurricane Project Responsibilities: Hurricane claims analysis; testing of the vulnerability component of the software

David Gatey, PhD, Principal Modeler, Model Development

Dr. Gatey joined RMS in 2011 and holds a PhD from the University of Western Ontario, where he researched the standardization and statistical analysis of extreme winds and worked in the commercial wind tunnel carrying out local wind climate studies to assess design criteria for numerous buildings and projects. Since joining the RMS London office, David has worked on both hazard and vulnerability development and has been involved with the Europe Windstorm Model, Europe Flood Models, and North Atlantic Hurricane Models. Dr. Gatey also holds a bachelor's degree in civil and structural engineering from the University of Western Ontario.

Hurricane Project Responsibilities: Updating the land-use land-cover data

Olga Goldin, QA Engineer

Olga has a diploma in power engineering and in economics from Azerbaijan University of Oil and Chemistry, Baku, Azerbaijan. She has about 15 years of extensive experience in software quality assurance for Windows-based applications. Olga joined RMS in April 1996 as a contractor and became a full time employee in September 1996. She is responsible for the testing different aspects of RiskLink and RiskBrowser applications including user interface, business components, functionalities, and databases.

Hurricane Project Responsibilities: Testing of the software related to the hurricane model

David Glaubman, Principal Architect

Mr. Glaubman joined RMS in October 2004 as a lead software developer. His responsibilities have included management of the team responsible for application infrastructure. Prior to joining RMS, he led development of several financial software products for Barra, Inc. Mr. Glaubman graduated from Northeastern University in Boston with a BS in mathematics. He is a member of IEEE and the Association for Computing Machinery (ACM).

Hurricane Project Responsibilities: Involved in the design and implementation of software libraries and components used by the loss model engine

Nathalie Grima, Senior Principal Software Engineer

Ms. Grima joined RMS in November 2004 as a financial modeler. Her responsibilities include development and quality assurance of new financial model related features. Prior to joining RMS, she was a mathematics graduate student at San Jose State University. Ms. Grima is a graduate of the University of Paris IX Dauphine with a degree in mathematics.

Hurricane Project Responsibilities: Involved in the design, documentation, and quality assurance of the financial model

Timothy Hall, PhD, Consultant

Dr. Hall is a senior scientist at the NASA Goddard Institute for Space Studies in New York, where he conducts research in ocean and atmospheric science. He has worked in diverse areas, including upper atmosphere dynamics, ocean transport and carbon cycle studies. Hall received a PhD in physics from Cornell University and performed post-doctoral work in atmospheric science at Columbia University in New York and Monash University in Melbourne, Australia.

Hurricane Project Responsibilities: Scientific consultant for RMS, helping to construct components of the North Atlantic tropical cyclone model

Sarah Hartley, Modeler

Sarah joined the RMS London model development team in 2013 working as part of the RMS event response team. Sarah was responsible for monitoring and evaluating events as they occur in real time and developing the processes by which RMS supports clients in the days prior to and weeks following major storms. Prior to RMS, Sarah worked at URS Corporation Ltd in air quality modeling and consulting. Sarah holds an MSc in applied meteorology from the University of Reading.

Hurricane Project Responsibilities: Updating historical reconstructions

Tim Huth, Associate Product Manager, Risk Analytics

Mr. Huth has an MA degree in environmental studies from Brown University in Providence, Rhode Island. He joined RMS in July 2012. After completing the risk analyst program, he joined the client support and services group.

Hurricane Project Responsibilities: Generation and QA of actuarial, statistical, and vulnerability forms

Jara Imbers, PhD, Lead Modeler

Jara Imbers joined the RMS model development team in October of 2012. In her role as a senior catastrophe modeler Jara has worked on various components of the RMS North Atlantic and North West Pacific tropical cyclone models, including historical reconstructions. Currently Jara leads the medium-term rates of the North Atlantic Hurricane Models.

Prior to starting at RMS, Jara held a postdoctoral research position at the department of applied mathematics in Oxford University, working on the uncertainty analysis of climate change. Jara holds an MPhys in theoretical physics and a PhD in theoretical physics from the University of Nottingham, U.K.

Hurricane Project Responsibilities: Development of historical footprints

Atin Jain, Principal Software Engineer

Mr. Atin Jain has an MS degree in physics with specialization in electronics from Awadhesh Pratap Singh University Rewa, India and has seven-years industry experience. For RMS, Mr. Atin Jain works on geocoding and hazard software components of the RiskLink and RiskBrowser products.

Hurricane Project Responsibilities: Development and modification of spatial hazard software component, design and implementation of upgrades to the geocoding software component

Jo Kaczmarska, PhD, Lead Modeler

Jo joined RMS in April 2013 after completing a PhD in statistical science from University College London. Prior to her PhD, Jo worked in the life insurance and investment industries. Recent roles involved developing and managing a customer insight team, and providing financial analysis to support product development and strategic initiatives. She is a fellow of the Institute and Faculty of Actuaries. Since joining RMS, Jo has worked on the Japan Typhoon Model and the North Atlantic Hurricane Models.

Hurricane Project Responsibilities: Historical reconstructions, hazard model validation

Vidya Karthigeyan, Principal Software Engineer

Mrs. Karthigeyan has a master of science in business administration degree in computer information systems from California State University, East Bay and MS in software systems from Birla Institute of Technology and Science, Pilani, India. In the past she worked for Geometric Software Solutions Co. Ltd. in India for four years. At RMS, Mrs. Karthigeyan works on software components of RiskLink product.

Hurricane Project Responsibilities: Enhancements to the software components associated with data generation for the hurricane model.

Shree Khare, PhD, Senior Director, Modeling

Shree has been working in the London model development group since 2006, and in that time has worked on a variety of projects, including hurricane wind model development, uncertainty quantification, catastrophe response, correlation calibration, and clustering in the North Atlantic Hurricane and Europe Windstorm Models. Currently, Shree is leading hazard development for the RMS Japan Typhoon Model upgrade. Prior to joining RMS, Shree completed two postdoctoral research fellowships: one at the Statistical and Applied Mathematical Sciences Institute (SAMSI) in Research Triangle Park, NC, and the second at the National Center for Atmospheric Research (NCAR) in Boulder, CO. Shree has a BS in honors physics from the University of British Columbia, and a PhD from the atmospheric sciences program at Princeton University with specialization in ensemble data assimilation. He has numerous peer reviewed journal publications on data assimilation and risk modeling.

Hurricane Project Responsibilities: Wind model development and clustering

Veena Krishnamoorthy, Lead Modeler, Model Certification

Veena received her master's of science in physics from Madurai Kamaraj University. She has been with RMS since 2010 in the analytics QA department working on the financial model QA team.

Hurricane Project Responsibilities: Quality assurance for RiskLink

James Lord, Senior Director, Application Support Engineering

Based in California, James manages performance requirements and technology issues for RMS software products. He works with clients in the installation, deployment, and configuration of RMS software and incorporates client needs into the design of new releases. James came to RMS from a combined technology and civil engineering background. As vice president of product management and technology at Visual Network Design, he was responsible for the success of the startup's enterprise data center management software, Rackwise. Prior to that, he was a senior structural engineer at URS Corporation. A licensed California civil and structural engineer, James holds a BS and MS in civil engineering from the University of California Berkeley, and Carnegie Mellon University, respectively. James also holds the Certified Catastrophe Risk Analyst (CCRA®) designation.

Hurricane Project Responsibilities: Technology, deployment, and performance product management for RiskLink software

Jenny Lu, Principal Software Engineer

Ms. Jenny Lu has an MS degree in computer science specialization in software design and development. Jenny joined RMS in 2013. Prior to RMS, she has more than 15-years industry experience. For RMS, Ms. Jenny Lu works on financial model engine software components of the RiskLink and RiskBrowser products and reports.

Hurricane Project Responsibilities: Financial Model implementation; report implementation

Manabu Masuda, P.E., Senior Director, Modeling

Mr. Masuda has a BS and an ME degree in engineering from Kobe University, and an MS in civil engineering from Stanford University. For RMS, Mr. Masuda has been engaged in multiple risk models including Japan earthquake, Mexico earthquake and China typhoon. Specifically, for the version 11.0 U.S. hurricane update, he developed the Industrial Facility Model and the Builders Risk Model. He is also responsible for the maintenance of complex relational databases, client services, and QA of various data layers.

Hurricane Project Responsibilities: Development and QA of the vulnerability module

Nicolas Joss Matthewman, PhD, Principal Modeler

Joss joined the RMS London model development team in March 2012. In his role as lead catastrophe risk modeler Joss has worked on the RMS North Atlantic and North West Pacific tropical cyclone models. Prior to starting at RMS, Joss held a postdoctoral research associate position in the department of meteorology at the University of Reading, before spending two years researching physical climate mechanisms as a postdoctoral scholar at the University of California, Irvine. Joss holds an MSci in mathematics and a PhD in applied mathematics from University College London.

Hurricane Project Responsibilities: Updating the modeled hurricane landfall rates and development of historical footprints and binary files creation

Rohit P. Mehta, Director, Model Analytics

Mr. Mehta has a BE degree in civil engineering from Delhi College of Engineering, India and an MS in statistics from California State University Hayward. He joined RMS in 2000 and is primarily responsible for implementation, validations, and data management for various models. Prior to joining RMS, he gained four-years' experience in the testing, validation, and vulnerability implementation for various models.

Hurricane Project Responsibilities: Implementation, validation, testing, quality assurance, and data management

Akwasi Mensah, PhD, Modeler

Akwasi joined RMS in June 2015, and holds a PhD in Civil Engineering from Rice University, Houston, where he researched risk assessment of infrastructural systems under hurricane forces. He also earned an MSc from University of Florida, Gainesville, with research focus on wind force interactions with low-rise, wood-framed structures. Since joining RMS, Akwasi has worked on several claim analysis projects, and has done extensive research on wind vulnerability of residential and commercial buildings. As part of the RMS field reconnaissance team, he also investigated the impacts of hurricane Matthew (2016) in Florida and Georgia.

