North Atlantic Hurricane Models

Version 23.0 (Build 2250)

May 19, 2023

Submitted in compliance with the 2021 Standards of the Florida Commission on Hurricane Loss Projection Methodology

Risk Management Solutions, Inc.
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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 on the primary platform: RiskLink 23.0 (Build 2250) and equivalent platform: Risk Modeler 2.27.0 on the RMS Intelligent Risk Platform™.

Dear Chairman Yaeger:

Enclosed are our submission 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, statistics, structural engineering, actuarial science, and computer/information science have reviewed North Atlantic Hurricane Models 23.0 (Build 2250); with model settings as specified in the (Pre-compiled) FCHLPM Certified Hurricane Losses DLM profile for compliance with the Commission's 2021 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 the model meets or exceeds the 2021 Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology. The model is ready to be reviewed by the Professional Team.

RMS has continued a consulting arrangement with Merlino's, Inc actuarial consultants to review and sign off on the actuarial standards in the RMS submission. The biographies of each consultant are found in Appendix B – Technical Staff and their CVs will be made available during the professional team on-site audit.

Enclosed with this letter please find all the required documentation.

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

Sincerely,

Matthew Nielsen
Senior Director
Government and Regulatory Affairs

Enc

HURRICANE MODEL IDENTIFICATION

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

***Hurricane Model Version Identification*:** 23.0 (Build 2250)

***Hurricane Model Platform Name and Identifications with Primary Hurricane Model Platform and Identification Designated*:**

RiskLink® 23.0 (Build 2250) (Primary)

Risk Modeler™ 2.27.0 on RMS Intelligent Risk Platform™

Interim Hurricane Model Update Version Identification: 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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***Date*:** June 2023

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Trade Secret Information

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

Forms V-3, V-5, and A-6 will be presented to the Professional Team during the on-site audit.

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

GENERAL HURRICANE STANDARDS

G-1 Scope of the Hurricane Model and Its Implementation

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

The Moody's 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. A documented process shall be maintained to assure continual agreement and correct correspondence of databases, data files, and computer source code to presentation materials, scientific and technical literature, and modeling organization documents.

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

Moody's 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.

D. A subset of the forms shall be produced through an automated procedure or procedures as indicated in the form instructions.

Moody's RMS creates and uses scripts that automate the generation of all forms for which the Report of Activities denotes a requirement for an automated procedure. These automation procedures and scripts may be reviewed on-site.

E. Vintage of data, code, and scientific and technical literature used shall be justifiable.

Moody's RMS regularly reviews and updates vintages of data, code, and both scientific and technical literature as needed to inform a model that reflects a current view of the hurricane risk landscape. As a result of regular updates, vintages vary by component. This information may be reviewed on-site.

G-1.1 Specify the hurricane model version identification. If the hurricane model submitted for review is implemented on more than one platform, specify each hurricane model platform identifying the primary platform and the distinguishing aspects of each platform.

The model being submitted for rate filing in Florida is the:

- North Atlantic Hurricane Models Version 23.0 (Build 2250)

Available in the following platforms:

- RiskLink 23.0 (Build 2250)
- Risk Modeler 2.27.0 on the Moody's RMS Intelligent Risk Platform

RiskLink is the software platform that has been delivered to our clients since 2003 and is an application typically installed on hardware owned and operated by a client. This is the primary platform for the purpose of this submission.

Risk Modeler is a cloud based software application on the Moody's RMS Intelligent Risk Platform. Risk Modeler contains an encapsulated version of RiskLink 23.0 loss analytics that includes the North Atlantic Hurricane Models. The model running within Risk Modeler is functionally equivalent to the model running on the RiskLink platform.

G-1.2 Provide a comprehensive summary of the hurricane model. This summary should include a technical description of the hurricane model, including each major component of the hurricane 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 hurricane model and include a description of the methodology, particularly the wind components, the vulnerability components, and the insured loss components used in the hurricane 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.

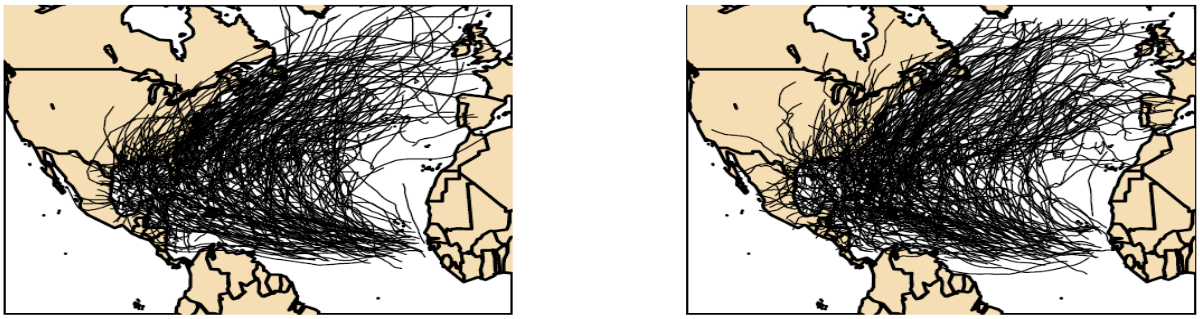
Stochastic Module

The stochastic module is made of a set of thousands of stochastic events that represents more than 100,000 years of hurricane activity. Moody's 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 and 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 Moody's 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 and Jewson 2007a, 2007b):

Equation 1

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

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.

Moody's 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, Moody's 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, Moody's 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 (121 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 20,153 stochastic events affecting Florida.

Wind Field (or Wind Hazard) Module

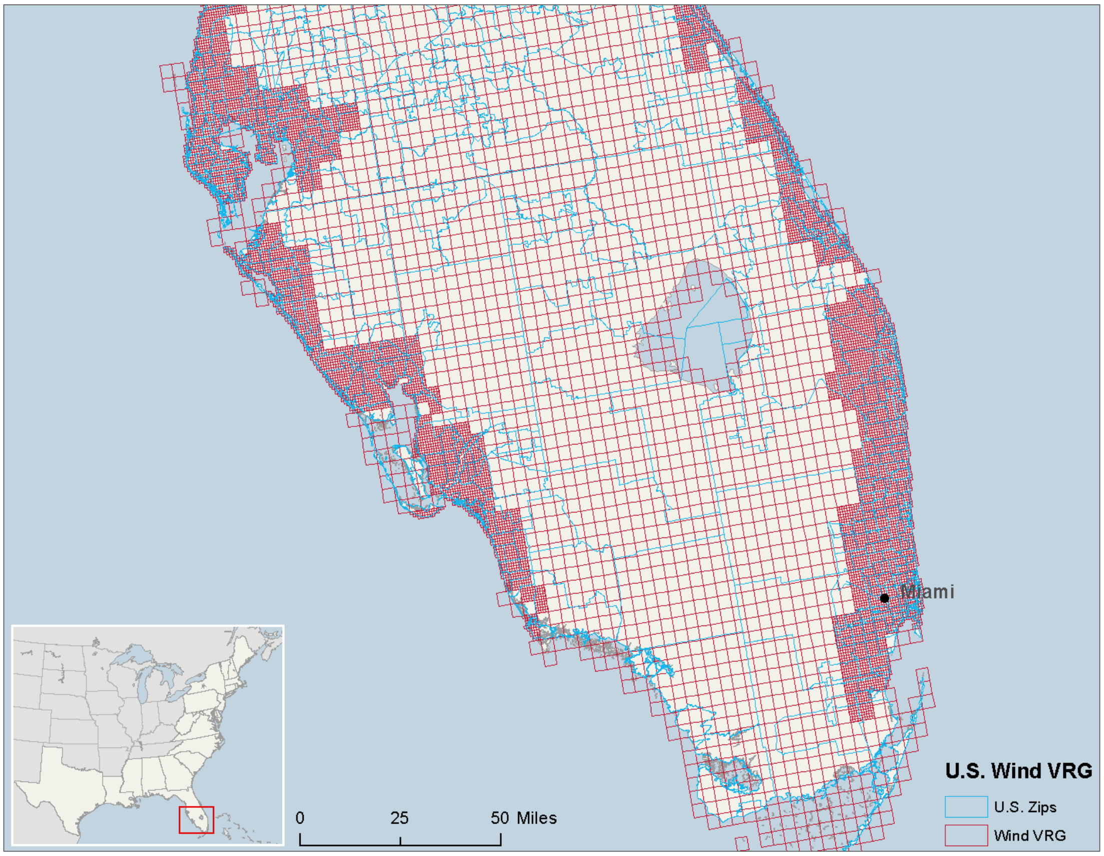
Once tracks and intensities have been simulated by the stochastic module, the wind field module simulates 10-meter 3-second gusts on a variable resolution grid (VRG) to be saved in the stochastic hazard database.

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, Moody's 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 Moody's 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. Moody's RMS has filtered out years with missing Rmax values set to climatology.

All other wind field parameters have been fitted to the Moody's RMS Hwind dataset, and additional validation has been performed using the extended best track dataset, especially for the radius of hurricane force winds. The Moody's 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, https://asterweb.jpl.nasa.gov/) with a 2007–2014 vintage. The ASTER imagery has been validated against the National Land Cover Database (NLCD) 2016 and Google Earth, and updated where necessary to ensure consistency between the Moody's RMS and NLCD 2016 databases. 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

Based on the geographic extent of the exposure data provided, events and event hazard data are retrieved from the event and hazard databases, respectively. 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. Moody's 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-1.8.

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, the model first determines an expected wind speed, and then looks up the corresponding MDRs for building and contents based on the building classification. Moody's 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 Moody's RMS component vulnerability model (CVM) (Khanduri 2003) coupled with analysis of historical storm loss data, building codes, published studies, and Moody's 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.

Moody's RMS also uses published documents, expert opinion, and conventional structural engineering analysis. Moody's 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-1.6.

The Moody's 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. Moody's RMS engineers have participated in several reconnaissance missions as described in Disclosure V-1.7.

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 $14.0 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-4.

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.

The model 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:

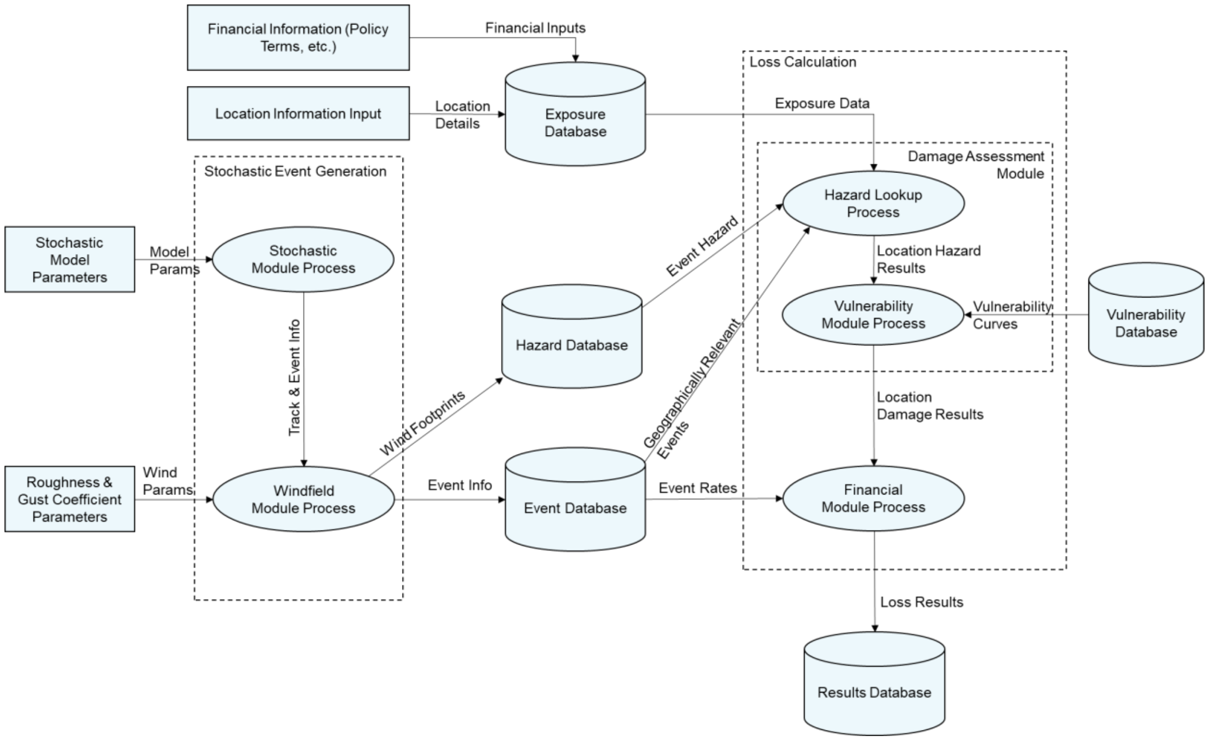
- Economic Demand Surge (EDS)—increase in the costs of building materials and labor costs as demand exceeds supply
- Claims Inflation (CI)—cost inflation due to the difficulties in fully adjusting claims following a catastrophic event
- Super Catastrophe Scenarios—coverage and loss expansion due to a 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 hurricane model components.

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

Figure 3: Flow diagram of major model components



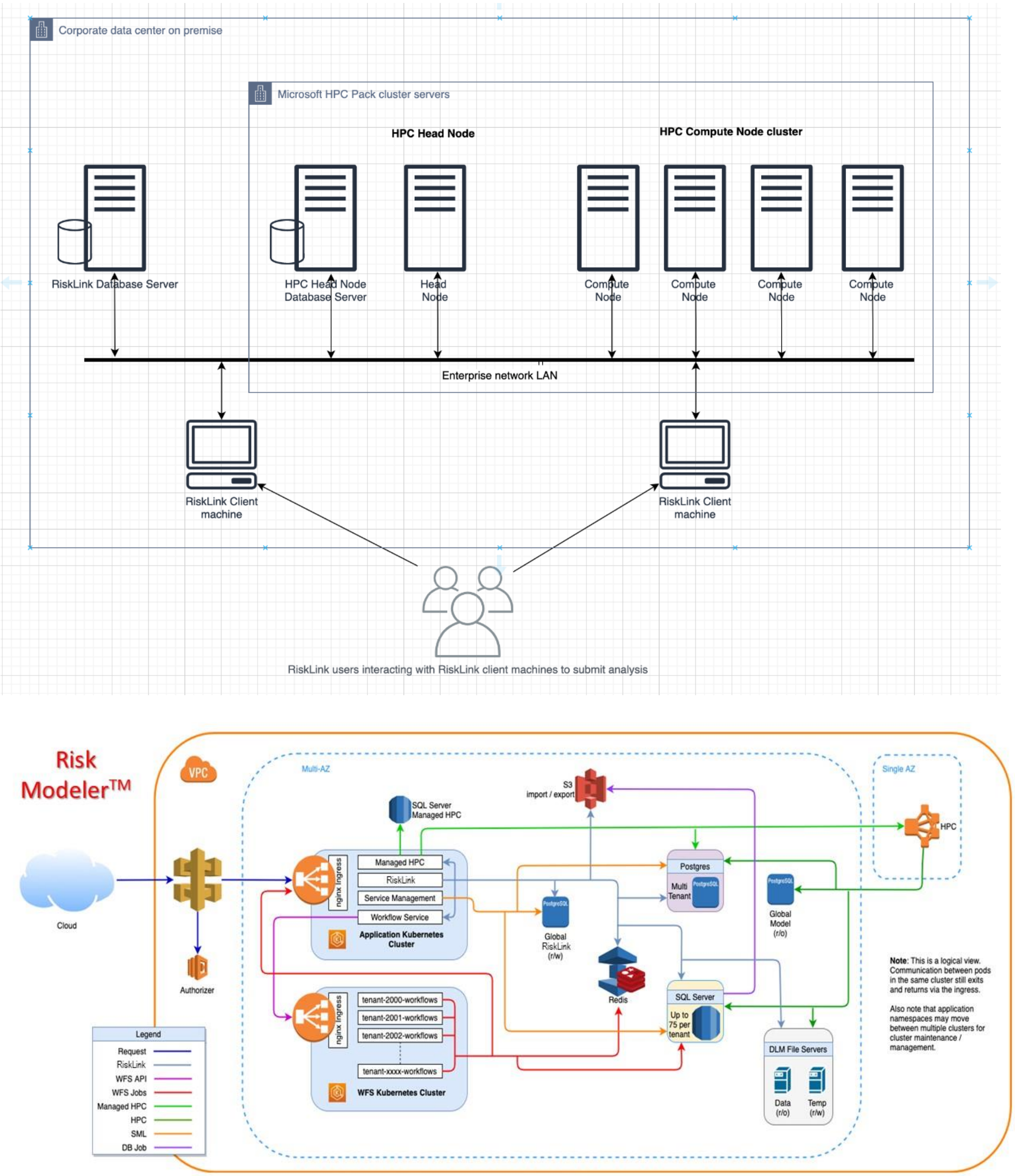
G-1.4 Provide a diagram defining the network organization in which the hurricane model is designed and operates.

The high-level diagram defining the RiskLink and Risk Modeler networks organization which the North Atlantic Hurricane Models are designed and operate is shown in Figure 4.

RiskLink is deployed on premise within a group of dedicated servers called as a cluster, over an Enterprise network, which allows high bandwidth data exchange between the RiskLink Database Server, HPC Head and Compute Nodes. RiskLink Client computers are used to submit jobs to the RiskLink clusters.

Risk Modeler application is deployed on a public cloud provider like AWS and utilizes a virtual private cloud (VPC) network isolation technology to create a secured network for all the servers to communicate with each other, without external interference. All servers are connected to a network with bandwidth exceeding 10 GBps.

Figure 4: Diagram defining the RiskLink network organization (top) and Risk Modeler network organization (bottom)



G-1.5 ***Provide detailed information on the hurricane model implementation on more than one platform, if applicable. In particular, submit Forms S-5, Average Annual Zero Deductible Statewide Hurricane Loss Costs – Historical versus Modeled; V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage; A-1, Zero Deductible Personal Residential Hurricane Loss Costs by ZIP Code; A-4, Hurricane Output Ranges; and A-8, Hurricane Probable Maximum Loss for Florida, from each platform including additional calculations showing no differences.***

The North Atlantic Hurricane Models Version 23.0 (Build 2250) are implemented on two platforms: RiskLink 23.0 and Risk Modeler 2.27.0.

RiskLink is the software platform that has been delivered to our clients since 2003 and is an application typically installed on hardware owned and operated by a client. This is the primary platform for the purpose of this submission.

Risk Modeler is a cloud based software application on the Moody's RMS Intelligent Risk Platform. Risk Modeler contains an encapsulated version of RiskLink 23.0 (Build 2250) loss analytics which includes the North Atlantic Hurricane Models. The model running within Risk Modeler is functionally equivalent to the model running on the RiskLink platform.

G-1.6 Provide a comprehensive list of complete references pertinent to the hurricane model by standard grouping using professional citation standards.

Meteorological Standards References

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G-1.7 Provide the following information related to changes in the hurricane model from the currently accepted hurricane model to the initial submission this year.

G-1.7.A Hurricane model changes:

1. ***A summary description of changes that affect the personal or commercial residential hurricane loss costs or hurricane 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 Changes: Updates to the geocoding module have been incorporated. There are three components to the update.

- March 2022 postal code vintage data has been incorporated as per our policy to update geocoding data at least every 24 months. All four databases described in Disclosure G-3.1 have been updated accordingly to reflect the new data vintage.
- Updates to the number of parcels, building footprints, address points, streets and postal codes
- Updated high-resolution geocoding with the addition of a new high-resolution source: points of interest.

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

- Stochastic Module—The landfall and bypass rates associated with the stochastic event set have been revised based on updated data from the official NHC HURDAT2 database (as available in June 2021).
- Historical Footprint Recreations—Moody's RMS has added historical footprint recreations from recent events, including Hurricane Dorian (2019), Hurricane Sally (2020), and Hurricane Zeta (2020). Additionally, the version of the HURDAT2 database published as of June 2021 includes reanalysis of years 1961-1965. Moody's RMS has revised the historical footprint recreations of five events: Hilda (1964), Cleo (1964), Dora (1964), Isbell (1964), and Betsy (1965). Moody's RMS also regenerated footprints for four historical events to be consistent with the newer vintage (2016) of land use land cover data and corresponding surface roughness factors: Hermine (2016), Matthew (2016), Nate (2017), and Michael (2018).
- Surface Roughness Data Update—New areas of low vegetation or urban growth from areas of high vegetation have been incorporated into the surface roughness factors of the wind fields using a more recent vintage of land use land cover data to comply with Standard M-4.B. Reaggregation of postal code and county-level wind hazard for all events against updated postal code vintage data and boundaries (March 2022).

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

- Addition of a new year built band (2021+) based on a new version of the Florida Building Code (2020)
- Recalibration of year-built and building height relativities for low-rise buildings to reflect current building stock and roof age / performance over time, and impacts of building code updates for mid- and high-rise buildings
- Updated occupancy relativities to better reflect wind-driven rain impacts in multi-family dwellings, based on analysis of homeowner association (condo association) claims data from hurricanes Irma (2017) and Michael (2018)
- Recalibration of construction class relativities, generally for multi-family dwellings, based on learnings from previous hurricanes
- Introduction of new distinct damage curves for RMS 4A (steel with concrete roof) and RMS 4C (steel with panel roof) to distinguish their vulnerability from the equivalent concrete construction
- Updated regional vulnerability relativities for multi-family dwellings and concrete/steel buildings, based on learnings from claims analyses and damage observations from hurricanes Irma (2017) and Michael (2018)
- Vulnerability region assignments have been reviewed for all postcodes with updates to some point postcodes
- Renamed secondary modifier options for the Construction Quality modifier to reflect updated Insurance Institute for Business and Home Safety FORTIFIED program standards, including a new program for multi-family exposure
- Updated credits and penalties associated with the Roof Age secondary modifier to align with roof age distribution and performance assumptions for different year built bands
- Updated post-event loss amplification factors for all stochastic events based on updated input parameters, including new exposure data and the corresponding modeled losses, updated economic demand surge and super cat loss thresholds, and Gross State Product for Florida
- Updated building inventory region assignments and inventory distributions (used when primary building characteristics are unknown) based on new data available from the U.S. Census, Moody's RMS Exposure Source Database, and Federal Emergency Management Agency Hazards United States (HAZUS)

Additionally, annual deductible factors have been updated to reflect updated model and model output. Post analysis, users must apply annual deductible factors to model output 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.

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

- In the North Atlantic Hurricane Models
    - New functionality to allow users to scale post-event loss amplification
    - New functionality to allow users to reflect non-modeled loss factors
    - New exposure data field to reflect the presence and extent of law and ordinance limit extensions at the location coverage level. This field is strictly for informational purposes in Version 23.0 (Build 2250). It does not affect modeled losses

- Geocoding updates in the U.S. outside of Florida, Canada, Caribbean, Mexico, and Central America
- Updates to the Moody's RMS® U.S. Hurricane Industry Exposure Database (IED), and the Moody's RMS industry loss curves (ILCs) in the United States and the Caribbean
- Updates to Moody's RMS® Simulation Platform

G-1.7.B ***Percentage difference in average annual zero deductible statewide hurricane loss costs based on the 2017 Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data found in the file named "hlpm2017c.zip" for:***

1. All changes combined, and

Moody's RMS has compiled the percentage difference in average annual zero deductible statewide loss costs relative to the Version 21.0 (Build 2050) model using the 2017 FHCF data. Overall, Version 23.0 (Build 2250) is 10.9 percent lower than the previous submission.

2. Each individual hurricane 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	Event Rates	Vulnerability	PLA
-10.9%	+0.0%	+0.2%	-3.1%	-9.9%	+1.9%

G-1.7.C ***Color-coded maps by county reflecting the percentage difference in average annual zero deductible statewide hurricane loss costs based on the 2017 Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data found in the file named "hlpm2017c.zip" for each hurricane model component change.***

Maps of the changes by significant component at a county resolution are shown in Figure 5 to Figure 9. Note that the scale in each map has been held constant to facilitate comparisons between components.

Figure 5: Percentage change in average annual loss with zero deductible by county due to geocoding changes

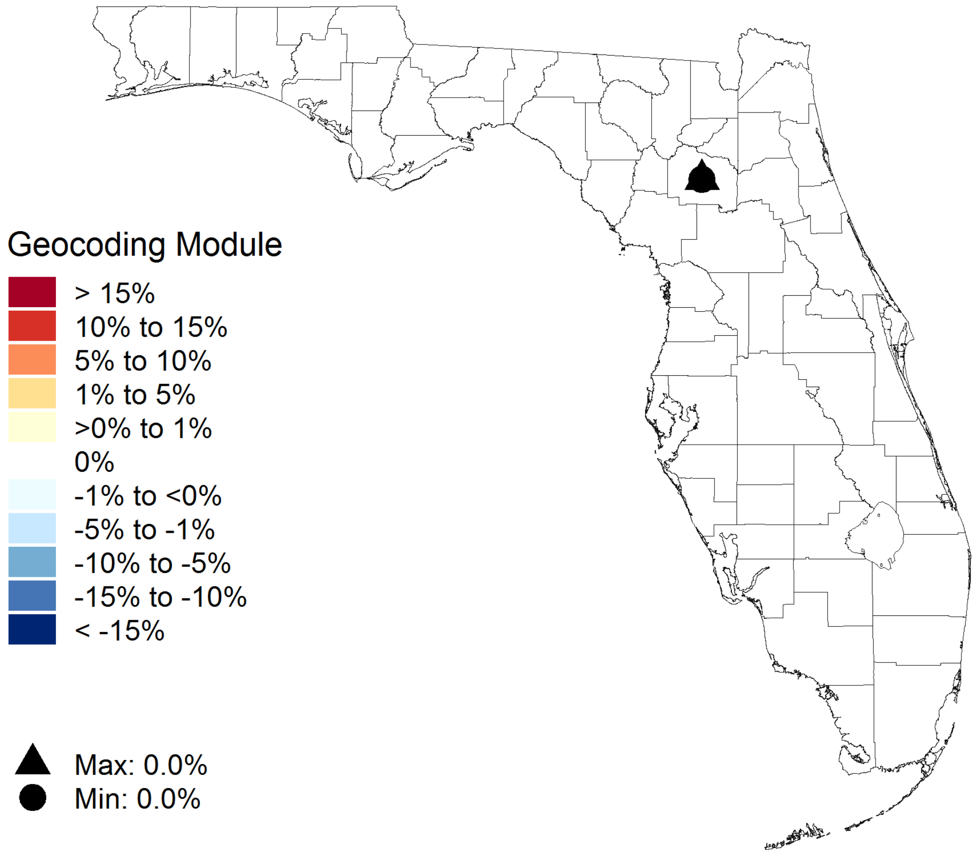


Figure 6: Percentage change in average annual loss with zero deductible by county due to hazard module changes

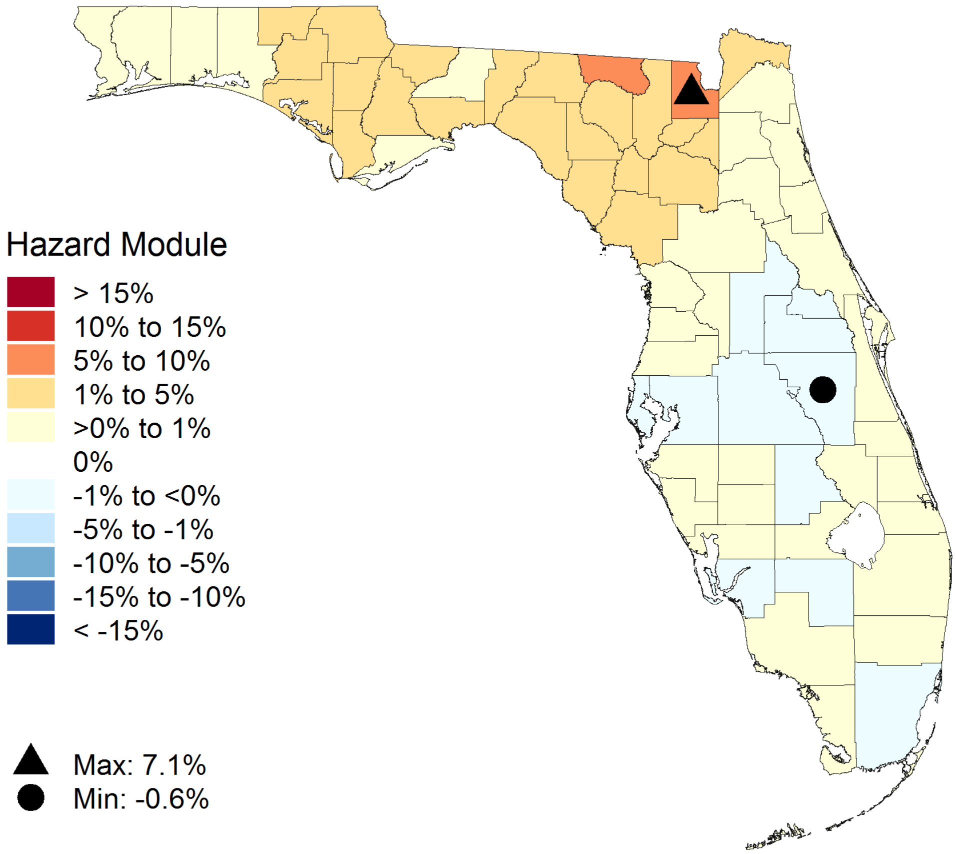


Figure 7: Percentage change in average annual loss with zero deductible by county due to event rates module changes

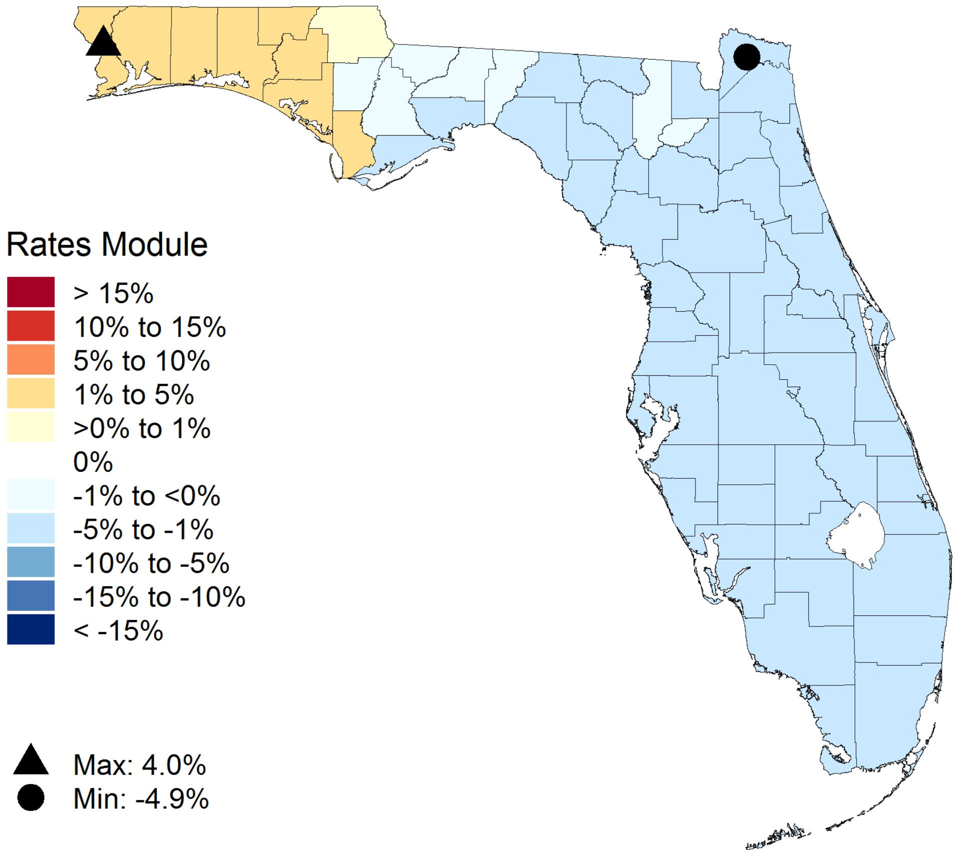


Figure 8: Percentage change in average annual loss with zero deductible by county due to vulnerability module changes

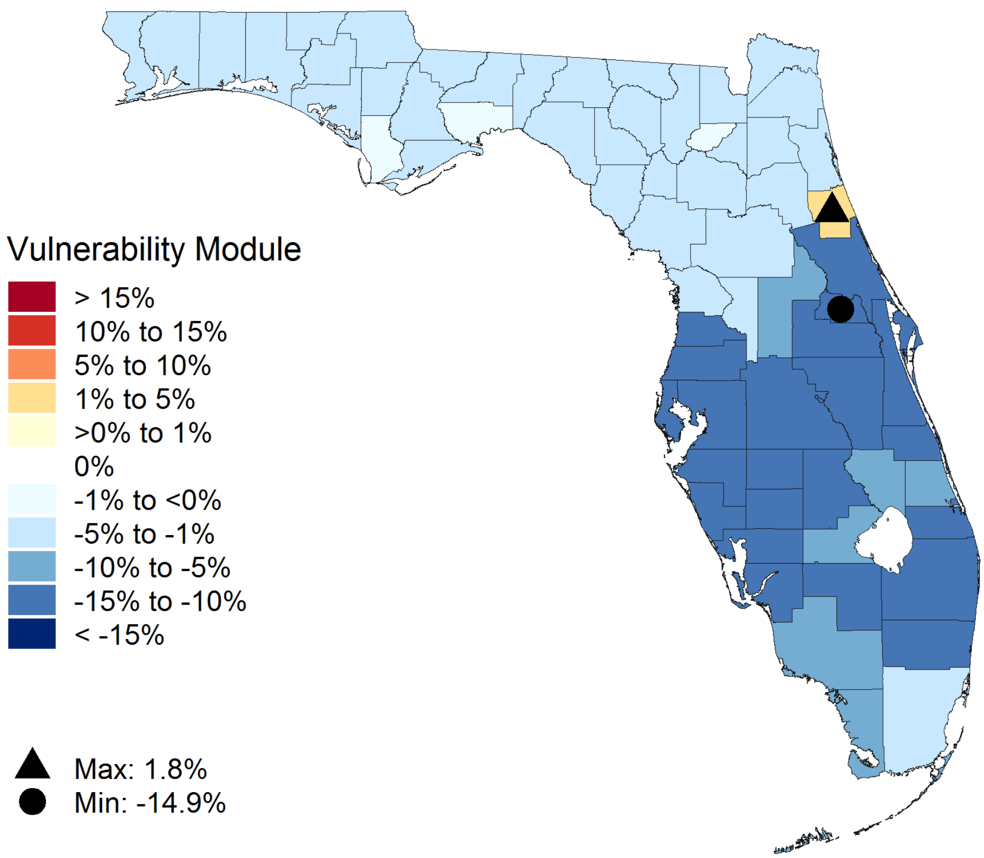
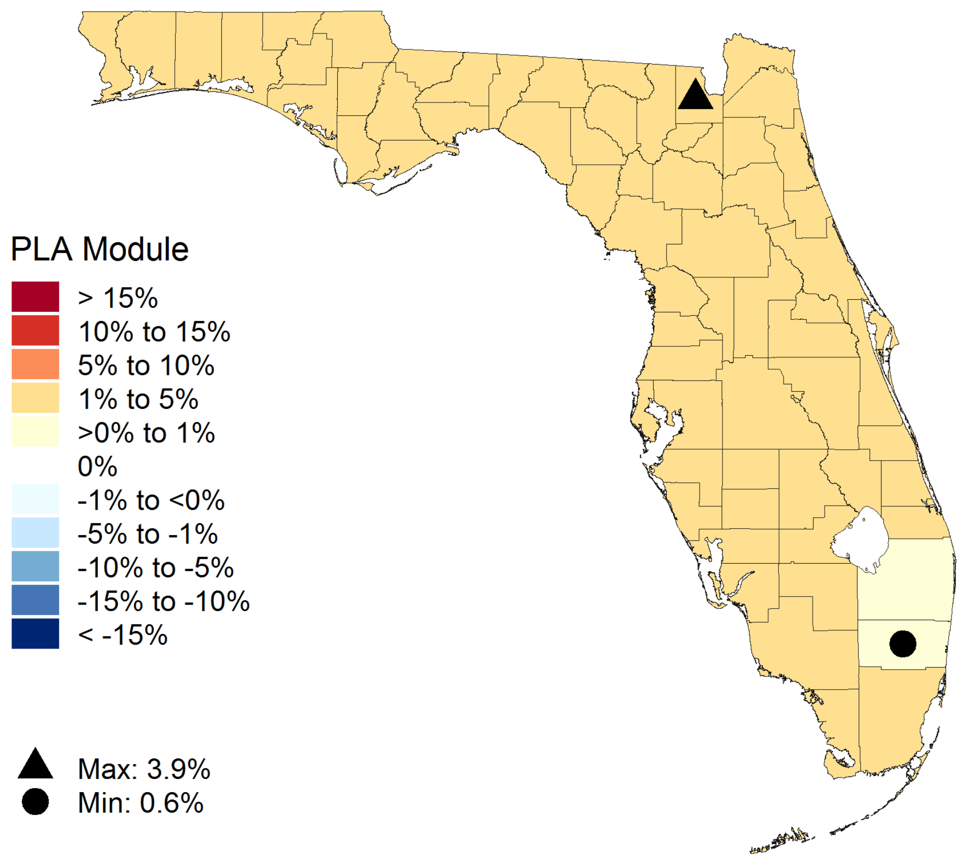


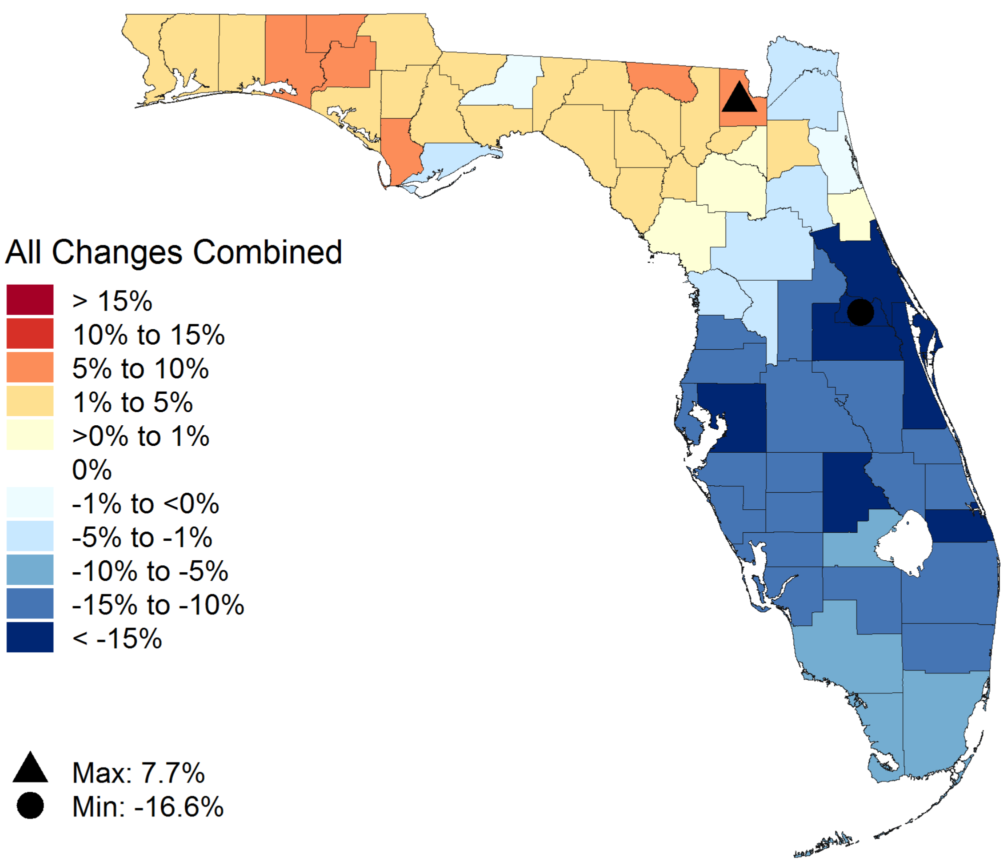
Figure 9: Percentage change in average annual loss with zero deductible by county due to post-event loss amplification module changes



G-1.7.D ***Color-coded map by county reflecting the percentage difference in average annual zero deductible statewide hurricane loss costs based on the 2017 Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data found in the file named "hlpm2017c.zip" for all hurricane model component changes combined.***

A map of the changes for all components combined is shown in Figure 10. Note that the scale of the map is the same as Figure 5 to Figure 9 to facilitate comparisons between components.

Figure 10: Percentage change in average annual loss with zero deductible by county due to all changes combined



G-1.8. Provide a list and description of any potential interim updates to underlying data relied upon by the hurricane model. State whether the time interval for the update has a possibility of occurring during the period of time the hurricane model could be found acceptable by the Commission under the review cycle in this Hurricane Standards Report of Activities.