Hurricane Project Responsibilities: Research on secondary modifiers and vulnerability development; claim analysis, testing of the vulnerability component of software

Charles Menun, Consultant to RMS Model Development

Dr. Menun joined RMS as a lead vulnerability engineer in 2005 after spending five years as a faculty member in the Department of Civil and Environmental Engineering at Stanford University, where his research focused on the development of probabilistic methods for safety and performance assessment in earthquake engineering. Prior to joining Stanford, he worked for six years as a licensed structural engineer in Canada, where he supervised the structural design of residential and commercial high-rise buildings in the Greater Vancouver area. His responsibilities at RMS include overseeing the development of hurricane and earthquake vulnerability models. Since July 2009, Dr. Menun has provided his services to RMS as a full-time consultant. Dr. Menun holds bachelor's and master's degrees in civil engineering from the University of British Columbia and earned his doctoral degree in structural engineering from the University of California at Berkeley.

Hurricane Project Responsibilities: Development and calibration of the vulnerability module in RiskLink 11.0

Bruce Miller, Senior Director, Software Product Management

Bruce's charter is to oversee the development of products for the RiskLink software platform. He has been at RMS since 1995, starting as an account manager in the client development organization focused on our reinsurance clients (primarily the Bermuda market). Bruce then managed the product support organization when it was centralized in California, and for the last 11 years has been in the product management group. Prior to joining RMS, Bruce was an underwriter and loss control engineer with Kemper Insurance in the highly protected risk department. He holds a BS in engineering physics from the University of Colorado.

Hurricane Project Responsibilities: General software product management; oversight of user interface updates for defining hurricane analysis options; generation of functional specifications

Rakesh Mohindra, PhD, Assistant General Manager

Dr. Rakesh Mohindra received a PhD degree in earth sciences (applied geology) from the Indian Institute of Technology, Roorkee, India in 1989. Before joining industry (RMS), he carried out quality research work for more than 10 years in the inter-disciplinary fields of paleo-seismology, tectonics and historical geomorphology and published many research papers. Some of his research works in paleo-seismicity and historical geomorphology are well cited. During the last 14 years, working with RMS/RMSI, Dr. Mohindra played a key role in the development of the RMS fire following earthquake model for the U.S. and Canada, and the India Earthquake Model. Besides RMS models, he has also developed country level probabilistic loss models for Romania, Iran, Maldives, Southeast Europe, Yemen and Morocco under World Bank and UNDP consulting projects. The last two years he has been associated with model certification teams, and involved in independent, white box RiskLink model updates testing before the market release.

Hurricane Project Responsibilities: Responsible for model certification and testing

Gilbert Molas, PhD, VP Modeling

Dr. Molas is leading the model certification and model implementation teams within model development at RMS. His primary technical duties are to develop earthquake and climate stochastic models. He is also actively involved in several technical aspects of RMS worldwide risk models including calibration, validation, and product implementation. He has been a major contributor to the development of earthquake and windstorm models for the North America, Central and South America, Japan, Europe, and New Zealand, including securitization projects for these models. Before joining RMS in 1995, Dr. Molas graduated *Cum Laude* from the University of the Philippines, with a BS in Civil Engineering. He received his MS and PhD in civil engineering from the University of Tokyo in 1995, where he developed new earthquake ground motion attenuation relations and damage estimation techniques using Neural Networks. He has worked on catastrophe risk model development for more than twenty years.

Hurricane Project Responsibilities: Develop climate stochastic models including calibration, validation, and product implementation

Venkat Morampudi, Senior Principal Software Engineer

Mr. Morampudi has an MS in computer science from the University of Alabama and a BTech in computer science and engineering from Acharya Nagarjuna University, India. After he graduated, he started working for RMS in 2006. Mr. Morampudi has worked mainly on developing software for business workflow and application logic modules in RiskLink. He also worked on database design, programming and maintenance.

Hurricane Project Responsibilities: Maintain EDM/RDM database scripts including upgrade and downgrade of RiskLink databases; developing software for business workflow and application logic modules

Robert Muir-Wood, PhD, Chief Research Officer

Robert Muir-Wood heads up research and development efforts at RMS. Robert joined RMS in 1996 and has developed probabilistic catastrophe models covering earthquake, tropical cyclone, windstorm, and flood for Europe, North America, Australia, and Japan. Author of six books, many scientific publications, and more than 150 articles, he has been the technical lead on a number of catastrophe risk securitization transactions, and is lead author on Insurance, Finance and Climate Change for the 2007 (4th) IPCC Assessment Report. He is also a member of the OECD High Level Advisory Board of the International Network on Financial Management of Large-Scale Catastrophes.

Hurricane Project Responsibilities: Advisor on science and technical issues

Roopa Nair, Product Manager, Risk Analytics

Ms. Nair has an MS degree in statistics from Delhi University, India. She joined RMS in August 2007, in the model certification group.

Hurricane Project Responsibilities: Generation and QA of actuarial, statistical, and vulnerability forms

Matthew Nielsen, Senior Director, Regulatory Affairs

Mr. Nielsen holds an MS degree in atmospheric science from Colorado State University and a BA degree in physics from Ripon College in Wisconsin. Matthew liaises with U.S. regulators to establish open channels of communication around RMS models and solutions. He previously supported the product marketing and business development activities for the RMS U.S. and Canada climate hazard peril models and derivative products, and has served as lead contact for RMS in the submission to the Florida Commission on Hurricane Loss Projection Methodology. He is a member of the American Meteorological Society (A.M.S.) and has authored and presented technical papers at several A.M.S. conferences. He has been with RMS since September of 2005.

Hurricane Project Responsibilities: Support of North Atlantic Hurricane Models product management

Geoffrey R. Overton, Geospatial Modeler

Geoffrey has a diploma in geography from University of Nebraska, Omaha. For RMS, Mr. Overton develops, manages, and tests data for the geocoding module and related components.

Hurricane Project Responsibilities: Geocoding data implementation and management, testing of related software and data issues in support of the hurricane model

Narvdeshwar Pandey, Lead Modeler, Model Certification

Mr. Pandey joined RMSI in 2004. He has completed an MS in future studies and planning from Devi Ahilya University, Indore, India and another MS in mathematics from Gorakhpur University, India. He was involved in creating regression dataset for testing in RiskLink, and profile generation and internal tool development for creating regression dataset. He has also performed model QA for India Earthquake Model and currently involved with Europe Earthquake Model QA.

Hurricane Project Responsibilities: Involved in model implementation and QA of geocoding, hazard, and vulnerability files

Ghanshyam Parasram, Senior Director, Geospatial Software, RMSI

Mr. Parasram has a bachelor's degree in mechanical engineering from Jawahar Lal Nehru Technological University, India. He has over 10 years of experience in design and development of software applications using object oriented technologies. Prior to joining RMSI in 2006, Mr. Parasram worked as software manager for the business services group at RMS, managing software development for the application logic and workflow layer in RiskLink and RiskBrowser products. Between August 1997 and June 2000, Mr. Parasram worked as a development manager at Liquid Software Inc., building enterprise application integration systems that provide integration solutions to PeopleSoft and SAP. Prior to that, he worked at CMC India, developing financial applications for the banking industry. At RMSI, Mr. Parasram's primary role is to manage software and data development for the international geocoding component in RiskLink and RiskBrowser products.

Hurricane Project Responsibilities: Managing software development for the geocoding component in RiskLink and RiskBrowser products

Rahul Patasariya, Principal Software Engineer, Platform Development

Mr. Patasariya has three-years' experience in catastrophe risk modeling QA at RMSI. He graduated in civil engineering from Indian Institute of Technology, Roorkee, India. He was involved in creation of the regression dataset for testing in RiskLink and QA of tool for aggregate loss model during its development phases. Rahul is also involved with Europe Earthquake Model QA.

Hurricane Project Responsibilities: Model implementation and QA of geocoding, hazard, and vulnerability files

Sudha Raghavan, Product Management Director

Sudha is a senior SQL server database administrator and developer who joined RMS in 2008. She is involved in database data model implementation and database optimization, performance and scalability efforts. Prior to RMS, Sudha has 11 years of industry experience working on various database technologies.

Hurricane Project Responsibilities: Data model implementation and database optimization, performance and scalability efforts

Mohsen Rahnama, PhD, General Manager, Models & Data, Chief Risk Modeling Officer

Mohsen leads the model development team responsible for the creation of catastrophe models at RMS. He has participated in and been project lead in the development of many RMS models. Mohsen was involved with the development of several major models, including RiskLink 11.0 models, Offshore Platform, IFM and Builders Risk models. He oversaw the development of the 2009 earthquake models for North, Central, and South America. Mohsen has over 25 years of experience in the field of earthquake engineering, seismic structural analysis and design, building performance evaluation, catastrophe modeling, and risk assessment. He earned his MS, engineer's degree, and PhD from Stanford University specializing in earthquake and structural engineering.

Hurricane Project Responsibilities: Advisor on development and upgrade of hurricane vulnerability and inventory models

Edida Rajesh, Director, Spatial Modeling

Rajesh has a master's of technology in geophysics from Andhra University, Visakhapatnam, India and has been working with RMS / RMSI since 1996. For RMS, Rajesh works on providing GIS based analysis, developing hazard data products consumed by both natural catastrophe models and underwriting solutions. Rajesh's experience includes analyzing the requirements, project specification, coordination, and providing industry-standard GIS-based solutions in developing hazard data products.

Hurricane Project Responsibilities: Developing land-use land-cover (LULC) data for study area using satellite images and GIS analysis

Rhoderick Rivera, Senior QA Engineer

Mr. Rivera joined RMS in June of 2005, taking a position as a configuration release engineer. Currently he is handling order fulfillment and QA duties. He graduated from the University of Illinois, Urbana-Champaign with a degree in computer engineering. Previously he worked two years as a hardware engineer for Arise Computer and two and a half years as an account manager at Washington Mutual.

Hurricane Project Responsibilities: Fulfillment of client orders, and quality assurance

Christina Robertson, Senior Modeler

Christina Robertson joined RMS in March 2010, initially working in event response and now in the wider model development team. Her role in event response has given her exposure to several RMS tropical and extra-tropical cyclone models, primarily through the creation of wind reconstruction footprints.

Christina holds an MSc in atmosphere ocean and climate from the University of Reading, and a BSc (Hons) in physics with meteorology from the University of Edinburgh.

Hurricane Project Responsibilities: Development of historical footprints, historical storm loss analysis, updated the modeled hurricane landfall rates

Agustín Rodríguez, Director, Modeling, Model Development

Mr. Rodríguez joined RMS in July 1999 as a model developer. His responsibilities include development and implementation of various models, including windstorm, severe convective storm, earthquake, and terrorism. Mr. Rodríguez joined RMS after earning his MS degree from the University of California at Berkeley and his BS degree from Stanford University, both in civil engineering.

Hurricane Project Responsibilities: Implementation of U.S. hurricane vulnerability model

Tom Sabbatelli, Product Manager, Model Product Management

Mr. Sabbatelli joined RMS in 2009 upon completion of BS and MS degrees in meteorology from The Pennsylvania State University, where he studied the statistical influence of climate state variables on tropical cyclone frequency. As product manager of the North Atlantic Hurricane Models suite of products, he is responsible for the product's commercial success and technical specifications. Prior to his product management role, he spent several years in the RMS knowledge center organization, primarily providing specialist peril model support for incoming client inquiries. Mr. Sabbatelli is a member of the American Meteorological Society (AMS).

Hurricane Project Responsibilities: Product manager of North Atlantic Hurricane Models

Shraddha Sahay, Senior Manager, Software

Ms. Sahay has a bachelor's of electrical engineering from Visvesvaraya Technological University, Karnataka, India. She has worked for nearly seven years for software companies developing various enterprise applications. For RMS, Ms. Sahay works mainly in the geospatial area where she is involved in different aspects of hazard retrieval for RiskLink.

Hurricane Project Responsibilities: Detailed design and implementation of hazard retrieval for RiskLink

Chris Sams, Senior Product Manager, Geocoding

Joining RMS in 2003, Chris develops RMS geospatial data that covers the entire world. He has also participated in many RMS catastrophe model implementation features. Chris holds a BA in geography from the University Kansas and specialized in geographic information systems, remote sensing and cartography.

Hurricane Project Responsibilities: Geocoding development liaison to the model development team

Pooya Sarabandi, PhD, P.E., Senior Director, Modeling

Dr. Sarabandi holds a PhD degree in structural engineering from Stanford University as well as MS degrees in earthquake engineering and electrical engineering. Dr. Sarabandi is a licensed civil engineer in the state of California and currently serves as a consulting faculty at Stanford University where he established the Advanced Global Risk Assessment Laboratory (AGRAL.) Prior to joining RMS in 2007, Dr. Sarabandi was involved in research and development of wireless sensing devices for measuring structural response of buildings and bridges, used in early earthquake warning systems as well as structural health monitoring. Prior to that, he served as a consultant to number of risk and disaster management companies, specializing in application of remote sensing and statistical inference techniques in modeling and assessing risk to urban area.

Hurricane Project Responsibilities: Responsible for the business interruption model, and providing data and requirements for inventory and exposure development in the model

Emilie Scherer, PhD, Principal Modeler, Model Development

Dr. Scherer has been involved in various components of the hazard model including historical reconstructions and model validation. Prior to joining RMS, she conducted postdoctoral research in geophysical fluid dynamics applied to the atmospheric and oceanic sciences at the Laboratoire de Meteorologie Dynamique in Paris, France and at the Laboratoire des Ecoulements Geophysiques et Industriels in Grenoble, France. Dr. Scherer received a PhD in meteorology, oceanology, and environment from the University Pierre and Marie Curie in Paris, France.

Hurricane Project Responsibilities: Development of historical footprints, hazard model validation, binary hazard files creation

Debjani Sen, Senior Director, Technical Publications

Debjani has a master’s in liberal arts from Southern Methodist University, Dallas, Texas. Prior to RMS, she has worked in the software industry for over 11 years, providing documentation, online help, and tutorials for enterprise level software products. Debjani joined RMS in July 2007 and is responsible for the development and delivery of software documentation, model documentation, and online help for RMS customers.

Hurricane Project Responsibilities: Development and delivery of technical software documentation, and online help

Neha Shah, Engineer, Model Certification

Neha joined RMS in April 2007, after completing her bachelor’s degree in applied mathematics at the University of California, Los Angeles. She also has an MS degree in biostatistics from California State University, East Bay. Neha has tested a number of different financial model features in releases of RiskLink and RiskBrowser.

Hurricane Project Responsibilities: Involved with testing of financial model features in the 11.0 release, and development of necessary test tools

Richa Sharma, Senior Software Engineer

Richa joined RMS in September 2010. She has a bachelor's degree in information technology from Uttar Pradesh Technical University, India. Since joining RMS she has been actively involved in installation, performance and regression testing of RiskLink and RiskBrowser for every release. She is responsible for the testing of different aspects of RiskLink and RiskBrowser applications including user interface, business components, functionalities, and databases.

Hurricane Project Responsibilities: Testing installation of RiskLink software

Nilesh Shome, PhD, Vice President, Model Development

Nilesh joined RMS in 2009 as a director in the model development group. He is involved in developing and reviewing vulnerability functions of residential and commercial structures for U.S. hurricanes as well as vulnerability functions of tall buildings for western U.S. earthquakes. Nilesh has more than 10 years of professional experience in loss estimation of hurricanes, earthquakes, floods, winter storms, and other natural hazards as well as man-made hazards like terrorism. Prior to joining RMS, he managed a number of projects to develop and update models for earthquakes, hurricanes, and winter storms. He has also worked on several projects for securitization of risks for earthquakes and hurricanes and a number of world-bank projects to evaluate risks of different countries for earthquakes and hurricanes. Nilesh has also worked as a consultant to Federal Emergency Management Agency (FEMA) and Applied Technical Council (ATC). He has authored a number of publications in international journals and refereed conferences, and is a technical reviewer and editor of a number of papers for several journals. He received the EERI award for the best journal paper in the year 1998. Nilesh earned his PhD in structural engineering from Stanford University.

Hurricane Project Responsibilities: Involved in developing vulnerability functions of residential and commercial structures

Bronislava Sigal, PhD, Director, Modeling

Ms. Sigal received her BS degree (with honors) in mathematics from Kiev State University in Ukraine and PhD in statistics from Stanford University.

She joined RMS in March of 2009. After joining RMS as a part of the model development team Ms. Sigal worked on projects related to terrorism, account fire, and offshore platform RMS models. Currently Ms. Sigal is a part of the financial modeling group. Prior to joining RMS, she worked in the field of catastrophe modeling at K2 Technologies and after that at Stanford University as a biostatistician on stochastic modeling in cancer research.

Hurricane Project Responsibilities: Financial modeling

Ajay Singhal, PhD, Senior Vice President, Model Development

Ajay leads the financial modeling group at RMS and joined RMS in 2002. He has been involved in the development of hazard, vulnerability, and financial models for these perils. At RMS, he has been leading teams for the development of the various models such as the terrorism model for estimating losses from various man-made catastrophes, offshore platforms model for hurricane loss analysis to offshore oil & gas platforms, fire risk analysis for estimating losses from accidental and arson fires, and the fire following earthquake model. Ajay holds a BTech degree from the Indian Institute of Technology, Madras (India), an MS in civil engineering from Rice University, Houston, Texas, and a PhD in civil engineering from Stanford University, California specializing in probabilistic loss estimation.

Hurricane Project Responsibilities: Managing financial model development for RiskLink

Puja Sinha, Senior Principal Software Engineer

Ms. Sinha has a bachelor's degree in electrical engineering from Nagpur University, India. Puja joined RMS in 2007. Prior to joining RMS, she has 3 years of experience in software development. At RMS, Ms. Sinha works on RiskLink, RiskBrowser, RiskTools, and RiskOnline. Her responsibilities include software planning, designing, and implementation.

Hurricane Project Responsibilities: Software development

Jayant Srivastava, Senior Director, SW Engineering

Mr. Srivastava has an MS in computer science from the Institute of Management and Technology, India. For RMS, Jayant is managing the business services development group and develops software enhancements and fixes for various functionalities of core applications.

Hurricane Project Responsibilities: Job distribution framework for RiskLink

Beth Stamann, Senior Documentation Specialist

Beth joined RMS in August of 1995. She worked within the client development organization until October 2007 when she moved to the public policy group as senior documentation specialist. Beth is currently part of the model knowledge management group where her responsibilities include production and publishing of peril model documentation.

Hurricane Project Responsibilities: Production of RMS submission to the FCHLPM

Derek Stedman, Senior Modeler

Derek joined RMS in February 2014. He has since worked on the 2015 FCHLPM submission and the RMS Marine Cargo Model. Currently he is responsible for claims analysis used for vulnerability calibration and building code research. Derek has also been involved in field reconnaissance for the Louisiana flooding (2016) and hurricane Matthew (2016). Prior to joining RMS, Derek earned his master's degree in civil and environmental engineering from University of Western Ontario, Canada (UWO), where he focused on the area of wind engineering culminating with two full scale experiments to apply a simulated wind load to a two-story residential building.

Hurricane Project Responsibilities: Building code research; hurricane claims analysis; testing of the vulnerability component of software

Cody Stumpo, Director, Product Management

Cody is responsible for managing the RMS financial model for RMS core software products such as RiskLink and RiskBrowser. Prior to joining RMS, Cody worked in quantitative commercial credit risk management with Moody's KMV and as senior catastrophe analyst for the St. Paul Travelers Companies. He holds a BA in applied mathematics from the University of California, Berkeley and an MS in engineering from Purdue University.

Hurricane Project Responsibilities: Management of modeled hurricane losses in the financial model

William Suchland, Vice President, Core Products, Geospatial Development

Mr. Suchland has a BA degree in geography/computer assisted cartography from the University of Washington in Seattle, Washington. He has over 25 years of professional experience in software design, development, and technical project management. Prior to joining RMS in 1996, Mr. Suchland worked for over 15 years as a software developer and software development manager in the geo-demographics industry, building consumer marketing analysis systems and supporting GIS and mapping capabilities. At RMS, Mr. Suchland's primary role is manager of geospatial software and data development for the RiskLink and RiskBrowser products.

Hurricane Project Responsibilities: Management of software design and implementation

Avinash Takale, Senior Principal Software Engineer

Mr. Takale has a master's of computer applications from Shivaji University, Maharashtra, India. Prior to RMS, he has worked for seven years for software companies developing various desktop and enterprise applications. For RMS, Mr. Takale works mainly in the geospatial area where he is involved in different aspects of hazard data management and retrieval for RiskLink.