Moody's 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.

Moody's 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 Hurricane Model

A. Hurricane 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, Moody's 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 percent hold advanced degrees and over 100 possess PhD level qualifications in their fields of expertise. One-third of Moody's 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 hurricane model and hurricane model submission documentation shall be reviewed by modeling organization personnel or consultants in the following professional disciplines with requisite experience: structural/wind engineering (currently licensed Professional Engineer), statistics (advanced degree or equivalent experience), actuarial science (Associate or Fellow of Casualty Actuarial Society or Society of Actuaries), meteorology (advanced degree), and computer/information science (advanced degree or equivalent experience and certifications). These individuals shall certify Expert Certification Forms G-1 through G-6 as applicable.

The education and experience of Moody's 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 Modeling Organization Background

G-2.1.A Describe the ownership structure of the modeling organization engaged in the development of the hurricane model. Describe affiliations with other companies and the nature of the relationship, if any. Indicate if the modeling organization has changed its name and explain the circumstances.

Risk Management Solutions, Inc. (RMS) is an operating unit within Moody's Analytics, a part of the Moody's Corporation. RMS was acquired by Moody's Corporation in August 2021 from DMG Information, Inc.

G-2.1.B If the hurricane model is developed by an entity other than the modeling organization, describe its organizational structure and indicate how proprietary rights and control over the hurricane model and its components are exercised. If more than one entity is involved in the development of the hurricane model, describe all involved.

The North Atlantic Hurricane Models were developed only by employees of Moody's RMS and its consultants.

G-2.1.C ***If the hurricane model is developed by an entity other than the modeling organization, describe the funding source for the development of the hurricane model.***

The North Atlantic Hurricane Models were developed only by employees of Moody's RMS and its consultants.

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

Moody's 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. Moody's 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 hurricane loss costs or hurricane probable maximum loss levels was disputed. Describe the nature of each case and its conclusion.***

Moody's RMS has interacted with several departments of insurance (DOIs such as Florida, Hawaii, Louisiana, and South Carolina) 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 general Moody's RMS® 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 Moody's RMS model. The decision on the 2007 filing concluded that the MPIUA did not demonstrate that the Moody's 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 hurricane 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 I	Tenure (Years)
Dr. Florian Arfeuille	PhD, Atmospheric Science ETH Zurich	S	5
Dr. Ed Bannister	PhD, Meteorology University of Birmingham	S	1
Dr. Enrica Bellone	PhD, Statistics University of Washington	S	17
Dr. Auguste Boissonnade	PhD, Civil Engineering Stanford University	S	27
Dr. Alison Dobbin	PhD, Atmospheric Physics University College London	S	11
Dr. Michael Drayton	PhD, Applied Mathematics Cambridge University	S/C	8/19
Mr. Philip Feiner	MS, Meteorology Pennsylvania State University	S	7
Dr. David Gatey	PhD, Wind Engineering and Environmental Fluid Mechanics University of Western Ontario	S	11
Dr. Jara Imbers Quintana	PhD, Theoretical Physics University of Nottingham, UK	S	10
Ms. Sarah Hartley	MSc, Applied Meteorology University of Reading	S	9
Dr. Jo Kaczmarska	PhD, Statistical Science, University College London	S	9
Ms. Chana Keating	MSc, Meteorology Florida State University	S	7
Dr. Shree Khare	PhD, Program in Atmospheric and Oceanic Sciences Princeton University	S	16
Dr. Nicolas Joss Matthewman	PhD, Applied Mathematics University College London (UCL)	S	11
Dr. Christos Mitas	PhD, Atmospheric Sciences University of Illinois at Urbana-Champaign	S	16
Dr. Robert Muir-Wood	PhD, Earth Sciences Cambridge University	S	26
Mr. Edida Rajesh	MS, Technology (Geophysics) Andhra University	S	26
Dr. Emilie Scherer	PhD, Atmospheric Science Paris VI University, France	S/C	8/5
Mr. Tyler Sherrod	MS, Meteorology Florida State University	C/S	1/.25
Dr Mohan Smith	PhD Atmospheric Physics, Imperial College London	S	0.8
Mr. Jeffrey Waters	MS, Meteorology Pennsylvania State University	S	11
Dr Xiaoning Wu	PhD, Marine and Atmospheric Science State University of New York at Stony Brook	S	1
Dr. Christine Ziehmann	PhD, Meteorology Frie University of Berlin	S	22

Table 3: Individuals involved in statistical aspects of the model

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Dr. Florian Arfeuille	PhD, Atmospheric Science ETH Zurich	S	5
Dr. Enrica Bellone	PhD, Statistics University of Washington	S	17
Dr. Auguste Boissonnade	PhD, Civil Engineering Stanford University	S	27
Mr. Abhijeet Chhatry	M.Tech, Remote Sensing and GIS National Institute of Technology Surathkal, India	S	3
Dr. Alison Dobbin	PhD, Atmospheric Physics University College London	S	11
Mr. Philip Feiner	MS, Meteorology Pennsylvania State University	S	7
Dr. David Gatey	PhD, Wind Engineering and Environmental Fluid Mechanics University of Western Ontario	S	11
Ms. Kian Greene	BS, Environmental Studies and Biological Anthropology University of California Santa Barbara	S	3
Dr. Jo Kaczmarska	PhD, Statistical Science, University College London	S	9
Ms. Anfisa Kashkenova	BS, Earth Science and Policy Pennsylvania State University	S	.5
Ms. Chana Keating	MSc, Meteorology Florida State University	S	5
Dr. Charles Menun	PhD, Structural Engineering University of California, Berkeley	S/C	4/14
Dr. Robert Muir-Wood	PhD, Earth Sciences Cambridge University	S	26
Mr. Edida Rajesh	MS, Technology (Geophysics) Andhra University	S	26
Dr. Emilie Scherer	PhD, Atmospheric Science Paris VI University, France	S/C	8/5
Mr. Tyler Sherrod	MS, Meteorology Florida State University	C/S	1/.25
Dr. Nilesh Shome	PhD, Structural Engineering Stanford University	S	13
Dr Mohan Smith	PhD Atmospheric Physics, Imperial College London	S	0.8
Ms. Carlin Starrs	MF, Master of Forestry University of California, Berkeley	S	4
Ms. Lindsay Stone	MS, Geography Wilfrid Laurier University	S	4
Dr. Anudeep Sure	PhD, Remote Sensing Indian Institute of Technology Kanpur, India	S	1.5
Mr. Joel Taylor	BS, Mathematics Bradley University	S	16
Mr. Barrett Travis	MS, Civil and Environmental Engineering Stanford University	S	4
Mr. Rajkiran Vojjala	MS, Civil Engineering Stanford University, CA	S	18
Mr. Jeffrey Waters	MS, Meteorology Pennsylvania State University	S	11

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Mr. Hugo Winter	PhD Statistics and Operational Research Lancaster University	S	2
Dr Xiaoning Wu	PhD, Marine and Atmospheric Science State University of New York at Stony Brook	S	1
Mr. Michael Young	MS, Engineering Science University of Western Ontario, Canada	S	19
Dr. Christine Ziehmann	PhD, Meteorology Frie University of Berlin	S	22

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	8
Dr. Enrica Bellone	PhD, Statistics University of Washington	S	17
Dr. Auguste Boissonnade	PhD, Civil Engineering Stanford University	S	27
Dr. Peter Datin	PhD, Civil Engineering University of Florida, Gainesville, FL	S	11
Dr. Laura Eads	PhD, Civil & Environmental Engineering Stanford University, CA	S	9
Mr. Philip Feiner	MS, Meteorology Pennsylvania State University	S	7
Ms. Kian Greene	BS, Environmental Studies and Biological Anthropology University of California Santa Barbara	S	3
Ms. Anfisa Kashkenova	BS, Earth Science and Policy Pennsylvania State University	S	.5
Mr. Manabu Masuda	MS, Civil Engineering, Stanford University	S	19
Mr. Rohit Mehta	MS, Statistics, California State University, Hayward	S	22
Dr. Akwasi Mensah	PhD, Civil Engineering Rice University, Houston	S	8
Dr. Charles Menun	PhD, Structural Engineering University of California, Berkeley	S/C	4/14
Dr. Mohsen Rahnama	PhD, Structural Engineering, Stanford University	S	24
Mr. Agustin Rodriguez	MS, Structural Engineering University of California, Berkeley	S	21
Dr. Nilesh Shome	PhD, Structural Engineering Stanford University	S	13
Ms. Carlin Starrs	MF, Master of Forestry University of California, Berkeley	S	4
Mr. Derek Stedman	MS, Civil & Environmental Engineering University of Western Ontario, Canada	S	9
Ms. Lindsay Stone	MS, Geography Wilfrid Laurier University	S	4
Mr. Barrett Travis	MS, Civil and Environmental Engineering Stanford University	S	4
Dr. Vahid Valamanesh	PhD, Civil and Environmental Engineering Northeastern University	S	7

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Mr. Rajkiran Vojjala	MS, Civil Engineering Stanford University, CA	S	18
Mr. Jeffrey Waters	MS, Meteorology Pennsylvania State University	S	11
Mr. Michael Young	MS, Engineering Science University of Western Ontario, Canada	S	19

Table 5: Individuals involved in actuarial aspects of the model

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Ms. Karen Argonza	BS, Journalism San Francisco State University	S	3
Dr. Auguste Boissonnade	PhD, Civil Engineering Stanford University	S	27
Dr. Laura Eads	PhD, Civil & Environmental Engineering Stanford University, CA	S	9
Mr. Greg Fanoe	FCAS, MAAA, and BS, Mathematics and Computer Sciences University of Richmond	C	N/A
Mr. Philip Feiner	MS, Meteorology Pennsylvania State University	S	7
Dr. Paul Ferrara	CERA, CSPA, FSA, IFoA, and PhD, Mathematical Statistics The University of Virginia	C	N/A
Mr. Zachary Gellis	BS, Meteorology Pennsylvania State University	S	6
Ms. Kian Greene	BS, Environmental Studies and Biological Anthropology University of California Santa Barbara	S	3
Ms. Nathalie Grima	MS, Mathematics San Jose State University	S	18
Ms. Valerie Harper	MS, Mathematics with concentration in Statistics and Decision Sciences Georgia State University	C	N/A
Dr. Mahmoud Kamalzare	PhD, Civil and Environmental Engineering University of Southern California	S	5
Ms. Anfisa Kashkenova	BS, Earth Science and Policy Pennsylvania State University	S	.5
Ms. Roopa Nair	MS, Statistics University of Delhi	S	15
Mr. Matthew Nielsen	MS, Atmospheric Science Colorado State University	S	17
Dr. Bronislava Sigal	PhD, Statistics Stanford University	S	14
Dr. Ajay Singhal	PhD, Civil Engineering Stanford University	S	21
Ms. Beth Stamann	Certificate of General Insurance Insurance Institute of America	S	27
Ms. Carlin Starrs	MF, Master of Forestry University of California, Berkeley	S	4
Ms. Lindsay Stone	MS, Geography Wilfrid Laurier University	S	4
Mr. Joel Taylor	BS Mathematics Bradley University	S	16

Name	Credentials	Staff (S)/ Consultant (C)	Tenure (Years)
Mr. Barrett Travis	MS, Civil and Environmental Engineering Stanford University	S	4
Mr. Jeffrey Waters	MS, Meteorology Pennsylvania State University	S	11
Mr. Michael Young	MS, Engineering Science University of Western Ontario, Canada	S	19

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	15
Ms. Masha Bilyak	BS, Economics and Management Polytechnic University in Lvov, Ukraine	S	22
Mr. Jason Bryngelson	MS, Structural Engineering San Jose State University	C/S	2/25
Mr. Jordan Byk	MBA, Marketing and Finance Rutgers – The State University of New Jersey	S	16
Mr. David Carttar	MS, City Planning University of California, Berkeley	S	28
Mr. Umesh Chander	MS, Computer Science – Northwestern Polytechnic University, Fremont, CA	S	16
Mr. Tommy Chou	BA, Developmental Studies of Industrial Societies University of California, Berkeley	S	18
Mr. Sushil Dhyani	MCA, Master of Computer Application University of Rohtak (India)	S	18
Mr. David Glaubman	BS, Mathematics Northeastern University, Boston	S	18
Ms. Olga Goldin	BS, Power Engineering, Azerbaijan University of Oil and Chemistry	S	27
Mr. Atin Jain	MS, Physics (Specialization Electronics) Rewa University, India	S	13
Mrs. Vidya Karthigeyan	MS, Computer Information Systems California State University, East Bay	S	15
Ms. Veena Krishnamoorthy	MS, Physics Madurai Kamaraj University	S	15
Ms. Jenny Lu	MS Computer Science Wuhan University, Wuhan, China	S	9
Mr. Rohit Mehta	MS, Statistics, California State University, Hayward	S	22
Dr. Rakesh Mohindra	PhD, Earth Sciences Indian Institute of Technology, Roorkee, India	S	22
Dr. Gilbert Molas	PhD, Civil Engineering University of Tokyo	S	27
Mr. Geoffrey Overton	BS, Geography University of Nebraska at Omaha	S	16
Mr. Narvdeshwar Pandey	MS, Future Studies and Planning, Dev Ahilya University, Indore, India MS, Mathematics Gorakhpur University, India	S	19
Mr. Ghanshyam Parasram	BA, Mechanical Engineering Jawahar Lal Nehru Technological University, India	S	23

Name	Credentials	Staff (S)/ Consultant I	Tenure (Years)
Mr. Viraj Patil	MS, Computer Science California State University, Long Beach	S	6
Ms. Richa Sharma	BTech, Information Technology UPTU, Lucknow	S	12
Ms. Kim Shuss	BS, Computer Science, California State University, Hayward	S	9
Dr. Ajay Singhal	PhD, Civil Engineering Stanford University	S	21
Mr. Jayant Srivastava	MS, Computer Science, Institute of Management and Technology, India	S	22
Mr. Avinash Takale	MS, Computer Application Shivaji University, Maharashtra, India	S	14
Mr. Srinivas Thupakula	BS Civil Engineering Indian Institute of Technology Kanpur, India	S	11
Ms. Monika Tomar	MS, Computer Applications (MCA) Bundelkhand University, Jhasi, India	S	20
Mr. Yogesh Vani	MS, Computing Technologies, Telecommunication Systems California State University, Hayward	S	17

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

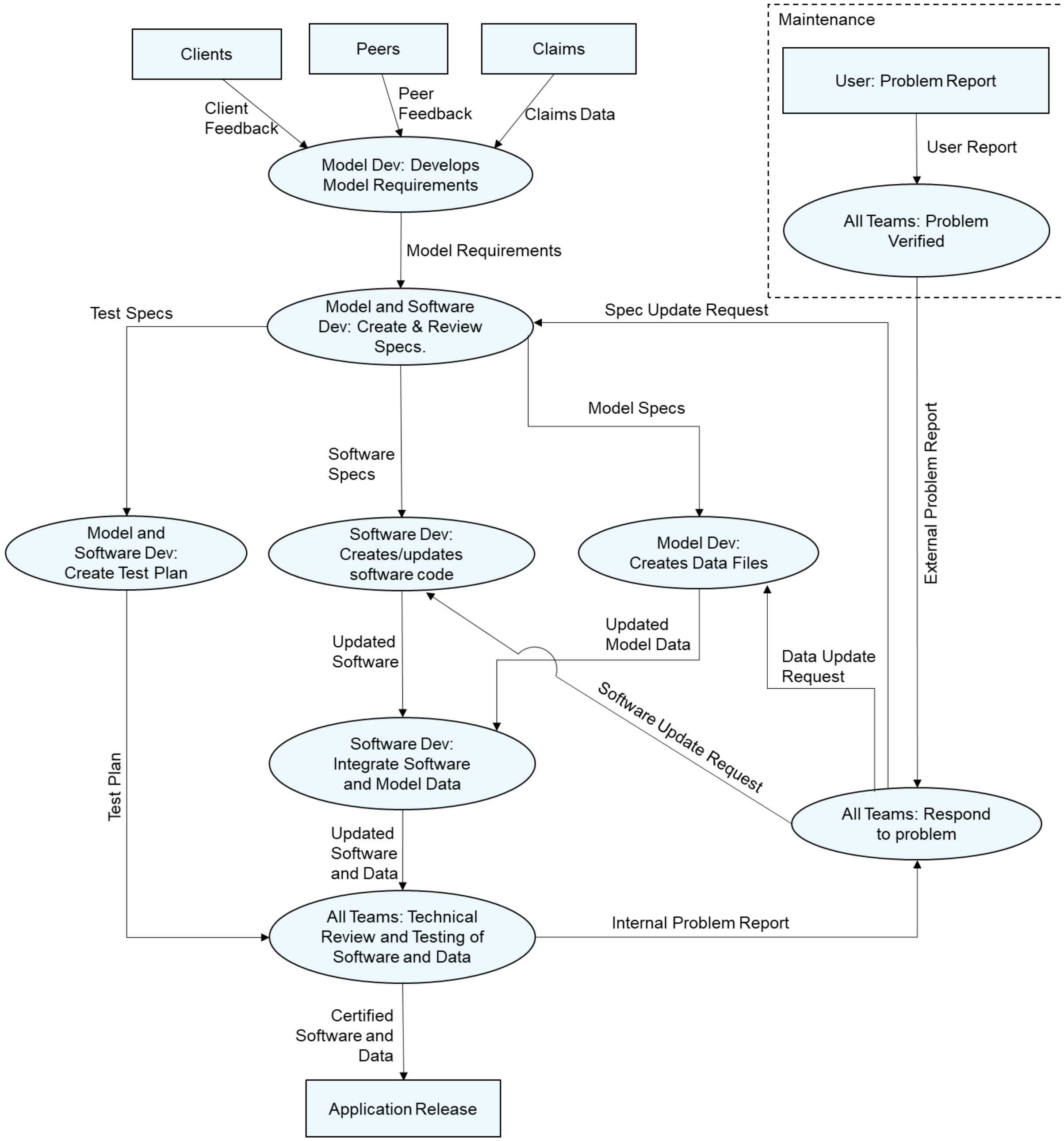
This submission introduces 14 new individuals: Ed Bannister, Abhijeet Chhatry, Alison Dobbin, Kian Greene, Anfisa Kashkenova, Shree Khare, Nicolas Joss Matthewman, Viraj Patil, Tyler Sherrod, Mohan Smith, Lindsay Stone, Anudeep Sure, Hugo Winter, and Xiaoning Wu.

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 hurricane model design, testing, execution, maintenance, and decision-making.

Figure 11 illustrates a typical workflow used at Moody's RMS.

Figure 11: Moody's RMS model development, testing, and maintenance business workflow diagram



In Figure 11, 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 Moody's 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 hurricane 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 Moody's 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, Moody's RMS may retain the services of an external expert to review the methodology, techniques, and other relevant changes to the model. The submission for RiskLink 11.0 involved significant changes to the hazard and vulnerability modules and therefore Moody's RMS engaged with experts for two external reviews. Moody's RMS considers these reviews relevant for the current model version because the core framework and methodology underlying both the hazard and vulnerability modules remains consistent with RiskLink 11.0.

Dr. Robert Hart is an Associate Professor 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 Moody's RMS since 2007. Moody's 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). Mr. Smith was retained by Moody's 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 responses to the current hurricane standards, disclosures, or forms. Identify any unresolved or outstanding issues as a result of these reviews.***

Moody's 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 this model, Version 23.0, pursuant to the Report of Activities (ROA) 2021 standards.

Dr. Hart's review of the hazard module as it was incorporated in Version 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 Version 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

Moody's 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., N. Leith, V. Daniel, E. Bellone, D. S. Nolan. 2010. "Using Mesoscale Simulations to Train Statistical Models of Tropical Cyclone Intensity over Land." *Monthly 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 modeling 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 Hurricane 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 Hurricane 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 Hurricane 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 Hurricane 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 Hurricane 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 Hurricane 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 hurricane model shall not differ from the United States Postal Service publication date by more than 24 months at the date of submission of the hurricane model. ZIP Code information shall originate from the United States Postal Service.

Moody's 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 (USPS). It is Moody's RMS policy to update these ZIP Codes at least every 24 months.

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

The Moody's 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 Moody's RMS for consistency and is subject to standardized quality control testing and checking by experts employed by Moody's RMS for that purpose.

D. If any hurricane model components are dependent on ZIP Code databases, a logical process shall be maintained 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. Moody's 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 Moody's 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 hurricane model and the hurricane model components to which they relate. Provide the effective (official United States Postal Service) dates corresponding to the ZIP Code databases.

A set of four internal databases use postal code data (see below). The USPS vintage of the ZIP Code data used in the submitted model is March 2022.

ZIP Code Assignment (GDMPOST)

This database is used for assigning a geographical coordinate returned from the geocoding module to a corresponding ZIP Codes.

ZIP Resolution Wind Hazard for Historic Storms (histfpZIPWIindex)

Data table used to identify the historical events that impact specific ZIP Codes.

ZIP Resolution Wind Hazard for Stochastic Storms (stocfpZIPWIindex)

Data table used to identify the stochastic events that impact specific ZIP Codes.

Vulnerability and Building Inventory Regions (HUVGEOUS)

This database is used to determine vulnerability and inventory regions associated with a geocoded location.

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 the model. 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 hurricane 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., the model 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.

Name	Description
Point of Interest	Geocodes to the estimated center of the business, building, or other feature that matches the user-entered name
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 hurricane 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 hurricane model ZIP Code-based databases.

Moody's 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, Moody's RMS selects the most recent geocoding update, performs quality and consistency testing that 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 – two exposure-weighted wind-speed averages for individual events databases, and the database to determine vulnerability region and inventory region. The development teams make updates that ensure consistency between the latest vintage of ZIP Codes, treatment of missing/incomplete data, and various vintages of exposure datasets that could be used by clients.

G-4 Independence of Hurricane Model Components

The meteorology, vulnerability, and actuarial components of the hurricane model shall each be theoretically sound without compensation for potential bias from other 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, Karen Argonza has coordinated the editorial process as described in the disclosure below. Karen has reviewed and edited where necessary all documents for accuracy and completeness.

Karen has led the development of catastrophe risk model documentation for the past 18 years. From 2004 to 2009, she was hired as a consultant to establish and manage the documentation effort for the Moody’s RMS peril models and support the editorial effort for the FCHLPM 2005 and 2006 model submissions.

Karen rejoined Moody’s RMS as a full-time employee in February 2020 as Senior Science Writer and Editor for the model knowledge management team. She plans, writes, and edits methodology, scope, and change management documents for cyber, terrorism, wildfire, and life risks models, and oversees content development and procedures for updating and delivering submissions to U.S. regulators.

Karen’s experience spans all aspects of technical publication including staff management, planning, scheduling, design and layout, writing, editing, formatting, review of grammar, verification of accuracy and completeness, localization, and distribution. Publications have also included environment impact reports, and scientific grant proposals and research papers.

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.

Moody’s 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, Moody’s 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, Karen Argonza. Form development is also tracked and edited within our source control system.

Moody’s 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 Expert Certification Forms G-1 through G-6 to ensure that the information contained under each set of hurricane 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.

Moody's 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 HURRICANE STANDARDS

M-1 Base Hurricane Storm Set

The Base Hurricane Storm Set is the National Hurricane Center HURDAT2 as of June 10, 2021 (or later), incorporating the period 1900-2020. A model may be constructed in any scientifically sound and defensible fashion. However, annual frequencies used in hurricane model validation shall be based upon the Base Hurricane Storm Set, allowing for modifications if justified. Complete additional season increments and updates to individual historical storms that are approved by the National Hurricane Center are acceptable modifications, as are weighting and partitioning of the Base Hurricane Storm Set, if it is justified in current scientific and technical literature.

The Moody's RMS hurricane model has been developed and validated using the official NHC HURDAT2 database (as available in June 2021) spanning the time frame from 1900 to 2020 inclusive. There has not been any modification to the official HURDAT2 track set.

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

The base hurricane storm set is made of all hurricanes contained in the official HURDAT2 database (as available in June 2021) spanning the time frame from 1900 to 2020 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 June 2021 vintage is described in Landsea et al. (2004), Landsea et al. (2008), Landsea et al. (2012), Landsea et al. (2014), Hagen et al. (2012), Delgado et al. (2018), and Delgado and Landsea (2020).

M-1.2 If the modeling organization has made any modifications to the Base Hurricane Storm Set related to hurricane landfall frequency and characteristics, provide justification for such modifications. Such modifications should be incorporated consistently into Form M-1, Annual Occurrence Rates; Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year; and Form A-2, Base Hurricane Storm Set Statewide Hurricane Losses.

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

M-1.3 If the hurricane 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 and provide comparisons to the unmodified Base Hurricane Storm Set, including occurrence and intensity.

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-1.5. If the modeling organization has accounted for climate change in either the historical record or hurricane model development, justify its use in modeling Florida hurricane rates from the peer-reviewed scientific literature. Describe the analysis and its impacts on Florida hurricane rates.

The Moody's RMS hurricane model does not account for climate change, as we do not make any modification to the HURDAT2 official track set.

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 current scientific and technical 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 hurricane model.

The hurricane parameters used in the hazard model are:

- Translation speed and storm heading (also known as bearing)
- Central pressure
- Inland filing 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 hurricane 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 varies 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 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 that 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 hurricane 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 Moody's 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 hurricane model's hurricane tracks. Discuss the appropriateness of the hurricane model stochastic hurricane tracks with reference to the historical hurricane 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 1970s when visible and infrared satellite imagery started to be used.

Modeled Vmax are calibrated and validated using HURDAT2 and the landfall summaries (https://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html) for years within the 1900–2020 time frame.

Modeled central pressures at landfall are derived from HURDAT records from the years 1900–2008. Where central pressure is missing in the earlier part of the record, it is inferred from Vmax.

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 Provide plots of distance along the coast of Florida and adjacent states (x-axis) versus modeled annual landfall occurrence rates (y-axis) in two intensity bands (Saffir-Simpson categories 1-2 and 3-5). Any set of coastal segments may be used for this purpose, as long as they are not greater than 100 miles in length. If the modeling organization has a currently accepted hurricane model, then provide the currently accepted hurricane model's rates on the same axes. Also provide on the same axes the modeled annual landfall occurrence rates computed directly from the modeling organization's Base Hurricane Storm Set.

Moody's RMS makes use of the Moody's RMS landfall gates to validate landfall frequencies. These landfall gates are
coastal segments of varying sizes, all less than 100 miles in length, as shown on Figure 12. Historical, modeled, and previously-modeled hurricane annual landfall occurrence rates along the Moody's RMS landfall gates are given on Figure 13 and Figure 14 for Category 1–2 and Category 3–5 hurricanes. Saffir-Simpson category is based on 1-minute wind speed at time of landfall.

Figure 12: Moody's RMS landfall gates

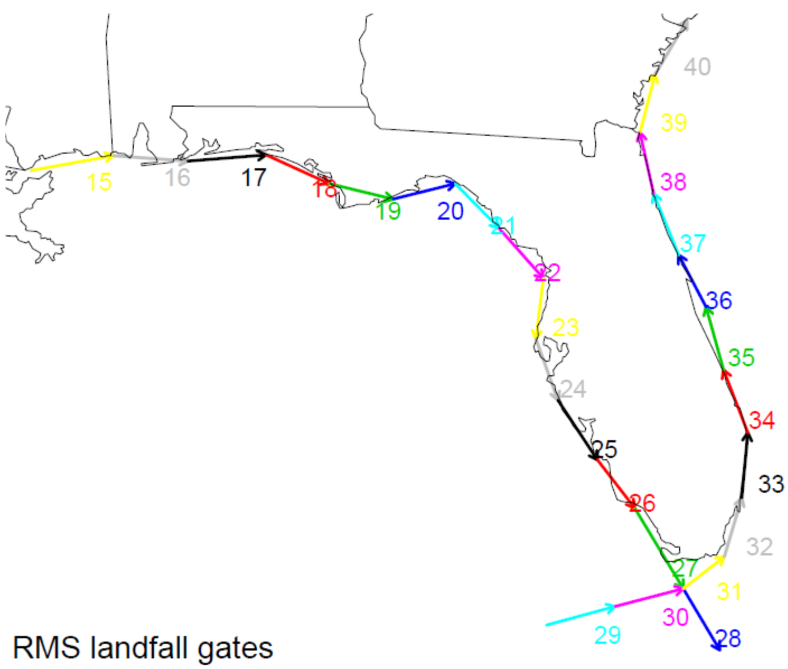


Figure 13: Historical, modeled (North Atlantic Hurricane Models 23.0 (Build 2250)), and previously-modeled (North Atlantic Hurricane Models 21.0 (Build 2050)) annual landfall occurrence rates (1900–2020) by landfall gate for Category 1–2 storms

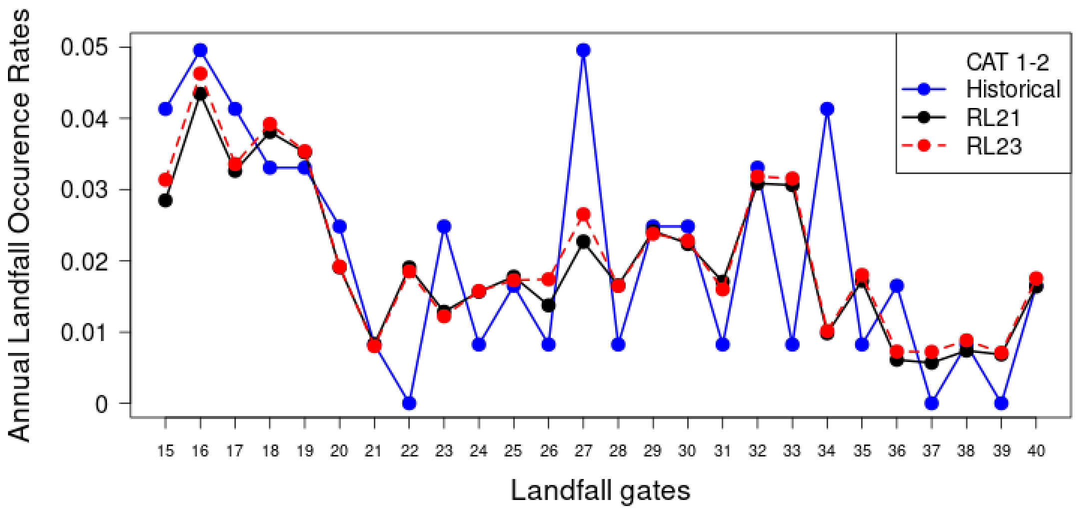
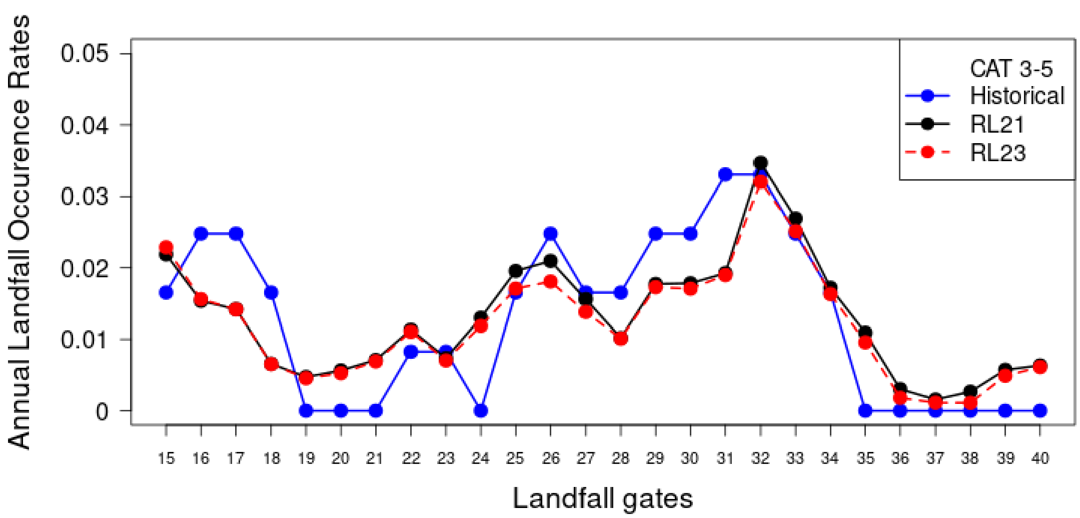


Figure 14: Historical, modeled (North Atlantic Hurricane Models 23.0 (Build 2250)), and previously-modeled (North Atlantic Hurricane Models 21.0 (Build 2050)) annual landfall occurrence rates (1900–2020) by landfall gate for Category 3–5 storms



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

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

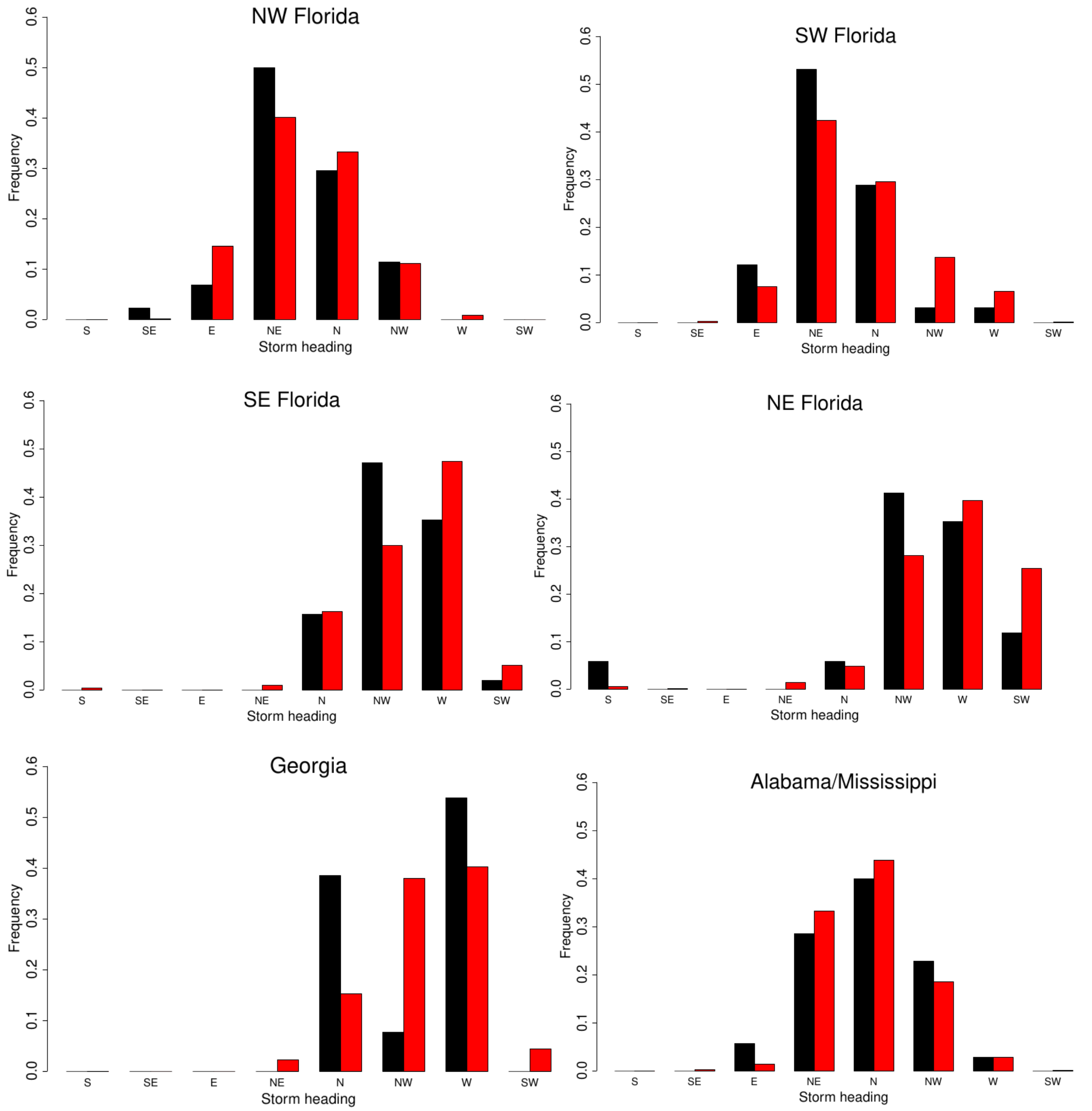
M-3 Hurricane Probability Distributions

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

Moody's RMS 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 15 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 Moody's RMS HWind snapshots. The quartiles of modeled radii (>110mph, >73mph, 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-6.4.

Figure 15: 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. ***Hurricane 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 Hurricane Wind Scale.***

Saffir-Simpson Hurricane Wind 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 Moody’s 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-3.3 ***Describe and justify any changes made to the modeled Base Hurricane Storm Set in the currently accepted hurricane model that are not reflected in changes to the distributions in Form S-3, Distributions of Stochastic Hurricane Parameters. Describe the methodology used to make such changes.***

Storm frequencies and Vmax distributions are updated using 1900–2020 HURDAT2 data, as mentioned in Form S-3. The update relies on changes to the Poisson rate associated to each storm in the stochastic event set. The distributions of other parameters change implicitly as a result. These changes are reflected in the validation provided throughout the submission.

M-4 Hurricane Windfield Structure

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

Wind fields generated by the Moody's 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) 2016 or later. Use of alternate datasets shall be justified.

The Moody's 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 Moody's RMS database was compared to the NLCD 2016 database to identify regions where land use land cover changed, for which the existing ASTER imagery was validated against NLCD 2016 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 grouped by similar roughness characteristics. 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 hurricane model shall account for the effects of the vertical variation of winds.

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

M-4.1 Provide a tangential windspeed (y-axis) versus radius (x-axis) plot of the average or default symmetric wind profile used in the hurricane model and justify the choice of this wind profile. If the windfield represents a modification from the currently accepted hurricane model, plot the previous and modified profiles on the same figure using consistent axes. Describe variations between the previous and modified profiles with references to historical storms.

The Moody's RMS model is based on an optimized version of the Willoughby profile (Willoughby et al., 2006). Figure 16 shows the radially averaged profile for typical Florida values:

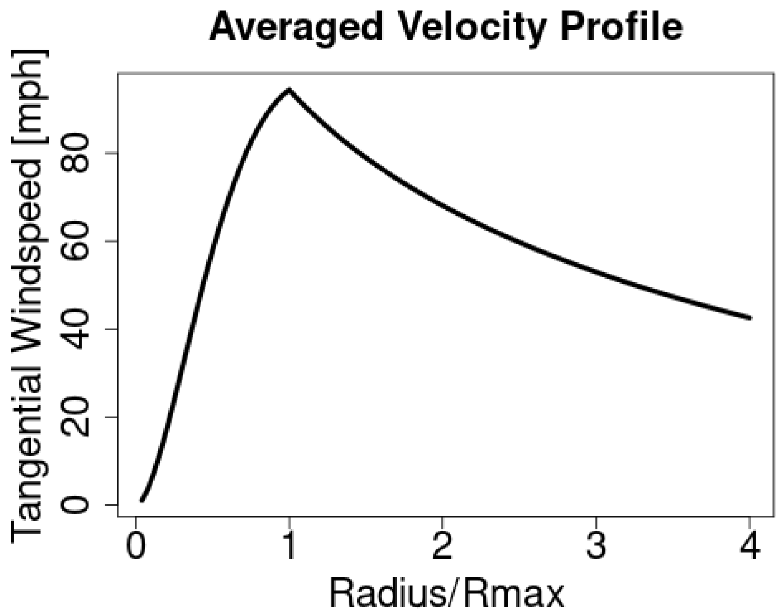
- Translational velocity – 5 m/s (11.2 mph)
- Latitude – 27.5 N
- Pressure difference – 58.5 hPa

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 Moody's RMS HWind snapshots (e.g., Powell et al., 2010).

Figure 16: Radially averaged velocity profile based on the parameters given in the text



Past modeling approaches at Moody's RMS have relied on the Holland profile (Holland 1980). Figure 17 and Figure 18 show the comparison between Moody's RMS HWind wind fields (https://www.rms.com/event-response/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. To better assess the model skills across different snapshots, Moody's 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 outperforms the Georgiou/Holland model.

Figure 17: Hurricane Charley on August 13, 2004–16:30 UTC. a) Moody's RMS HWind snapshot b) Moody's RMS HWind composite, c) Best fit for the Georgiou/Holland Model, d) Best fit for the Moody's RMS wind field model – all wind speeds are 1-minute mean 10 m winds in mph

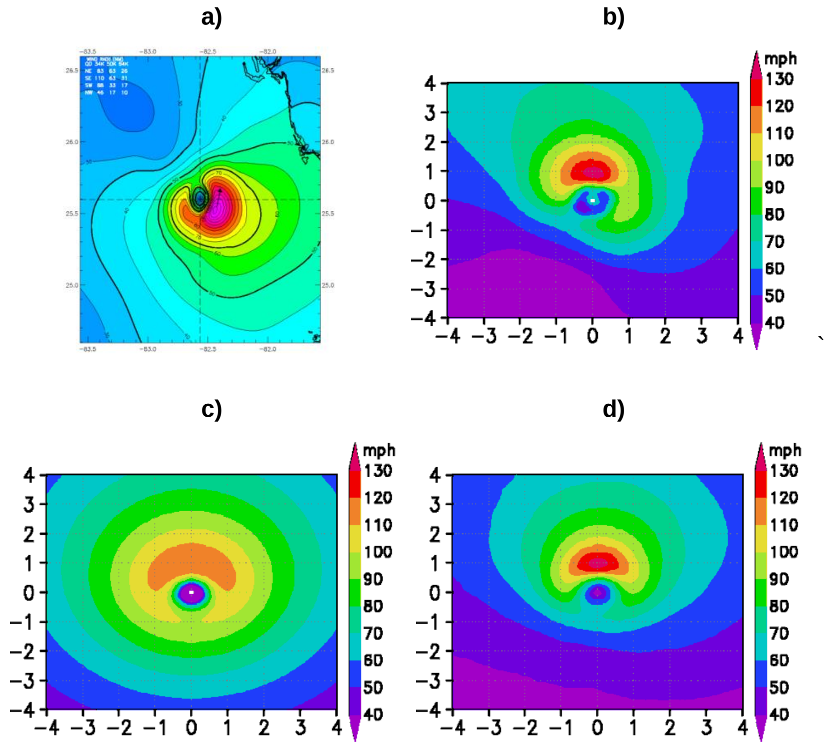
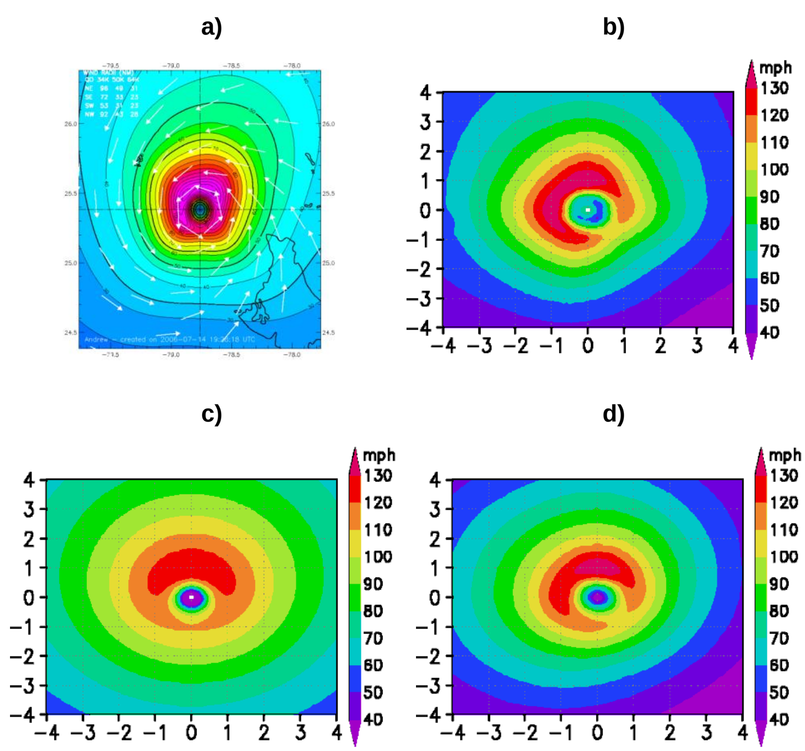


Figure 18: As Figure 17, but for Hurricane Andrew on August 24, 199



The wind profile has not changed since the previous submission.

The model wind field has not changed in any way since the previous submission.

M-4.2 Describe how the vertical variation of winds is accounted for in the hurricane 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-4.3 Describe the relevance of the formulation of gust factor(s) used in the hurricane 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 Moody's 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 Skerlj 2005).

M-4.4 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-4.5 Provide the collection and publication dates of the land use and land cover data used in the hurricane 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, https://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 2016 data set to ensure consistency and identify regions where land use land cover has changed. Consistency checks between the Moody's RMS and NLCD 2016 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 2016.

M-4.6 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 factors are 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 Moody's RMS variable resolution grid (1–10 km) using weights that depend on insured exposure.

M-4.7 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 historical storms all having a different time series of the wind model parameters. The chosen realization (i.e., time series of track parameters) yields the best agreement with the station observations. Therefore, the historical 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 2013; Landsea et al., 2014; Hagen et al., 2012; Delgado et al., 2018, Delgado and Landsea 2020
- National Hurricane Center reports (NOAA) https://www.nhc.noaa.gov/data/publications.php, https://www.nhc.noaa.gov/data/tcr/
- 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
- Weatherflow: Proprietary data from hurricane hardened network and a professional observation network
- MDA Federal: Commercial data provider of public-domain data, including Automated Surface Observing System (ASOS), Coastal Marine Automated Network (C-MAN) and buoy data from National Data Buoy Center (NDBC, NOAA)

Figure 19 to Figure 27 show footprints and time series at two example stations for hurricanes Charley (2004), Wilma (2005), Irma (2017), and Michael (2018). The reconstruction of Hurricane Irma uses a further step, which modifies the optimized footprint using spatially smoothed differences between the modeled and observed maximum peak gusts (e.g., Barnes 1964). The figures in this section and the exhibits in Standard S-1.2 are based on the wind field generated by the Moody's RMS stochastic model before this final adjustment step.

Figure 19: Footprint of Hurricane Charley (2004). Shown is the maximum 3-second 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 20.

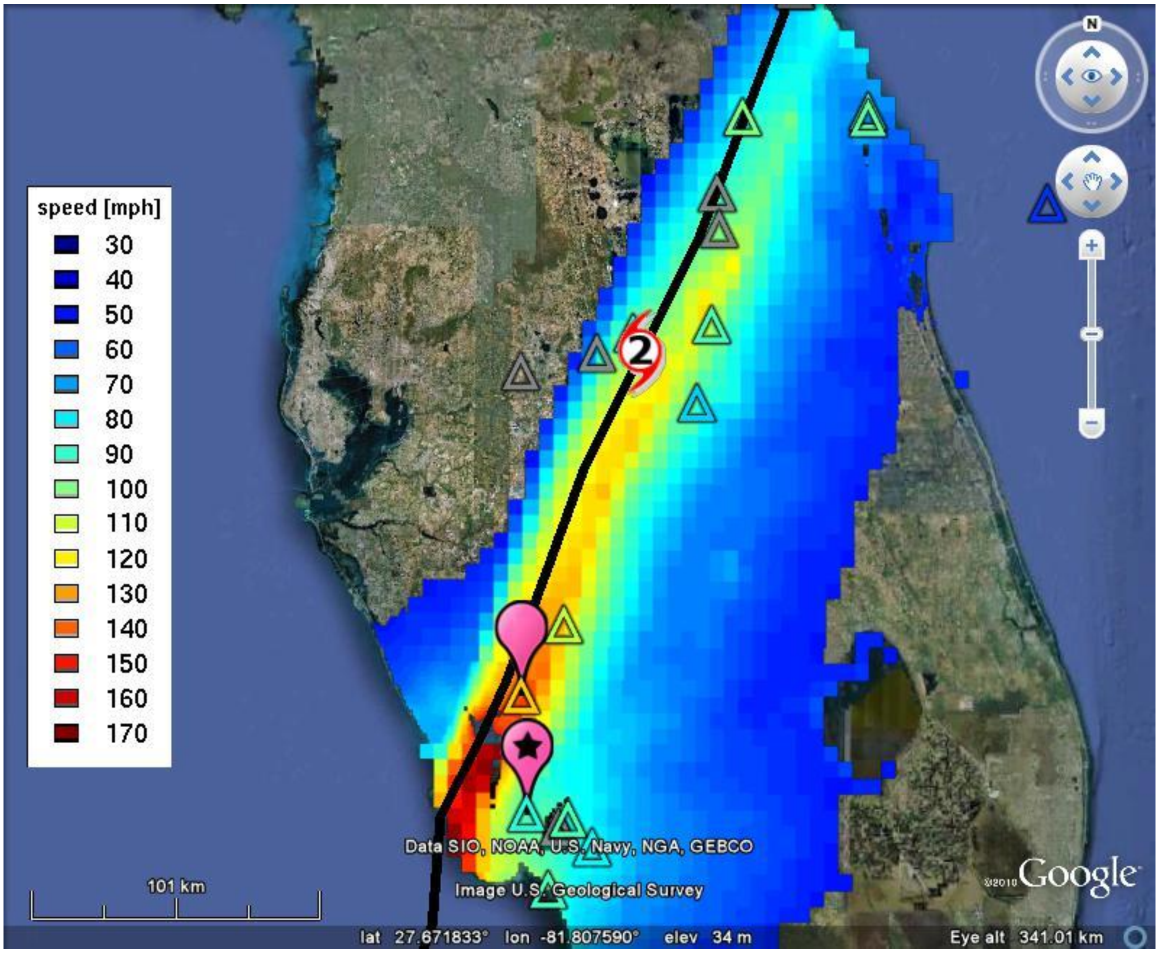


Figure 20: Two station time series of 3-second gust wind speeds comparing model with observations for Hurricane Charley (2004)

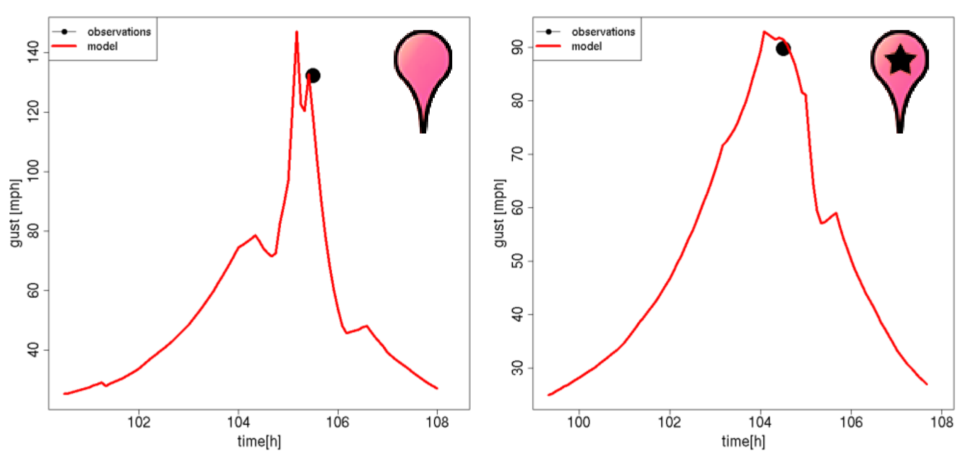


Figure 21: As Figure 19 but for Hurricane Wilma (2005)

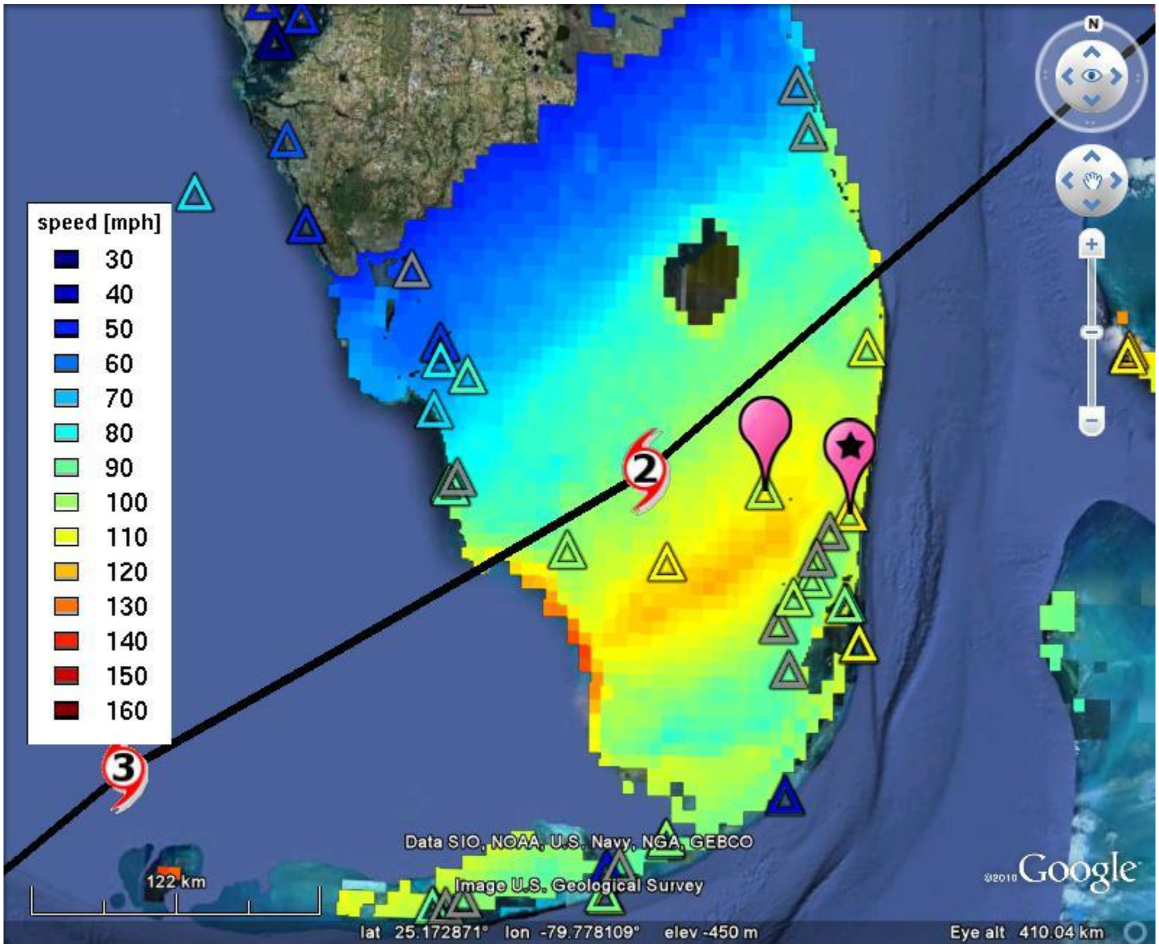


Figure 22: Two station time series of 3-second gust wind speeds comparing model with observations for Hurricane Wilma (2005)

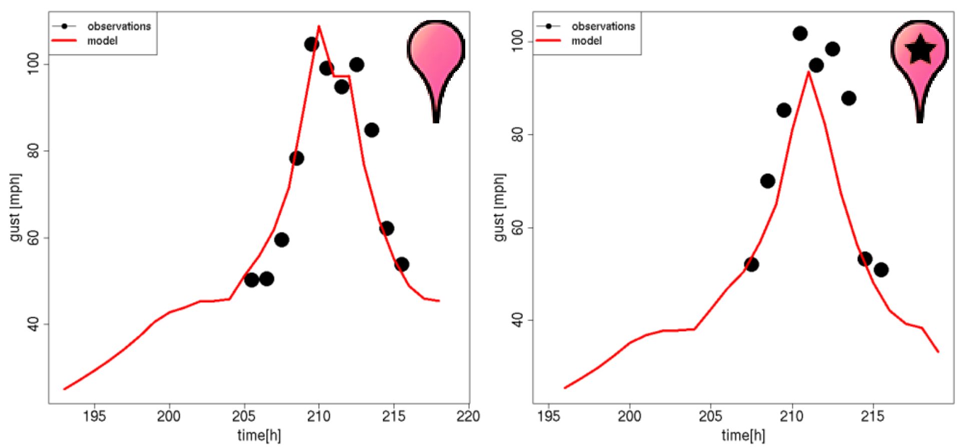


Figure 23: As Figure 19 but for Hurricane Irma (2017)

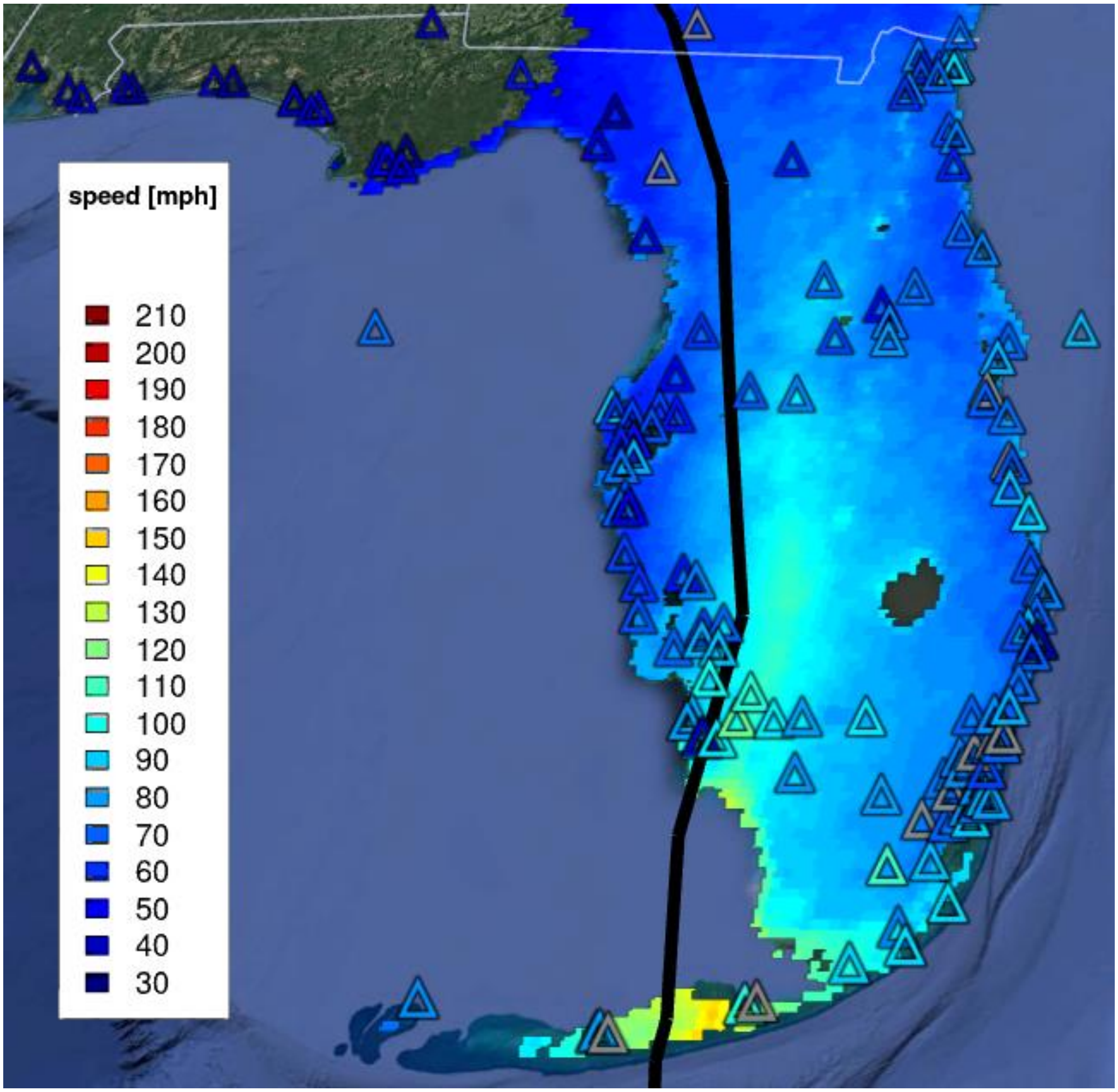


Figure 24: Zoom on Southern Florida for Hurricane Irma (2017)

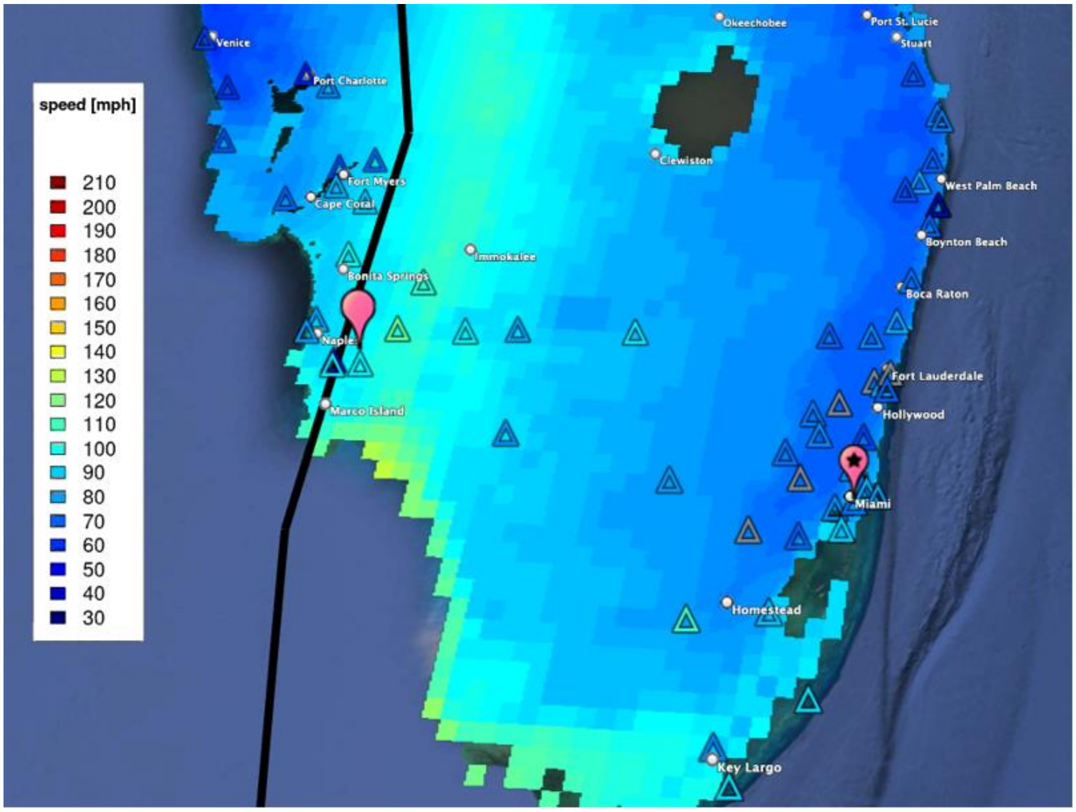


Figure 25: Two station time series of 3-second gust wind speeds comparing model with observations for Hurricane Irma (2017)

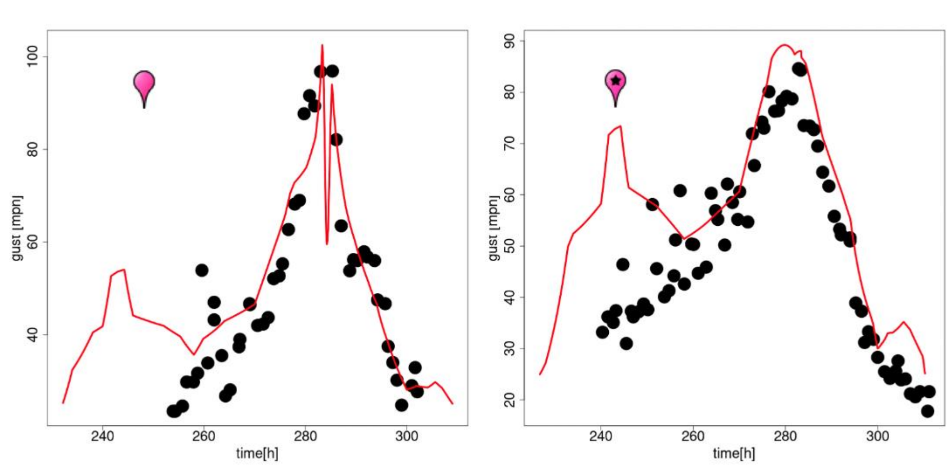


Figure 26: As Figure 19 but for Hurricane Michael (2018). Most anemometers around landfall and along the track failed, and they are shown in gray.

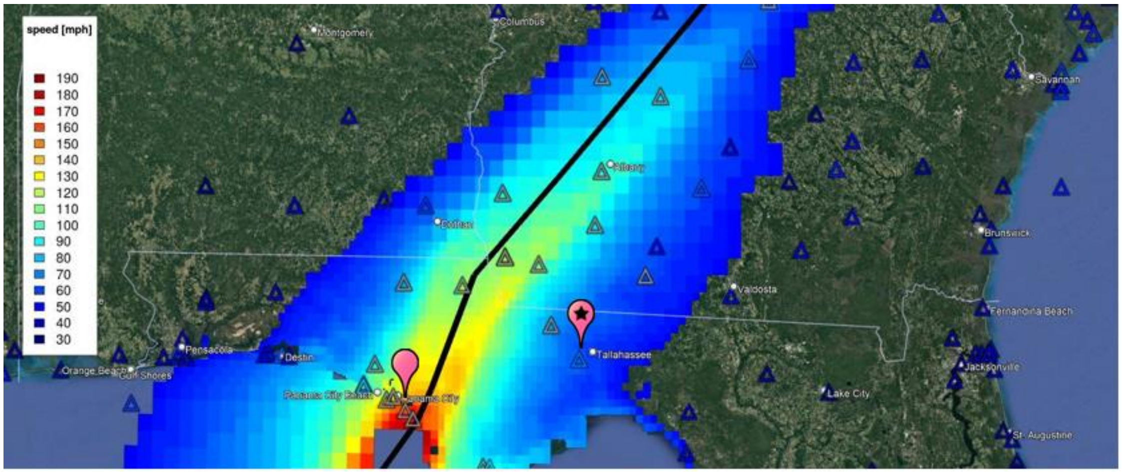
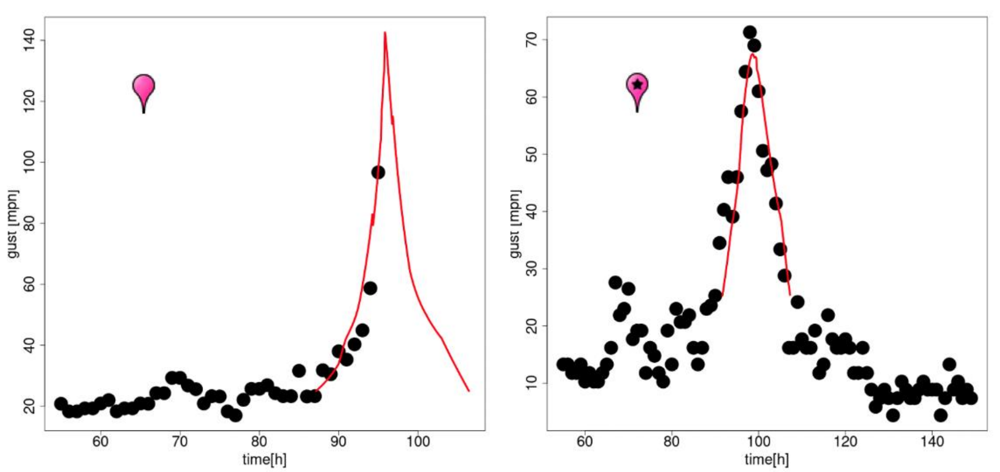


Figure 27: Two station time series of 3-second gust wind speeds comparing model with observations for Hurricane Michael (2018)



M-4.8 Describe how the hurricane model windfield is consistent with the inherent differences in windfields for such diverse hurricanes as Hurricane Charley (2004), Hurricane Wilma (2005), Hurricane Irma (2017), and Hurricane Michael (2018).

Charley (2004), Wilma (2005), Irma (2017), and Michael (2018) 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. Irma made two landfalls, in the Keys (Category 4) and on Marco Island (Category 3), then traveled north through Florida. Irma had a broad structure and caused strong winds over almost the entire Florida peninsula. Michael was the strongest of these storms, and the most intense on record to make landfall in the Florida panhandle (Category 5). It was still intensifying as it made landfall and went on to produce strong winds far inland in Florida and across state borders. Although more intense than Irma, Michael was a much more compact storm. The variability in storm intensity and structure 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-4.7, modeled wind fields are in agreement with observations for these four hurricanes.

M-4.9 Describe any variations in the treatment of the hurricane model windfield for stochastic versus historical storms and justify this variation.

Stochastic and historical 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. For historical events up to and including 2008, the gusts are calculated as in the 2013 Standards of the Florida Commission on Hurricane Loss Projection Methodology (land-use and land-cover database shall be consistent with NLCD 2006 or later), which is consistent with the urban exposures of the 2004–2005 seasons. For historical events from 2009 onwards, gusts are calculated using the land-use land-cover data as described in Standard M-4.B (in Florida, this pertains to hurricanes Hermine, Matthew, Irma, Nate, Michael, Dorian, Sally, and Zeta). For Hurricane Irma, the wind field is also modified as described in Disclosure M-4.7, to further improve the match with observations.

M-4.10 Provide a completed Form M-2, Maps of Maximum Winds. Provide a link to the location of the form [Form M-2].

M-5 Hurricane Landfall and Over-Land Weakening Methodologies

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

The Moody's RMS inland filling model simulates central pressure decay rates that are consistent with historical records as demonstrated in Disclosures M-5.2 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 hurricane 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 hurricane model.

Hurricane decay rates are modeled through the Moody's 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):

Equation 2

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

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

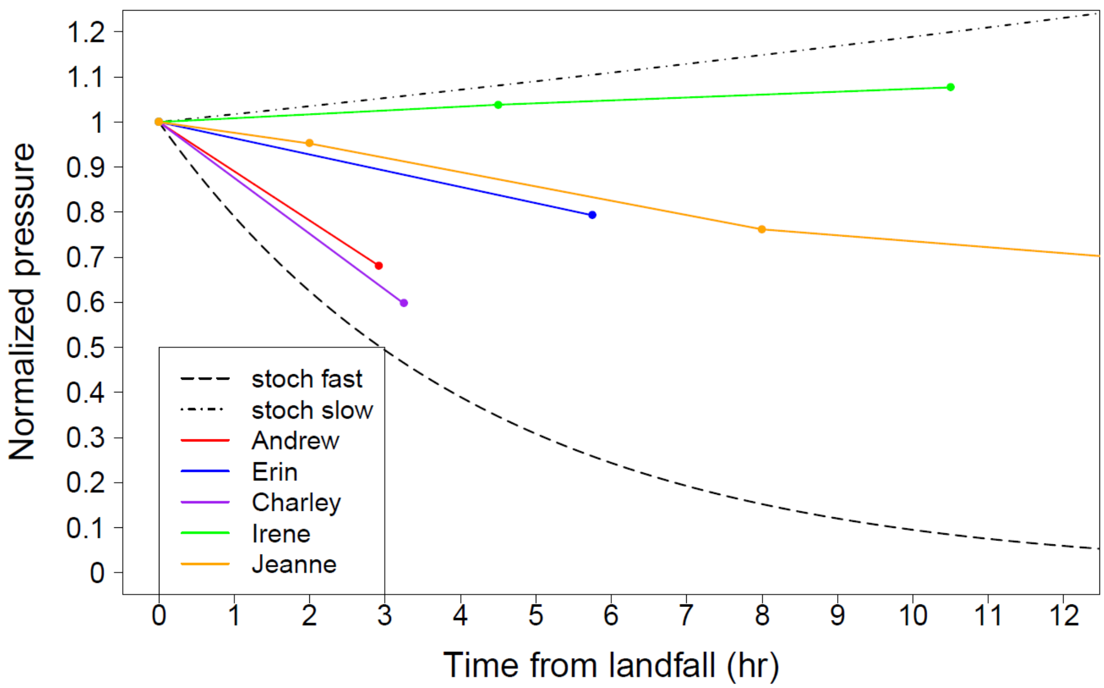
In Florida, the inland filling rate is drawn from a normal distribution with a mean that depends on pressure difference (FFP-$P_c(t_0)$), translational speed and Rmax at the time of landfall, as well as two predictors that describe the proportion of the storm over different terrain at and just after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

Figure 28 illustrates a comparison of the normalized central pressure time series for key historical Florida land-falling storms compared with the Moody's RMS stochastic set's fastest (0.1^{th} percentile) and slowest (99.9^{th} percentile) filling rates. This figure demonstrates that the Moody's 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 28: 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, Moody's 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 Moody's RMS inland filling model (given the storm characteristics). This pressure time series is used to develop a wind footprint that is compared to station observations. Figure 29 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 30 is a scatterplot of modeled 3-second gusts compared with 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 29: 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 Moody's RMS inland filling model and not by the HURDAT time series.

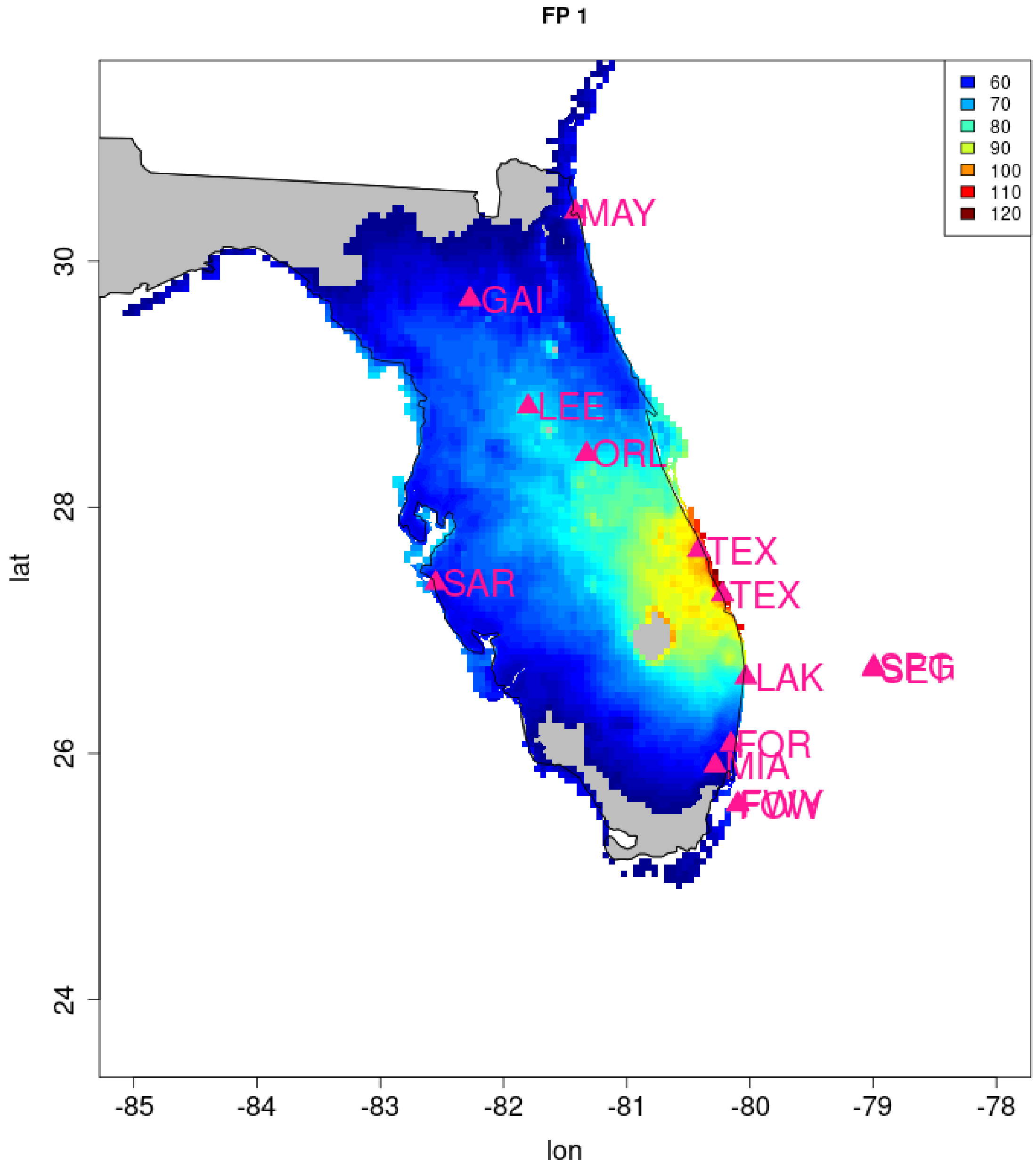


Figure 30: Scatterplot of modeled versus observed 3-second gusts (mph) for Hurricane Frances

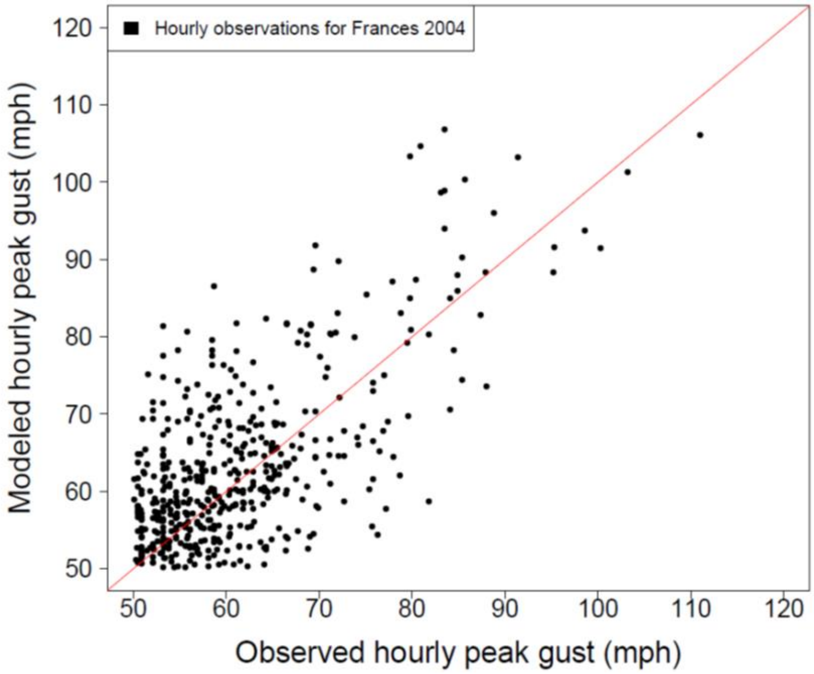


Table 9: Observed and modeled maximum peak gusts at the stations with locations given in Figure 29

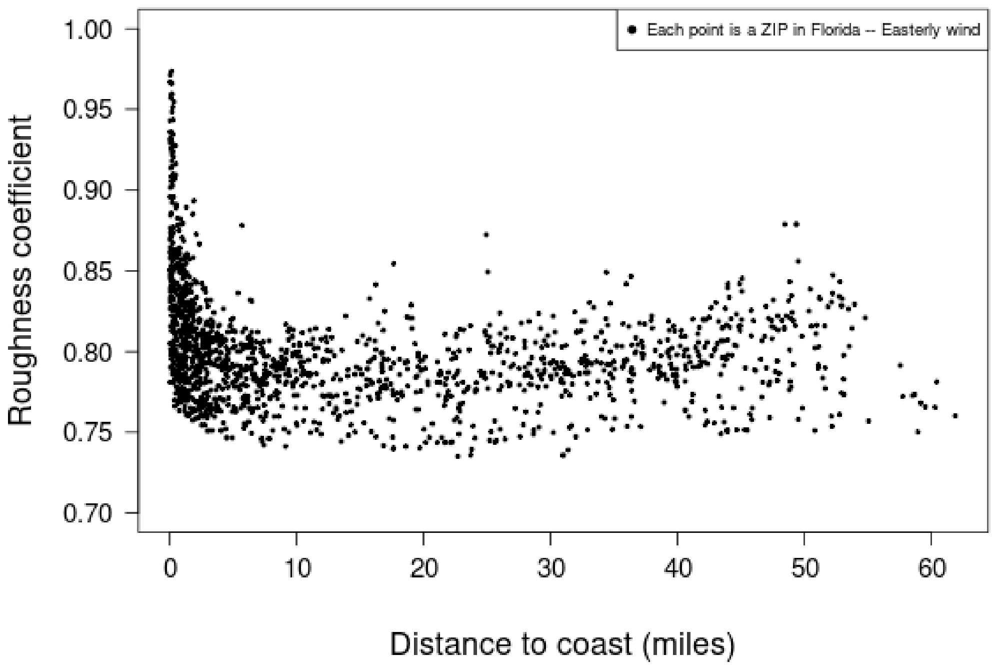
Code	Station_name	Observed Peak Gust (mph)	Modeled Peak Gust (mph)
FWY	FWYF1	65.8	64.1
SET	SETTLEMENT POINT	91.4	106.8
SPG	SPGF1	111	106.0
TEX	TexasTech Frances 04 SBCCOM_CI	95.3	91.6
MIA	MIAMI/OPA LOCKA	55.8	54.3
LAK	LAKE WORTH	75.1	90.1
TEX	TexasTech Frances 04 WEMITE 1	85.7	104.7
FOW	FOWEY ROCKS	65.7	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 hurricane model.