Hurricane Project Responsibilities: Implementation of migration of high resolution (spatial) hazard lookup from C++ to C# .NET and migration of hurricane hazard tabular lookup from MS Access to SQL

Joel Taylor, Senior Manager, Risk Analytics

Mr. Taylor has a BS degree in mathematics from Bradley University, Peoria, Illinois. He joined RMS in April 2007. After completing the risk analyst program, he joined the mitigation and regulatory affairs group. Mr. Taylor participated in post-hurricane reconnaissance visits after Hurricanes Gustav (2008) and Ike (2008).

Hurricane Project Responsibilities: Generation and QA of actuarial, statistical, and vulnerability forms

Daniel Temesi, Senior Software Engineer

Daniel Temesi joined RMS in April 2014. He has a master's degree in computer science and economics from University of Szeged, Hungary. Prior to RMS, Daniel has over seven years of experience in the software industry.

Hurricane Project Responsibilities: Implement import/export requirements and RiskTools maintenance

Srinivas Thupakula, Senior Modeler

Mr. Srinivas has a BS degree in civil engineering from the Indian Institute of Technology Kanpur, India. He joined RMS in September, 2011. Prior to joining RMS, Srinivas worked with the National Geophysical Research Institute in India to develop technologies for fault plane mapping and characterizing microseismicity in India and simulating design accelerograms for the Nuclear Power Corporation of India Ltd. At RMS, Srinivas has worked on exposure modeling for various perils, catastrophe response, and is the build data manager for RiskLink 15.0.

Hurricane Project Responsibilities: Build data manager for RiskLink 15.0

Monika Tomar, Project Manager, Analytical Services

Ms. Tomar completed her master's degree in computer applications in 2003 from Bundelkhand University, Jhasi, India. Ms. Tomar has over 11 years of experience in software design and development of software solutions.

Hurricane Project Responsibilities: Previously involved in RiskLink financial model software

Vahid Valamanesh, Senior Modeler

Vahid joined the Americas' climate peril vulnerability group at RMS as a senior modeler in April 2016 and is the architect of the component-based analytical flood vulnerability module for residential and commercial buildings to be used in the probabilistic U.S. flood and North Atlantic hurricane storm surge models. As part of the RMS field reconnaissance team, he performed post-event damage assessments after Louisiana floods (2016), and

Hurricane Matthew (2016) in the Carolinas. Vahid has a PhD in civil and environmental engineering from Northeastern University, where he developed a probabilistic model for analysis of extreme environmental conditions on offshore wind turbines in the Atlantic.

Hurricane Project Responsibilities: Research on wind, surge, and flood vulnerability

Kevin Van Leer, Senior Product Manager

Kevin has an MS in atmospheric science from the University of Illinois at Urbana-Champaign and a BS in atmospheric science from Purdue University. He joined RMS in July 2013. Kevin is a product manager for the Americas climate hazard peril models and derivative products. He is a member of the American Meteorological Society (A.M.S.) and has authored and presented technical papers at several A.M.S. conferences.

Hurricane Project Responsibilities: Support of North Atlantic Hurricane Models management

Yogesh Vani, Senior Manager, Software

Yogesh has an MS in telecommunication systems from California State University, Hayward. For RMS, he has worked on RiskLink installation and platform testing. In the past, Yogesh has also worked on remote distributed processing testing. His responsibilities include testing RiskLink installation across multiple OS platforms and SQL server combinations.

Hurricane Project Responsibilities: Testing installation of RiskLink software and DLM data

Rajkiran Vojjala, Senior Director, Model Development

Raj leads the engineering group for the RMS Americas' region climate perils—hurricane, storm surge, offshore wind and wave, tornado, hail, flood, and wildfire risks. Over the last 11 years, Raj has been involved in the design and development of several probabilistic risk models and model components at RMS. Raj was the architect of the offshore platform model to quantify hurricane risks from wind and waves to oil and gas platforms in the Gulf of Mexico as part of the version 11.0 North Atlantic Hurricane Models release. More recently, he led the U.S. Severe Convective Storm Model update, focusing on vulnerability and correlation of tornado, hail, and straight-line wind risks. In the last few years, Raj has led the research on wind vulnerability aspects through detailed claims investigation of past storms, field reconnaissance, and damage surveys after hurricanes Irene (2011), Sandy (2012), Matthew (2016), etc. He holds an MS in civil engineering from Stanford University and is an associate member of the Structural Engineering Association of Northern California and the American Society of Civil Engineers.

Hurricane Project Responsibilities: Development lead for the vulnerability component of RiskLink 17.0 North Atlantic Hurricane Models; vulnerability signatory

Paul Wilson, PhD, VP, Model Development

Dr. Wilson is the lead developer for the RMS North Atlantic hurricane and storm surge models. Paul joined RMS in 2007 and has overseen multiple projects including leading the RMS contribution to the risky business project on the economic risk of climate change in the United States, oversight of the RMS medium-term U.S. hurricane activity rate forecasts and the RMS real-time catastrophe response development agenda as well as supporting the RMS capital markets team in the development of parametric indices and their use of the RMS catastrophe models. Paul is a co-author of the *"American Climate Prospectus: Economic Risks in the United States"'* addressing the economic risks to the united states of global climate change.

Before joining RMS Paul worked for the Lighthill Risk Network, a not-for-profit organization dedicated to linking academia and industry as well as spending time in Aon's catastrophe modeling team in London. Paul has an MSc in physics and a PhD in atmospheric physics both from Imperial College London where his research focused on the application of extreme value statistics in the climate system and the impact of long-ranged correlations on extreme events.

Hurricane Project Responsibilities: Development lead across all model components

Michael Young, Senior Director, Model Product Management

Mr. Young holds an MSc from the University of Western Ontario in Canada where he studied wind loading on low-rise buildings. He was worked in commercial wind tunnel laboratories doing studies on wind loads for a variety of buildings. Before joining RMS, he worked as a modeler at Applied Research Associates on hurricane vulnerability risk models. He was involved in the development of the HAZUS-MH software for hurricane risk assessment and studies on mitigation cost-effectiveness for building codes, such as the 2001 Florida Building Code and the North Carolina Building Code. Mr. Young has conducted post-hurricane reconnaissance visits after Hurricanes Bonnie (1998), Isabel (2003), Charley (2004), Frances (2004), Ivan (2004), Jeanne (2004), Gustav (2008), and Ike (2008). He is a member of the American Society of Civil Engineers and the American Association of Wind Engineers.

Hurricane Project Responsibilities: Oversees product specifications for RMS climatic models including the North Atlantic Hurricane Models, oversees regulatory certification process

Christine Ziehmann, PhD, VP, Model Product Management

Dr. Ziehmann received her PhD in meteorology from the Free University of Berlin in 1994 where she also studied for her bachelor's and master's degrees in meteorology. Dr. Ziehmann joined RMS in 2001 from the Institute of Physics at the University of Potsdam (Max-Planck-Institute for Nonlinear Dynamics), Germany, where she held a post doc position with main research interest the predictability of weather and climate and nonlinear systems in general. Dr. Ziehmann was also a lecturer at the University of Potsdam and previously the University of Hamburg in theoretical meteorology, atmospheric boundary layer meteorology and non-linear time series analysis. In October 2007 Dr. Ziehmann was appointed as product manager for the Atlantic hurricane model after having various roles in RMS product management and weather derivatives business units. She is a member of the German Meteorological Society (DMG).

Hurricane Project Responsibilities: Advisor on science and technical issues

APPENDIX C—EXTERNAL EXPERT REVIEW OF HAZARD MODULE

28 October 2010

Vincent Daniel

Risk Management Solutions

Peninsular House, 30 Monument Street

London EC3R 8NB, UK

Subject: External Expert Review of Hazard Module of the RiskLink 11.0 North Atlantic Hurricane Model

Mr. Daniel,

The following summary reviews the Hazard Module Component of the RMS RiskLink 11.0 North Atlantic Hurricane Model (NAHU). The analysis is based upon 10 days of direct meetings with the NAHU team, significant inquiry during and following the meetings, and independent research, over a period of 18 months.

a. Overview

The latest version of the RMS NAHU model is sound, incorporates numerous developments in the science since the last version, and based upon statistical analysis of the performance, appears to be a considerable improvement in bias reduction. Key state of the art science additions to the model include:

i. The incorporation of an improved inland decay model that models much more correctly the rate of decay inland

ii. The use of the H*Wind dataset archive to more correctly capture the variability in two-dimensional wind structure observed within hurricanes

iii. The use of the extended best-track dataset to inform the NAHU of the size climatology of hurricanes

iv. A component upgrade with regard to the handling of extra-tropically transitioning hurricanes, which has shown a marked improvement in historical wind footprint across New England

v. The incorporation of potential intensity theory to ensure that the stochastic set does not include storms that are physically unjustified given the upstream ocean energy source

1

vi. The use of numerical modeling (WRF) to aid in the calibration of inland decay and extratropical transition timing, without relying on WRF modeling in areas where it is not suited

More detailed evaluation of each component of the NAHU model follows next.

b. Track modeling

The track modeling component of the model uses techniques that ensure the stochastic set produces a climatology similar to the best-track, while (necessarily) permitting a distribution of hurricane track more broad than observed. The seasonal and annual variability of the historical record of motion is incorporated into the track modeling. The model for over water intensity is based initially upon central pressure rather than maximum wind speed. This choice is among the most important. Central pressure is arguably more stable over short time periods, more easily observed and verifiable, and doesn't suffer from measurement uncertainty as much as maximum wind speed. RMS has chosen to use the satellite era (1979-) for the intensity training, which has the effect of limiting the training period compared to the longer track period, but also ensures a more confident historical intensity record subset. Further, RMS's approach is to model temporal change in pressure rather explicit pressure. This has the benefit of being more directly tied to the dynamics of the hurricane, since changes in pressure (rather than pressure per se) are associated with wind field changes. As a consequence of the choice of modeled variable, maximum wind speed must then be determined parametrically based upon central pressure as well as environmental pressure.