Moody’s 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 31 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 31: 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 hurricane model of passage over non-continental U.S. land masses on hurricanes affecting Florida.

Hurricanes affecting Florida are part of the Moody's 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 hurricane model for stochastic hurricanes compared to historical hurricanes affecting Florida.

When modeling historical events, Moody's 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, as described in Disclosure M-6.1.

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, as described in Disclosure M-6.2.

M-6.1 Describe how the asymmetric structure of hurricanes is represented in the hurricane 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:

Equation 3

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

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

M-6.2 Discuss the impact of surface roughness on mean windspeeds.

Increasing surface roughness acts to decrease the mean wind speed. Over a smooth surface, such as open-water, the amount of momentum required to overcome the surface shear stress is less than that for a rough surface, such as suburban or urban areas. Each surface will result in a different mean wind profile, with the mean wind speed being greater near the surface for smoother surfaces than rougher surfaces. This can be simply confirmed by evaluating the influence of surface roughness (via the aerodynamic roughness length) in the logarithmic law ("log-law") wind profile. Wind speed V at height z is given by

Equation 4

$$V(z) = \frac{u_*}{\kappa} \log\left(\frac{z}{z_0}\right)$$

where: $u_*$is the friction velocity, κ is von Karman's constant (≈ 0.4) and z_0 the aerodynamic roughness length. Holding all parameters constant and assessing z_0 values for open-water (0.001 m), open-country (0.03 m) and urban (1.0 m), the resulting mean wind speeds **relative** to the open-water case for open-country and urban are 0.63 and 0.25, respectively. This confirms that increasing surface roughness results in decreasing mean wind speeds.

M-6.3 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].

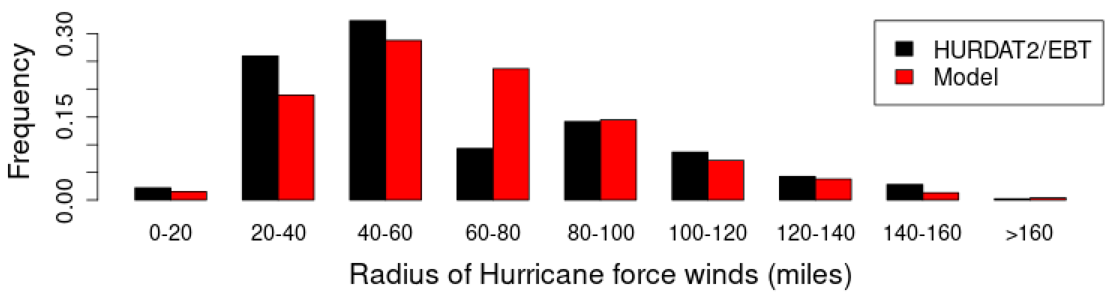
M-6.4 Discuss the radii values for each wind threshold in Form M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds, with reference to available hurricane observations such as those in HURDAT2. Justify the appropriateness of the databases used in the radii validations.

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 32 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 32: 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 HURRICANE STANDARDS

S-1 Modeled Results and Goods-of-Fit

A. The use of historical data in developing the hurricane model shall be supported by rigorous methods published in current scientific and technical literature.

Moody's 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 current scientific and statistical methods for the academic disciplines appropriate for the various hurricane model components or characteristics.

The results of the Moody's 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 Moody's 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 Moody's 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.) Moody's 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 that 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)

Moody's 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 1900–2020. Moody's 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). Moody's 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

Moody's 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). Moody's 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 Moody's 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 43.

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

Moody's 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. Moody's RMS has performed the conditional chi-square and Neyman-Scott tests. Moody's 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, Texas Tech University, and Weatherflow) over land, and Moody's 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. In terms of maximum at station locations, the model very slightly over-estimates the observed winds by less than 0.5 mph over all footprints. The comparison over all snapshots indicates that on average the modeled wind speeds are above the observed by approximately 3 mph. The proportion of data points for which the modeled values are within 10, 20, 30, and 40 percent of the observed wind speeds are shown in Table 10 for all footprints and all snapshots.

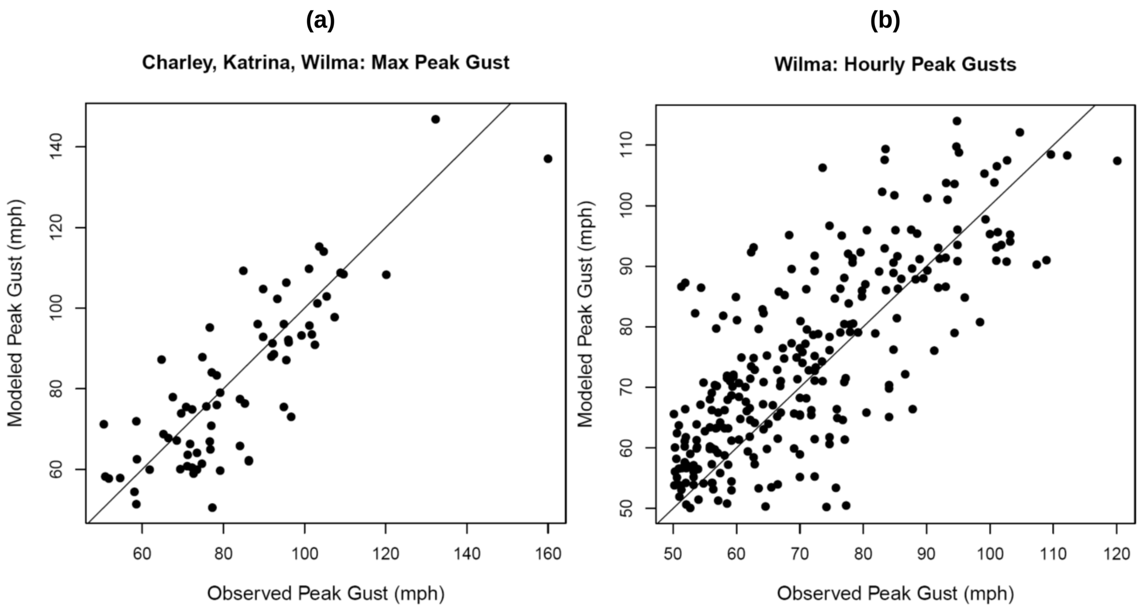
Table 10: Portion of modeled wind speeds within 10%, 20%, 30%, and 40% of the observed value

Difference Range	Proportion of Data Points	
	Footprints	Snapshots
± 10%	58%	55%
± 20%	84%	83%
± 30%	94%	94%
± 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 33. Figure 33(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 33(b) for Hurricane Wilma (2005). Both scatterplots demonstrate a reasonable agreement between modeled and observed wind speeds.

Figure 33: Modeled versus observed wind speeds (3-second gust)



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

The year of the loss is given below:

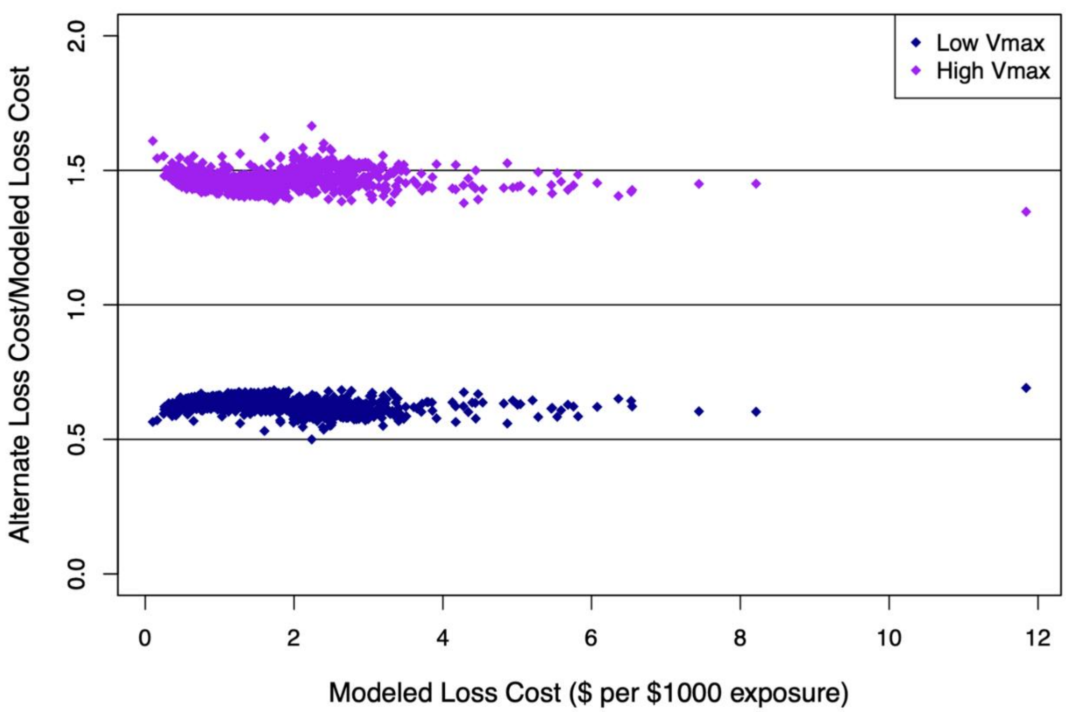
- Hugo–1989
- Bob–1991
- Andrew–1992
- Erin–1995
- Opal–1995
- Fran–1996
- Georges–1998
- Charley–2004
- Frances–2004
- Ivan–2004
- Jeanne–2004
- Dennis–2005
- Katrina–2005
- Rita–2005
- Wilma–2005
- Ike–2008
- Irene–2011
- Isaac–2012
- Sandy–2012
- Matthew–2016
- Irma—2017
- Michael—2018

S-1.4 Provide an assessment of uncertainty in hurricane probable maximum loss levels and hurricane loss costs for hurricane output ranges using confidence intervals or other 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.

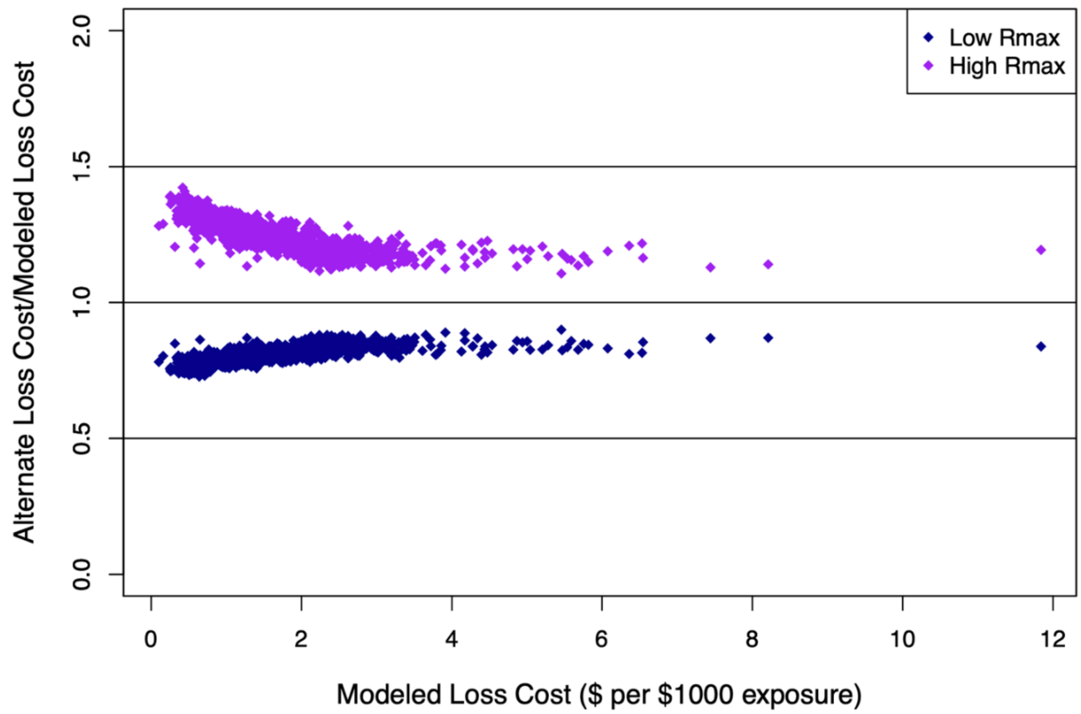
Figure 34 shows the uncertainty in loss costs for output ranges due to the uncertainty in Vmax. In the figure, each point represents the average annual loss per $1,000 of exposure for a ZIP Code. Vmax is set to “low” and "high" values to obtain alternate loss costs, which are compared to the original losses. The 5 percent and 95 percent confidence bounds on the Vmax CDF are used to set the “low” and "high" limits (the 99 percent confidence bounds are shown in Figure 39). 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 34: 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 35. 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 percent and 95 percent confidence bounds on the Rmax CDF are used to set the "low" and "high" limits (the 99 percent confidence bounds are shown in Figure 42). 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 35: Uncertainty in loss costs due to Rmax



Similar analyses were performed for several return level losses at the high end of the distribution. Figure 36 and Figure 37 show the effect of uncertainties in Vmax and Rmax on 100-year ZIP Code losses. Comparison of Figure 34 and Figure 36 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 37) less than the loss cost (Figure 35) for the majority of ZIP Codes, although with a greater variability across ZIP Codes.

Figure 36: Uncertainty in 100-year loss due to Vmax

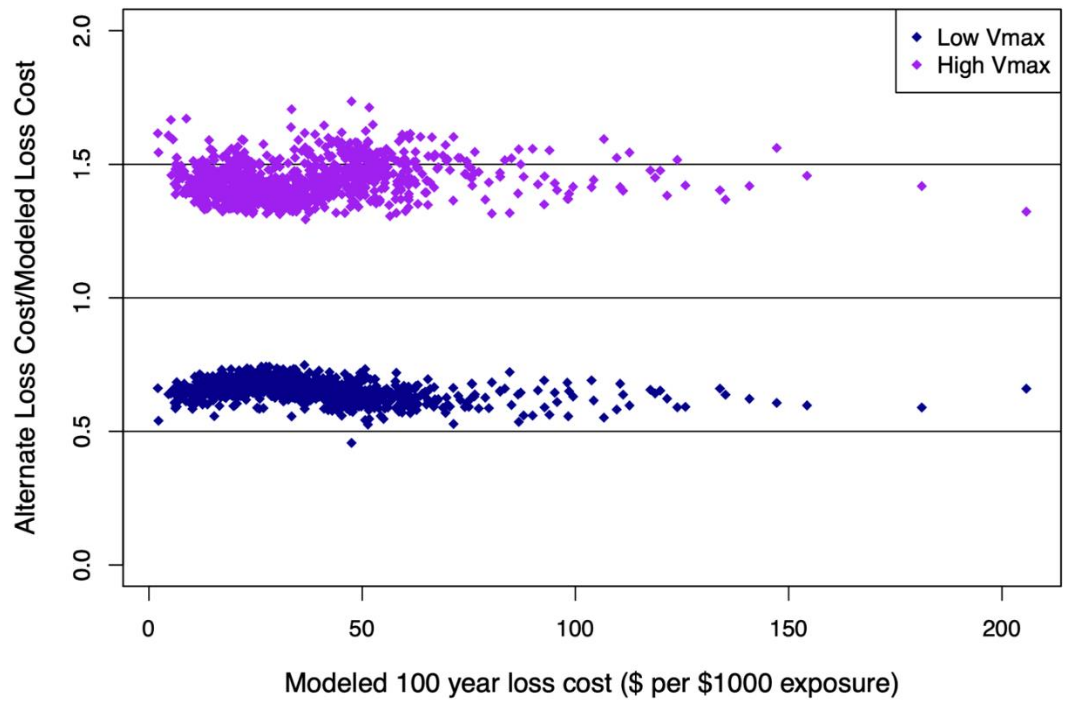
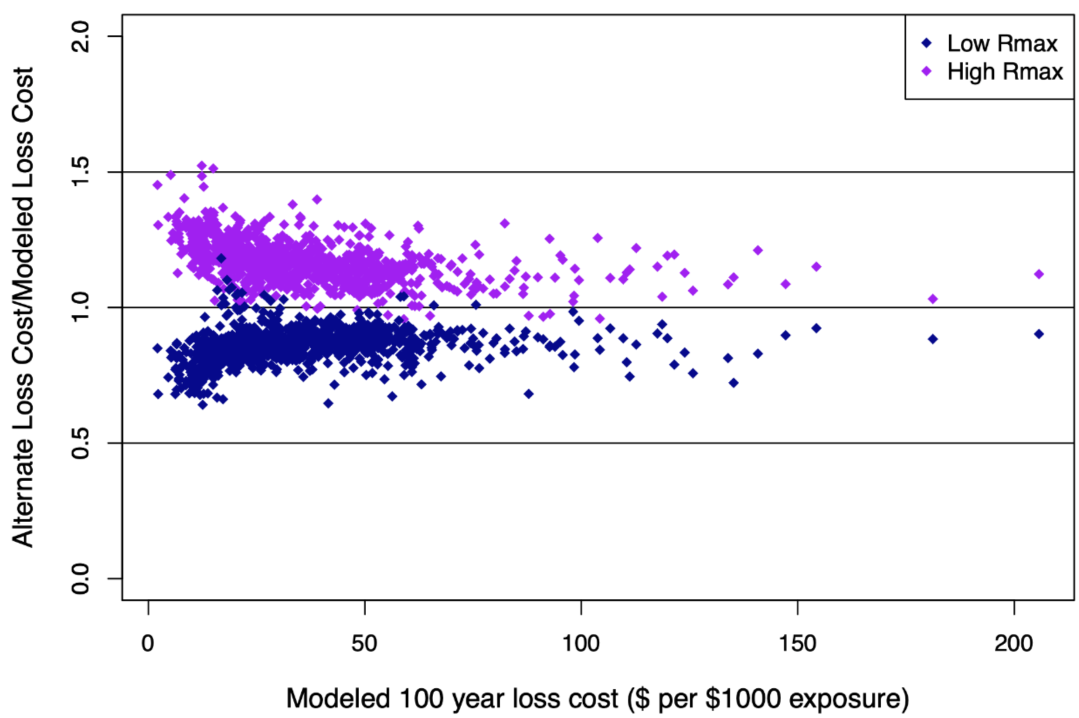


Figure 37: Uncertainty in 100-year loss due to Rmax



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

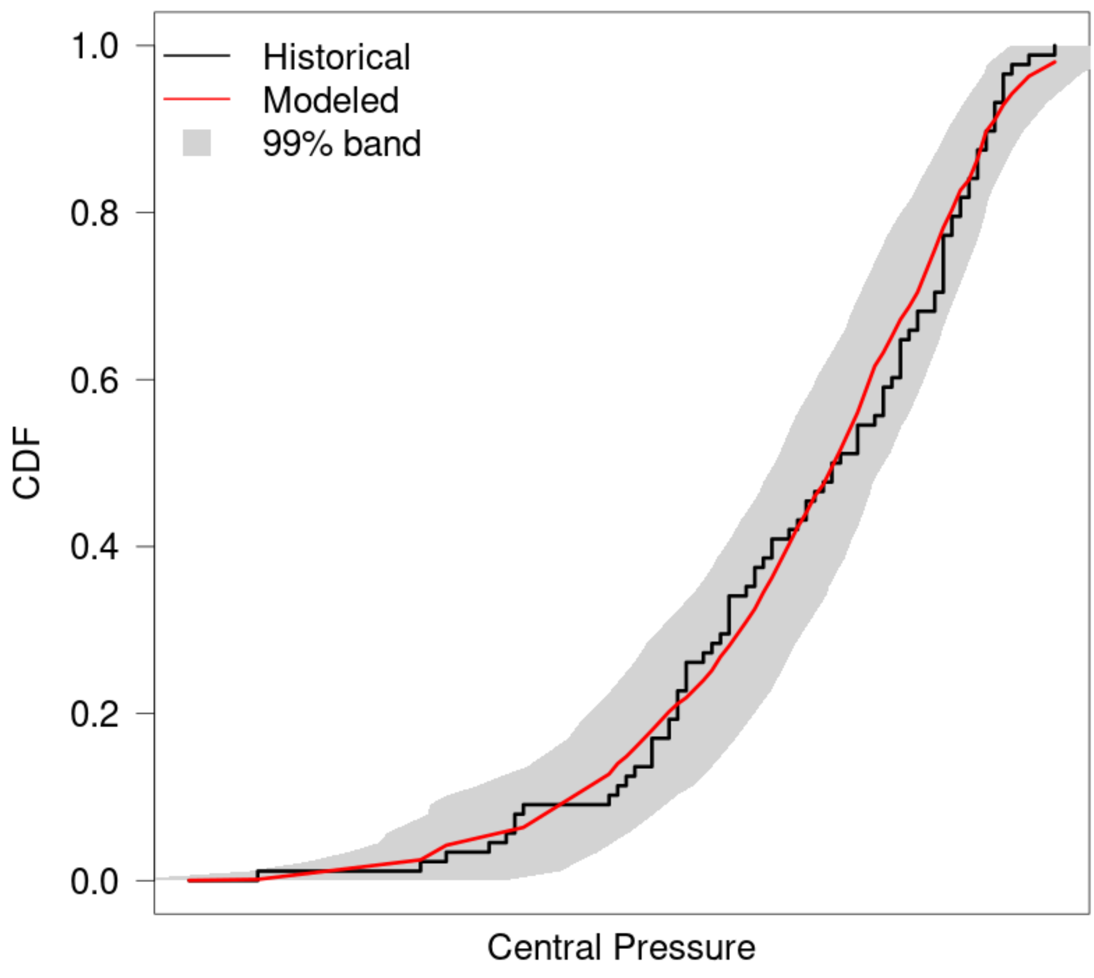
Historical and modeled results are in agreement according to currently accepted statistical methods.

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

Intensity – Central Pressure, Vmax and Inland Filling Rate

Figure 38 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 percent band around the modeled CDF.

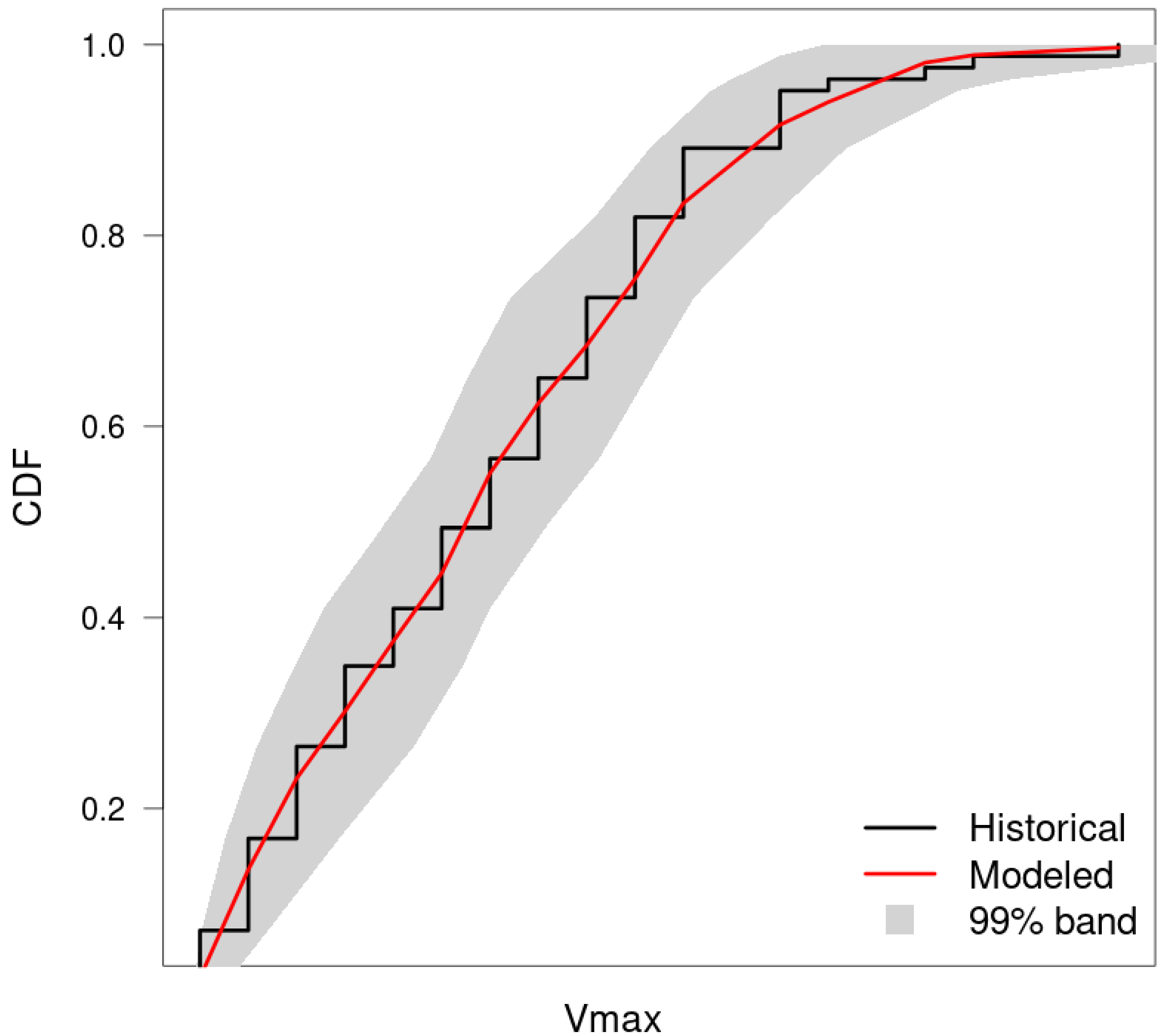
Figure 38: Central pressure cumulative distribution function (CDF)



The Kolmogorov-Smirnov test corresponding to the CDFs in the figure above produces a p-value of 64 percent. A chi-square test with eight cells produces a p-value of 19 percent. The historical data used for comparison is from the HURDAT2 database landfall summary, as of June 2021.

Figure 39 shows a similar comparison for Vmax.

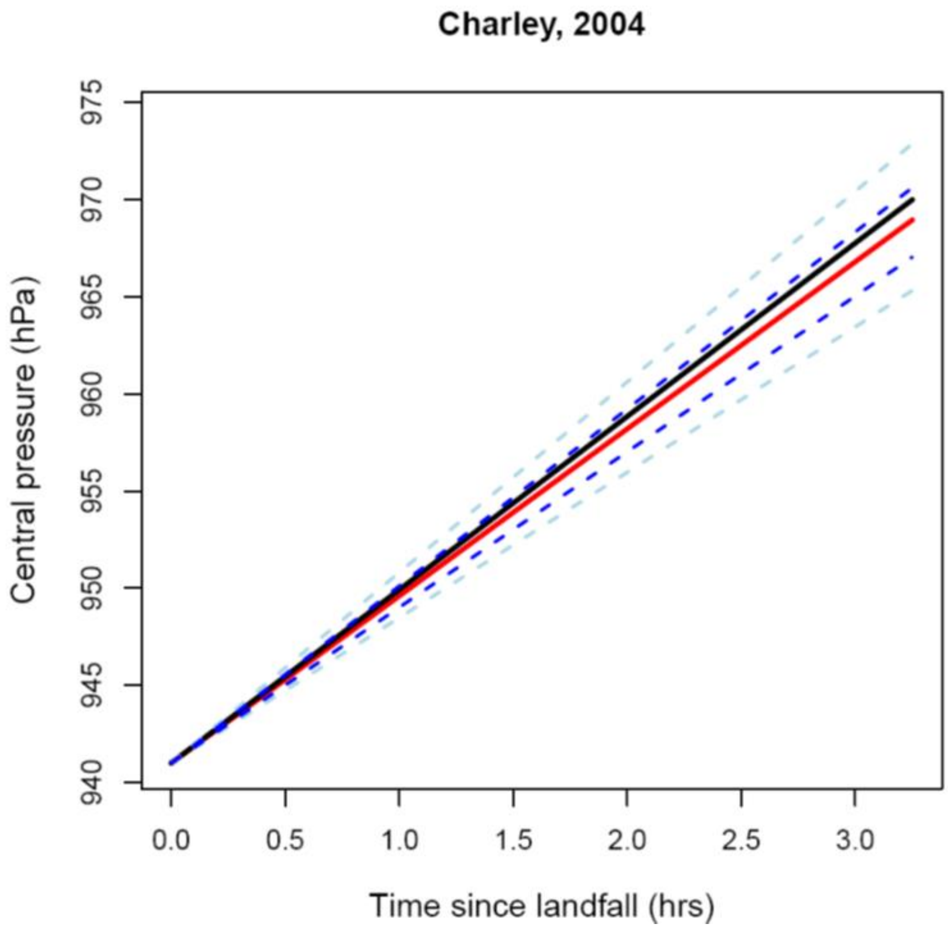
Figure 39: Vmax cumulative distribution function



The Kolmogorov-Smirnov test corresponding to the CDFs in the figure above produces a p-value of 86 percent. A chi-square test with eight cells produces a p-value of 32 percent. The historical data used for comparison is from the HURDAT2 6-hourly database as of June 2021.

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 40 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 percent (dark blue), and 90 percent (light blue) simulated filling rates for this storm.

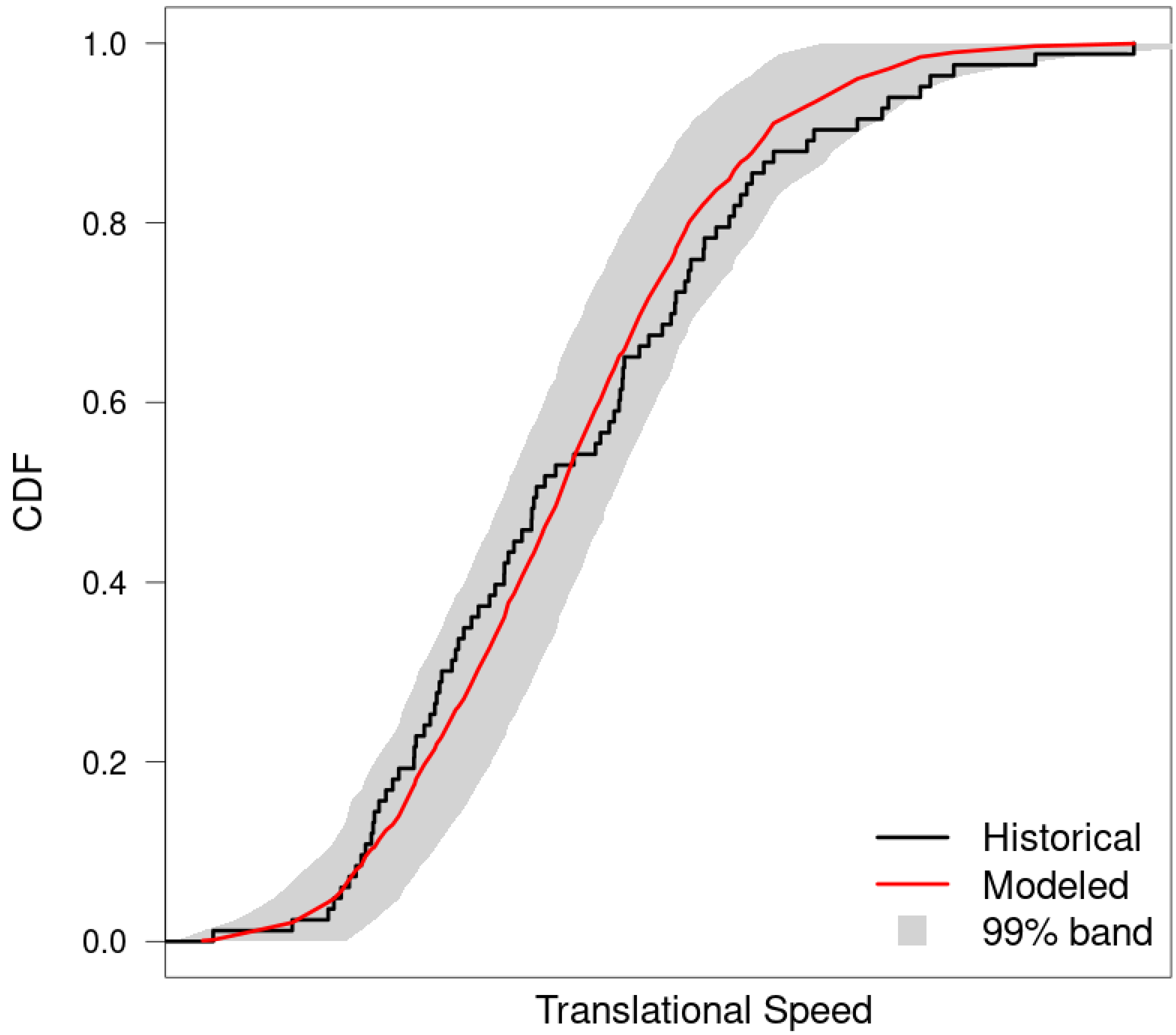
Figure 40: Pressure time series over land with observed (black), predicted (red), and simulated (dark blue for 50% and light blue for 90% bands) filling rate



Translational Speed and Heading

Figure 41 compares historical and modeled distributions of translational speed.

Figure 41: Translational speed (forward speed) cumulative distribution function



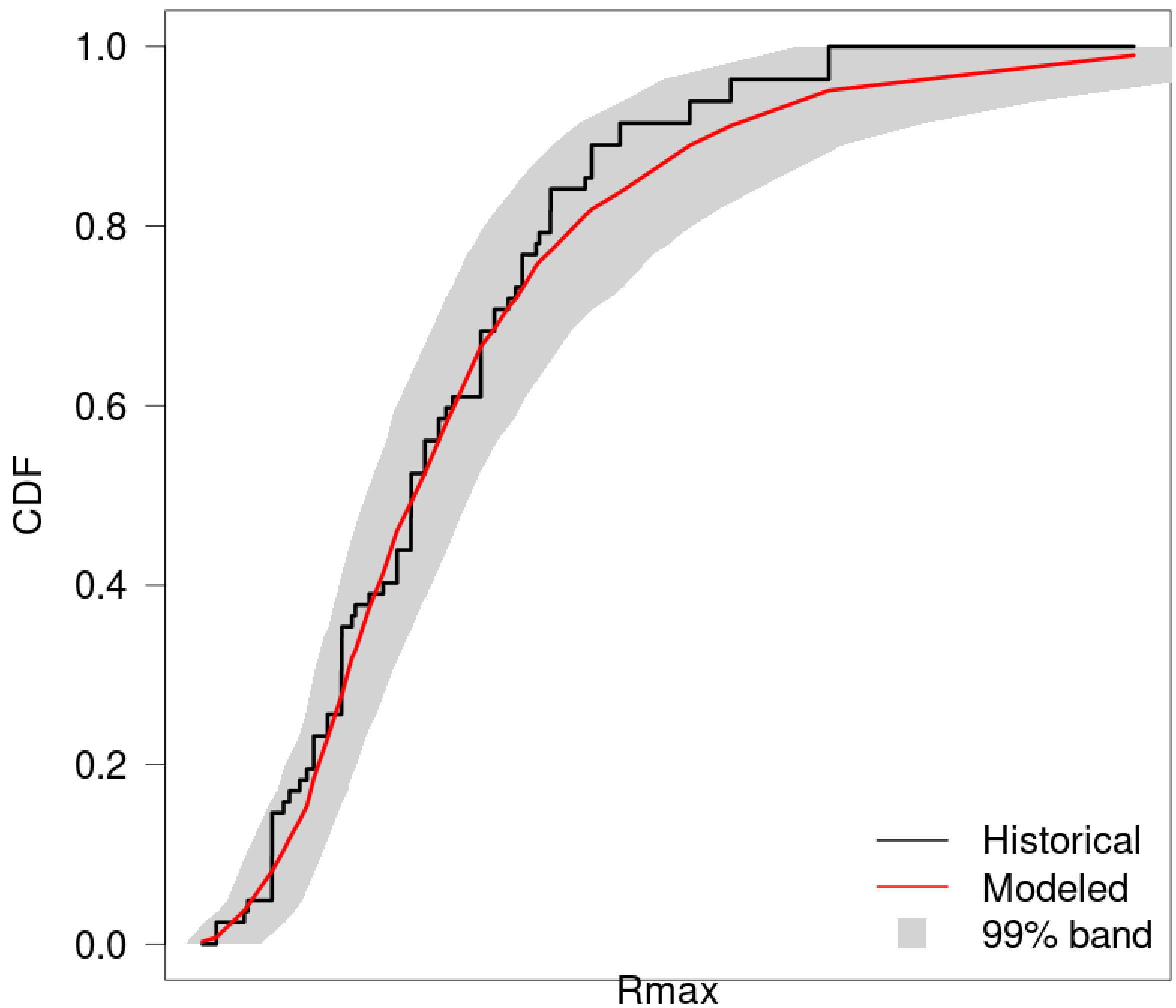
The Kolmogorov-Smirnov test on the translational speed produces a p-value of 65 percent, and a chi-square test with eight equal cells produces a p-value of 24 percent. The historical data used for comparison is from the HURDAT2 6-hourly database as of June 2021.

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

Figure 42: Rmax cumulative distribution function

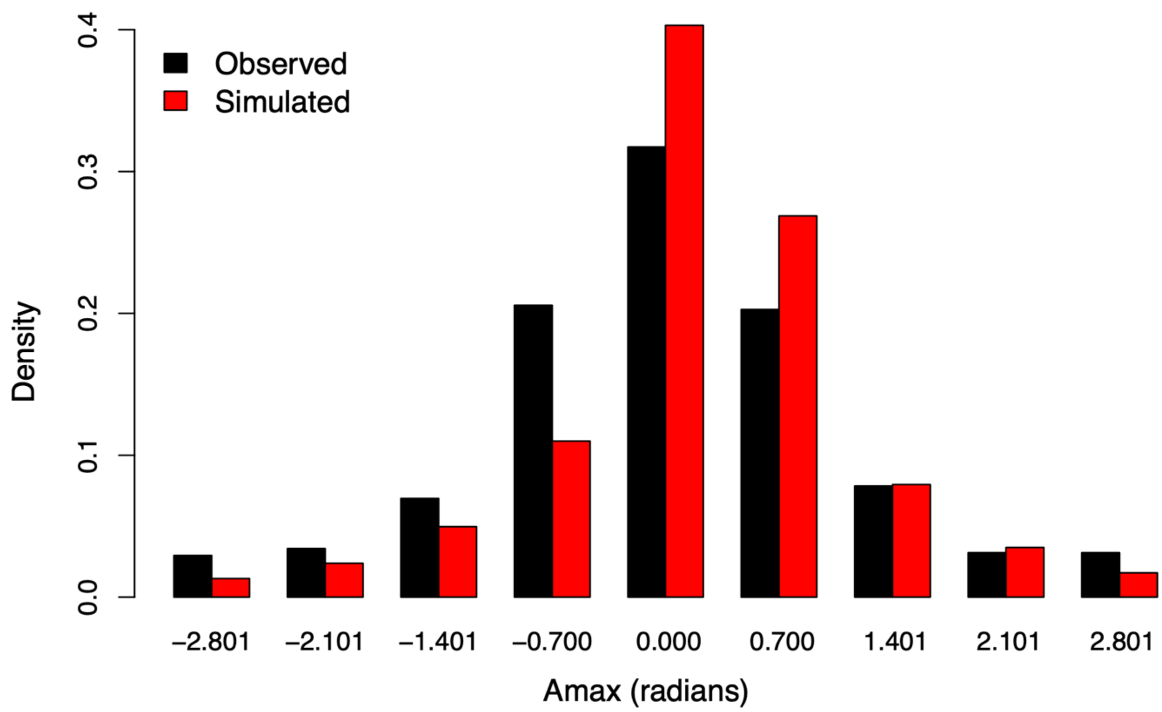


The reasonable agreement suggested by the figure above is confirmed by the goodness-of-fit test results. The Kolmogorov-Smirnov test on the radius of maximum winds produces a p-value of 69 percent, and a chi-square test with eight equal cells produces a p-value of 50 percent. The historical data used for the comparison covers the 1900 to 2020 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 43 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 Moody's RMS HWind snapshots to derive the historical values.

Figure 43: 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 0.32. This is based on 51 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 landfalling storm frequency was tested using a conditional chi-square test (p-value=15%) and Neyman-Scott test (p-value=15%). 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 99 percent. 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 Hurricane Loss Exceedance Estimates. Provide a link to the location of the form [Form S-2].

S-2 Sensitivity Analysis for Hurricane 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 current scientific and statistical methods in the appropriate disciplines and shall have taken appropriate action.

Moody's RMS has assessed the sensitivity of temporal and spatial outputs with respect to the simultaneous variation of input variables via Form S-6, which was submitted in compliance with the 2009 Standards. Disclosures S-2.1 to S-2.5 describe the results of the sensitivity assessment, and discuss whether any action was needed in response.

S-2.1 Identify the most sensitive aspect of the hurricane 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 hurricane 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 present and other previous 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 Moody's 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 hurricane models submitted by modeling organizations which have not previously provided the Commission with this analysis. For hurricane models currently 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].

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

S-3 Uncertainty Analysis for Hurricane Model Output

The modeling organization shall have performed an uncertainty analysis on the temporal and spatial outputs of the hurricane model using current 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 hurricane model output as the input variables are simultaneously varied.

Moody's RMS has performed an uncertainty analysis on the temporal and spatial outputs of the model via Form S-6, which was previously submitted in compliance with the 2009 Standards. Disclosure S-1.4 describes additional uncertainty analysis, while S-3.1 to S-3.4 discuss the results of the assessment and whether any action was necessary in response.

S-3.1 Identify the major contributors to the uncertainty in hurricane 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 34 and Figure 35. 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 percent and 95 percent limits on the respective cumulative distribution functions.

S-3.2 Describe how other aspects of the hurricane 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 is 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 Hurricane Standard S-2, Sensitivity Analysis for Hurricane Model Output, will be used in the verification of Hurricane Standard S-3, Uncertainty Analysis for Hurricane Model Output.

Moody's 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 hurricane loss cost estimates attributable to the sampling process shall be negligible.

The Moody's 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 hurricane loss costs and hurricane 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 hurricane model shall estimate incurred hurricane 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 hurricane loss experience may be used to replicate structure-only and contents-only hurricane losses. The replications shall be produced on an objective body of hurricane loss data by county or an appropriate level of geographic detail and shall include hurricane loss data from Hurricane Irma (2017) and Hurricane Michael (2018), to the extent data are available for these storms.

The Moody's 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 Moody's RMS model is able to reasonably reproduce aggregate incurred industry losses in recent events.

For recent events, on a company-specific basis. The Moody's 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 Moody's 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 Moody's 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.[1]

S-5.1 Describe the nature and results of the analyses performed to validate the hurricane loss projections generated for personal and commercial residential hurricane losses separately. Include analyses for the 2017 and 2018 hurricane seasons, to the extent data are available.

Moody's RMS has compiled reported loss information from industry sources at the time of key historical events. The reported losses are normalized to the year 2023 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 2023. Comparisons are made to modeled losses based on the Moody's RMS industry exposure model.

In addition, insurance companies have supplied Moody's 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 44 and Figure 45 show the results of representative samples of the comparative analyses that have been performed.

[1] While these industry loss 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 44: Florida industry loss estimates (residential) for recent storms[2]

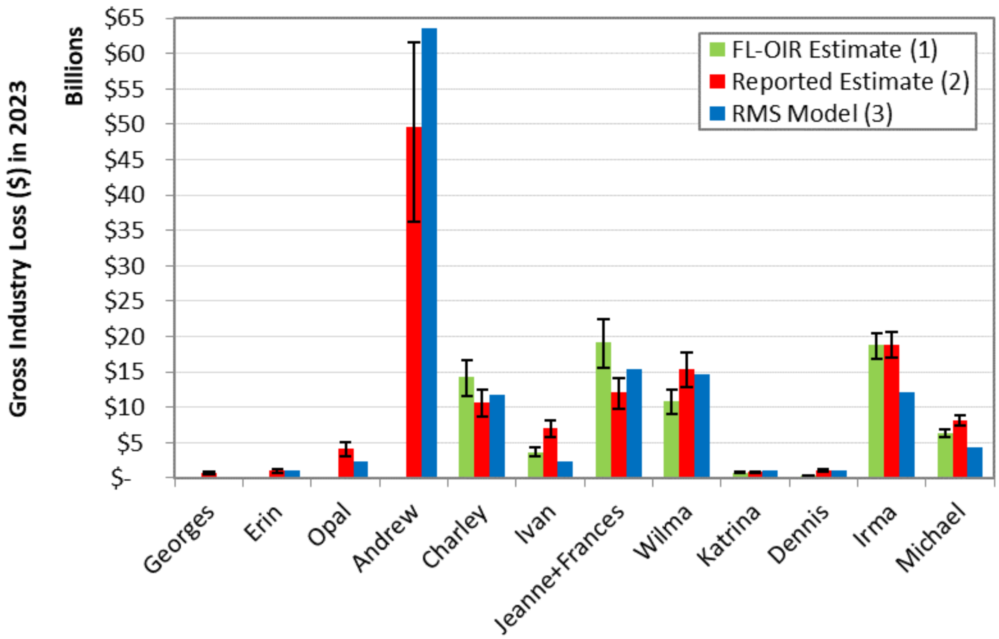


Table 11: Comparison of actual and estimated industry loss ($ million)

Storm	Year	Reported Estimate (2)	FL-OIR Estimate (1)	Moody's RMS Model (3)
Andrew	1992	49,592	-	63,659
Erin	1995	1,059	-	1,014
Opal	1995	4,115	-	2,289
Georges	1998	755	-	254
Charley	2004	10,645	14,255	11,788
Ivan	2004	7,016	3,702	2,369
Jeanne+Frances	2004	12,097	19,187	15,380
Wilma	2005	15,315	10,816	14,683
Katrina	2005	833	792	1,045
Dennis	2005	1,115	339	1,061
Irma	2017	18,887	18,756	12,071
Michael	2018	8,118	6,321	4,259

*See notes for Figure 44

2 Notes on Figure and Table:

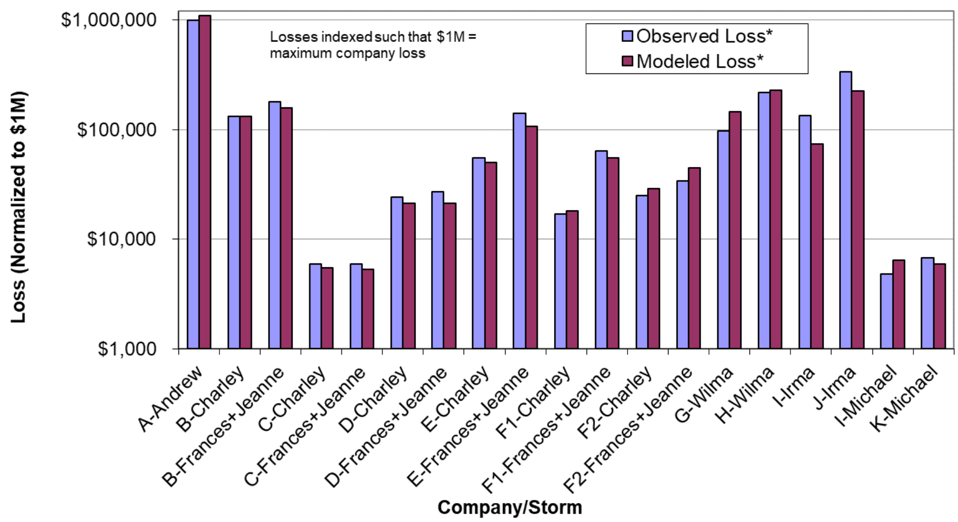
(1) Estimates from Florida Office of Insurance Regulation (FL-OIR) report, "Hurricane Summary Data: CY 2004 and CY 2005" from August 2006 for all storms except for Hurricanes Irma and Michael. Irma and Michael losses are current as of November 2020 as reported on the FL-OIR website. Losses are normalized to 2023 values, represent residential lines, include demand surge and underreporting estimates, and exclude loss adjustment expense.

(2) Reported estimate of losses from industry sources. Losses for Florida are normalized to 2023 values, represent residential lines and includes demand surge and excludes loss adjustment expense.

(3) RMS estimates for residential lines are based on RMS Industry Exposure for 2023. 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 45: 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*	Observed Loss**	Modeled Loss **	Ratio
A	Andrew	17,496,000	1,000,000	1,097,833	1.10
B	Charley	7,962,000	131,670	131,199	1.00
B	Frances+Jeanne	68,468,000	180,632	158,137	0.88
C	Charley	347,000	5,948	5,507	0.93
C	Frances+Jeanne	2,352,000	5,896	5,284	0.90
D	Charley	928,000	24,050	21,379	0.89
D	Frances+Jeanne	7,451,000	27,321	21,390	0.78
E	Charley	1,693,000	54,949	50,336	0.92
E	Frances+Jeanne	48,269,000	140,340	107,696	0.77
F1	Charley	1,749,000	17,114	18,226	1.06
F1	Frances+Jeanne	16,097,000	64,280	55,045	0.86
F2	Charley	3,108,000	24,955	28,978	1.16
F2	Frances+Jeanne	21,448,000	33,876	45,118	1.33
G	Wilma	9,491,000	97,056	146,601	1.51
H	Wilma	22,652,000	219,822	229,683	1.04
I	Irma	9,447,000	133,606	73,300	0.55
J	Irma	74,783,000	335,235	226,463	0.68
I	Michael	207,000	4,817	6,414	1.33
K	Michael	87,000	6,751	5,946	0.88

*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 hurricane 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. The following standards, disclosures, and forms provide comparisons between historical and modeled annual average statewide hurricane loss costs along with relevant discussion on the differences.

S-6.1 Describe the nature and results of the tests performed to validate the expected hurricane loss projections generated. If a set of simulated hurricanes or simulation trials was used to determine these hurricane 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.

Moody's 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 Moody's RMS model contains 20,153 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 hurricane model produces hurricane loss costs for specific historical events versus hurricane 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. For historical storms up to the 2008 season, gusts over land are consistent with the urban exposures of the 2004 and 2005 seasons, while for more recent historical storms and all stochastic storms, 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 Hurricane Loss Costs – Historical versus Modeled. Provide a link to the location of the form [Form S-5].

VULNERABILITY HURRICANE STANDARDS

V-1 Derivation of Building Hurricane Vulnerability Functions

A. Development of the building hurricane 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 hurricane 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 hurricane 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. The methodology is described in further detail in Disclosures V-1.2, V-1.5, and V-1.11. This has been supplemented by post-storm site inspections and an extensive review of published literature on building damage assessment. This development is supported by over $14.0 billion of historical hurricane loss data as described in Disclosure V-1.3.

As outlined in Disclosure G-2.2 and Appendix B the individuals within Moody's 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 hurricane vulnerability functions and the treatment of associated uncertainties shall be theoretically sound and consistent with fundamental engineering principles.

The methods used by Moody's 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-1.5.

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 hurricane 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-1.11. 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. Hurricane 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. Moody's 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 hurricane vulnerability functions shall include damage as attributable to windspeed and wind pressure, water infiltration, and missile impact associated with hurricanes. Building hurricane vulnerability functions shall not include explicit damage to the building due to flood (including hurricane storm surge and 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 hurricane model since the currently accepted hurricane model.

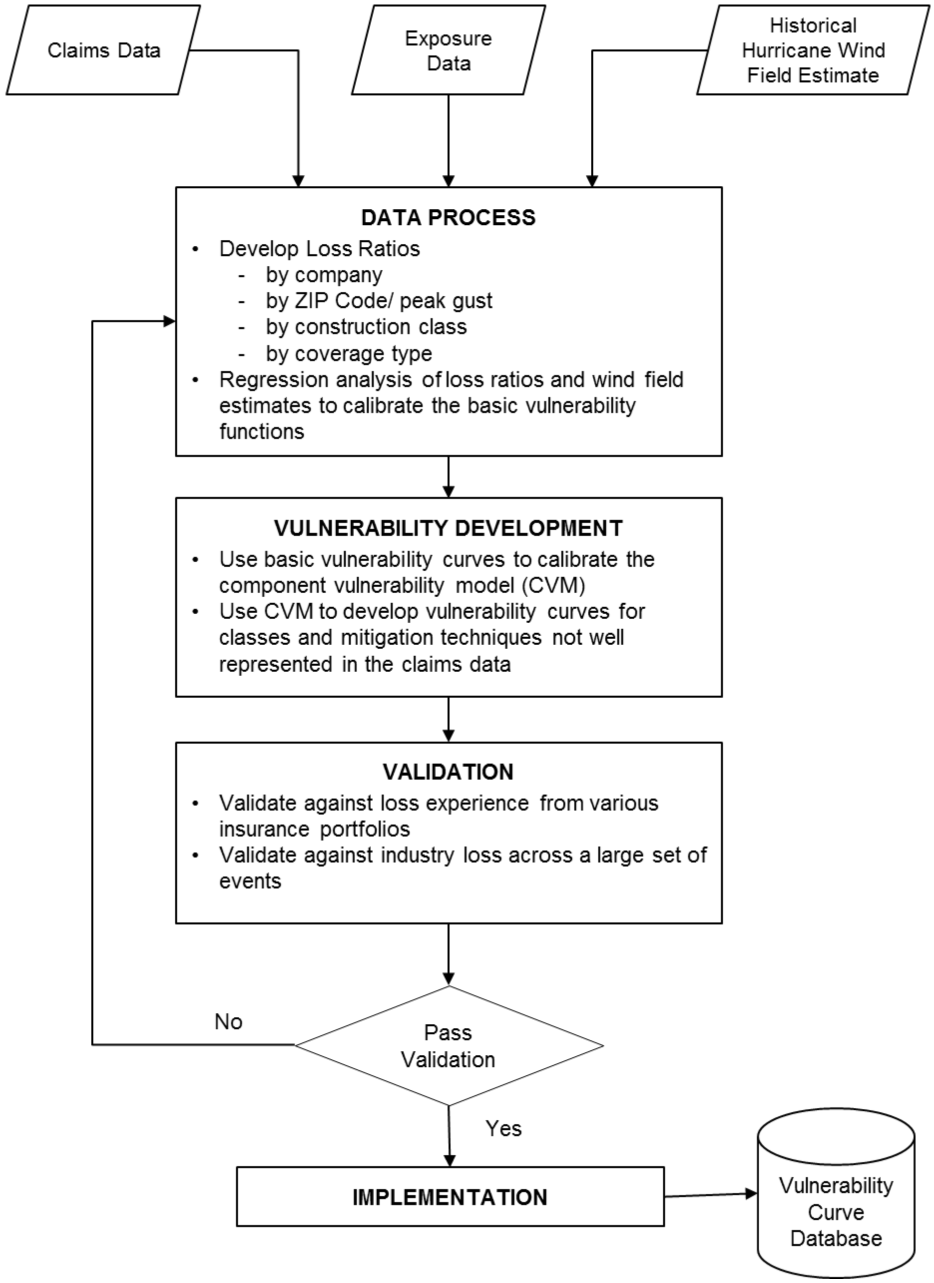
The following items listed in Disclosure G-1.7.A describe the changes related to building vulnerability:

- Addition of a new year built band (2021+) based on a new version of the Florida Building Code (2020)
- Recalibration of year-built and building height relativities for low-rise buildings to reflect current building stock and roof age / performance over time, and impacts of building code updates for mid- and high-rise buildings
- Updated occupancy relativities to better reflect wind-driven rain impacts in multi-family dwellings, based on analysis of home owner association (condo association) claims data from hurricanes Irma (2017) and Michael (2018).
- Recalibration of construction class relativities, generally for multi-family dwellings, based on learnings from previous hurricanes
- Introduction of new distinct damage curves for RMS 4A (steel with concrete roof deck) and RMS 4C (steel with wood or metal roof deck) to distinguish their vulnerability from the equivalent concrete construction
- Updated regional vulnerability relativities based on learnings from claims analyses and damage observations from hurricanes Irma (2017) and Michael (2018)
- Vulnerability region assignments have been reviewed for all postcodes with updates for some point postcodes
- Updated building inventory region assignments and inventory distributions (used when primary building characteristics are unknown) based on new data available from the U.S. Census, Moody’s RMS Exposure Source Database, and Federal Emergency Management Agency Hazards United States (HAZUS)

V-1.2 Provide a flowchart documenting the process by which the building hurricane 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 vulnerability functions



The implementation of vulnerability functions is described in the response to Disclosure V-1.8.

V-1.3 Describe the nature and extent of actual insurance company hurricane claims data used to develop the building hurricane vulnerability functions. Describe in detail the breakdown of data into number of policies, number of insurers, dates of hurricane loss, amount of hurricane loss, and amount of dollar exposure, separated into personal residential, commercial residential, and manufactured homes.

Moody's 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 Moody's 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, Moody's RMS has used over $14.0 billion of hurricane loss data from the U.S. corresponding to 2.25 million claims and nearly $1.9 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 (with number of claims in parentheses): $13 billion for residential (1.95 million), $427 million for mobile/manufactured homes (207,000), $145 million for condo unit owners (11,000), $263 million for homeowners association (4,000), and $216 million for multi-family dwelling (78,000). A sample of the datasets is shown in the following table.

Moody's RMS received 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

LOB*	Storm	Company	Data Resolution
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
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	Charley 2004	D	Location/Coverage/Construction Class
RES	Frances 2004	D	Location/Coverage/Construction Class
RES	Jeanne 2004	D	Location/Coverage/Construction Class
RES	Ivan 2004	D	Location/Coverage/Construction Class
RES	Wilma 2005	D	Location/Coverage/Construction Class
RES	Irma 2017	J	Location/Construction Class
RES	Irma 2017	K	Location/Coverage/Construction Class
RES	Michael 2018	J	Location/Construction Class
RES	Michael 2018	K	Location/Coverage/Construction Class
MFD	Irma 2017	V	Location/Coverage/Construction Class
MFD	Michael 2018	V	Location/Coverage/Construction Class
MFD	Irma 2017	K	Location/Coverage/Construction Class
HOA	Irma 2017	K	Location/Coverage/Construction Class
MFD	Michael 2018	K	Location/Coverage/Construction Class
HOA	Michael 2018	K	Location/Coverage/Construction Class
MFD	Irma 2017	X	Location/Construction Class
HOA	Irma 2017	X	Location/Construction Class
MFD	Michael 2018	X	Location/Construction Class
HOA	Michael 2018	X	Location/Construction Class

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

V-1.4 Describe any new insurance company hurricane claims datasets reviewed since the currently accepted hurricane model.

Moody's RMS received $167 million in new commercial residential and homeowners association insurance claims since the previously accepted hurricane model. This includes data from hurricanes Irma (2017) and Michael (2018).

V-1.5 Describe the assumptions, data (including insurance claims data), methods, and processes used for the development of the building hurricane 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 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 are 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 model (CVM) as documented in the process shown in Disclosure V-1.2. The Moody's 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 Moody's RMS staff and has been published by Moody's 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 Moody's RMS for developing the vulnerability functions include references listed in Disclosure G-1.6 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, 2009b), IBHS (2007, 2009, 2010b), and Gurley (2006).

The process and method of developing the building curves relevant to renter and condo-unit owners follow 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-1.6 Describe the treatment of uncertainties associated with the building hurricane vulnerability functions.

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.

V-1.7 Summarize post-event site investigations, including the sources, and provide a brief description of the resulting use of these data in the development or validation of building hurricane vulnerability functions.

Moody's 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 Moody's RMS in two ways. First, it is provided to the Moody's 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 Moody's 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 Moody's RMS reconnaissance teams was greater than expected for the wind speeds recorded during the storm. In response to this observation, Moody's 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 Moody's 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

Hurricane/Typhoon	Year	Region
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 and South Carolina, Bahamas
Harvey	2017	Texas
Irma	2017	Florida, Puerto Rico, U.S. Virgin Islands
Maria	2017	Puerto Rico, U.S. Virgin Islands
Florence	2018	South Carolina, North Carolina
Michael	2018	Florida, Georgia

V-1.8 Describe the categories of the different building hurricane 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 for which a unique building hurricane vulnerability function is used. Provide the total number of building hurricane vulnerability functions available for use in the hurricane model for personal and commercial residential classifications.

There is a total of 2,875 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 2,875 per region, 845 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: Moody's RMS hurricane primary building classification options

Construction Class	Number of Stories	Occupancy
Unknown	Unknown	Unknown
Wood Frame	1	Single Family
Masonry	2–3	Multiple Family
Unreinforced Masonry	4–7	Condo Unit Owner
Reinforced Masonry	8–14	Condo Association
Reinforced Concrete	15+	Non-Residential[1]
Steel		
Mobile/Manufactured Home w/o Tie-Downs		
Mobile/Manufactured Home with Tie-Downs		

Year Band (non-MH)
Unknown
Pre 1995
1995–2001
2002–2008
2009–2020
2021 + later
(For MH only)
Unknown
Pre 1976
1976–1994
1995–2008
2009 + later

Region	Floor Area (Single Family)
South FL inland (≥0.5 miles from coast)	Unknown (≤10 ft²)
South FL coastal (<0.5 miles from coast)	11–1,506 ft² (1–139 m²)
Central FL inland (≥0.5 miles from coast)	1,507–2,507 ft² (140–232 m²)
Central FL coastal (<0.5 miles from coast)	2,508–5,005 ft² (233–464 m²)
North FL inland (≥0.5 miles from coast)	5,006–10,010 ft² (465–929 m²)
North FL coastal (<0.5 miles from coast)	≥ 10,011 ft² (≥930 m²)

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

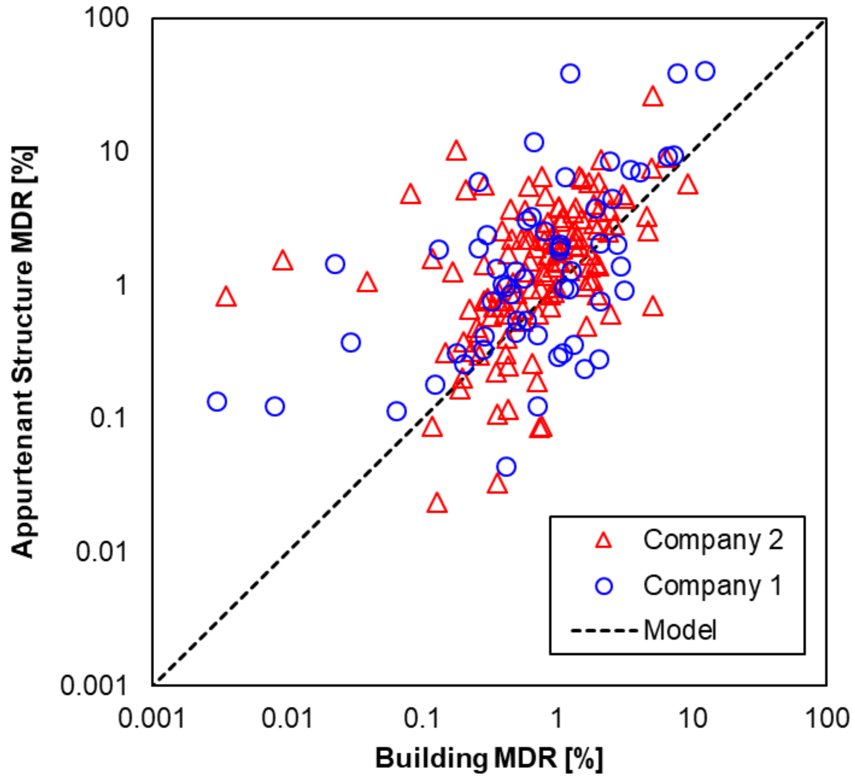
V-1.9 Describe the process by which local construction practices and statewide and county building code adoption and enforcement are considered in the development of the building hurricane vulnerability functions.

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 Moody's 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-1.10 Describe the relationship between building structure and appurtenant structure hurricane vulnerability functions and their consistency with insurance claims data.

Appurtenant structures are modeled separately using the same vulnerability functions as buildings. Moody's 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 comparison using two company data sets showing the building structure mean damage ratio versus the appurtenant structure mean damage ratio. Users can also specify the Residential Appurtenant Structures modifier (e.g., fences, carport, screen enclosure, etc.) to specify the appurtenant structure, which will increase the vulnerability.

Figure 47: Relationship of building structure versus appurtenant structure mean damage ratios (MDR): observed and modeled



V-1.11 Describe the assumptions, data (including insurance claims data), methods, and processes used to develop building hurricane vulnerability functions when:

a. ***residential construction types are unknown, or***

b. ***one or more primary building characteristics are unknown, or***

c. ***one or more secondary characteristics are known, or***

d. ***building input characteristics are conflicting.***

a. 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 the Moody's RMS model are specified by ZIP Code and are based on an extensive industry database compiled by Moody's RMS from third party data sources and Moody's RMS in-house research, aggregate insurance exposure data, and studying aerial and satellite imagery.

b. 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 1507–2507 square foot floor area band.

c. When one or more secondary characteristics is known, 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. 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 is combined together with a multiplicative methodology to reflect the combined effect of different attributes that may increase or decrease the loss.

d. 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-1.12 Identify the one-minute average sustained windspeed and the windspeed reference height at which the hurricane 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-1.13 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, Moody's 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-1.14 Describe how the hurricane 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-1.15 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 Hurricane Vulnerability Functions

A. A. Development of the contents hurricane vulnerability functions shall be based on at least one of the following: (1) insurance claims data, (2) tests, (3) rational engineering analysis, and (4) post-event site investigations. Any development of the contents hurricane vulnerability functions based on rational engineering 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 Moody's RMS involved in the development of vulnerability functions have extensive experience in the field of structural and wind engineering and data analysis.

B. The relationship between the hurricane model building and contents hurricane vulnerability functions shall be consistent with, and supported by, the relationship observed in historical data.

Moody's 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.

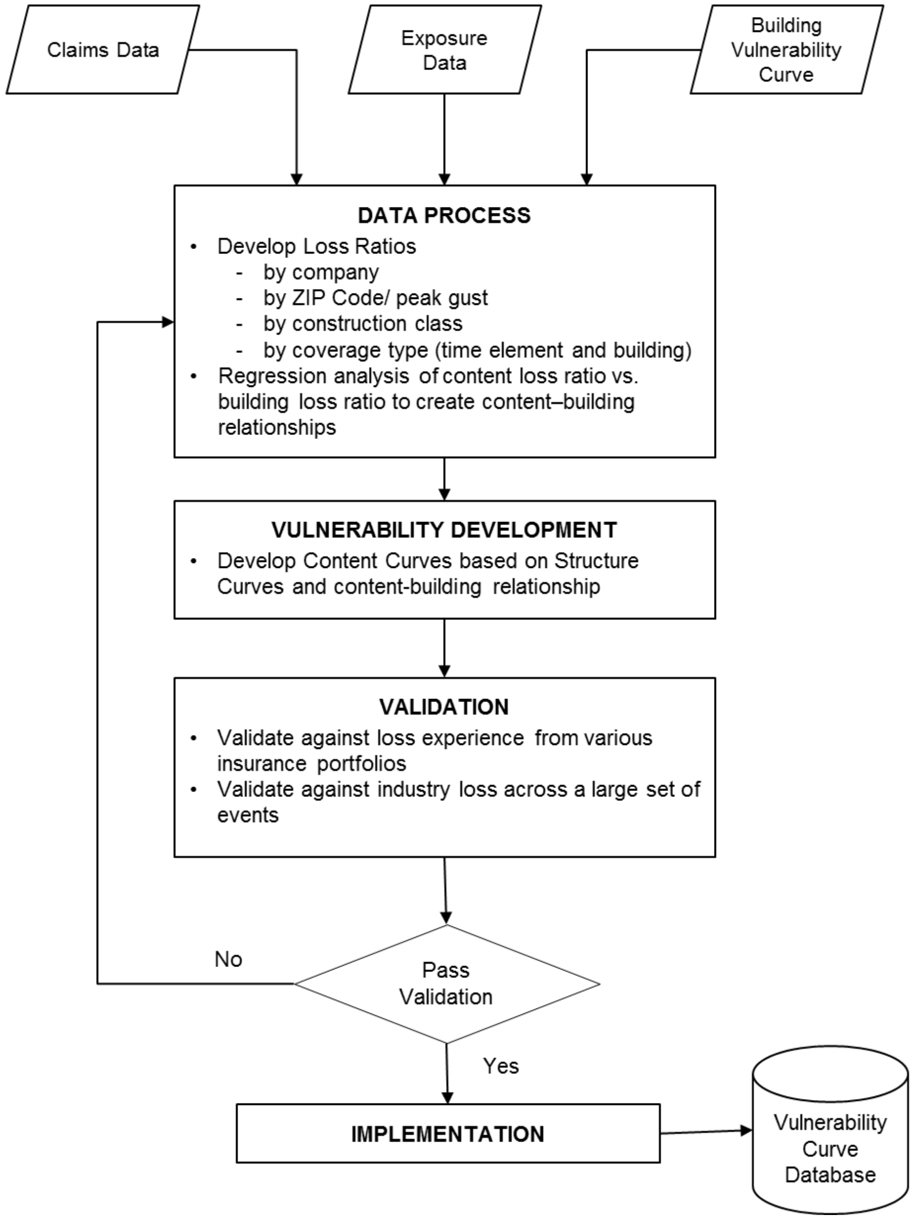
V-2.1 Describe any modifications to the contents vulnerability component of the hurricane model since the currently accepted hurricane model.

The contents vulnerability curves for personal residential (except manufactured homes) and commercial residential occupancies in all Florida vulnerability regions have been recalibrated. Since contents vulnerability are developed as a function of the amount of damage to the building structure, changes made to the structure curves also affect the corresponding contents curves.

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

The general procedure used to process such data is diagrammed in Figure 48.

Figure 48: Process for deriving and implementing contents vulnerability functions



V-2.3 Describe the assumptions, data, methods, and processes used to develop and validate the contents hurricane 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 Moody's RMS to develop and validate the contents vulnerability functions are 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.

Moody's 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 hurricane vulnerability functions. Describe whether different contents hurricane vulnerability functions are used for personal residential, commercial residential, manufactured homes, 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-1.8. 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 Describe the relationship between building structure and contents hurricane 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-3 Derivation of Time Element Hurricane Vulnerability Functions

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

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 policyholder while the house is being repaired). Moody's RMS has used historical loss data to calibrate time element vulnerability functions.

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

B. The relationship between the hurricane model building and time element hurricane vulnerability functions shall be consistent with, and supported by, the relationship observed in historical data.

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 Moody's 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.

C. Time element hurricane 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. Time element hurricane vulnerability functions shall include time element hurricane losses associated with 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 associated with wind, missile impact, flood, and storm surge, 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.

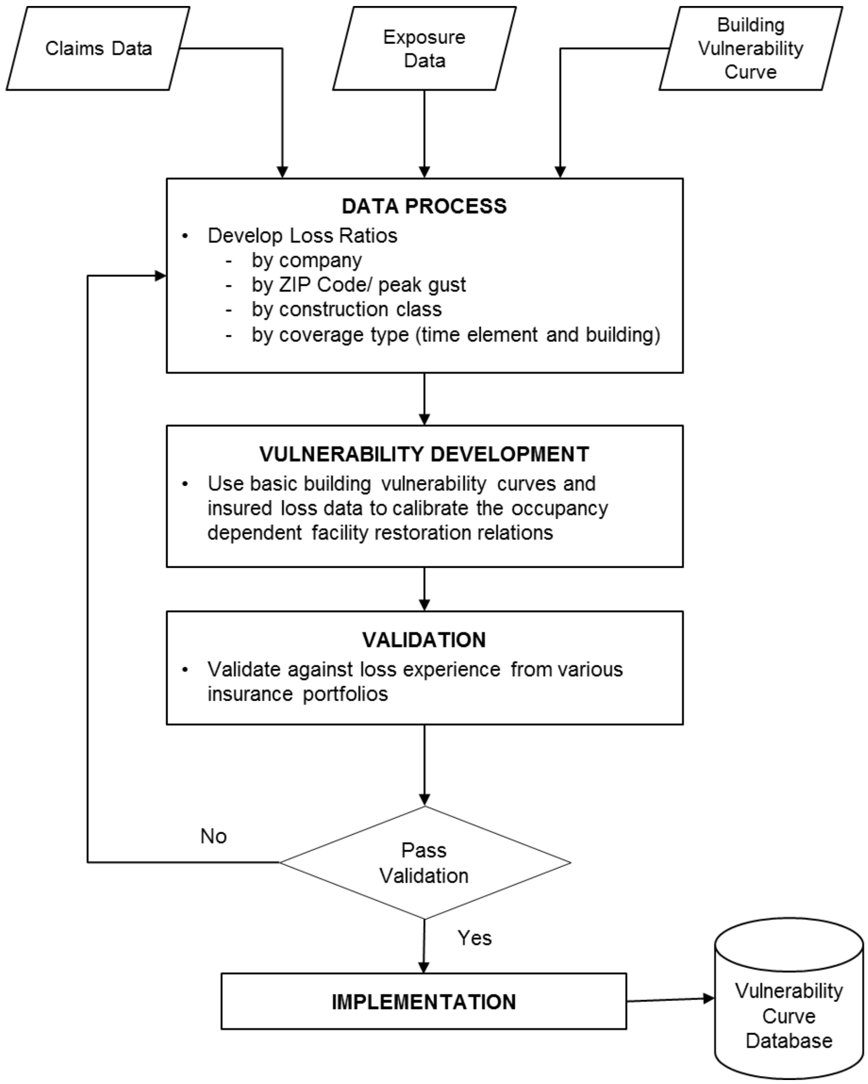
V-3.1. Describe any modifications to the time element vulnerability component of the hurricane model since the currently accepted hurricane model.

Time element losses are a function of the building damage state, therefore changes made to the structure curves also affect the corresponding time element losses.

V-3.2 Provide a flowchart documenting the process by which the time element hurricane vulnerability functions are derived and implemented.

The general procedure used to process such data is diagrammed in Figure 49.

Figure 49: Process for deriving and implementing time element vulnerability functions



V-3.3 Describe the assumptions, data (including insurance claims data), methods, and processes used to develop and validate the time element hurricane 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).

Moody's 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 percent of time element claims were associated with no structure coverage claim.

V-3.4 Describe how time element hurricane vulnerability functions take into consideration the damage to local and regional infrastructure.

Modeled time element loss costs include direct losses only (e.g., 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 Moody's RMS post-event loss amplification (PLA) methodology (see Disclosure A-4.3).

V-3.5 Describe the relationship between building structure and time element hurricane 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-4 Hurricane Mitigation Measures and Secondary Characteristics

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

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

The North Atlantic Hurricane Models support 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-4.8.

B. The modeling organization shall justify all hurricane mitigation measures and secondary characteristics considered by the hurricane model.

The mitigation measures and secondary characteristics considered by the hurricane model are common components and elements used on buildings that research and damage investigations have shown influence hurricane wind-related losses. The full list of mitigation measures and secondary characteristics is provided in Disclosure V-4.4.

C. Application of hurricane mitigation measures that affect the performance of the building and the damage to 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.

D. Treatment of individual and combined secondary characteristics that affect the performance of the building and the damage to contents shall be justified.

Moody's RMS develops and calibrates secondary characteristics that affect the performance of the building and the damage to contents based on loss data, published reports and papers, and engineering judgment and as such, treatment of individual and combined secondary characteristics is reasonable.

V-4.1 Describe any modifications to hurricane mitigation measures and secondary characteristics in the hurricane model since the currently accepted hurricane model.

As described in Disclosure G-1.7.A, the following are updated:

- Renamed secondary modifier options for the Construction Quality modifier to reflect updated Insurance Institute for Business and Home Safety FORTIFIED program standards, including a new program for multi-family exposure
- Updated credits and penalties associated with the Roof Age secondary modifier to align with roof age distribution and performance assumptions for different year built bands

V-4.2 Describe the procedures used to calculate the impact of hurricane mitigation measures and secondary characteristics, including software, its identification, and current version. Describe whether or not such procedures have been modified since the currently accepted hurricane model.

The impact of hurricane mitigation measures and secondary characteristics has been developed using various published reports and studies combined with engineering judgment. This procedure has not been modified from the currently-accepted hurricane model.

V-4.3 Provide a completed Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, 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-2..

V-4.4 Provide a description of the hurricane mitigation measures and secondary characteristics used by the hurricane model, whether or not they are listed in Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage.

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: Moody's 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. Options are included 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	
	–-Wind Only - Fortified Home/Multifamily/Commercial, Roof, Option 1	
	–-Wind Only - Fortified Home/Multifamily/ Commercial, Roof, Option 2	
	–-Wind Only - Fortified Home/Multifamily/Commercial, Silver, Option 1	
	–-Wind Only - Fortified Home/Multifamily/Commercial, Silver, Option 2	
	–-Wind Only - Fortified Home/Multifamily/Commercial, Gold, Option 1	
	–-Wind Only - Fortified Home/ Multifamily/Commercial, Gold, Option 2	
	–-Wind Only - Fortified for Safer Living/Business – [Post 2001]	
	9-Certified design & construction	

Characteristic	Options	Notes
	1–-Hail&Wind - Fortified Home/Multifamily/Commercial, Roof, Option 1	
	1–-Hail&Wind - Fortified Home/Multifamily/Commercial, Roof, Option 2	
	1–-Hail&Wind - Fortified Home/Multifamily/Commercial, Silver, Option 1	
	1–-Hail&Wind - Fortified Home/Multifamily/Commercial, Silver, Option 2	
	1–-Hail&Wind - Fortified Home/Multifamily/Commercial, Gold, Option 1	
	1–-Hail&Wind - Fortified Home/Multifamily/Commercial, Gold, Option 2	
	1–-Hail&Wind - Fortified for Safer Living/Business – [Post 2001]	
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	
	16-Concrete roof	
	17-Bermuda-style roof	
	18-Fabric (tensile membrane)	
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
	1-Flat roof with parapets	
	2-Flat roof without parapets	

Characteristic	Options	Notes
	3-Hip roof with slope less than or equal to 6:12 (26.5 degrees)	more likely to experience more loading than hipped or high-pitched roofs.
	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	
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	

Characteristic	Options	Notes
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	
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	

Characteristic	Options	Notes
	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	

Characteristic	Options	Notes
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	
	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-4.5 Describe how hurricane mitigation measures and secondary characteristics are implemented in the hurricane 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-4.6 Describe how the effects of multiple hurricane mitigation measures and secondary characteristics are combined in the hurricane model and the process used to ensure that multiple hurricane mitigation measures and secondary characteristics 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 that can 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. Moody's RMS has validated the impact of multiple features through a variety of tests and comparisons to external publications (i.e., FEMA 2009b, ARA 2008). Moody's 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-4.7 Describe how building and contents damage are affected by performance of hurricane mitigation measures and secondary characteristics. Identify any assumptions.

As described in Disclosure V-4.4, 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-4.8 Describe how hurricane mitigation measures and secondary characteristics affect the uncertainty of the vulnerability. Identify any assumptions.

Similar to the impacts on mean damage ratio described in Disclosures V-4.4 and V-4.6, 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 as 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.

V-4.9 Provide a completed Form V-3, Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret Item), if not considered as Trade Secret. Provide a link to the location of the form [Form V-3].

V-4.10 Provide a completed Form V-4, Differences in Hurricane Mitigation Measures and Secondary Characteristics. Provide a link to the location of the form [Form V-4].

V-4.11 Provide a completed Form V-5, Differences in Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane Loss Costs (Trade Secret Item), if not considered as Trade Secret. Provide a link to the location of the form [Form V-5].

ACTUARIAL HURRICANE STANDARDS

A-1 Hurricane Model Input Data and Out Reports

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

Insurance company input data used in the modeling process contains information provided by the company and Moody's 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 hurricane model shall be actuarially sound and shall be included with the hurricane model output report. Treatment of missing values for user inputs required to run the hurricane model shall be actuarially sound and described with the hurricane model output report.

Input data to the Moody's RMS hurricane model are 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 "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 hurricane losses. Provide a sample calculation for determining the property value.

The Moody's RMS hurricane model 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 the model.

The Moody's RMS hurricane model 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 percent 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 hurricane losses on account of depreciation. Provide a sample calculation for determining the amount of depreciation and the actual cash value (ACV) hurricane losses.

The Moody's RMS hurricane model 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 the model. Depreciation assumptions are made by the user prior to running the model.

For example, if it is determined that a $100,000 valued home has depreciated 10 percent 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 Moody's RMS nor the model performs any depreciation calculations, including the type given in the example. Any depreciation calculations are done by the user before inputting information into the model.

A-1.3 Describe the methods and input data used to distinguish among policy form types (e.g., homeowners, dwelling property, manufactured homes, tenants, condo unit owners) and their deductibles and coverage limits.

Policy forms vary in their terms, conditions, deductibles, and coverage limits and the Moody's RMS hurricane model 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 as well as their limits and deductibles can be entered in the user interface and modeled for either commercial or personal lines.

A-1.4 Provide a copy of the input form(s) used by the hurricane model with the hurricane 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 hurricane model output produced from the input form. Include the hurricane model name, version identification, and platform identification on the input form. All items included in the input form should be clearly labeled and defined.

Appendix E includes screen shots of the RiskLink and Risk Modeler user interfaces showing the location level user inputs. All valid data input in these forms 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 model name and version number are accessible in the Moody's RMS Peril Models List for Risk Modeler, while the platform name and version number for Risk Modeler are accessible in the Risk Modeler Global Menu. Screen shots for RiskLink and Risk Modeler are also available in the Appendix E. All items in the RiskLink and Risk Modeler model input forms are clearly labeled and defined.