The improvement of extratropical transition representation within the track model is a considerable advance forward, in particular for correct modeling of New England landfalls. Consequently, the new model provides a more consistent and more accurate risk estimate across the region. RMS had a challenging decision regarding how to address transition, however. While transition is included within the besttrack dataset, it is a binary operator – when in fact science has shown over the past decade that transition is not instantaneous. Further, the transition flag is not well-defined as being at the start of transition or the end. Conversely, it is not feasible (nor desirable) to run WRF model simulations for every member in the stochastic set to attempt to objectively determine transition period (such as might be done using the Hart [2003] framework). RMS wisely chose a compromise of these two approaches. Through a WRF simulation of 39 historical storms over the past two decades, the best-track timing of instantaneous transition was compared to the objective transition period as defined by the cyclone phase space. This intercomparison revealed that the transition flag in the best-track dataset is more consistent with the end of transition than the beginning. Using this benchmark, RMS then modeled the transition period leading up to the end-point, and was able to produce a broad distribution of transition periods that permits the inclusion of very slow transitioning to very fast transitioning storms, as we observe in nature. Finally, potential intensity theory is appropriately relaxed for transitioning storms, to permit New England landfalling hurricanes to have intensities considerably beyond their potential intensity – as a function of their forward movement.

RMS has utilized the extended best-track dataset (DeMuth et al. 2006, 2009) to model the radius of maximum winds. Although the extended best-track has its limitations (such as the fact that size parameters in the absence of recon may often be based on climatology), it is the only extended dataset that provides such size parameters. Future revisions of the NAHU model may wish to limit their use of the extended best track to the subset of storms where recon flights were known to have sampled the storms. Nonetheless, the use of the extended best track brings in a reasonable climatology of storm size. For transitioning storms, WRF simulations (combined with the EBT) were used to more accurately capture the variability in radius of maximum winds – this has the effect of much more accurately capturing the wind swath across New England during transitioning landfalls.

Using research recently published in Monthly Weather Review by NAHU scientists at RMS, RMS simulated thousands of landfalling storms in WRF. The rate of filling after landfall was validated against best-track, and the distribution of stochastic filling rates is a smoothed distribution of the best-track. The consequence of this more appropriate filling is that prior biases on inland damage have been significantly corrected. The ratio of observed inland loss to modeled loss is much closer to unity than in the prior version of this model.

c. Wind field modeling

Two dimensional wind fields from hurricanes are among the most difficult fields to acquire, as the observations leading to them are sparse, from various levels, and instruments. RMS has decided to utilize the H*Wind (Powell) archive of wind fields to produce a parametric model for wind field modeling. While H*Wind is not perfect, it does represent the most complete and reliable database of two dimensional hurricane wind fields. RMS chose to parametrically represent a 629 snapshot (among 46 storm) sample of the H*Wind database using a modified Willoughby (2004, 2006) model, which is a wise choice as it permits more degrees of freedom in storm structure. Further, the Willoughby model captures the strong gradients of wind around the radius of maximum winds more clearly, although it tends to underestimate the far field wind. Given the damaging winds are obviously focused more around radius of maximum winds, the far field biases (compared to H*WIND) are not a major concern. RMS chose to further improve the fit to H*WIND fields by modifying Willoughby to add an additional degree of freedom. It is recommended to RMS that this modification—and its evaluation--be published in peer reviewed literature. Finally, two dimensional detail is then added to the modified Willoughby radial profile by capturing the remaining unexplained variance in the H*WIND archive using principal component analysis (PCA). The resulting wind field has an unexplained cross-validation variance for historical storms that is significantly reduced compared to the other models.

d. Roughness modeling

The new version of NAHU has an improved roughness model that leads to several important improvements in realistic modeling of the details of the wind risk across a surface with varying roughness. These important improvements were the result of incorporating new datasets and science since the prior version of the model. Specifically, the use of ASTER imagery in Florida and all U.S. metropolitan regions has lead to a more realistic and consistent surface roughness database. Secondly, following the key science results of Powell (2003; Nature), RMS reduced the surface roughness over water to be consistent with that work. Finally, RMS utilized an improved method to aggregate the roughness factors from satellite pixels to the model grid cells. This aggregation method ends up producing a smoother risk map (compared with the current model) that is in better qualitative agreements with patterns derived from location-level claims data. Through the use of observation data more directly, the new model avoids the application of the Cook paradigm to a scale (local) where it is no longer as valid. The results are regional and local estimates of damage that are more consistent with claims data and also have less very small scale inconsistency. While there remains certain aspects of surface roughness that cannot be captured (such as Bernoulli-driven accelerations on the building-scale as well as topographic speed up over complex terrain [Miller and Davenport 1998]), these latter factors are of such a complex and small scale (and depend so heavily on detailed wind direction) that they cannot yet be accounted for in any risk model.

e. Landfall calibration

RMS incorporates the use of the "gate smoothing technique" to the historical record, whereby the track of a given historical storm is permitted to influence gates outside of the original landfall gate. This is one method to get an "optimal landfall rate distribution" from the historical record. This method reduces the undersampling/oversampling issues associated with the limited historical records (109 years). The "optimal distribution" can then be compared to the stochastic landfall rates and the latter can be iteratively adjusted to converge towards the former. The result is a landfall calibration that more appropriately quantifies the broader landfall risk, rather than that limited to the shorter historical record, but is still consistent with the historical record.

f. Event set boiling down

To ensure that RMS has a manageable stochastic set size for their clients, the stochastic set was reduced significantly. This process was done by carefully subsampling the stochastic set without significantly changing the full-set hurricane parameters (including landfall rates). Ideally, all stochastic members should be included such that "boiling down" is not necessary, and RMS should rely upon improved client hardware to ensure this. However, until that time, the boiling down process effectively keeps the stochastic set size manageable without significantly changing the risk implied by that stochastic set.

g. Historical reconstructions

RMS presented historical reconstructions of several hurricanes obviously not included in the training. As part of the reconstruction process, RMS collected all possible sources of information (onshore and offshore) to produce the most complete historical observation archive possible. This task is often daunting, but leads to the necessary synthesis of the historical observational record to derive all the parameters needed by the stochastic model. It is important to note that each historical reconstruction is one realization of the stochastic model, and thus important for the anticipation of other extreme events in the future and the quantification of their risk.

These reconstructions included the 1938 New England Hurricane. The new model produced wind swaths that are considerably more consistent with observations and proxy estimates of wind speed throughout New England. Strong winds are modeled much closer to the track, extends further west overall, and accounts for higher terrain influences across central and northern New England. It is evident that the updated transitioning model within the new RL version improved the wind footprint for the 1938 New England hurricane.

A summary of historical loss predictions for 22 historical storms was presented, on average, the modeled losses were an improvement on the prior RMS model. Several storms had considerable overestimates in predicted loss using the prior RMS model. The new RMS model reduces the bias considerably for that subset. While some reconstructions show modeled loses of the new model becoming slightly worse (compared to PCS loses) than with the old model, that degradation is far smaller in magnitudes than the improvement for the storms where the old model over-forecast the modeled losses.

h. <u>Summary</u>

In summary, the new RMS NAHU model is an improvement over the earlier version of their model. Considerable new research and datasets have been incorporated into the new model, leading to an improvement on the regionalization of the risk. The most significant improvements appear to be in modeling inland wind threat, the threat to New England from both pure hurricanes and transitioning hurricanes, as well as improved representation of surface roughness across over-water and urban areas. RMS has wisely chosen to not rely too heavily on NWP for their training, but at the same time using NWP for limited guidance when appropriate and physically justified. For the historical reconstructions examined, there is an overall improvement in prediction of PCS loses, and while there is a decreased predictive skill for some historical storms, that decrease is overcome by the improvement for a majority of the 22 historical reconstructions presented. The resulting model is currently state of the art for quantifying hurricane damage risk across the US, and while there are deficiencies and biases, these generally cannot be overcome using the resources currently available to the community.

Robert E. Hart, PhD

Associate Professor, Meteorology

Department of Earth, Ocean, and Atmospheric Science

Florida State University

APPENDIX D—EXTERNAL EXPERT REVIEW OF VULNERABILITY MODULE

TLSmith Consulting Inc.

Thomas Lee Smith, AIA, RRC

October 4, 2010

Michael Young, PE
Senior Director of Mitigation and Regulatory Affairs
RMS
7015 Gateway Boulevard
Newark, CA 94560

Subject: External Expert Review of the U.S. Vulnerability Module of the RiskLink 11.0 Atlantic Hurricane Model

Dear Mr. Young:

I was retained by RMS to perform an external expert review of the development of the United States portion of the vulnerability module of the RMS Atlantic Hurricane Model, to be released in RiskLink 11.0. The following report identifies documents that I reviewed, discusses the review process and presents my conclusions and recommendations.

Documents Reviewed

- RMS U.S. Hurricane Model, RiskLink 8.0.1a (dated May 2009) – "Submission to the Florida Commission on Hurricane Loss Projection Methodology." Note: I was provided the entire document, however I limited my review to sections *G-1 Scope of the Computer Model and its Implementation, G-2.3 Independent Peer Review*, *V-1 Derivation of Vulnerability Functions*, *V-2 Mitigation Measures*, *Form V-1: One Hypothetical Event* and *Form V-2: Mitigation Measures – Range of Changes in Damage*.

- RMS Secondary Modifiers for U.S. Hurricane Vulnerability, RiskLink 6.0 (dated October 2009).

- PowerPoint presentation titled *2011 USHU Wind Vulnerability Development Overview*

- PowerPoint presentation titled *Development of Wind-Induced Secondary Modifiers for 2011 Atlantic Basin Hurricane Model*

Review Process

My review included review of the current vulnerability model (RiskLink 8.0.1a) and review of the proposed changes to the model (RiskLink 11.0) as follows: I attended a two day review meeting at the RMS office located in Newark, CA. Prior to the meeting I reviewed the RMS

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U.S. Hurricane Model, RiskLink 8.0.1a document. The first PowerPoint noted above was reviewed on the first day. I was given an overview of the FCHPLM purpose and process, and an overview of the various components of the model (such as meteorology and economics). However, the majority of this presentation pertained to the vulnerability component. The second PowerPoint noted above was reviewed on the second day.

During the presentations, there was ample time for discussion. I was given sufficient time to provide comments and ask questions. My comments did not pertain to fundamental issues that affect the vulnerability model. Rather, they pertained to the written document (bullet one above), and they were of an editorial or clarification nature. The RMS personnel that I met with answered questions to my satisfaction and they were very receptive of my comments.

Conclusions and Recommendations

My conclusions and recommendations regarding the Hurricane Model are based on my experience with wind performance of buildings, which includes field research in the aftermath of twelve hurricanes. The field research included work on four hurricanes that struck Florida (Hurricane Andrew, Charley, Frances and Ivan). My conclusions regarding the vulnerability section of the hurricane model are as follows:

- Damage functions: The damage functions were developed in a rational, technically based manner (i.e., validated claims data from various hurricanes were analyzed with respect to estimated wind speeds).