A-1.5 Disclose, in a hurricane model output report, the specific inputs required to use the hurricane model and the options of the hurricane model selected for use in a residential property insurance rate filing in Florida. Include the hurricane model name, version identification, and platform identification on the hurricane model output report. All items included in the hurricane model output report should be clearly labeled, highlighted 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 Moody's RMS hurricane model contains several optional features that are not part of the FCHLPM approval, such as alternative rate sets reflecting "medium term" versus "historical" perspectives, additional vulnerability curve sets, and settings related to storm surge modeling. Model settings submitted for FCHLPM approval are not the same as the Moody's RMS reference view of risk for the Moody's RMS hurricane model. The Moody's RMS reference view is based on different inclusion of sub-perils and assumptions.

All user modifiable model options are described in sets of model option profiles called "DLM (Detailed Loss Model) profiles" in RiskLink and "Model Profiles" in Risk Modeler – to ensure that results from the certified version of the model are clearly labeled, Moody's RMS provides a specified profile, with approved settings, labeled "(Pre-compiled) FCHLPM Certified Hurricane Losses" in RiskLink and "RMS Default FCHLPM Certified Hurricane Losses 23" in Risk Modeler. Regulators may audit that FCHLPM approved model settings were used by verifying that" the field "DLM/Model Profile Name" is set to "FCHLPM Certified Hurricane Losses/RMS Default FCHLPM Certified Hurricane Losses 23" in the Analysis Summary Report (Appendix F). The model settings corresponding to this certified profile are shown in Table 17.

Table 17: Model settings corresponding to "(Pre-compiled) FCHLPM Certified Hurricane Losses/RMS Default FCHLPM Certified Hurricane Losses 23"

Analysis Option	Approved Setting	Notes
Peril	Windstorm	
Region	North Atlantic (including Hawaii)	Florida is included in this region.
Analysis Mode / Type	Distributed / Exceedance Probability	
Model Version	RMS – RL23	Model Version only available as an option in Risk Modeler
Event Rate Set	RMS 2023 Historical Event Rates	
Vulnerability Curves	Vulnerability Default	Additional vulnerability curves are available for sensitivity analyses and use cases beyond residential ratemaking purposes in the state of Florida.
Assume 2% Deductible when UNKNOWN	Selected	This option will cause any residential locations within the state of Florida, with an unknown

Analysis Option	Approved Setting	Notes
		deductible, to default to 2% of the structure value.
Calculate Losses from:	Wind	The storm surge option must 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	
PLA Scale Factor	Equal to 1.00	No modification
Scale Exposure Factors:	Equal to 1.00	No exposure modification
Non-Modeled Damage Factors	Equal to 1.00	No modification

Post analysis, users must apply annual deductible factors to model output 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. To demonstrate these factors have been applied post analysis, users should complete a copy of the form included in Table 51 in Appendix F.

A-1.6 Provide a list of all options available (e.g., base storm set, vulnerability functions) to the user. Identify the specific options acceptable for a Florida rate filing.

A list of all available options available to users is shown in Table 18. Specific options acceptable for a Florida rate filing are denoted in bold and italics.

Table 18: List of model options available to users highlighting options acceptable for Florida rate filings

Analysis Option	Available Settings	Notes
Insurance Type	***Property***	
	Workers Comp	Workers Comp is not available for Hurricane analyses
Peril	Earthquake	
	Flood	
	Severe Convective Storm	
	Windstorm	
	Winterstorm	
Region	Australia	
	China	
	Europe	
	Guam	
	Japan	
	North Atlantic (including Hawaii)	North Atlantic includes all sub-regions in the North Atlantic Hurricane model including Florida
	Canada	
	Caribbean	
	Anguilla	
	Antigua and Barbuda	

Analysis Option	Available Settings	Notes
	Aruba	
	Bahamas	
	Barbados	
	Bermuda	
	Bonaire	
	British Virgin Islands	
	Cayman Islands	
	Cuba	
	Curacao	
	Dominica	
	Dominican Republic	
	Grenada	
	Guadeloupe	
	Haiti	
	Jamaica	
	Martinique	
	Montserrat	
	Puerto Rico	
	Saba	
	Saint Barthelemy	
	Saint Eustatius	
	Saint Kitts and Nevis	
	Saint Lucia	
	Saint Martin	
	Saint Vincent & The Grenadines	
	Sint Maarten	
	Trinidad & Tobago	
	Turks and Caicos	
	U.S. Virgin Islands	
	Central America	
	Belize	
	Costa Rica	
	Guatemala	
	Honduras	
	Nicaragua	
	Panama	
	Mexico	
	Offshore US - Gulf of Mexico	
	United States	
	Florida	
	Gulf	
	Alabama	
	Louisiana	

Analysis Option	Available Settings	Notes
	Mississippi	
	Hawaii	
	Mid-Atlantic	
	Delaware	
	District of Columbia	
	Maryland	
	New Jersey	
	Pennsylvania	
	Virginia	
	West Virginia	
	Northeast	
	Connecticut	
	Maine	
	Massachusetts	
	New Hampshire	
	New York	
	Rhode Island	
	Vermont	
	Southeast	
	Georgia	
	North Carolina	
	South Carolina	
	Texas	
	Philippines	
	South Korea	
	Taiwan	
Analysis Type	***Exceedance Probability***	
	Footprint File	
	Historical	
	Maximum Historical	
	Simulated	
Analysis Mode	***Distributed***	
	Expected	
	Percentile	
Model Version	***RMS – RL23***	Model Version only available as an option in Risk Modeler
	RMS – RL22	
	RMS – RL21	
	RMS – RL18.1	
	RMS – RL18	
Event Rate Set	2011 Historical Event Rates	
	RMS 2011 Stochastic Event Rates	
	2013 Historical Event Rates	

Analysis Option	Available Settings	Notes
	RMS 2013 Stochastic Event Rates 2015 Historical Event Rates RMS 2015 Stochastic Event Rates RMS 2017 Historical Event Rates RMS 2017 Stochastic Event Rates RMS 2019 Historical Event Rates RMS 2019 Stochastic Event Rates RMS 2021 Historical Event Rates RMS 2021 Stochastic Event Rates ***RMS 2023 Historical Event Rates*** RMS 2023 Stochastic Event Rates	
Sea Level Rise Scenario		Field disabled unless user licenses the relevant Moody's RMS Products. When licensed, the field only affects storm surge analyses in use cases beyond residential ratemaking purposes in the state of Florida
Vulnerability Curves	***Vulnerability - Default*** Vulnerability Sensitivity Test - High Vulnerability Sensitivity Test - Low	
Use RiskAssessor Curves (if present)	***Toggled off*** Toggled on	Legacy field, only applicable for users of a separately licensable product that is no longer sold.
Calculate Losses From:	***Wind (and Wave for offshore U.S. locations)*** Storm Surge (where modeled)	
Calculate Loss Amplification Factors for:	***Building and Appurtenant Structures*** ***Contents*** ***Business Interruption/Time Element***	All 3 Loss Amplification options should be toggled to 'on'
PLA Scale Factor	***Equal to 1.00***	Field can be set to a user-defined value for use cases beyond residential ratemaking purposes in the state of Florida
Assume 'UNKNOWN' for the following primary characteristics	Construction Class Occupancy Class Year Built Number of Stories Floor Area Floors Occupied	All options should be toggled to 'off'

Analysis Option	Available Settings	Notes
Assume 'UNKNOWN' for secondary modifiers:	***Toggled off*** Toggled on	
Ignore Local Flood Defenses	***Toggled off*** Toggled on	This option only relevant to Flood analyses
Scale Exposure Values	***Equal to 1.00***	Fields can be set to a user-defined value for use cases beyond residential ratemaking purposes in the state of Florida
Assume 2% Deductible when 'UNKNOWN' (FCHLPM runs only)	***Toggled on*** Toggled off	
Map IFM to base property model	***Toggled off*** Toggled on	Option only applicable to users who separately license the RMS Industrial Facilities Model
Map Builders Risk to base property model	***Toggled off*** Toggled on	Option only applicable to users who separately license the Moody's RMS Builders Risk Model
Map Marine Cargo to base property model	***Toggled off*** Toggled on	Option only applicable to users who separately license the Moody's RMS Marine Cargo Model
Non-Modeled Damage Factors	***Equal to 1.00***	Fields can be set to a user-defined value for use cases beyond residential ratemaking purposes in the state of Florida

A-1.7 Describe actions performed to ensure the validity of insurer or other input data used for hurricane model inputs or for 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. Moody's RMS does not perform loss cost 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 percent 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 percent.
- 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 five 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, ensuring that matches are constrained to the proper geographic region.

A-1.8 Disclose if changing the order of the hurricane model input exposure data produces different hurricane model output or results.

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

A-1.9 Disclose if removing or adding policies from the hurricane model input file affects the hurricane model 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 Hurricane Events Resulting in Modeled Hurricane Losses

A. Modeled hurricane loss costs and hurricane probable maximum loss levels shall reflect all insured wind related damages from hurricanes that 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.

B. The modeling organization shall have a documented procedure for distinguishing wind-related hurricane losses from other peril losses.

Moody's RMS has a documented procedure for distinguishing wind-related hurricane losses from other peril losses. These documents can be reviewed on-site.

When examining insurance company claims data, Moody's RMS excludes locations that fall within the Moody's RMS modeled storm surge footprint for the event. This removes locations that have a wind claim that may be contaminated by storm surge damage.

A-2.1 Describe how damage from hurricane model generated storms (landfalling and by-passing hurricanes) is excluded or included in the calculation of hurricane loss costs and hurricane 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 (including hurricane storm surge) is treated in the calculation of hurricane loss costs and hurricane 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, contents, or time element coverages.

A-3 Hurricane Coverages

A. The methods used in the calculation of building hurricane loss costs, including the effect of law and ordinance coverage, shall be actuarially sound.

The methods used in the development of building loss costs are actuarially sound. The vulnerability relationships, which implicitly include the impacts of law and ordinance coverage, are developed using structural and wind engineering principles coupled with the analysis of historical storm loss data, building codes, published studies, and Moody's RMS internal engineering developments in consultation with wind engineering experts. In addition, Moody's 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. Moody's 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 hurricane 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 hurricane 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 hurricane loss costs shall be actuarially sound.

In the Moody's 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 hurricane model to calculate hurricane 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.

The Moody's RMS hurricane model 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 hurricane model to calculate hurricane 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.

The Moody's RMS hurricane model 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 hurricane model to calculate hurricane 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.

The Moody's RMS hurricane model 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 hurricane model to calculate hurricane 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). Moody's 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.

The Moody's RMS hurricane model 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-3.5 Describe the methods used in the hurricane model to account for law and ordinance coverage associated with personal residential properties.

The impacts of law and ordinance coverage, such as the roof replacement rule in the Florida Building Code, is implicitly included in the base vulnerability functions for personal residential properties.

In addition, the impact of the statutory required 25 percent and 50 percent coverage options for personal residential properties is factored into the post-event loss amplification (PLA).

A-4 Modeled Hurricane Loss Cost and Hurricane Probable Maximum Loss Level Considerations

A. Hurricane loss cost projections and hurricane 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. Hurricane loss cost projections and hurricane 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. Hurricane loss cost projections and hurricane probable maximum loss levels shall not include any explicit provision for direct flood losses (including those from hurricane storm surge).

Loss cost projections and probable maximum loss levels do not include any provision for direct flood or hurricane storm surge losses. Flood and storm surge losses are explicitly calculated using separate models and are provided separately from wind-related losses.

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

The Moody's RMS hurricane model 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 hurricane model's calculation of hurricane loss costs and hurricane probable maximum loss levels using relevant data and actuarially sound methods and assumptions.

Demand surge is included in the Moody's RMS hurricane model 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 Moody's 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 hurricane loss costs and hurricane probable maximum loss levels and the treatment of associated uncertainties. 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 that are used to obtain the severity distribution that describes the distribution of the size of losses, given that an event has occurred. The beta distributions provide the information used to calculate the standard deviations as well as other secondary uncertainty metrics. A Poisson distribution is used for event frequency with the mean frequency obtained as the sum of all the event rates. The primary uncertainty in the model is derived from the Poisson distribution. 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 all possible resolutions available for the reported hurricane output ranges. Identify the finest level of resolution (i.e., the most granular level) for which hurricane loss costs and hurricane probable maximum loss levels can be provided.

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

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

Additionally, for residential single-family dwelling occupancy properties, the impact of the statutory required 25 percent and 50 percent coverage options for law and ordinance is factored into the PLA.

A-4.4 Provide citations to published papers, if any, or modeling-organization studies that were used to develop how the hurricane 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, Moody's 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 hurricane loss costs and hurricane probable maximum loss levels.

As described in Disclosure S-5.1, in order to create replications of known hurricane losses, Moody's 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 date of the exposure used in the loss validation exercises. 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 Hurricane 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. Disclosure A-5.1 provides more detailed information on how deductibles and policy limits are handled in the Moody's RMS model.

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

The relationship among the modeled deductible loss costs is reasonable. Disclosure A-5.1 provides more detailed information on how deductibles and policy limits are handled in the Moody's RMS model.

C. Deductible hurricane 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. Disclosure A-5.1 provides more detailed information on how deductibles and policy limits are handled in the Moody's RMS model.

A-5.1 Describe the methods used in the hurricane model to treat deductibles (both flat and percentage), policy limits, and insurance-to-value criteria when projecting hurricane loss costs and hurricane probable maximum loss levels. Discuss data or documentation used to validate the method used by the hurricane model.

The Moody's RMS hurricane model uses a distributed approach for estimating losses net of deductibles and limits for each event. When projecting losses, the Moody's RMS hurricane model 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.

Equation 5

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

The Moody's RMS hurricane model 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.

The Moody's RMS hurricane model 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 the model.

The Moody's RMS hurricane model 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 percent 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.

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-5.2 Describe if and how the hurricane 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 storm surge). No other peril exclusions can be made by the user. Moody's 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 claims experience and assumes the treatment of loss settlement at the time of the loss will prevail in the future.

A-5.3 Describe how the hurricane 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.

Equation 6

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 Hurricane Loss Outputs and Logical Relationships to Risk

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

The methods, data, and assumptions used in the estimation of loss costs and probable maximum loss levels are actuarially sound. These have all been reviewed by credentialed actuaries.

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

Loss costs generated by Moody's RMS do not show an illogical relation to risk nor do they exhibit a significant change when the underlying risk does not change significantly. Loss costs were reviewed by credentialed actuaries.

C. Hurricane loss costs produced by the hurricane 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. Hurricane 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. Hurricane 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. Hurricane 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. Hurricane 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. Hurricane 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 hurricane 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. ***Hurricane output ranges shall be logical for the type of risk being modeled and apparent deviations shall be justified.***

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

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

1. masonry construction versus frame construction,

Output ranges derived from Moody's 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 Moody's 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,

Output ranges derived from the Moody's 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, and

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

5. newer construction versus older construction.

Output ranges derived from the Moody's RMS model reflect generally lower loss costs for newer construction compared to older construction, all other factors held constant.

L. ***For hurricane loss cost and hurricane 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 Moody's 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 Moody's 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 Hurricane 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 Hurricane Losses. Provide a link to the location of the form [Form A-2].

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

A-6.4 Provide a completed Form A-4, Hurricane 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 Hurricane Output Ranges). Provide a link to the location of the form [Form A-5].

A-6.6 Provide a completed Form A-6, Logical Relationships to Hurricane Risk (Trade Secret Item), if not considered as Trade Secret. Provide a link to the location of the form [Form A-6].

A-6.7 Provide a completed Form A-7, Percentage Change in Logical Relationships to Hurricane Risk. Provide a link to the location of the form [Form A-7].

A-6.8 Explain any assumptions, deviations, and differences from the prescribed exposure information in Form A-6, Logical Relationships to Hurricane Risk (Trade Secret Item), and Form A-7, Percentage Change in Logical Relationships to Hurricane Risk. In particular, explain how the treatment of unknown is handled in each sensitivity

There are no assumptions, deviations, or differences form the prescribed exposure information in Form A-6.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. This is described in. Disclosure V-1.11.

A-6.9 Provide a completed Form A-8, Hurricane Probable Maximum Loss for Florida. Provide a link to the location of the form [Form A-8].

A-6.10 Describe the calculation of uncertainty intervals.

See the response to Disclosure A-4.1.

A-6.11 Describe how the hurricane model produces hurricane probable maximum loss levels.

See the response to Disclosure A-4.1.

A-6.12 Provide citations to published scientific and technical literature, if any, or modeling-organization studies that were used to estimate hurricane probable maximum loss levels.

See the response to Disclosure A-4.1.

A-6.13 Describe how the hurricane probable maximum loss levels produced by the hurricane 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 input by the user. This input includes identification of personal or commercial residential coverage.

A-6.14 Explain any differences between the values provided on Form A-8, Hurricane Probable Maximum Loss for Florida, and those provided on Form S-2, Examples of Hurricane Loss Exceedance Estimates.

There are no differences between the values.

A-6.15 Provide an explanation for all hurricane 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-6.16 Provide an explanation of the differences in hurricane output ranges between the currently accepted hurricane model and the hurricane model under review.

The differences are due to factors described in Disclosure G-1.7, where the impact of each component change is also given.

A-6.17 Identify the assumptions used to account for the effects of coinsurance on commercial residential hurricane loss costs.

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

COMPUTER/INFORMATION HURRICANE STANDARDS

CI-1 Hurricane Model Documentation

A. Hurricane model functionality and technical descriptions shall be documented formally in an archival format separate from the use of correspondence including emails, presentation materials, 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 Moody's RMS.

B. A primary document repository shall be maintained, containing or referencing a complete set of documentation specifying the hurricane model structure, detailed software description, and functionality. Documentation shall be indicative of current model development and software engineering practices.

A Computer/Information Standards primary document binder in electronic form has been prepared by Moody's 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 and Risk Modeler development teams.

C. All computer software (i.e., user interface, scientific, engineering, actuarial, data preparation, and validation) relevant to the hurricane model shall be consistently documented and dated.

Through the use of various techniques such as documentation templates and development standards, the RiskLink and Risk Modeler 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 following shall be maintained: (1) a table of all changes in the hurricane model from the currently accepted hurricane 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 7 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, CI-6, and CI-7.

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.

F. ***A list of all externally acquired, currently used, hurricane model-specific software and data assets shall be maintained. The list shall include (1) asset name, (2) asset version number, (3) asset acquisition date, (4) asset acquisition source, (5) asset acquisition mode (e.g., lease, purchase, open source), and (6) length of time asset has been in use by the modeling organization.***

A list of externally acquired assets have been created and will be available for review during the audit.

CI-2 Hurricane Model Requirements

A complete set of requirements for each software component, as well as for each database or data file accessed by a component, shall be maintained. Requirements shall be updated whenever changes are made to the hurricane model.

Moody's 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 hurricane model and platform(s) documentation for interface, human factors, functionality, system documentation, data, human and material resources, security, and quality assurance.

Moody's 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
- Risk Modeler What's New and Release Notes—covers the release details
- Risk Modeler User Guide—product reference guide that describes detailed steps on getting started with Risk Modeler, importing data, managing exposure data, running DLM and HD analyses, viewing results
- Risk Modeler Highlights—product reference guide and focus on main features
- 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 Moody's 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 Moody's 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 Moody's RMS to provide secure access, auditing, and backup facilities for source code
- Information Technology Security Documents—a collection of documents explaining Moody's 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 Hurricane Model Organization and Component Design

A. The following shall be maintained and documented: (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 hurricane model-related flow of information and its processing by modeling organization personnel or consultants, (4) network organization, and (5) system model representations associated with (1)-(4) above. Documentation shall be to the level of components that make significant contributions to the hurricane model output.

Moody's 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 Moody's RMS hurricane model software is shown in the following figures.

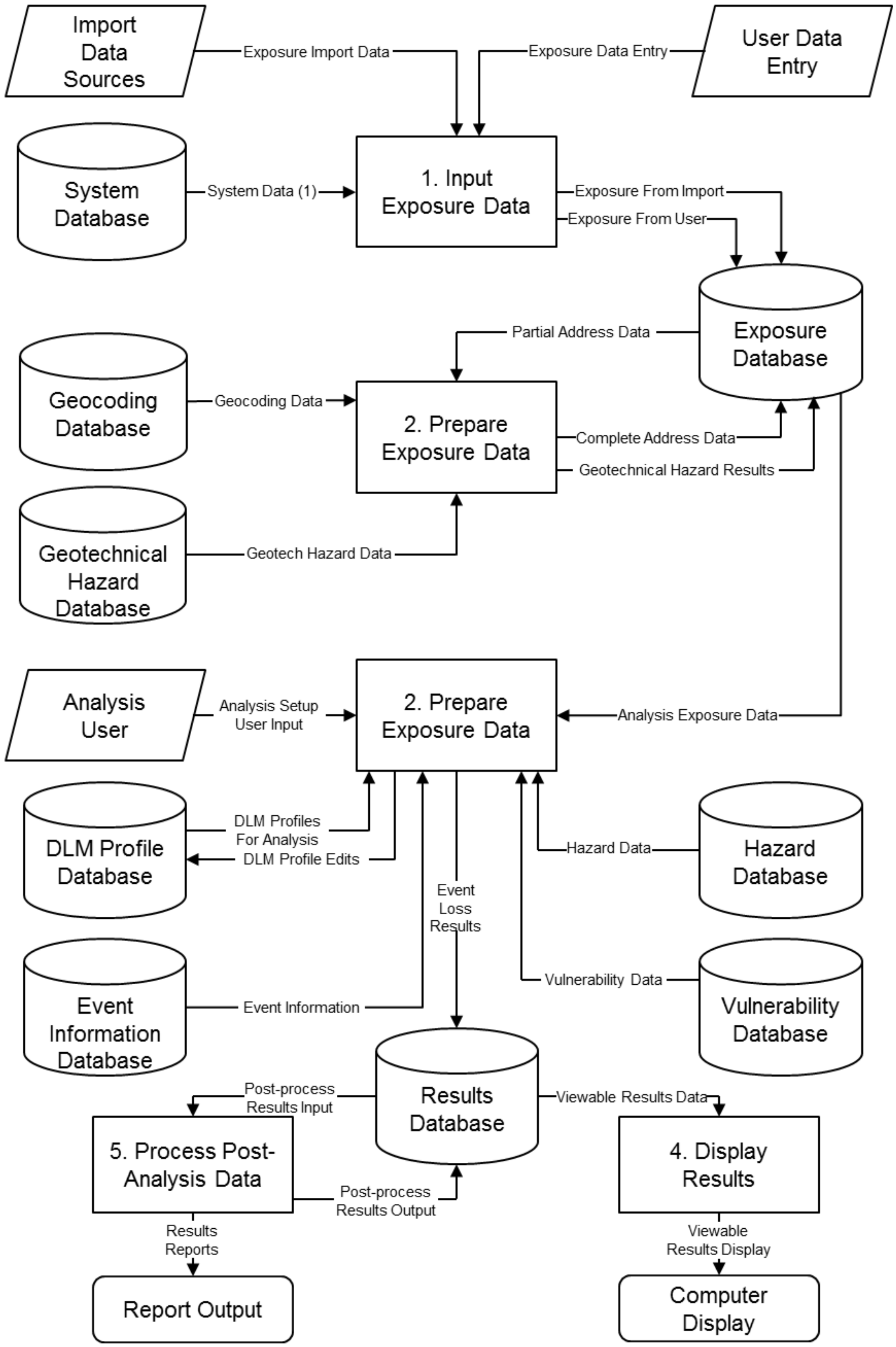
The architecture for the hurricane model involves breaking the basic components into smaller modules and sub-modules, such as the wind hazard module and the vulnerability module. This structure is carried over into the software architecture. This internal model architecture and component design documentation,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

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

B. All flowcharts (e.g., software, data, and system models) in the submission or in other relevant documentation shall be based on (1) a referenced industry standard (e.g., UML, BPMN, SysML), or (2) a comparable internally-developed standard which is separately documented.

All flowcharts comply with an internally-developed standard which is separately documented, and available for review on-site.

Figure 50: Moody's RMS hurricane model top level data flow



CI-4 Hurricane Model Implementation

A. A complete procedure of coding guidelines consistent with accepted software engineering practices shall be maintained.

Moody's 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 is monitored through peer and management review.

B. Network organization documentation shall be maintained.

Moody's RMS maintains the network topology diagrams for RiskLink and Risk Modeler applications. RiskLink is deployed on premise within a group of dedicated servers called as a cluster, over an Enterprise network, which allows high bandwidth data exchange between the RiskLink Database Server, HPC Head and Compute Nodes. RiskLink Client computers are used to submit jobs to the RiskLink clusters.

Risk Modeler application is deployed on a public cloud provider like AWS and utilizes a virtual private cloud (VPC) network isolation technology to create a secured network for all the servers to communicate with each other, without external interference. All servers are connected to a network with bandwidth exceeding 10 GBps. Topology diagrams of RiskLink and Risk Modeler are shown in Disclosure G-1.4.

C. A complete procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components shall be maintained.

Moody's 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.

D. All components shall be traceable, through explicit component identification in the hurricane 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.

E. A table of all software components affecting hurricane loss costs and hurricane probable maximum loss levels shall be maintained 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.

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

F. 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 Moody's 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.

G. The following documentation shall be maintained for all components or data modified by items identified in Hurricane Standard G-1, Scope of the Hurricane Model and Its Implementation, Disclosure 7 and Audit 7:

1. ***A list of all equations and formulas used in documentation of the hurricane model with definitions of all terms and variables, and***
2. ***A cross-referenced list of implementation source code terms and variable names corresponding to items within G.1 above.***

For all components and data modified by items identified in Standard G-1, Disclosure 7, Moody's 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.

H. Hurricane model code and data shall be accompanied by documented maintenance, testing, and update plans with their schedules. The vintage of the code and data shall be justified.

Moody's RMS regularly reviews and updates vintages of data, code, and both scientific and technical literature as needed to inform a model that reflects a current view of the hurricane risk landscape. As a result of regular updates, vintages vary by component. This information may be reviewed on-site.

CI-4.1 Specify the hardware, operating system, and essential software required to use the hurricane model on a given platform.

The following are required to use the Moody's RMS model running RiskLink Version 23.0 (Build 2250):

- Operating system options:
  - Microsoft Windows Server 2019 and Microsoft Windows Server 2022 64-bit operating system for desktop installations and client (remote database) installations
  - Microsoft Windows 10 and Windows 11 64-bit operating system for client installations
  - Microsoft Windows Server 2019 and Microsoft Windows Server 2022 64-bit operating system for database server installations
  - Microsoft Windows HPC Pack 2019 Update 1 for Enterprise Grid Computing (EGC) 64-bit compute nodes (analysis servers)
  - Microsoft Windows HPC Pack 2019 Update 1 for EGC 64-bit head nodes
  - Microsoft Windows Server 2019 and Microsoft Windows Server 2022 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, 64 GB RAM, 1024 x 768 display, one available USB connector, and at least 1 TB disk space
- Database options:
  - SQL Server 2016 SP3 Standard/Enterprise or SQL Server 2019 Standard/Enterprise for EGC database server installations
- .NET 4. 8 Framework
- Microsoft ODBC 18 for SQL Server
- Microsoft Command Line Utilities 15 for SQL Server
- Microsoft SQL Server 2012 Native Client

- Microsoft SQL Server 2016 Management Objects (SMO)
- Visual C++ 2019 Redistributable
- Microsoft XML Core Services (MSXML)
- Microsoft Enterprise Library
- Microsoft HPC Class Library
- SAP Crystal Reports runtime engine for .NET Framework (64-bit)Group 1 (Sagent) geocoding software
- SQLite/SpatiaLite version 5.0
- 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. The following are required to use the Moody's RMS model running on Risk Modeler 2.27.0:

- Google Chrome browser Version 107 and above
- Operating system options:
  - macOS Catalina 10.15.7 and above
  - Windows 10 (Build 22H2) and above

CI-5 Hurricane Model Verification

A. General

For each component, procedures shall be maintained 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.

Moody's 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 Moody's 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. ***Testing software shall be used to assist in documenting and analyzing all components.***

   The IBM/Rational Enterprise Suite is the primary software development toolkit used at Moody's 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 Moody's 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 updated 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 is performed and documented on incremental builds of the RiskLink and Risk Modeler software. Most 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 QA 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. Integration tests shall be performed and documented to ensure the correctness of all hurricane model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.

Integration tests are performed and documented to ensure correctness of all components and data defining the model. Most of the integration 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. Testing software shall be used to assist in documenting and analyzing all databases and data files accessed by components.

Moody’s 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 Microsoft Excel, Microsoft Access, or other generic data manipulation packages. Commercial mapping software (e.g., 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. Integrity, consistency, and correctness checks shall be performed and documented on all databases and data files accessed by the components.

Moody’s RMS performs and documents data integrity, consistency, and correctness checks on all databases and data files accessed by components. Tools such as Microsoft Excel and

Microsoft 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 hurricane model with no changes in input data, parameters, code, and seeds of random number generators produce the same hurricane loss costs and hurricane 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.

Integration Tests

- Manual integration tests are developed and run for features added with the current product release cycle.
- Automated integration 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 is 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 Moody's 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 depend on what data/software/models are being reviewed, but include:

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

CI-6 Human-Computer Interaction

A. Interfaces shall be implemented as consistent with accepted principles and practices of Human-Computer Interaction (HCI), Interaction Design, and User Experience (UX) engineering.

The interfaces in both RiskLink and Risk Modeler are consistent with accepted principles and practices of HCI, Interaction Design, and user UX engineering. Moody's RMS has developed internal standards based on industry standards. Documented principles can be shared on-site.

B. Interface options used in the hurricane model shall be unique, explicit, and distinctly emphasized.

The interface options in the hurricane model are unique, explicit, and distinctly emphasized. These options are meant to provide the users with choices as to the output granularity, the peril to be analyzed, and other factors. The factors are listed in responses to A-1.5.

C. For a Florida rate filing, interface options shall be limited to those options found acceptable by the Commission.

The interface options in RiskLink and Risk Modeler are limited to those options that will produce a Florida Commission approved analysis, as defined in the Moody's RMS response to section A-1.5.

CI-6.1 Identify procedures used to design, implement, and evaluate interface options.

Moody's RMS has developed an internal set of procures to capture the principles related to design implementation and evaluation of the interface options. These procedures are captured within an internal standard called the Radius℠ Design System that contains all the elements needed to create experiences consistent with our principles, design language, and best practices. Through well-defined guidelines, components, and patterns, this site provides a range of resources to support designers, developers, and UX writers as they deliver best-in-class applications serving the insurance and reinsurance industries. Examples will be shown on-site.

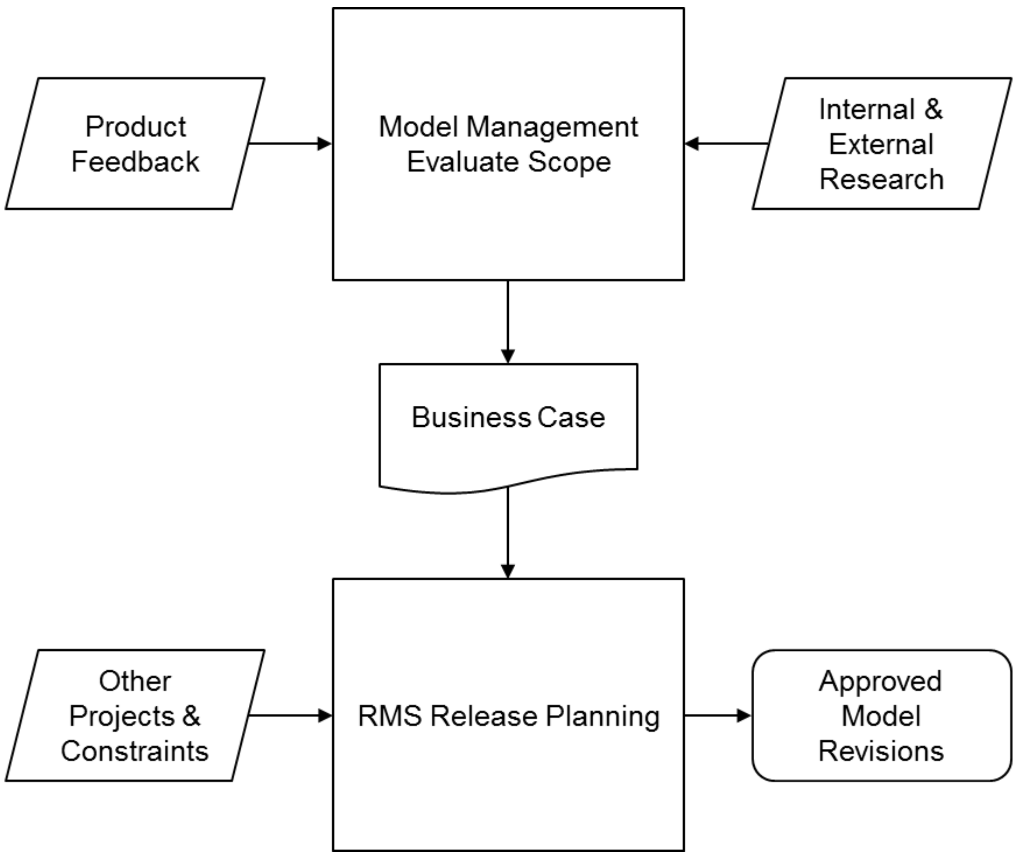
CI-7 Hurricane Model Maintenance and Revision

A. A clearly written policy shall be implemented for review, maintenance, and revision of the hurricane model and network organization, including verification and validation of revised components, databases, and data files.

The general policy of Moody's 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 51: High-level description of model-revision policy



The process of model revision and release is rigorous and well-documented. The figure in Disclosure CI-7.1 illustrate the model-revision process in more detail.

B. A revision to any portion of the hurricane model that results in a change in any Florida residential hurricane loss cost or hurricane probable maximum loss level shall result in a new hurricane model version identification.

The North Atlantic Hurricane Models are periodically enhanced to reflect advances in our knowledge of hurricanes and the consequences of hurricanes. Whenever Moody's 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. Tracking software shall be used to identify and describe all errors, as well as modifications to code, data, and documentation.

Microsoft Team Foundation Server and GitHub are 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.

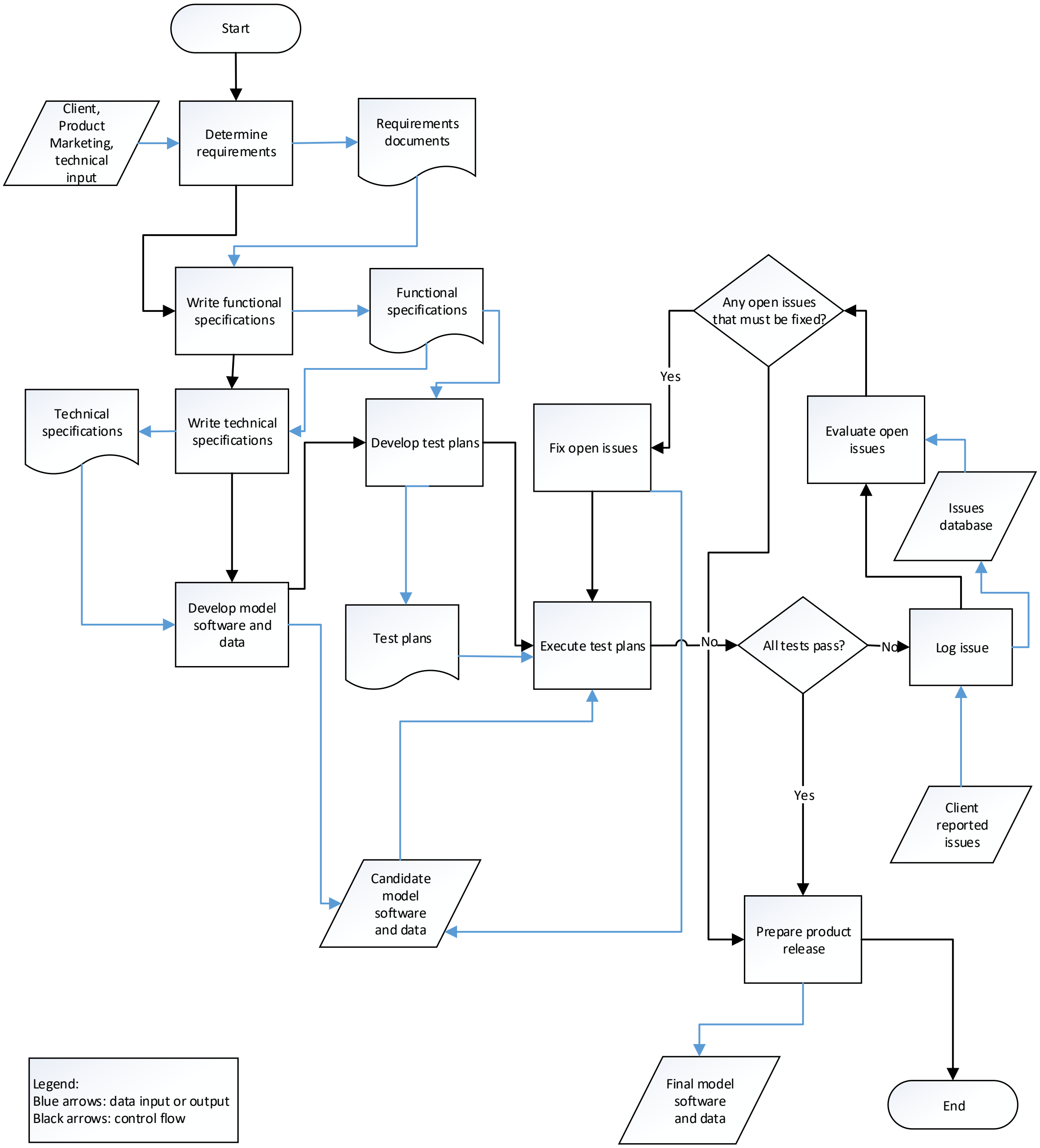
D. A list of all hurricane model versions since the initial submission for this year shall be maintained. Each hurricane model description shall have a unique version identification and a list of additions, deletions, and changes that define that version.

Moody's 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-7.1 Identify procedures used to review and maintain code, data, and documentation.

The following figure depicts the process and procedures used to maintain code, data, and documentation.

Figure 52: Detailed description of model-revision policy



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 Moody's 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 Moody's RMS Client Response System. A product Knowledge Base is maintained and enhanced to assist Moody's RMS client development teams in supporting Moody's RMS client needs.

CI-7.2 Describe the rules underlying the hurricane model and code revision identification systems.

Moody's RMS products that implement specific models are composed 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.

Moody's 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 Moody's 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.

Moody's 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, 23.0.SP0 Build (2250) may simply be referred to externally with clients as Version 23.0.

If the model is updated and released outside of the primary product release cycle, Moody's 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 Version 23.0 (Build 2250), which has software components identified as "23.0.2250.0." All analysis results generated by the software will contain a field called EngineVersion which contains the identified "23.0.2250.0."

CI-8 Hurricane Model Security

Security procedures shall be implemented and fully documented for (1) secure access to individual computers where the software components or data can be created or modified, (2) secure operation of the hurricane model by clients, if relevant, to ensure that the correct software operation cannot be compromised, (3) anti-virus software installation for all machines where all components and data are being accessed, and (4) secure access to documentation, software, and data in the event of a catastrophe.

Moody's 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-8.1 Describe methods used to ensure the security and integrity of the code, data, and documentation. These methods include the security aspects of each platform and its associated hardware, software, and firmware.

The following is a summary of key aspects of Moody's RMS security procedures that apply to all model platforms:

- Security requirements are documented and enforced by the Moody's 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 Moody's 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 GitHub 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 Moody's RMS for processing and analysis.

Security for Moody's 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 Moody's RMS software.

Access to Risk Modeler application requires licensing and is protected by user name and password combination, only accessible over a secure Hypertext Transfer Protocol Secure (HTTPS) connection from the user browser. Users do not have access to the application binaries that are hosted in Moody's RMS servers.

APPENDIX A – FCHLPM FORMS

Form G-1: General Hurricane Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models Version 23.0 (Build 2250) *for compliance with the 2021 Hurricane Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:*

1) *The hurricane model meets the General Hurricane Standards (G-1 – G-5);*
2) *The disclosures and forms related to the General Hurricane 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.*

Jeff Waters	MS, Meteorology
Name	*Professional Credentials (Area of Expertise)*
[signature]	October 31, 2022
Signature (original submission)	*Date*
[signature]	*January 24, 2023*
Signature (response to deficiencies, if any)	*Date*
[signature]	*April 27, 2023*
Signature (revisions to submission, if any)	*Date*
[signature]	*May 19, 2023*
Signature (final submission)	*Date*

An updated signature and form are required following any modification of the hurricane 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 should be added as necessary with the following format:

Signature (revisions to submission)	*Date*

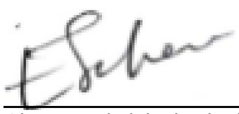
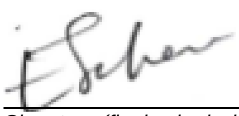
Note: A facsimile or any properly reproduced signature will be acceptable to meet this requirement.