- Coastal vulnerability: Wind speeds decay as hurricanes track inland. However, analysis of validated claims data revealed differences between coastal and inland building damage as a function of wind speed. For given wind speeds, the claims data show decreased vulnerability along the coast. Therefore, RiskLink 11.0 proposes a new coastal vulnerability region. Based on my experience and discussion with other design professionals, the inclusion of the new coastal region is appropriate because of the greater attention that is generally given to the design and construction of buildings near the coast.

- Revisions to the secondary modifiers: The changes to the secondary modifiers proposed in RiskLink 11.0 will simplify and clarify the use of the modifiers. During the extensive discussion that we had on the secondary modifier changes, I made recommendations regarding which category certain building elements (such as stucco) would be placed. I also made specific recommendations as listed below. I fully support the changes to the secondary modifiers.
  .
  - Gutters: In RiskLink 8.0.1a, the secondary modifiers for low-slope ("flat") roofs include the type of roof membrane. However, post-storm damage investigations have shown that the presence of a gutter has greater influence on the wind performance of low-slope roofs than does the type of roof membrane. Gutter failure has significant ramifications because subsequent progressive lifting and peeling of the roof membrane often occurs. Therefore, for low-slope roofs, I recommended that in

RiskLink 11.0, consideration be given to combining the "single-ply membrane " and "built-up roof" options for the "roof covering" secondary modifier and adding an option that identifies the presence of gutters.

- Pool cages (lanais): Changes pertaining to pool cages were made to the Florida Building Code (FBC) around 2004. Cages designed and built in accordance with the new criteria should have improved wind performance. Cages are addressed in the Appurtenant Structures portion of the model (section V-1.5 in the first document bulleted on the previous page). I recommended that RMS consider the changes in the FBC pool cage criteria.

- Soffits: Damage investigations following the 2004 hurricanes revealed soffit performance problems. At the present time, soffit performance is difficult to address in a model. However, in the future as soffit issues are more fully addressed by codes and standards, and as field-evaluation techniques are developed, I recommended that a future revision regarding soffits be made to the model when criteria are available to sufficiently do so.

- Window and door protection: In RiskLink 8.0.1a, window and door protection are considered via two independent modifiers. RiskLink 11.0 addresses windows, doors and garage doors in a single modifier, based on an increasing scale of building envelope protection. The proposed changes simplify use of the model, and recognize the relationship between window and door openings and their key role in wind performance. I concur with the proposed changes.

Respectfully submitted,

Thomas Lee Smith, AIA, RRC

APPENDIX E—RISKLINK USER INTERFACE SCREEN SHOTS

Figure 92: Screen Shot of Model Location Input Form (part 1)

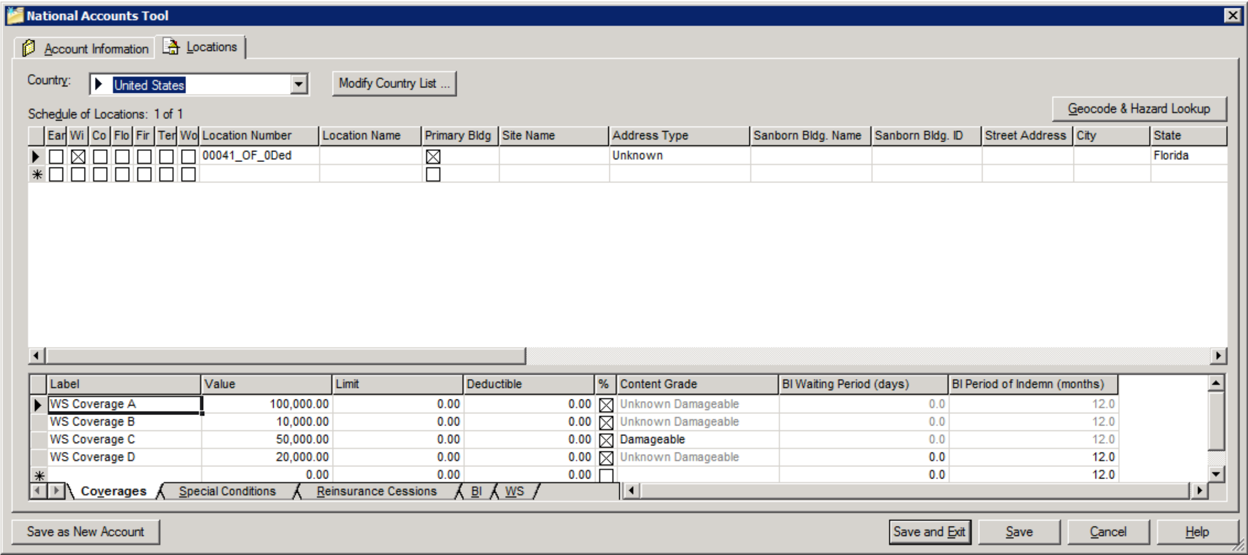

Figure 93: Screen Shot of Model Location Input Form (part 2)

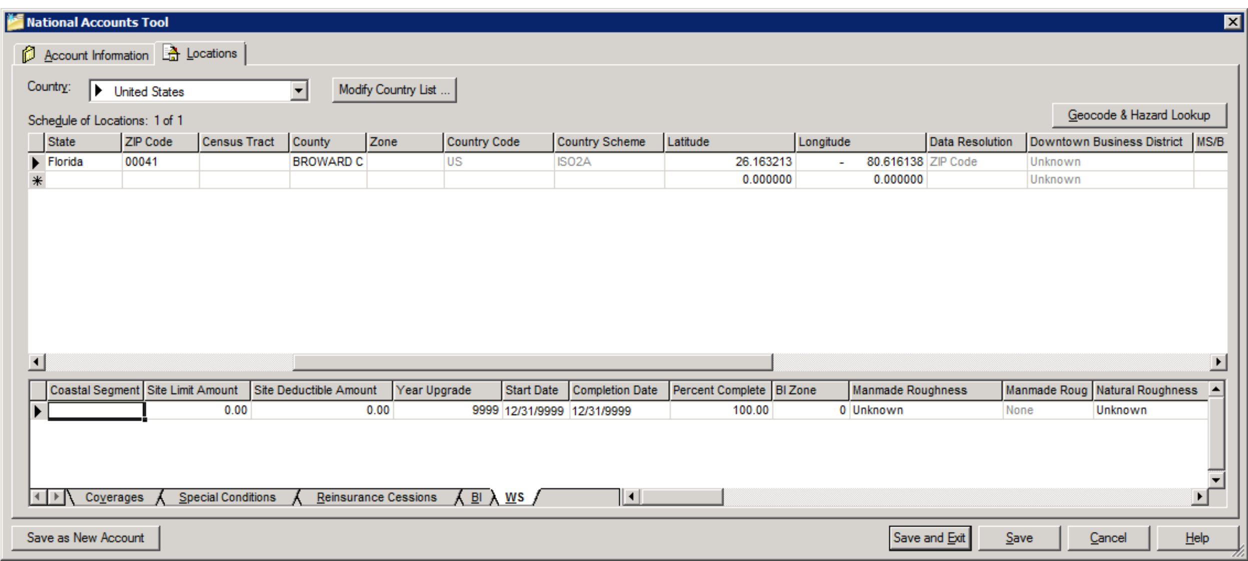

Figure 94: Screen Shot of Model Location Input Form (part 3)

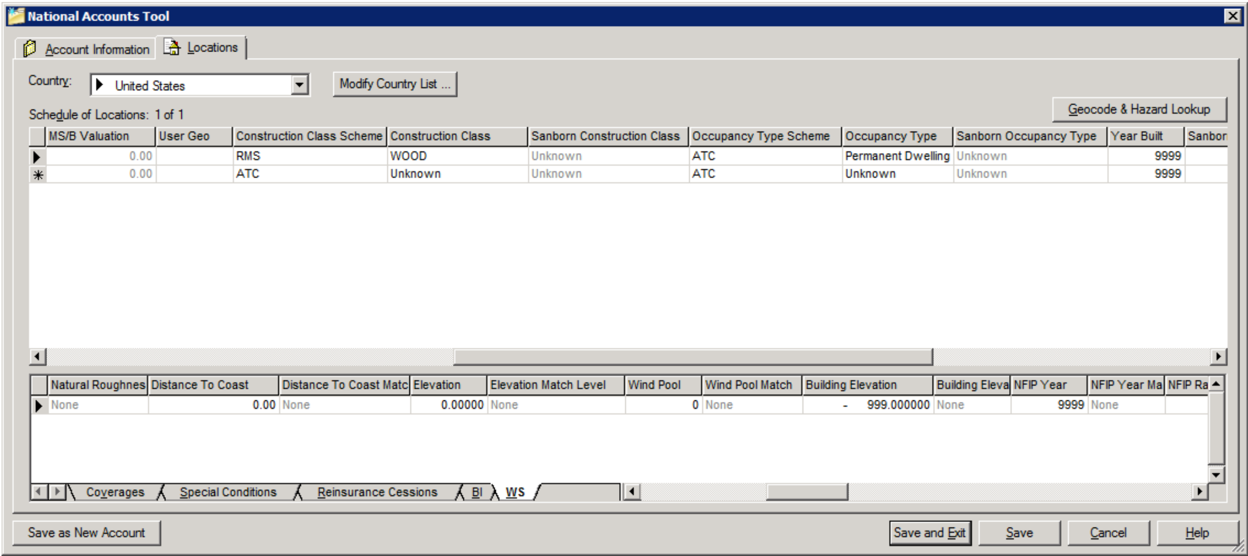

Figure 95: Screen Shot of Model Location Input Form (part 4)