Include Form G-1, General Hurricane Standards Expert Certification, in a submission appendix.

Form G-2: Meteorological Hurricane Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models Version 23.0 (Build 2250) *for compliance with the 2021 Hurricane Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:*

1) *The hurricane model meets the Meteorological Hurricane Standards (M-1 – M-6);*
2) *The disclosures and forms related to the Meteorological Hurricane 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.*

Emilie Scherer	PhD, Atmospheric Science
Name	*Professional Credentials (Area of Expertise)*
	October 31, 2022
Signature (original submission)	*Date*
	*January 24, 2023*
Signature (response to deficiencies, if any)	*Date*
Signature (revisions to submission, if any)	*Date*
	*May 19, 2023*
Signature (final submission)	*Date*

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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 Hurricane Standards Expert Certification, in a submission appendix.

Form G-3: Statistical Hurricane Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models Version 23.0 (Build 2250) *for compliance with the 2021 Hurricane Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:*

1) *The hurricane model meets the Statistical Hurricane Standards (S-1 – S-6);*
2) *The disclosures and forms related to the Statistical Hurricane 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)

Signature (original submission)

October 31, 2022
Date

Signature (response to deficiencies, if any)

January 24, 2023
Date

Signature (revisions to submission, if any)

Date

Signature (final submission)

May 19, 2023
Date

An updated signature and form are required following any modification of the hurricane 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 should 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 Hurricane Standards Expert Certification, in a submission appendix.

Form G-4: Vulnerability Hurricane Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models Version 23.0 (Build 2250) *for compliance with the 2021 Hurricane Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:*

1) *The hurricane model meets the Vulnerability Hurricane Standards (V-1 – V-4);*
2) *The disclosures and forms related to the Vulnerability Hurricane 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.*

Michael Young
Name

PE, MS, Engineering Science
Professional Credentials (Area of Expertise)

State: North Carolina__ *Expiration Date*: 12/31/23__

Professional License Type: Professional Engineer__

Signature (original submission)

October 31, 2022
Date

Signature (response to deficiencies, if any)

January 24, 2023
Date

Signature (revisions to submission, if any)

April 27, 2023
Date

Signature (final submission)

May 19, 2023
Date

An updated signature and form are required following any modification of the hurricane 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 should 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 Hurricane Standards Expert Certification, in a submission appendix.

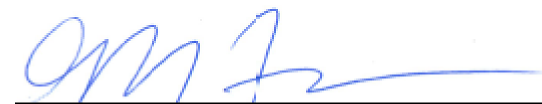
Form G-5: Actuarial Hurricane Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models Version 23.0 (Build 2250) *for compliance with the 2021 Hurricane Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:*

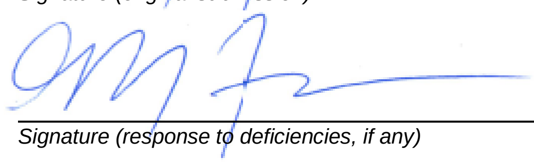
1) *The hurricane model meets the Actuarial Hurricane Standards (A-1 – A-6);*
2) *The disclosures and forms related to the Actuarial Hurricane Standards section are editorially and technically accurate, reliable, unbiased, and complete;*
3) *My review was completed in accordance with the Actuarial Standards 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.*

Greg Fanoe
Name

FCAS, MAAA
Professional Credentials (Area of Expertise)


Signature (original submission)

October 31, 2022
Date


Signature (response to deficiencies, if any)

January 24, 2023
Date

Signature (revisions to submission, if any)

Date


Signature (final submission)

May 19, 2023
Date

An updated signature and form are required following any modification of the hurricane 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 should 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 Hurricane Standards Expert Certification, in a submission appendix.

Form G-6: Computer/Information Hurricane Standards Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models Version 23.0 (Build 2250) *for compliance with the 2021 Hurricane Standards adopted by the Florida Commission on Hurricane Loss Projection Methodology and hereby certify that:*

1) *The hurricane model meets the Computer/Information Hurricane Standards (CI-1 – CI-8),*
2) *The disclosures and forms related to the Computer/Information Hurricane 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.*

Aviansh Takale
Name

MS, Computer Application
Professional Credentials (Area of Expertise)

Signature (original submission)

October 31, 2022
Date

Signature (response to deficiencies, if any)

January 24, 2023
Date

Signature (revisions to submission, if any)

April 27, 2023
Date

Signature (final submission)

May 19, 2023
Date

An updated signature and form are required following any modification of the hurricane 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 should 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 Hurricane Standards Expert Certification, in a submission appendix.

Form G-7: Editorial Review Expert Certification

I hereby certify that I have reviewed the current submission of North Atlantic Hurricane Models Version 23.0 (Build 2250) *for compliance with the "Process for Determining the Acceptability of a Computer Simulation Hurricane Model" adopted by the Florida Commission on Hurricane Loss Projection Methodology in its Hurricane Standards Report of Activities as of November 1, 2021, and hereby certify that:*

5) *The hurricane model submission is in compliance with the Notification Requirements and General Hurricane Standard G-5, Editorial Compliance;*
6) *The disclosures and forms related to each hurricane 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;*
7) *There are no incomplete responses, charts or graphs, inaccurate citations, or extraneous text or references;*
8) *The current version of the hurricane model submission has been reviewed for grammatical correctness, typographical errors, completeness, the exclusion of extraneous data/information and is otherwise acceptable for publication; and*
9) *In expressing my opinion I have not been influenced by any other party in order to bias or prejudice my opinion.*

Karen Argonza *Name*	B.A. Journalism *Professional Credentials (Area of Expertise)*
Karen Argonza *Signature (original submission)*	October 31, 2022 *Date*
Karen Argonza *Signature (response to deficiencies, if any)*	*January 24, 2023* *Date*
Karen Argonza *Signature (revisions to submission, if any)*	*April 27, 2023* *Date*
Karen Argonza *Signature (final submission)*	*May 19, 2023* *Date*

An updated signature and form are required following any modification of the hurricane 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 should 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. One or more automated programs or scripts should be used to generate and arrange the data in Form M-1, Annual Occurrence Rates.

B. Provide a table of annual occurrence rates for hurricane landfall from the dataset defined by marine exposure that the hurricane model generates by hurricane category (defined by maximum windspeed at hurricane landfall in the Saffir-Simpson Hurricane Wind Scale) for the entire state of Florida and additional regions as defined in Figure 1. List the annual occurrence rate per hurricane category. Annual occurrence rates should be rounded to three decimal places.

The historical frequencies below have been derived from the Base Hurricane Storm Set as defined in Hurricane Standard M-1, Base Hurricane Storm Set. If the modeling organization Base Hurricane Storm Set differs from that provided in Form A-2, Base Hurricane Storm Set Statewide Hurricane Losses (as described in the response to Hurricane Standard M-1, Base Hurricane Storm Set, Disclosure 2), then the historical rates for the modeling organization Base Hurricane Storm Set should be added in the appropriate column as labeled in the table below.

As defined, a by-passing hurricane (ByP) is a hurricane which does not make landfall on Florida, but produces minimum damaging windspeeds or greater on Florida. For the by-passing hurricanes included in the table only, the intensity entered is the maximum windspeed at closest approach to Florida as a hurricane, not the windspeed over Florida.

A table providing annual occurrence rates for the model is provided in Table 19. The historical numbers in the table provided in the Hurricane Standards Report of Activities correspond to the counts of region and category descriptions in Form A-2 of the same document.

The historical bypass numbers have been updated to reflect the historical events which cause a loss in the Moody's RMS model.

C. Describe hurricane 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.

D. Provide vertical bar graphs depicting distributions of hurricane frequencies by category by region of Florida (Figure1), 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 hurricane model are adequate.

Histograms comparing modeled and observed landfall frequencies by region are given on Figure 53 which denotes the regions of Florida corresponding to Figure 1 of the ROA.

E. 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.

F. List all hurricanes added, removed, or modified from the currently accepted hurricane model version of the Base Hurricane Storm Set.

In agreement with HURDAT2 as of June 2021, three storms have been added (Dorian 2019, Sally 2020, and Zeta 2020), and five storms have been modified in the 1961-1965 time frame as a result of the HURDAT2 reanalysis.

The eight storms changed since the last submission are listed below, and shown in Figure 53 and Figure 54.

Name	Original HURDAT	HURDAT2 Storm Number	Added/Removed/Modified
Cleo 1964	AL051964	AL051964	Modified
Dora 1964	AL061964	AL061964	Modified
Hilda 1964	AL101964	AL101964	Modified
Isbell 1964	AL111964	AL111964	Modified
Betsy 1965	AL031965	AL031965	Modified
Dorian 2019	NA	AL052019	Added
Sally 2020	NA	AL192020	Added
Delta 2020	NA	AL262020	Added

G. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the hurricane 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 RMS21FormM1.xlsx at the link provided to the FCHLPM.

Notes on Form M-1, Annual Occurrence Rates:

1. ***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 hurricane 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.***
2. ***Form M-1, Annual Occurrence Rates, Form A-2, Base Hurricane Storm Set Statewide Hurricane Losses; and Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, are based on the 121-year period 1900-2020 (consistent with Hurricane 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 Hurricane Losses; and S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, will be the same.***
3. ***As specified in Hurricane 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 current scientific and technical literature. This may result in the modeling organization's Base Hurricane Storm Set differing from the storm set listed in Form A-2, Base Hurricane Storm Set Statewide Hurricane Losses. In this case, the modeling organization should modify the storm set listed in Form A-2, Base Hurricane Storm Set Statewide Hurricane Losses, to make it consistent with the modeling organization's Base Hurricane Storm Set. The modeling organization's Base Hurricane Storm Set should be used to populate the historical counts and rates of Form M-1, Annual Occurrence Rates, as well as the Florida landfall historical frequency in Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year.***

Table 19: Annual occurrence rates

	Entire State					Region A – NW Florida				
	Historical		Modified Base Storm Set		Modeled	Historical		Modified Base Storm Set		Modeled
Category	Nbr	Rate	Nbr	Rate	Rate	Nbr	Rate	Nbr	Rate	Rate
1	26	0.215			0.181	16	0.132			0.127
2	15	0.125			0.125	4	0.033			0.037
3	14	0.117			0.105	6	0.050			0.039
4	11	0.091			0.091	0	0.000			0.012
5	3	0.025			0.017	1	0.008			0.003

	Region B – SW Florida					Region C – SE Florida				
	Historical		Modified Base Storm Set		Modeled	Historical		Modified Base Storm Set		Modeled
Category	Nbr	Rate	Nbr	Rate	Rate	Nbr	Rate	Nbr	Rate	Rate
1	7	0.058			0.051	8	0.066			0.052
2	4	0.033			0.034	6	0.050			0.055
3	5	0.042			0.050	5	0.041			0.035
4	5	0.041			0.025	6	0.050			0.056
5	0	0.000			0.002	2	0.017			0.011

	Region D – NE Florida					Florida By-Passing Hurricanes				
	Historical		Modified Base Storm Set		Modeled	Historical		Modified Base Storm Set		Modeled
Category	Nbr	Rate	Nbr	Rate	Rate	Nbr	Rate	Nbr	Rate	Rate
1	1	0.008			0.009	4	0.033	12	0.099	0.149
2	2	0.017			0.014	3	0.025	8	0.066	0.077
3	0	0.000			0.002	6	0.050	6	0.050	0.084
4	0	0.000			0.001	0	0.000	3	0.025	0.053
5	0	0.000			0.000	0	0.000	0	0.000	0.012

	Region E – Georgia					Region F – Alabama/Mississippi				
	Historical		Modified Base Storm Set		Modeled	Historical		Modified Base Storm Set		Modeled
Category	Nbr	Rate	Nbr	Rate	Rate	Nbr	Rate	Nbr	Rate	Rate
1	0	0.000			0.009	7	0.058			0.051
2	2	0.017			0.016	3	0.025			0.027
3	0	0.000			0.005	4	0.033			0.021
4	0	0.000			0.005	0	0.000			0.015
5	0	0.000			0.001	1	0.008			0.002

*All values rounded to 3 decimal places

Figure 53: Comparison of historical and modeled multiple landfall occurrences by region as defined in Figure 1 on Page 138 of the Hurricane Standards ROA

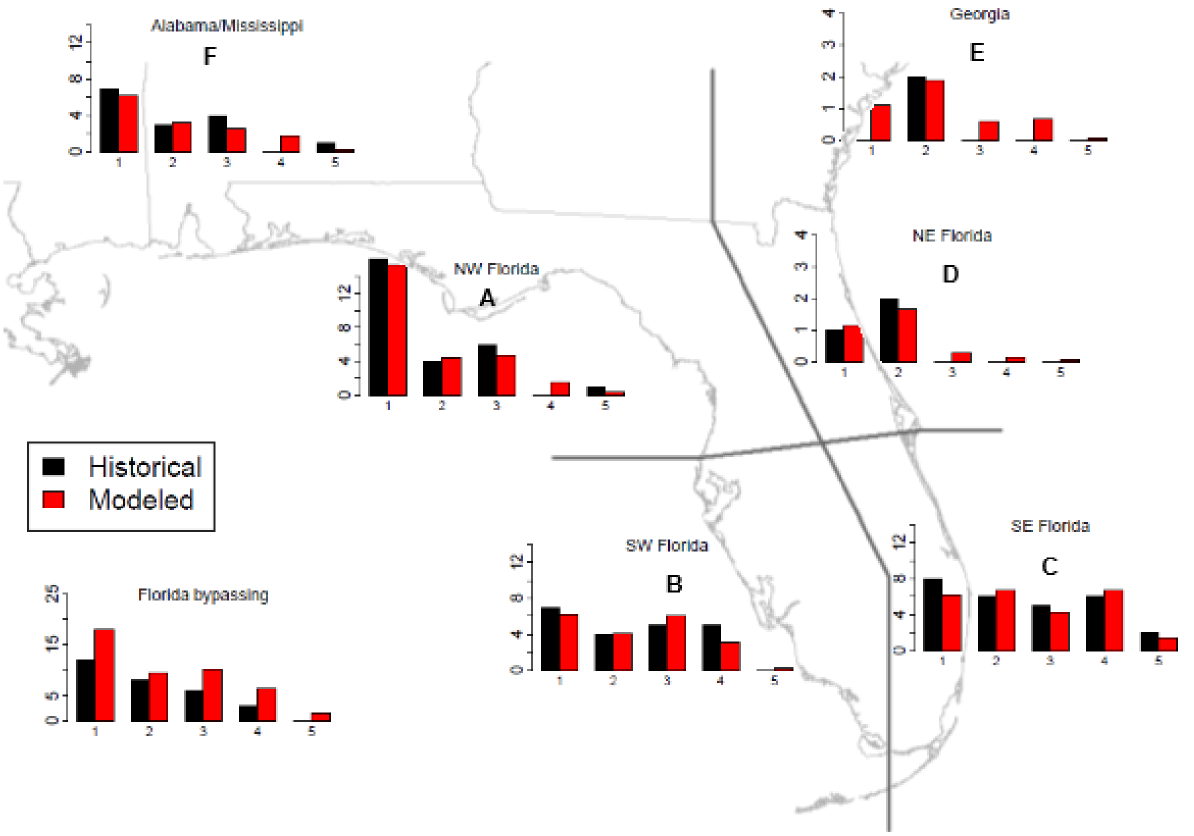


Figure 54: Track parameters for three hurricanes added in the current submission – from top left to bottom right: Dorian 2019, Sally 2020, Zeta 2020

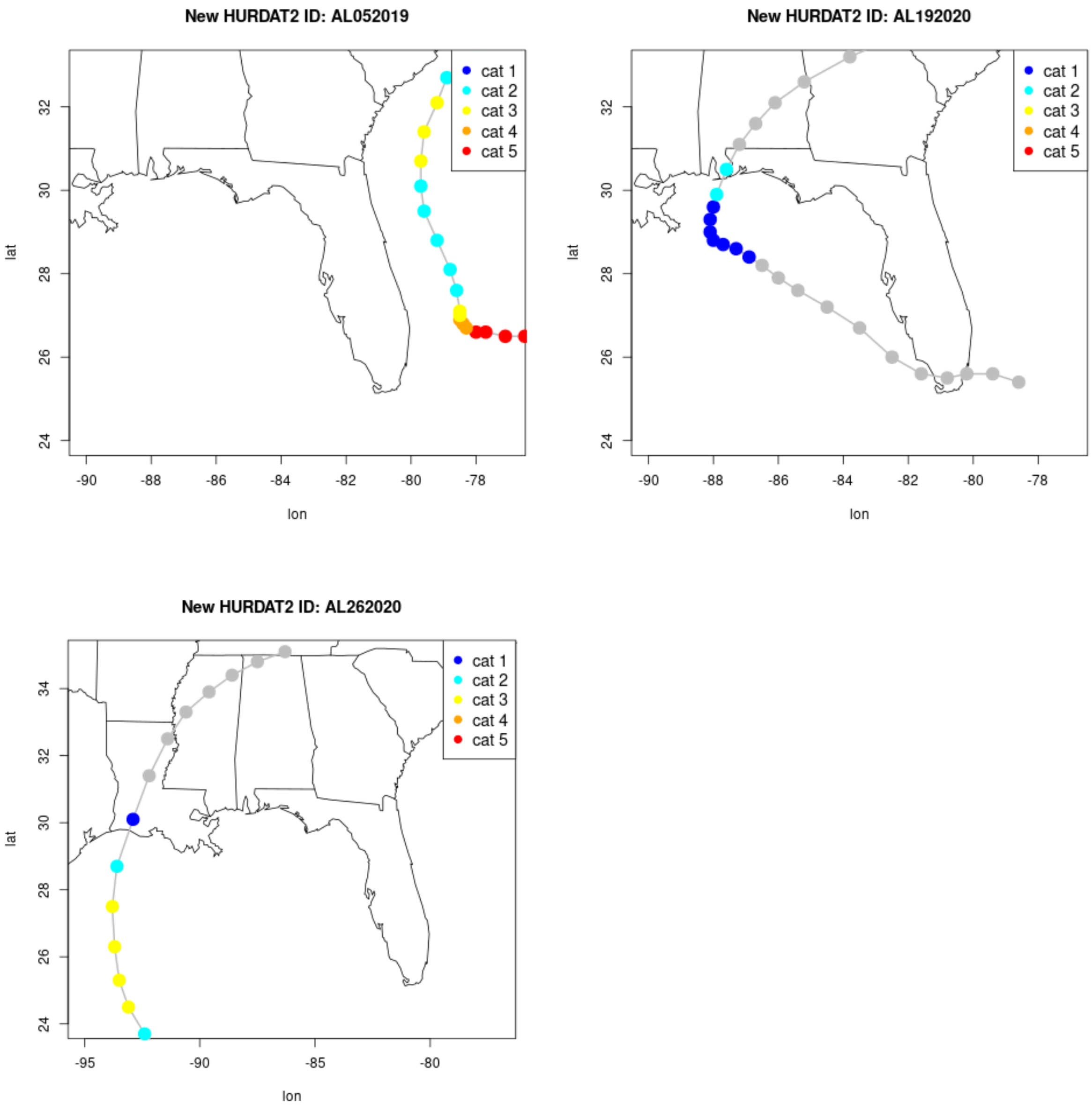
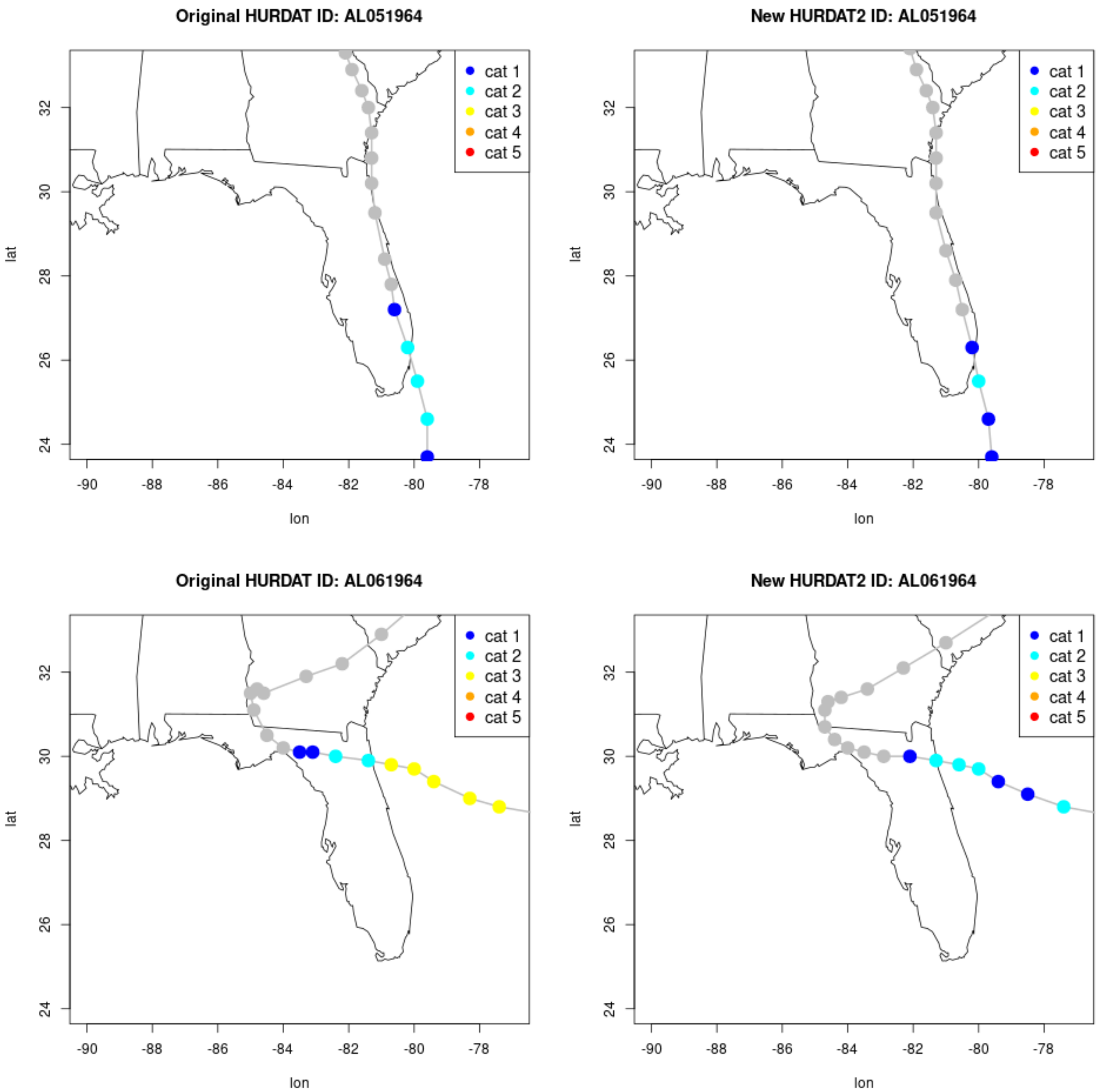
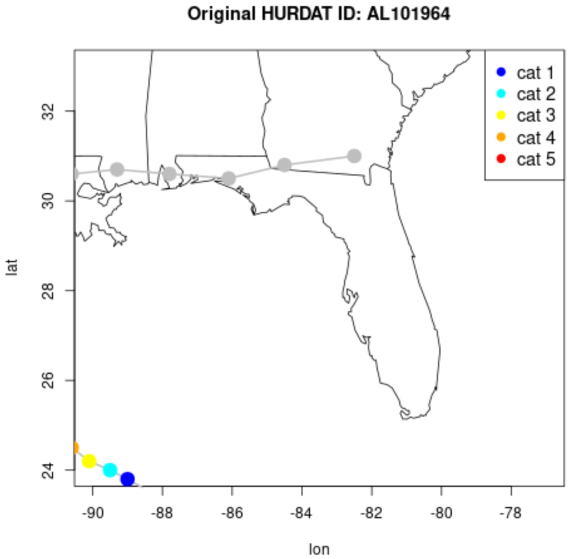
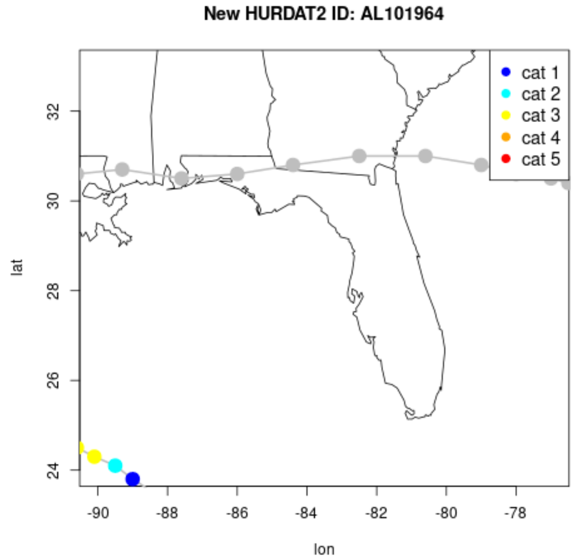


Figure 55: Track parameters for five hurricanes from the 1961-1965 reanalysis period modified in the current submission – from top to bottom: Cleo 1964, Dora 1964, Hilda 1964, Isbell 1964 and Betsy 1965




Original HURDAT ID: AL101964
cat 1
cat 2
cat 3
cat 4
cat 5
lat
lon
32
30
28
26
24
-90
-88
-86
-84
-82
-80
-78


New HURDAT2 ID: AL101964
cat 1
cat 2
cat 3
cat 4
cat 5
lat
lon
32
30
28
26
24
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-84
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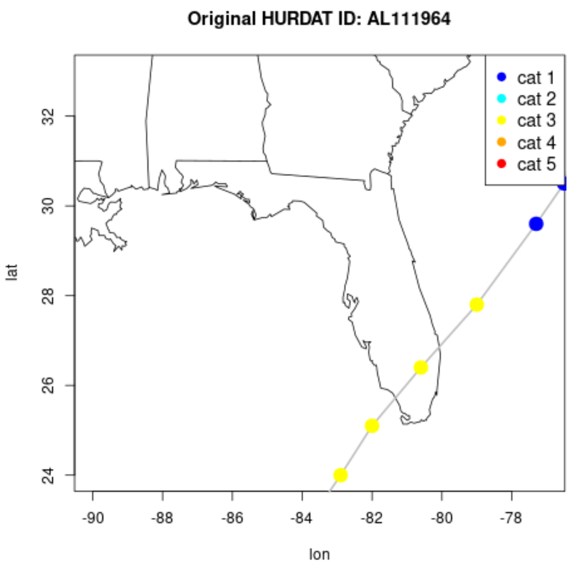
-80
-78


Original HURDAT ID: AL111964
cat 1
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cat 4
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lat
lon
32
30
28
26
24
-90
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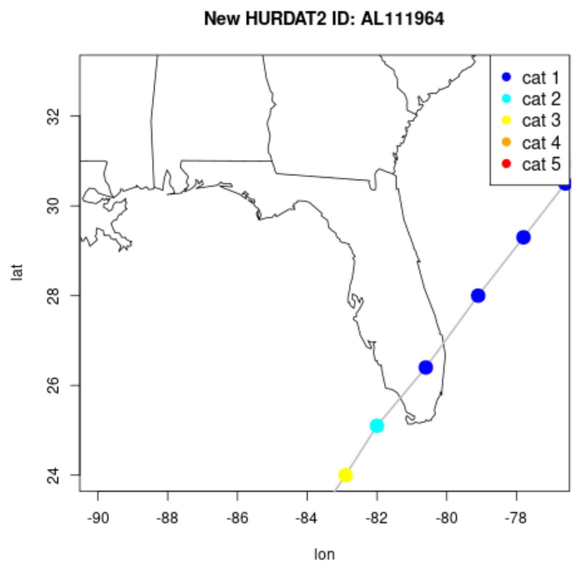
-84
-82
-80
-78


New HURDAT2 ID: AL111964
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cat 2
cat 3
cat 4
cat 5
lat
lon
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30
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26
24
-90
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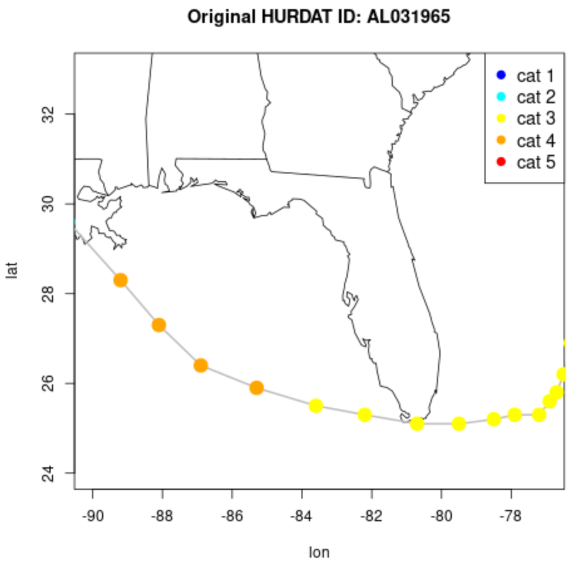
-84
-82
-80
-78


Original HURDAT ID: AL031965
cat 1
cat 2
cat 3
cat 4
cat 5
lat
24
26
28
30
32
lon
-90
-88
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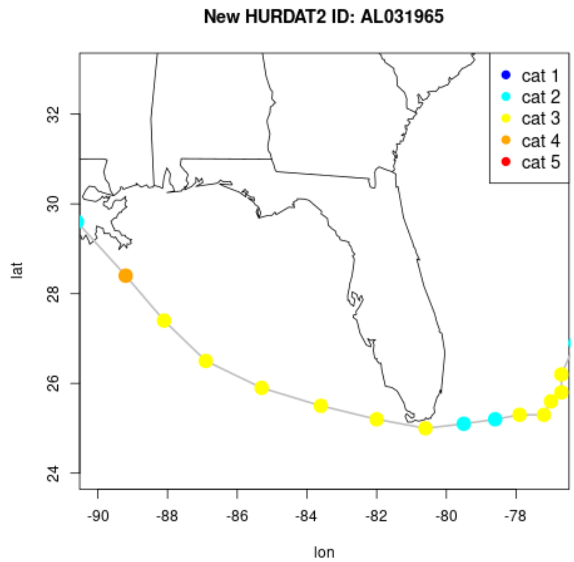
-84
-82
-80
-78


New HURDAT2 ID: AL031965
cat 1
cat 2
cat 3
cat 4
cat 5
lat
24
26
28
30
32
lon
-90
-88
-86
-84
-82
-80
-78

Form M-2: Maps of Maximum Winds

A. Provide color-coded contour plots on a map with ZIP Code boundaries of the maximum winds for the modeled version of the Base Hurricane Storm Set. Plot the position and value of the maximum windspeed on the contour map.

See Figure 56.

B. Provide color-coded 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. Plot the position and value of the maximum windspeed on each contour map.

See maps Figure 57 and Figure 58.

Maximum winds in these maps are defined as the maximum one-minute sustained winds as modeled and recorded at each location.

The same color scheme and increments should 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 56: Maximum 1-minute mean wind speed (mph) at ZIP Code level – historical set (1900–2020)

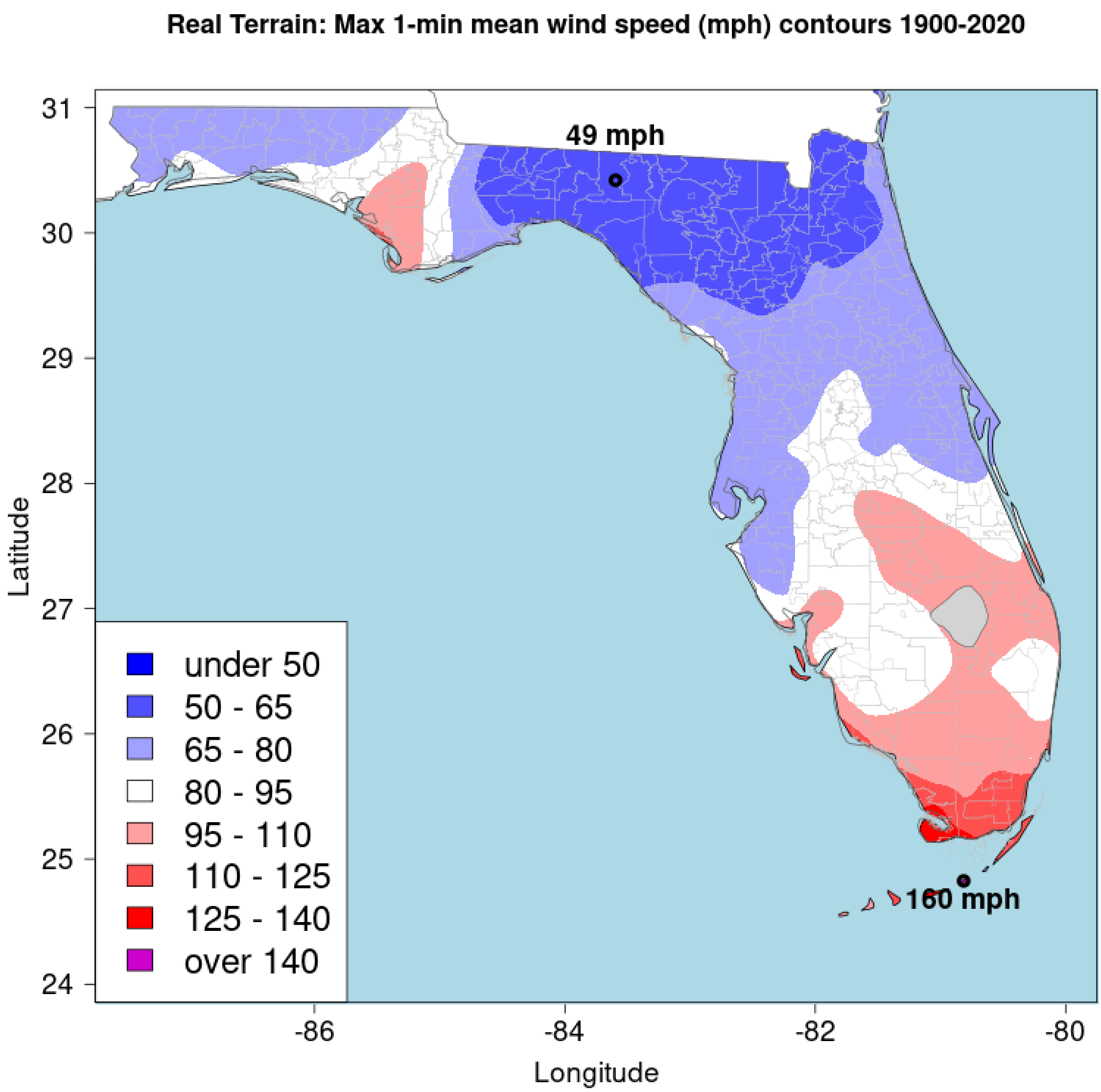


Figure 57: 100-year return period 1-minute mean wind speed (mph) at ZIP Code level – stochastic set

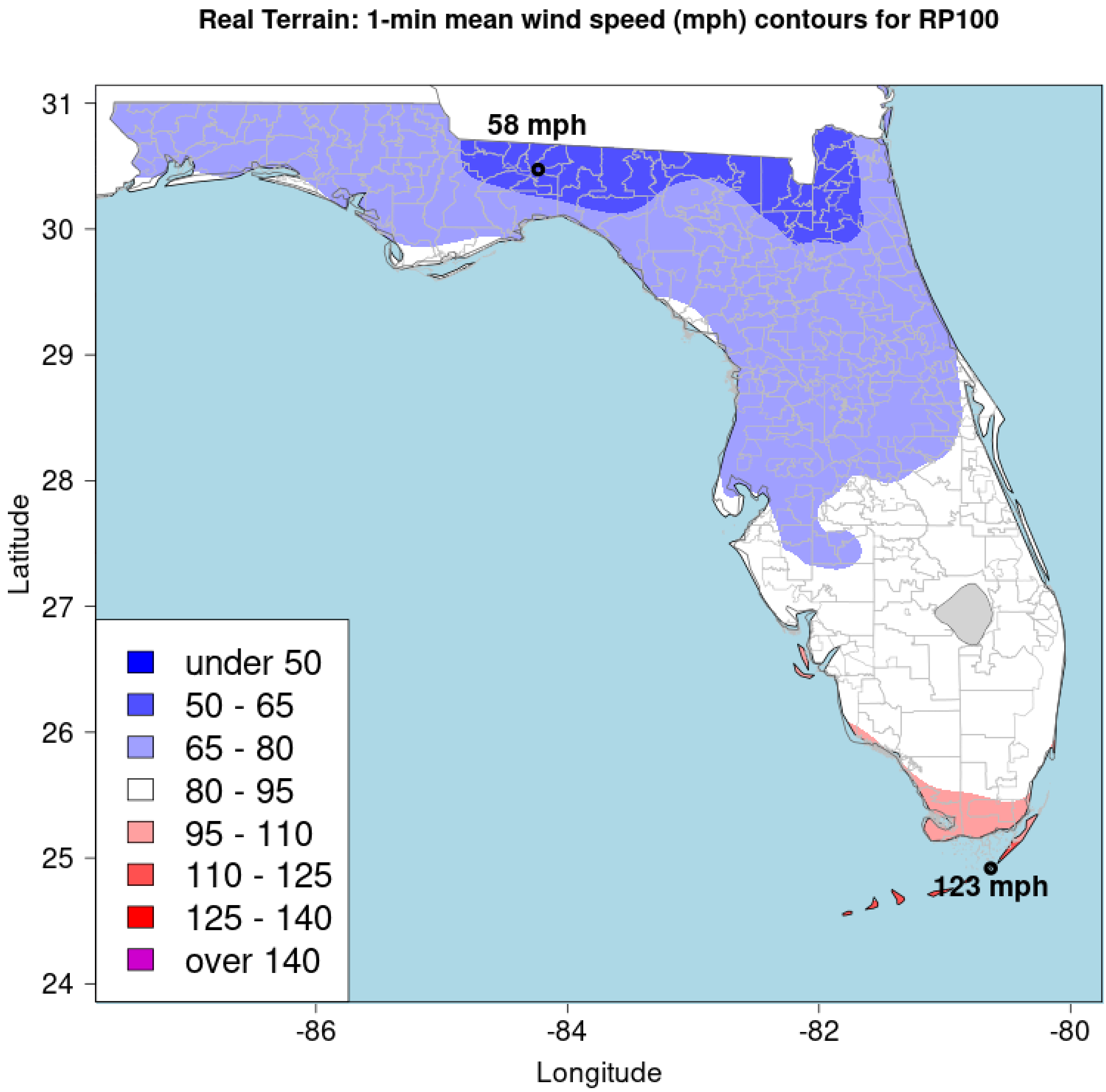
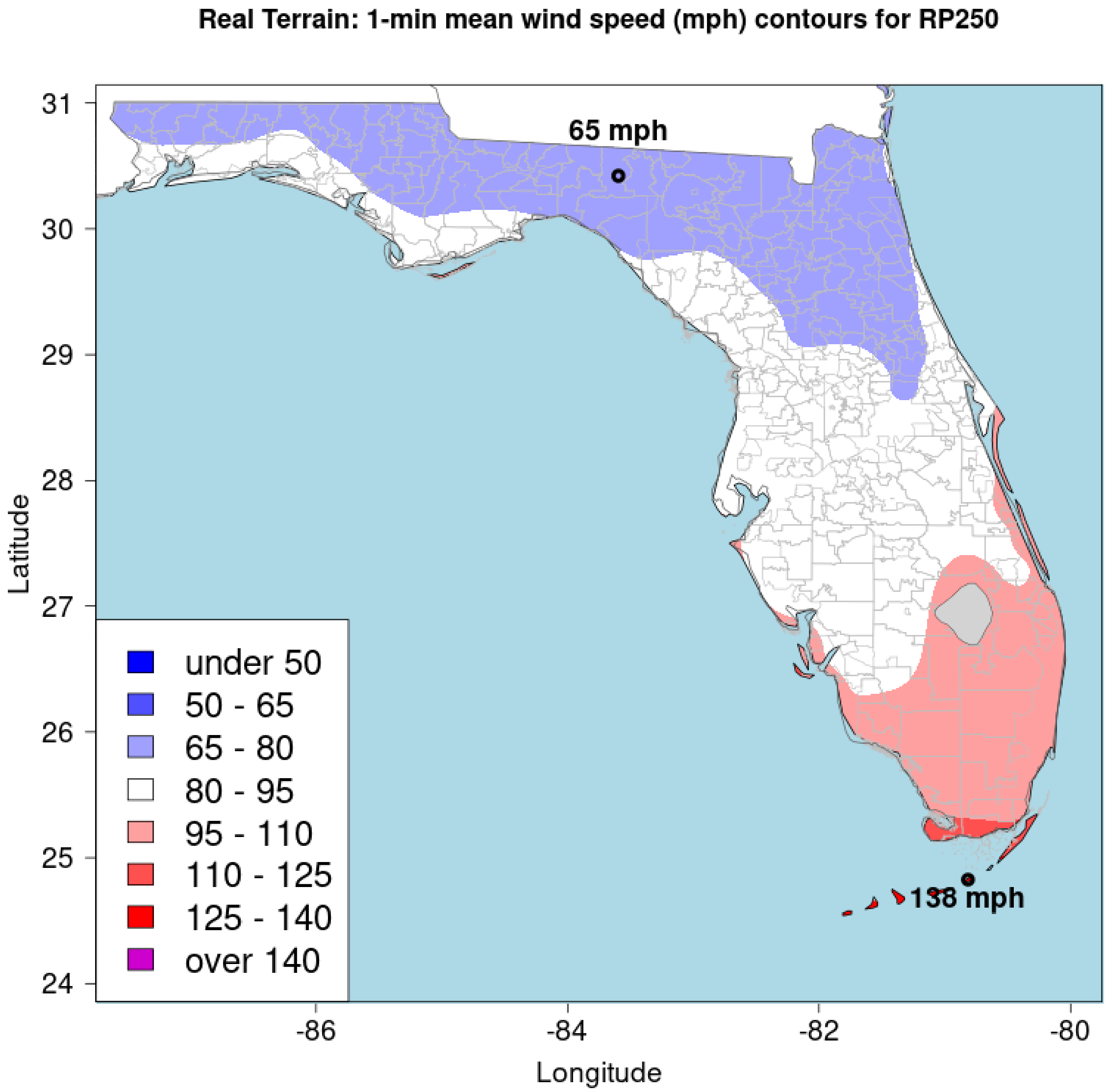


Figure 58: 250-year return period 1-minute mean wind speed (mph) at ZIP Code level – stochastic set



Form M-3: Radius of Maximum Winds and Radii of Standard Wind Thresholds

A. One or more automated programs or scripts should be used to generate and arrange the data in Form M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds.