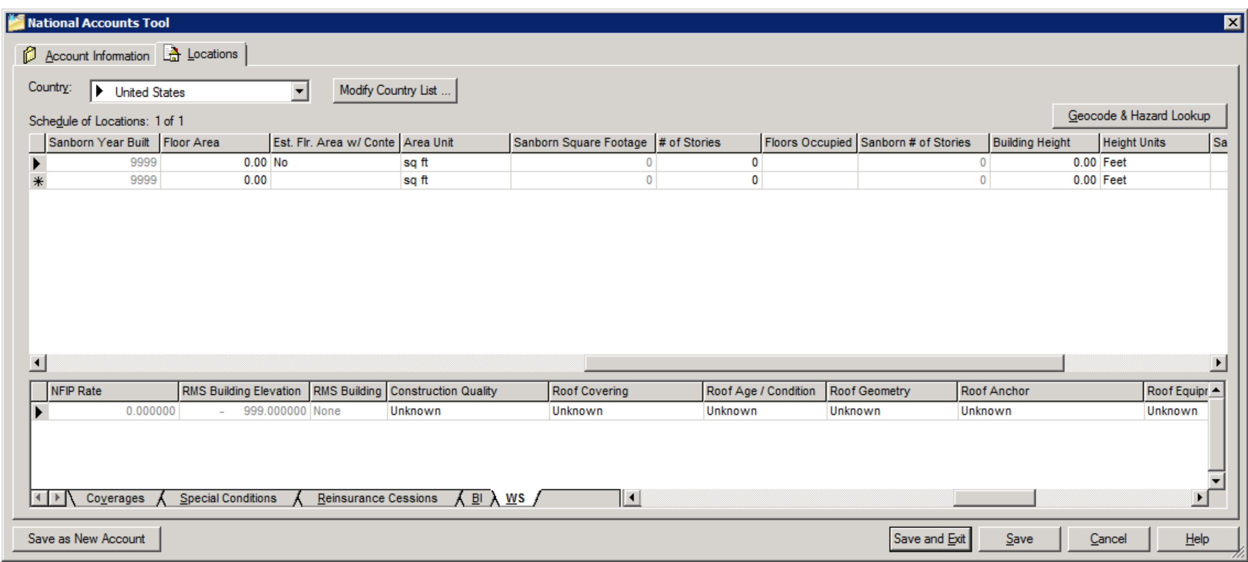

Figure 96: Screen Shot of Model Location Input Form (part 5)

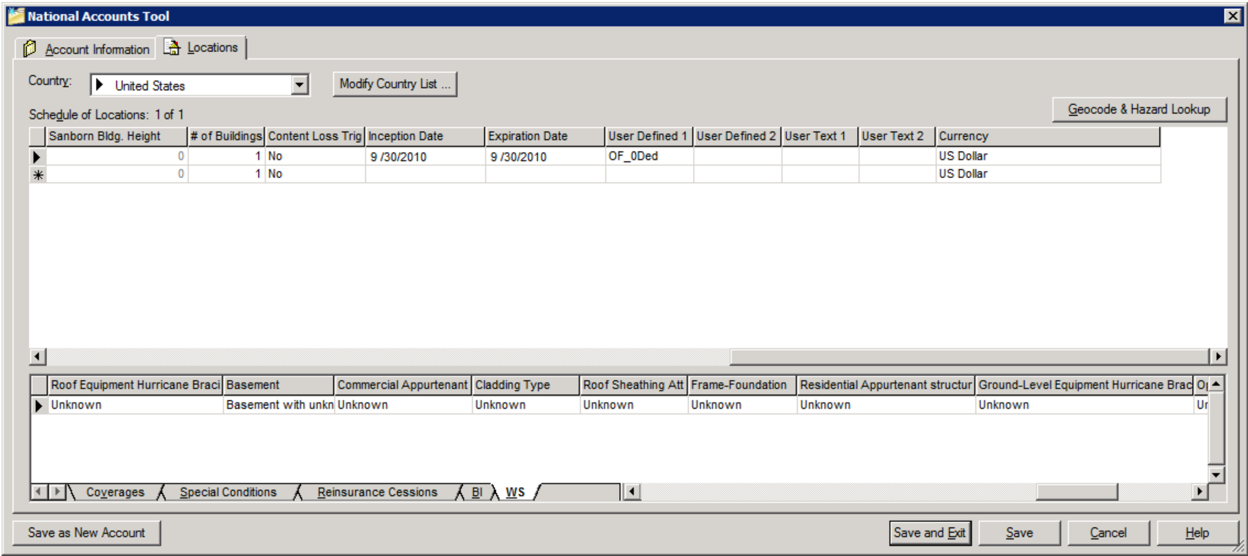

Figure 97: Screen Shot of Model Location Input Form (part 6)

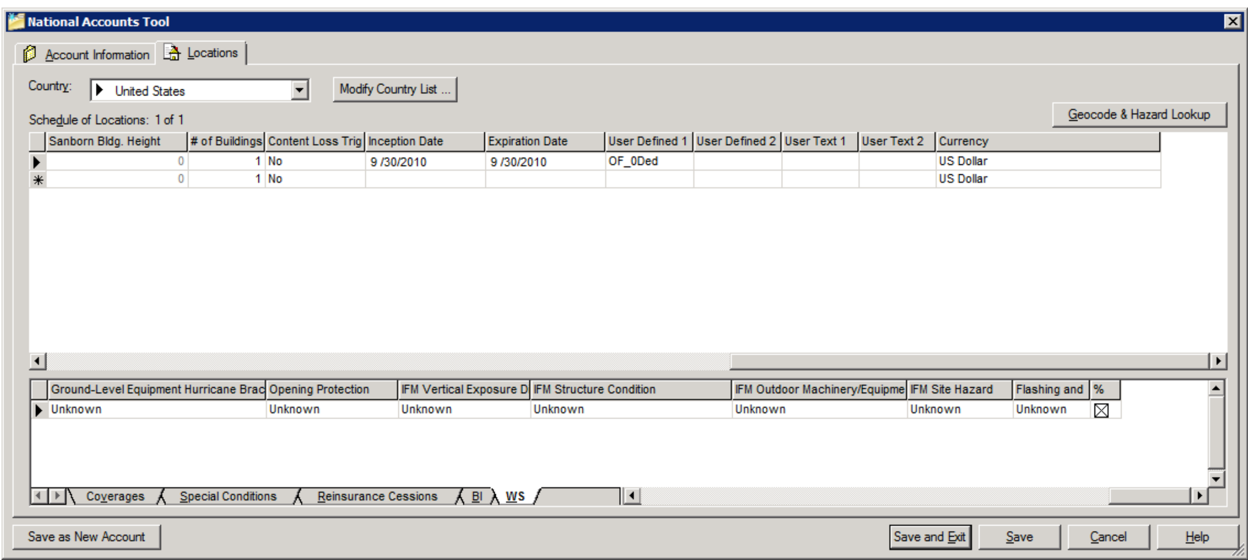

Figure 98: Screen Shot of the About RiskLink Screen, Showing Model Name and Version Number

APPENDIX F—RISKLINK REPORTS

Figure 99: Analysis Summary Report (page 1 of 3)

Analysis Summary Report for FCHLPM

Tuesday, October 18, 2016

Version 17.0 (Build 1825)

Analysis Settings:

Analysis Name (ID) : All Locs(2)

RDM Database : FCHLPM_RDM

DLM Profile Name : FCHLPM Certified Hurricane Lo

Analysis Date : 10/18/2016

Perils : Wind Only

Region : North Atlantic (including Hawaii)

Analysis Mode : Distributed

Analysis Type : Exceedance Probability

Vulnerability Curves : Vulnerability - Default

Loss Amplification : Bldg+Cont+BI

Residual Demand Surge : Excluded

Currency : US Dollar

EDM Database : FormA1_RL17_Geo_EDM

Exposure Type : Portfolio

EDM Portfolio : 1

Use RiskAssessor Curves : No

Event Rate Set : RMS 2017 Historical Event Rates

Storm Surge assumptions : None

- **SFD** : 0.00
- **Low-Rise MFD and COM** : 0.00
- **Other** : 0.00

Primary modifiers assumed 'Unknown' : None

All secondary modifiers assumed 'Unknown' : No

Scale Factors

- **Building** : 1.00
- **Contents** : 1.00
- **BI Values** : 1.00

'Unknown' deductibles assumed 2% : Yes

Local defenses ignored : No

All user entered Base Flood Elevation values reset to RMS Default : No

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

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7575 Gateway Blvd
Newark, CA 94560 U.S.A
Phone:(510) 505-2500 Fax: (510) 505-2501

Page 1 of 3

Figure 100: Analysis Summary Report (page 2 of 3)

Exposure Data Summary Statistics:

Average Location Value	:	150,000.00
Average Location Limit	:	0.00
Average Location Deductible	:	0.00

Exposure Data Detail Statistics:

CONSTRUCTION QUALITY	# Locations	% of Locations	BASEMENT	# Locations	% of Locations
0 Unknown	4866	100.00	0 w/ Unknown Flood Protection	4866	100.00

ROOF COVERING	# Locations	% of Locations	ROOF GEOMETRY	# Locations	% of Locations
0 Unknown	4866	100.00	0 Unknown	4866	100.00

ROOF ANCHOR	# Locations	% of Locations	ROOF AGE	# Locations	% of Locations
0 Unknown	4866	100.00	0 Unknown	4866	100.00

ROOF EQUIPMENT HURRICANE BRACING	# Locations	% of Locations	FLASHING AND COPING QUALITY	# Locations	% of Locations
0 Unknown	4,866.00	100.00	0 Unknown	4,866.00	100.00

COMMERCIAL APPURTENANT STRUCTURES	# Locations	% of Locations	CLADDING TYPE	# Locations	% of Locations
0 Unknown	4866	100.00	0 Unknown	4866	100.00

ROOF SHEATHING ATTACHMENT	# Locations	% of Locations	FRAME-FOUNDATION CONNECTION	# Locations	% of Locations
0 Unknown	4866	100.00	0 Unknown	4866	100.00

RESIDENTIAL APPURTENANT STRUCTURES	# Locations	% of Locations	MEC./ ELEC. EQPT - GROUND	# Locations	% of Locations
0 Unknown	4866	100.00	0 Unknown	4866	100.00

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

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Page 2 of 3

Figure 101: Analysis Summary Report (page 3 of 3)

OPENING PROTECTION	# Locations	% of Locations
0 Unknown	4866	100.00

WS DETAIL VALID FLAG	# Locations	% of Locations
1 Valid	4866	100.00

ADDRESS MATCH LEVEL	# Locations	% of Locations
5 Postal Code	4866	100.00

NUMBER OF BUILDINGS	# Locations	% of Locations
1	4866	100.00

NUMBER OF STORIES	# Locations	% of Locations
0 Unknown	3244	66.67
1	1622	33.33

YEAR BUILT	# Locations	% of Locations
Unknown	4866	100.00

LOCATION VALID FLAG	# Locations	% of Locations
1 Valid	4866	100.00

COVERAGE DAMAGEABILITY GRADE	# Locations Coverages	% of Locations Coverages
0 Unknown	14598	75.00
3 Damageable	4866	25.00

CONSTRUCTION CLASS

Schema	Class	# Locations	% of Locations
RMS	Manufactured/Mobile Home with Tie-Downs	1622	33.33
RMS	MASONRY	1622	33.33
RMS	WOOD	1622	33.33

OCCUPANCY TYPE

Schema	Class	# Locations	% of Locations
ATC	Permanent Dwelling (single family housing)	4866	100.00

SQUARE FOOT BANDS

Square Foot Bands	# Locations	% of Locations
Unknown	4,866	100.00
< 1506	0	0.00
BETWEEN 1507 AND 2507	0	0.00
BETWEEN 2508 AND 5005	0	0.00
BETWEEN 5006 AND 10010	0	0.00
>10011	0	0.00

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

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Figure 102: Post Import Summary (page 1 of 4)

Post Import Summary

Tuesday, October 18, 2016

Version 17.0 (Build 1825)

EDM Database : FormA1_RL17_Geo_EDM

Portfolio Name : *1*

Peril : *Wind*

Location:

Location Coverage Values and Limits :

Valid	Loc Cov Count	Loc Cov Limits	Loc Cov Values
Yes	19,464	0.00	729,900,000.00
Total	**19,464**	**0.00**	**729,900,000.00**

Valid Location Coverage Values and Limits :

Loss Type	Loc Cov Count	Valid Loc Cov Value	Min Value	Max Value	Average Value
Building	9,732	446,050,000.00	5,000.00	100,000.00	45,833.33
Content	4,866	202,750,000.00	25,000.00	50,000.00	41,666.67
BI/ALE	4,866	81,100,000.00	10,000.00	20,000.00	16,666.67
Total	**19464**	**729,900,000.00**			

Loss Type	Loc Cov Count	Valid Loc Cov Limit	Min Limit	Max Limit	Average Limit
Total					

Geocoded Values and Limits :

Geocoded	Loc Count	Loc Cov Values	Loc Cov Limits
Yes	4,866	729,900,000.00	0.00
Total	**4,866**	**729,900,000.00**	**0.00**

Site:

Site Limits :

Valid	Loc Count	Site Limits
Yes	4,866	0.00
Total	**4,866**	**0.00**

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

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Valid Site Limits:

Min Site Limit	Max Site Limit	Average Site Limit

Account and Policy:

Account :

Valid	Account Count	Loc Cov Values
Yes	4,866	729,900,000.00
Total	4,866	729,900,000.00

Policy Coverage Limits :

Valid	Pol Cov Count	Pol Cov Limits
Total		

Valid Policy Coverage Limits :

Loss Type	Valid Policy Cov Limit	Min Limit	Max Limit	AverageLimit
Total				

Policy Limits :

Valid	Blanket Limits Count	Blanket Limits
Yes	0	0.00
Total	0	0.00

Valid Policy Limits :

Min Blanket Limit	Max Blanket Limit	Average Blanket Limit
0.00	0.00	0.00

Policy Dates :

Expired Policy Count

Active Policy Count

Line of Business:

Line of Business	Valid Loc Cov Values
Total	

Construction Class:

Schema	Class	Valid Loc Cov Values
	Total	

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Figure 104: Post Import Summary (page 3 of 4)

Occupancy Class:

Schema	Class	Valid Loc Cov Values
	Total	

Geocoding Resolution:

Resolution	Location Count	Loc Cov Values
Postcode	4,866	729,900,000.00
Total	4,866	729,900,000.00

Area :

Country	State/Cresta	Valid Loc Cov Value
US	FL	729,900,000.00
Total		729,900,000.00

Peril Details (WS) :

Distance to Coast (in miles)					Valid Loc Cov Values
>=	0.00	and	<	0.00	0.00
>=	0.00	and	<	0.00	0.00
>=	0.00	and	<	0.00	0.00
>=	0.00	and	<	0.00	0.00
>=	0.00	and	<	0.00	0.00
>=	0.00	and	<	0.00	0.00
>=	0.00				729,900,000.00

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Figure 105: Post Import Summary (page 4 of 4)

Aggregate US Windstorm Exposures for Coastal Counties by Geocoding Resolution :

Category	State	Geocoding Resolution		# of Locations	Location Cov Values
Tier 1					
	FL				
		Postcode		3,465	519,750,000.00
			Total	3,465	*519,750,000.00*
	All Tier 1 Counties				
		Postcode		3,465	519,750,000.00
	Total for Tier 1 Counties			3465	519,750,000.00
Tier 2					
	FL				
		Postcode		1,233	184,950,000.00
			Total	1,233	*184,950,000.00*
	All Tier 2 Counties				
		Postcode		1,233	184,950,000.00
	Total for Tier 2 Counties			1233	184,950,000.00
Total for Tier 1 and Tier 2 counties					704,700,000.00

Aggregate US Windstorm Exposures for Coastal Counties by Unknown Building Characteristics :

Category	State	Building Characteristics	# of Locations	Location Cov Values
Total for Tier 1 and Tier 2 counties				0.00

Reinsurance :

Facultative :

Location Count
0

Policy Count
0

Surplus Share Treaty :

Location Count
0

Policy Count
0

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Table 52: Example of Client Output Table Showing Application of Annual Deductible Factors

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Signature: ___________________________

Date: ___________________________

Instructions:

In order to verify that the annual deductible factors have been applied to the model output, clients should report the following results as evidence of appropriate application:

a.) portfolio level occurrence deductible gross AAL and the annual deductible gross AAL,

b.) selected return period losses for each of occurrence deductibles and annual deductibles, and

c.) for three sample locations in the portfolio, location level occurrence deductible gross AAL and the annual deductible gross AAL.

Client Information:

Client Name:	
Model Version:	
Annual Deductible Factors Used (AOP/Non-AOP):	

Portfolio Level Model Output:

	Portfolio Name	Number of Accounts/Locations	Gross Occurrence Deductible AAL	Gross Annual Deductible AAL	Ratio: (Annual AAL) / (Occurrence AAL)
AAL					

	100-year RPL with Occurrence Deductible	100-year RPL with Annual Deductible	Ratio: (Annual 100 RPL) / (Occurrence 100 AAL)
100 year RPL			

	250-year RPL with Occurrence Deductible	250-year RPL with Annual Deductible	Ratio: (Annual 250 RPL) / (Occurrence 250 AAL)
250 year RPL			

Location Level Model Output:

Location Identifier	Postal Code	LOB-Construction Type	HU Deductible Amount	Gross Occurrence AAL	Gross Annual Deductible AAL	Ratio: Annual / Occurrence

APPENDIX G—ACRONYMS

Table 53: Acronym Definitions

Acronym	Definition
AAL	Average annual loss
ACM	Association for Computing Machinery
AEP	Aggregate exceedance probability
ALE	Additional living expenses
Amax	Angle to maximum winds
ASCE	American Society of Civil Engineers
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
BA	Bachelor of arts
BE	Bachelor of engineering
BI	Business interruption
BS	Bachelor of science
BSE	Bachelor of science in engineering
BTech	Bachelor of technology
CDF	Cumulative distribution function
CI	Claims Inflation
CO	Condo owner
CP	Central pressure
CV	coefficient of variation
CVM	Component vulnerability model
DEA	Diploma of profound studies
DLL	Dynamic link libraries
DLM	Detailed Loss Model
DMG	German Meteorological Society
DOI	Department of Insurance
EDS	Economic demand surge
EDT	Effective down time
EGC	Enterprise grid computing
EIFS	Exterior insulation and finish systems
EOF	Empirical orthogonal functions
EP	Exceedance probability
EPRs	Expected percentage reductions
ES	Edge systems
ESRI	Environmental Systems Research Institute
FCAS	Fellow of the Casualty Actuarial Society
FCHLPM	Florida Commission on Hurricane Loss Projection Methodology
FCMP	Florida Coastal Monitoring Program
FEMA	Federal Emergency Management Agency
FFP	Far field pressure
FHCF	Florida Hurricane Catastrophe Fund
Ft	Foot/feet
GB	Gigabyte
GIS	Geographic information systems
GPS	Global positioning system
HOA	Condo association
hPa	Hectopascal—unit of pressure
HPC	High performance computing

Acronym	Definition
HUD	U.S. Housing and Urban Development
HURDAT	HURricane DATabase
HWind	RMS Real-time Hurricane Wind Analysis System
HWS	High wind schedule
IBHS	Insurance Institute for Business and Home Safety
IEDs	Industry exposure databases
IEEE	Institute of Electrical and Electronics Engineers
ILCs	Industry loss curves
ISD	Integrated surface database
JIRA	[brand name of Issue tracking software]
Km	Kilometer
LOB	Line of business
LULC	Land use land cover
m	Meter
m/s	Meter per second
MAAA	Member American Academy of Actuaries
MBA	Master of business administration
MCA	Master of computer application
MDR	Mean damage ratio
MFD	Multi-family dwelling
MH	Mobile/Manufactured Home
MIS	Master of international studies
Mph	Mile per hour
MPhys	Masters of physics
MPIUA	Massachusetts Property Insurance Underwriting Association
MS	Master of science
MSc or MSci	Master of science
MSXML	Microsoft XML Core Services
NCDC	National Climatic Data Center
NHC	National Hurricane Center
NLCD	National land cover database
NOAA	National Oceanic and Atmospheric Administration
OEP	Occurrence exceedance probability
OIR	Office of Insurance Regulation
OSB	Oriented strand board
PCS	Property Claims Services
PhD	Doctor of philosophy
PLA	Post-event loss amplification
PV	Photovoltaic
QA	Quality assurance
RES	Residential
RM	Reinforced masonry
Rmax	Radius to maximum winds
RMS	Risk Management Solutions, Inc.
ROA	Report of activities
SBC	Standard building code
SFBC	Standard Florida building code
SMO	Server management objects
SP	Software patch

Acronym	Definition
Sq ft	Square foot
SWR	Secondary water resistance
TFS	Team foundation server
TIV	Total insured value
TTUHRT	Texas Tech Hurricane Research Team
URM	Unreinforced masonry
USB	Universal serial bus
USPS	U.S. Postal Service
UTC	Coordinated universal time
Vmax	Maximum wind
VRG	Variable resolution grid
XML	Extensible markup language