B. For the central pressure bins in the table below, provide the first quartile (1Q), second quartile (2Q), and third quartile (3Q) in the stochastic storm set of the following quantities: radii to maximum wind (Rmax), the Category 3 (110 mph) wind radii, the Category 1 (73 mph) wind radii, and the gale force (40 mph) wind radii. If a value is unavailable, then populate with "NA."

Table 20: Ranges of Rmax used in hurricane 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
980 ≤ cp < 990	22	31	44	NA	NA	NA	33	47	69	115	165	233
970 ≤ cp < 980	20	28	39	NA	NA	NA	36	53	77	118	170	241
960 ≤ cp < 970	18	25	35	NA	NA	26	40	60	86	120	176	251
950 ≤ cp < 960	16	22	30	NA	22	37	45	67	97	122	182	259
940 ≤ cp < 950	13	19	25	14	26	40	45	65	95	114	166	241
930 ≤ cp < 940	12	17	24	18	28	41	45	65	93	110	158	231
920 ≤ cp < 930	10	15	20	19	27	41	44	62	87	102	150	213
910 ≤ cp < 920	9	12	17	18	27	39	40	57	84	91	129	192
900 ≤ cp < 910	8	10	15	16	23	36	35	48	73	75	113	160
cp < 900	6	8	12	14	21	33	32	44	67	70	98	144

C. Describe the procedure used to complete this form.

Moody's RMS does not store wind radii other than Rmax. The radii provided in Table 20 are computed by applying the optimized Willoughby profile for each hurricane storm point in the stochastic set anywhere in the Basin. The resulting dataset is then split according to the central pressure bands specified, and the requested radii quantiles are calculated for each wind-speed, within each band.

D. Identify other variables that influence Rmax.

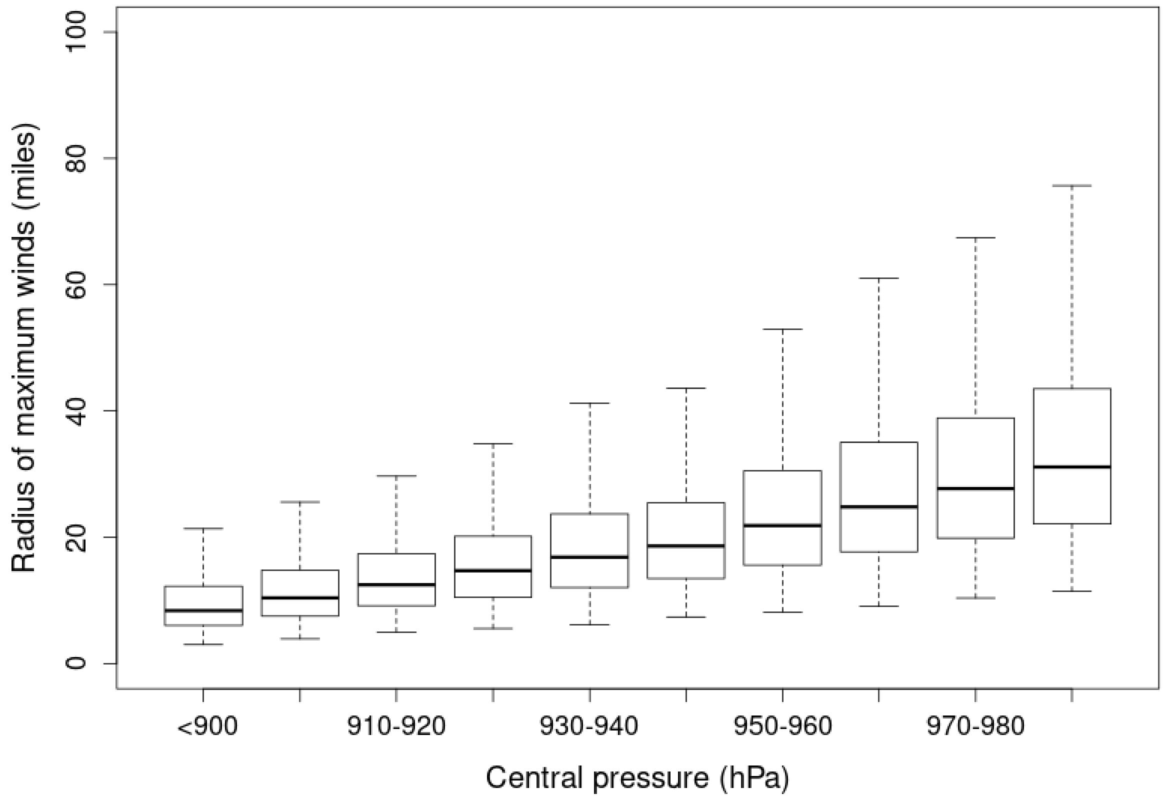
Rmax is a function of central pressure and latitude.

E. Specify any truncations applied to Rmax distributions in the hurricane 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.

F. Provide a box and whiskers plot of the data from the table with Central Pressure on the x-axis and Rmax on the y-axis.

Figure 59: Box plot of Rmax (miles) as a function of central pressure (hPa) for the data in Table 20



G. Provide this form in Excel using the format given in the file named "2021FormM3.xlsx." The file name should include the abbreviated name of the modeling organization, the hurricane 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 RMS21FormM3.xlsx at the link provided to the FCHLPM.

Form S-1: Probability and Frequency of Florida Landfalling Hurricanes per Year

A. ***One or more automated programs or scripts should be used to generate and arrange the data in Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year.***

B. ***Complete the table below for the modeled probabilities of the number of landfalling Florida hurricanes per year. Values derived from the Base Hurricane Storm Set (as given in Form A-2, Base Hurricane Storm Set Statewide Hurricane Losses) have been provided. If the modeling organization has modified the Base Hurricane Storm Set, as identified in their response to Hurricane Standard M-1, Base Hurricane Storm Set, then the probabilities and frequencies of the modified set should also be provided in the appropriate columns. Probabilities should be rounded to three decimal places.***

C. ***Include Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, in a submission appendix.***

The table below provides the probability of landfalling Florida hurricanes per year, for the period 1900 to 2020. Moody's RMS has not made any modifications to the landfalls and associated categories in the Base Hurricane Set.

Table 21: Probability and frequency of Florida landfalling hurricanes per year

Number of Hurricanes Per Year	Historical Probability	Modified Base Storm Set Probability	Modeled Probability	Historical Frequency	Modified Base Storm Set Frequency
0	0.603		0. 595	73	
1	0.248		0. 309	30	
2	0.124		0. 080	15	
3	0.025		0.014	3	
4	0.000		0.002	0	
5	0.000		0.000	0	
6	0.000		0.000	0	
7	0.000		0.000	0	
8	0.000		0.000	0	
9	0.000		0.000	0	
10 or more	0.000		0.000	0	

Form S-2: Examples of Hurricane Loss Exceedance Estimates

A. One or more automated programs or scripts should be used to generate and arrange the data in Form S-2, Examples of Hurricane Loss Exceedance Estimates.

B. Provide estimates of the annual aggregate combined personal and commercial insured hurricane losses for various probability levels using the notional risk dataset specified in Form A-1, Zero Deductible Personal Residential Hurricane Loss Costs by ZIP Code, and using the 2017 Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data provided in the file named "hlpm2017c.zip." Provide the total average annual hurricane loss for the hurricane loss exceedance distribution. If the modeling methodology does not allow the hurricane model to produce a viable answer for certain return periods, state so and why.

A. Include Form S-2, Examples of Hurricane Loss Exceedance Estimates, in a submission appendix.

Part A

Table 22: Examples of hurricane loss exceedance estimates (2017 FHCF exposure data)

Return Period (Years)	Annual Probability of Exceedance	Estimated Hurricane Loss Notional Risk Dataset	Estimated Personal and Commercial Residential Hurricane Loss 2017 FHCF Dataset
Top Event	NA	324,526,046	778,159,890,193
10,000	0.01%	149,841,737	337,707,697,919
5,000	0.02%	125,416,714	276,625,095,391
2,000	0.05%	96,118,384	204,660,085,433
1,000	0.10%	76,983,591	159,200,989,403
500	0.20%	60,912,676	122,051,387,835
250	0.40%	47,509,701	91,507,393,225
100	1.00%	32,632,494	58,516,253,094
50	2.00%	23,227,193	39,157,006,096
20	5.00%	13,386,245	20,807,300,684
10	10.00%	7,517,606	10,702,864,398
5	20.00%	2,895,665	3,478,822,180

Part B

Table 23: Average annual loss for hurricane loss exceedance distribution (2017 FHCF exposure data)

	Estimated Hurricane Loss Notional Risk Dataset	Estimated Personal and Commercial Residential Hurricane Loss 2017 FHCF Dataset
Mean (Total Average Annual Hurricane Loss)	2,534,476	3,972,450,470
Median	16,915	17,493,683
Standard Deviation	7,140,565	13,556,611,980
Interquartile Range	1,738,972	1,870,221,185
Sample Size	100,000 Years of Simulated Events	100,000 Years of Simulated Events

Form S-3: Distributions of Stochastic Hurricane Parameters

A. Provide the probability distribution functional form used for each stochastic hurricane parameter in the hurricane model. Provide a summary of the justification for each functional form selected for each general classification.

Year Range Used for Fitting refers to the year range of data upon which the hurricane model distribution parameters are estimated.

Year Range Used for Validation refers to the year range of data upon which the goodness-of-fit statistics are based.

B. Include Form S-3, Distributions of Stochastic Hurricane Parameters, in a submission appendix.

Table 24: Distributions of hurricane parameters

Stochastic Hurricane Parameter (Function or Variable)	Functional Form of Distribution	Data Sources	Year Range Used	Year Range Used for Validation	Justification for Functional Form and Parameter Estimates
Storm Frequency	Poisson	HURDAT2	1900–2020	1900-2020	The Poisson assumption is supported by historical data. The Poisson rates are in good agreement with historical data.
Central Pressure at Landfall	Smoothed empirical distribution by landfall region	HURDAT HURDAT2	1900–2008	1900-2020	The distribution of central pressure at landfall is calibrated to match historical data.
Inland Filling Rate	Gaussian, with mean that depends on intensity, size, translational speed, and proportion of the storm over different types of terrain.	HURDAT HURDAT2 NHC Reports Numerical simulations	1988–2008	1900-2020	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).

Stochastic Hurricane Parameter (Function or Variable)	Functional Form of Distribution	Data Sources	Year Range Used	Year Range Used for Validation	Justification for Functional Form and Parameter Estimates
Vmax	Log-normal with mean that depends on central pressure, far field pressure, and latitude.	HURDAT HURDAT2	1900–2020	1900-2020	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 and parameters have 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 HURDAT2	1950–2007	1900-2020	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.
Rmax	Truncated log-normal. The mean depends on pressure and latitude.	Extended Best Track HURDAT2 Reanalysis Ho et al (1987)	1988–2008	1900-2020	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	1998-2020	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 four validation comparisons of actual personal residential exposures and hurricane loss to modeled exposures and hurricane loss. Provide these comparisons by line of insurance, construction type, policy coverage, county or other level of similar detail in addition to total hurricane losses. Include hurricane loss as a percentage 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 hurricane loss. If this is not available, use exposures for only those policies that had a hurricane loss. Specify which was used. To the extent data are available, comparisons should include hurricane losses from Hurricane Irma (2017) and Hurricane Michael (2018).

B. Provide a validation comparison of actual commercial residential exposures and hurricane loss to modeled exposures and hurricane loss. Use and provide a definition of the hurricane model relevant commercial residential classifications.

C. Provide scatter plot(s) of modeled versus historical hurricane losses for each of the required validation comparisons. (Plot the historical hurricane losses on the x-axis and the modeled hurricane 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 hurricane loss cost calculations must be produced by the hurricane model being evaluated and should be the same hurricane parameters as used in completing Form A-2, Base Hurricane Storm Set Statewide Hurricane Losses.

Example A1: Comparison of a Company's Personal Residential Modeled and Actual Hurricane Loss as a Percent of Total Exposure

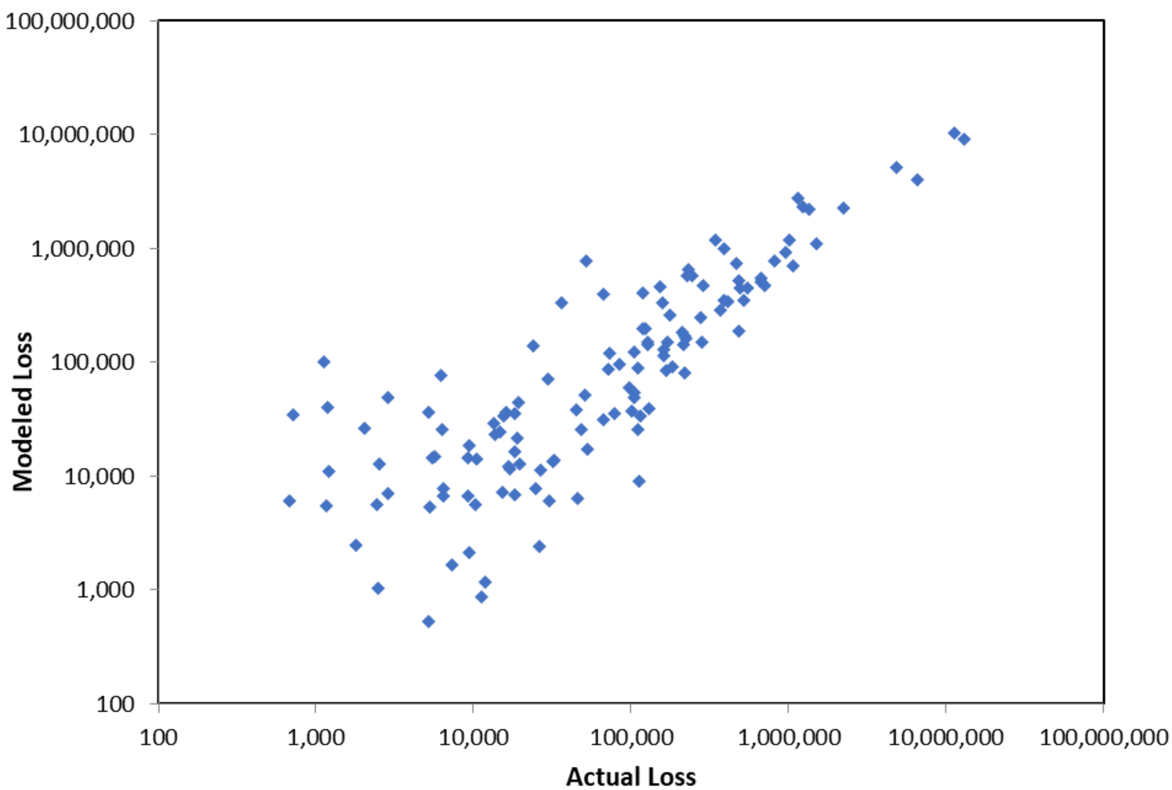
Hurricane = Charley (2004)

Exposure = Manufactured Homes – Total exposure (modeled and actual losses include demand surge)

Table 25: Example A1 portfolio comparison of modeled and actual hurricane loss

Construction	Company Actual Hurricane Loss / Exposure	Modeled Hurricane Loss / Exposure	Difference
Manufactured Home	6.25%	6.21%	0.04%

Figure 60: Example A1 comparison of modeled and actual hurricane losses by ZIP Code



Example A2: Comparison of a Company's Personal Residential Modeled and Actual Hurricane Loss as a Percent of Total Exposure

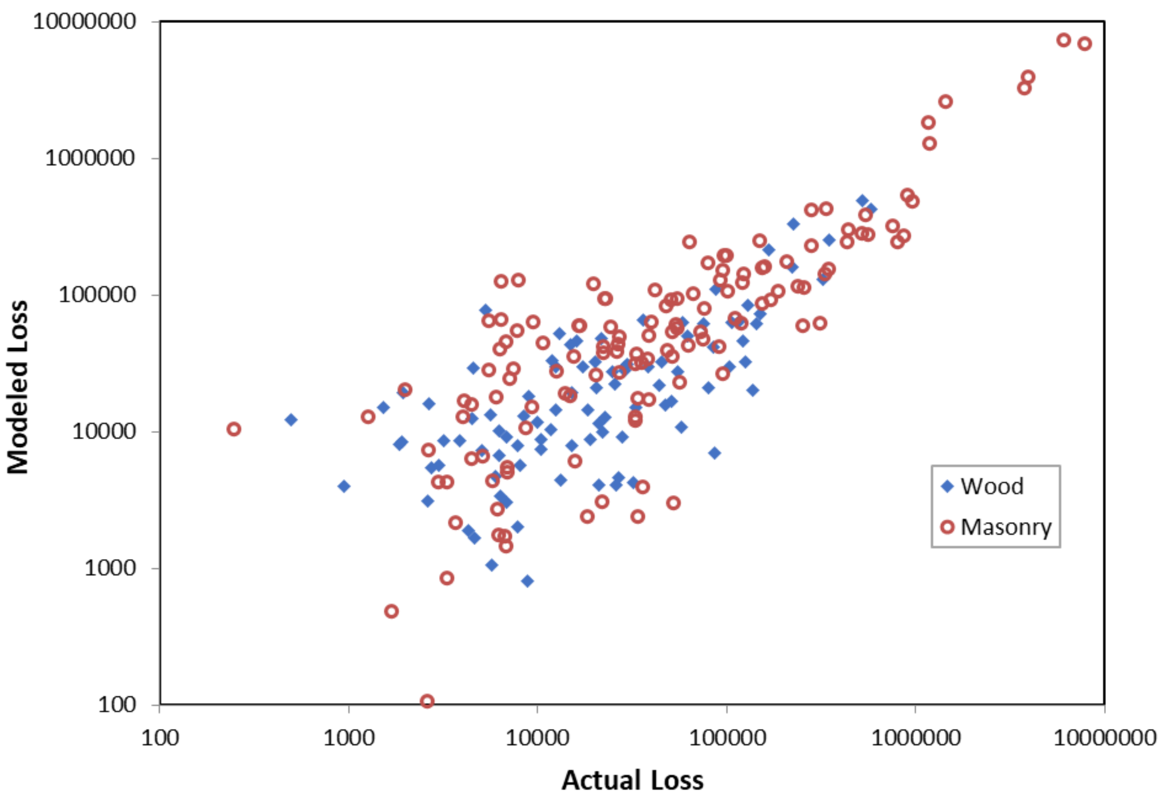
Hurricane = Charley (2004)

Exposure = Single-Family Residential – Total exposure (modeled and actual losses include demand surge)

Table 26: Example A2 portfolio comparison of modeled and actual hurricane loss

Construction	Company Actual Hurricane Loss / Exposure	Modeled Hurricane Loss / Exposure	Difference
Wood Frame	1.73%	1.50%	0.24%
Masonry	2.77%	2.69%	0.08%
Total	2.59%	2.48%	0.11%

Figure 61: Example A2 comparison of modeled and actual hurricane losses by ZIP Code



Example A3: Comparison of a Company's Personal Residential Modeled and Actual Hurricane Loss as a Percent of Total Exposure

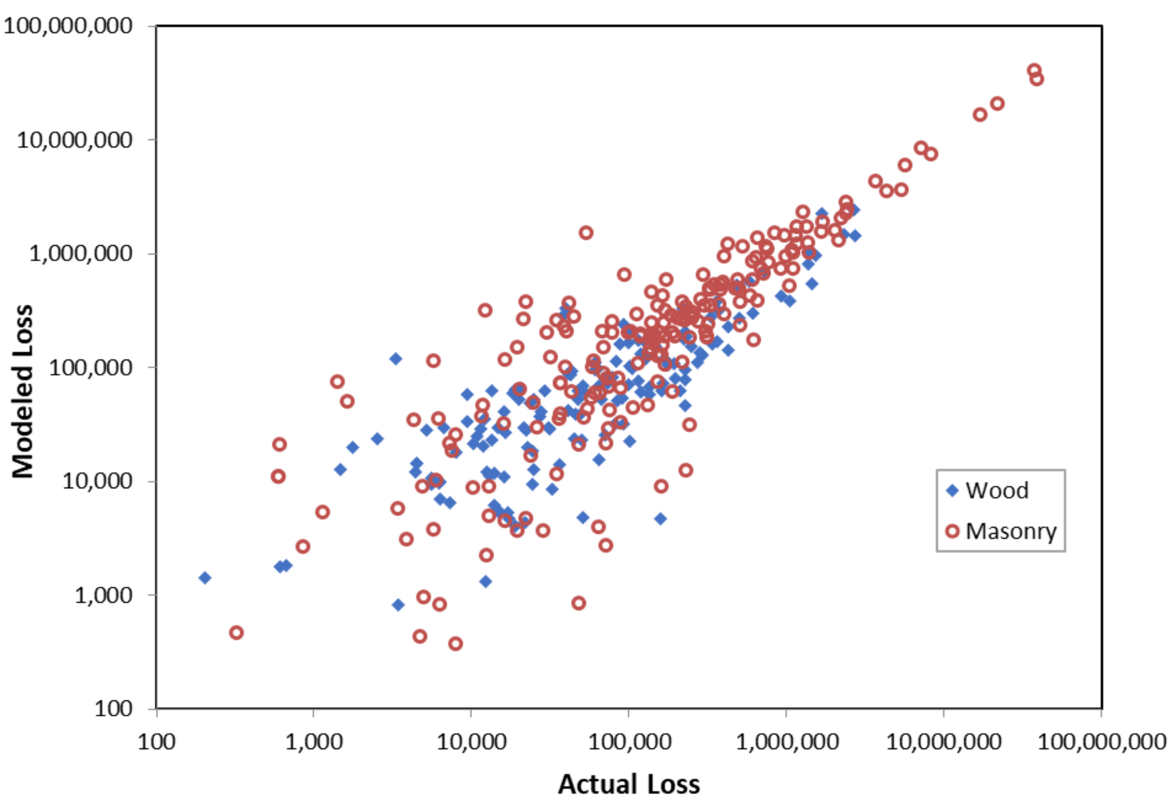
Hurricane = Charley (2004)

Exposure = Single-Family Residential – Total exposure (modeled and actual losses include demand surge)

Table 27: Example A3 portfolio comparison of modeled and actual hurricane loss

Construction	Company Actual Hurricane Loss / Exposure	Modeled Hurricane Loss / Exposure	Difference
Wood Frame	1.65%	1.29%	0.35%
Masonry	1.63%	1.68%	-0.05%
Total	1.64%	1.63%	0.01%

Figure 62: Example A3 comparison of modeled and actual hurricane losses by ZIP Code



Example A4: Comparison of a Company's Personal Residential Modeled and Actual Hurricane Loss as a Percent of Total Exposure

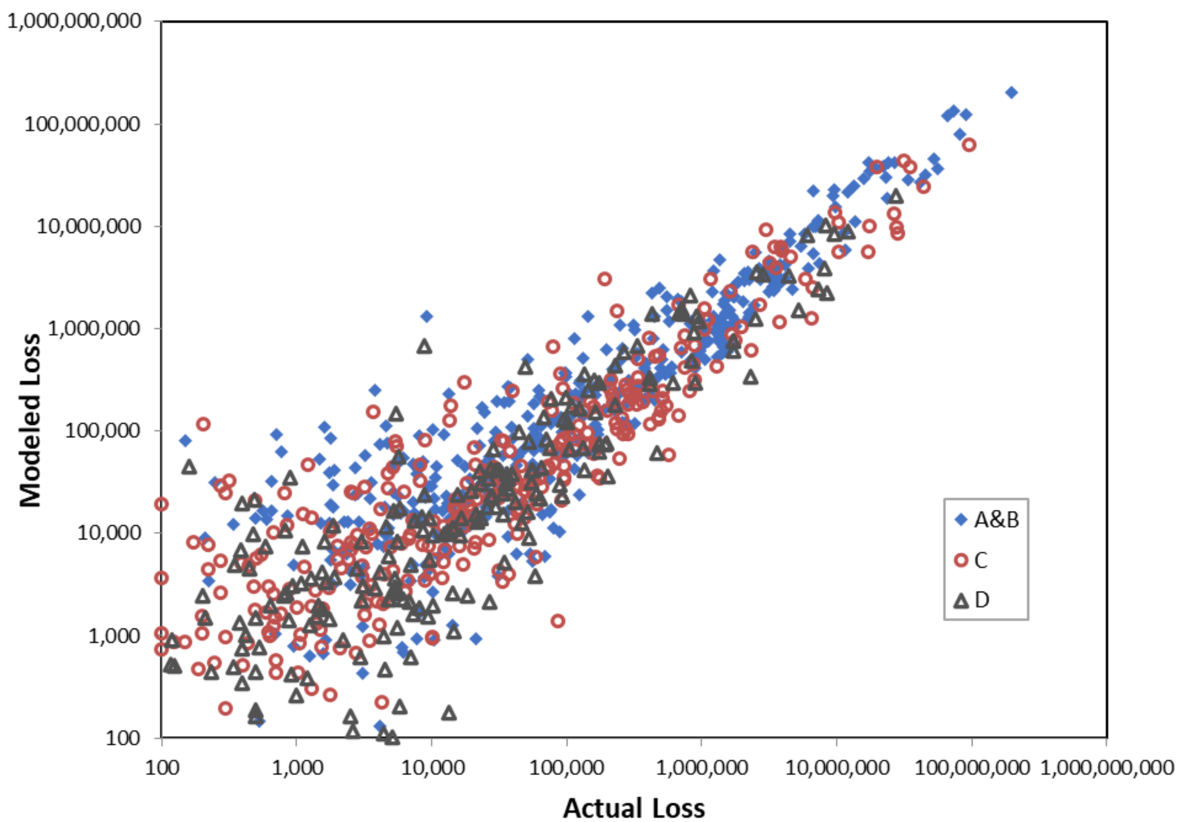
Hurricane = Andrew (1992)

Exposure = Total exposure (modeled and actual losses include demand surge)

Table 28: Example A4 portfolio comparison of modeled and actual hurricane loss

Coverage	Company Actual Hurricane Loss / Exposure	Modeled Hurricane Loss / Exposure	Difference
A & B	6.91%	8.58%	-1.67%
C	4.46%	3.54%	0.91%
D	3.40%	2.71%	0.69%
Total	5.72%	6.27%	-0.56%

Figure 63: Example A4 comparison of modeled and actual hurricane losses by ZIP Code



Example A5: Comparison of a Company's Personal Residential Modeled and Actual Hurricane Loss as a Percent of Total Exposure

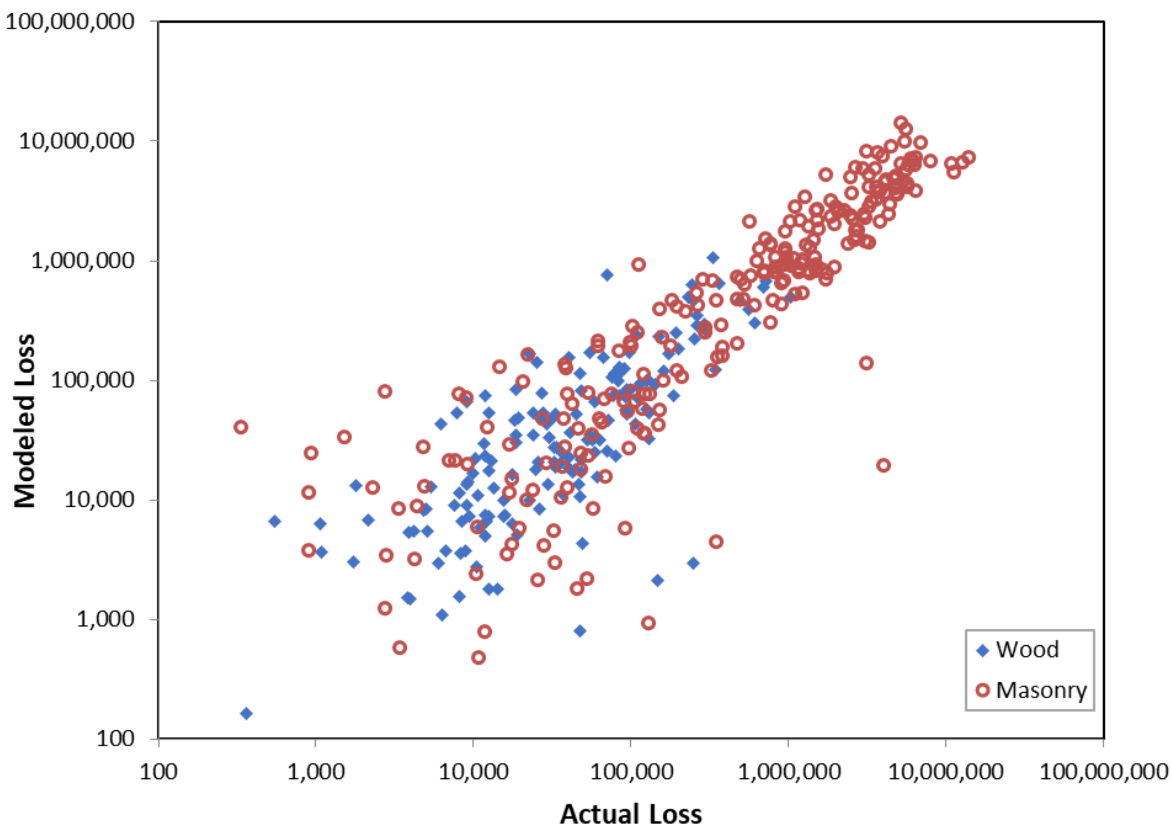
Hurricane = Wilma (2005)

Exposure = Single-Family Residential – Total exposure (modeled and actual losses include demand surge)

Table 29: Example A5 portfolio comparison of modeled and actual hurricane loss

Construction	Company Actual Hurricane Loss / Exposure	Modeled Hurricane Loss / Exposure	Difference
Wood	0.70%	0.83%	-0.13%
Masonry	0.98%	1.02%	-0.04%
Total	0.97%	1.01%	-0.04%

Figure 64: Example A5 comparison of modeled and actual hurricane losses by ZIP Code



Example A6: Comparison of a Company's Personal Residential Modeled and Actual Hurricane Loss as a Percent of Total Exposure

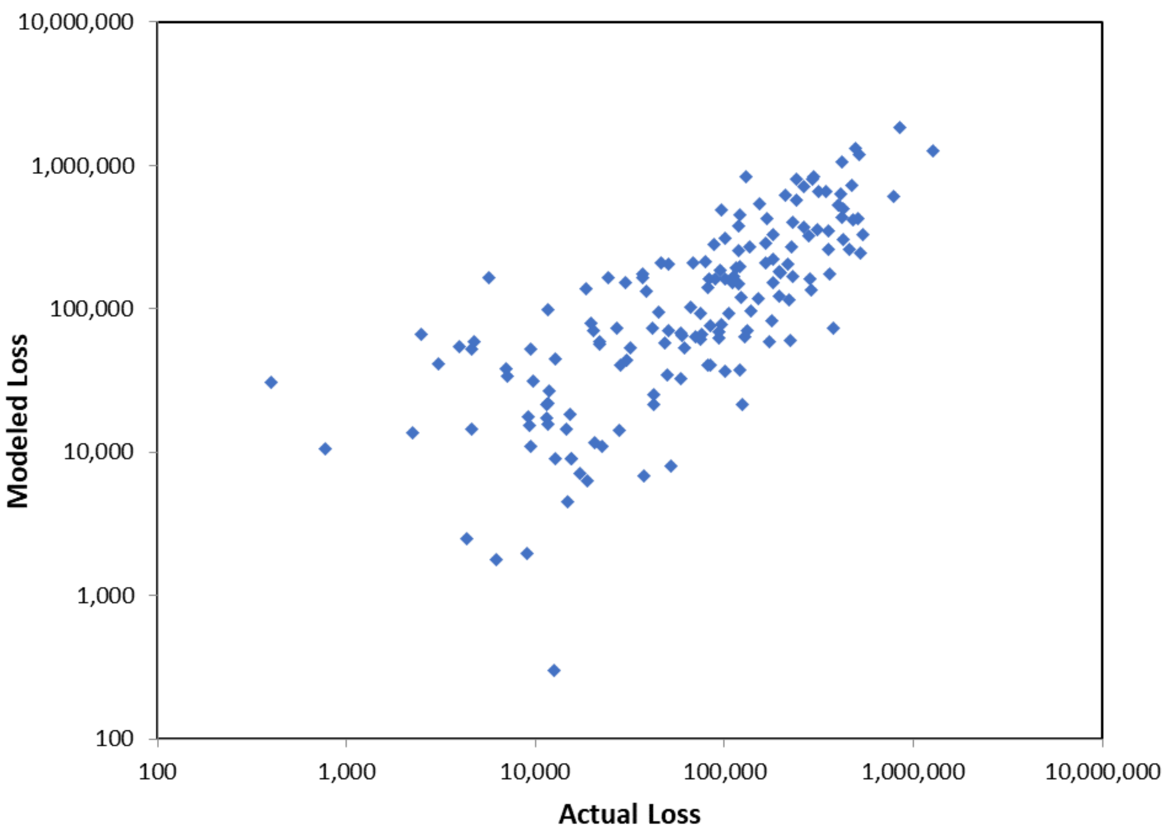
Hurricane = Irma (2017)

Exposure = Single-Family Residential – Total exposure (modeled and actual losses include demand surge)

Table 30: Example A6 Portfolio Comparison of Modeled and Actual Hurricane Loss

Construction	Company Actual Hurricane Loss / Exposure	Modeled Hurricane Loss / Exposure	Difference
Wood	0.25%	0.36%	-0.11%

Figure 65: Example A6 comparison of modeled and actual hurricane losses by ZIP Code



Example B1: Comparison of a Company's Commercial Residential Modeled and Actual Hurricane Loss as a Percent of Total Exposure

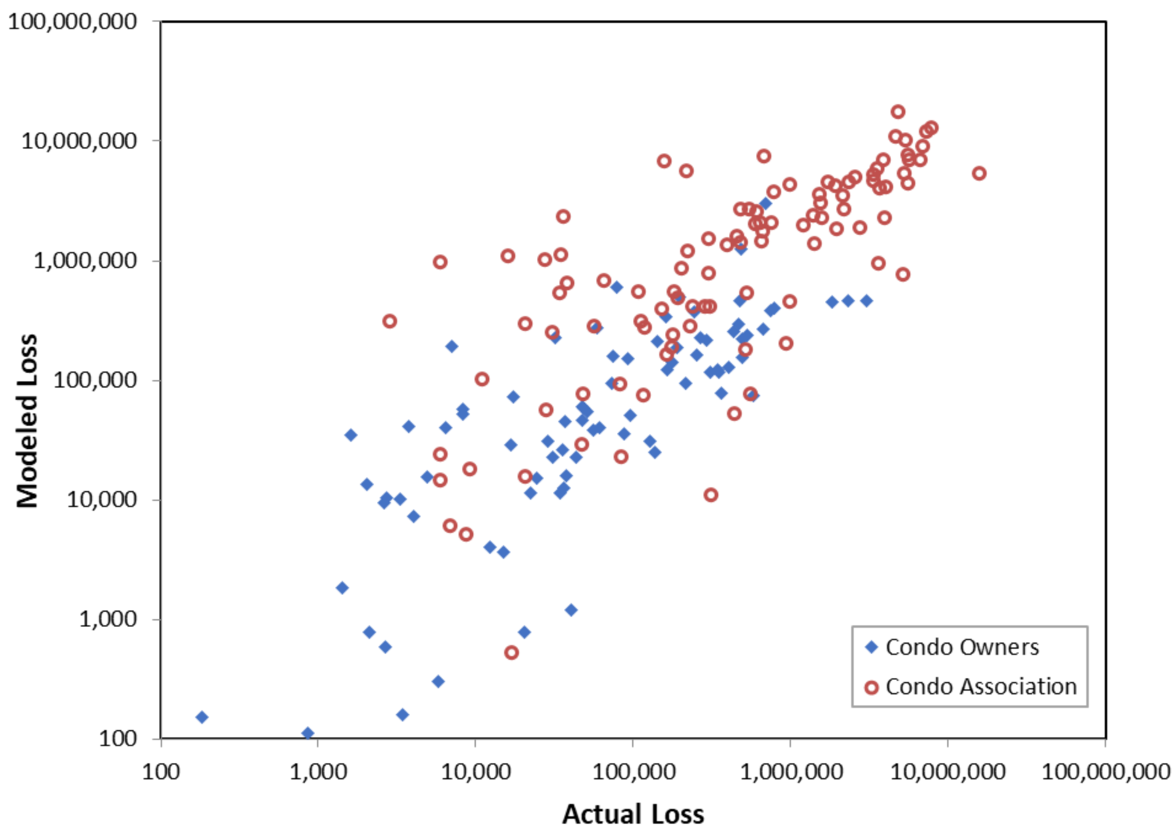
Hurricane = Wilma (2005)

Exposure = Condominium – Total exposure (modeled and actual losses include demand surge)

Table 31: Example B1 portfolio comparison of modeled and actual hurricane loss

Line of Business	Company Actual Hurricane Loss / Exposure	Modeled Hurricane Loss / Exposure	Difference
Condo Unit Owner	0.57%	0.44%	0.13%
Condo Association	1.13%	1.82%	-0.68%
Total	1.02%	1.54%	-0.52%

Figure 66: Example B1 comparison of modeled and actual hurricane losses by ZIP Code



Form S-5: Average Annual Zero Deductible Statewide Hurricane Loss Costs – Historical versus Modeled

A. Provide the average annual zero deductible statewide personal and commercial residential hurricane loss costs produced using the list of hurricanes in the Base Hurricane Storm Set as defined in Hurricane Standard M-1, Base Hurricane Storm Set, based on the 2017 Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data found in the file named "hlpm2017c.zip."

Average Annual Zero Deductible Statewide Personal and Commercial Residential Hurricane Loss Costs

Table 32: Average annual zero deductible statewide personal and commercial residential hurricane loss costs produced by RiskLink 23.0 and Risk Modeler 2.27.0 (2017 FHCF exposure data)

Time Period	Historical Hurricanes	Produced by Hurricane Model
Current Submission	$2.98	$3.97
Currently Accepted Hurricane Model* (2019 Hurricane Standards)	$3.27	$4.46
Percent Change Current Submission/ Currently Accepted Hurricane Model*	-8.82%	-10.93%
Second Previously-Accepted Hurricane Model* (2017 Hurricane Standards)	$2.58	$3.47
Percent Change Current Submission/Second Previously Accepted Hurricane Model*	15.44%	14.43%

*NA if no current or previously-accepted hurricane model

B. Provide a comparison with the statewide personal and commercial residential hurricane loss costs produced by the hurricane model on an average industry basis.

The Moody's RMS hurricane model calculated historical annual average zero deductible loss for the 2017 Florida Hurricane Catastrophe Funds' (FHCF) personal and commercial residential aggregate exposure database is $2.98 billion per year. The Moody's RMS hurricane model simulated annual average zero deductible loss for the same exposure database is $3.97 billion per year.

C. Provide the 95% confidence interval on the differences between the means of the historical and modeled personal and commercial residential hurricane loss costs.

The 95% confidence interval on the difference between the mean of the historical and the modeled loss is -$2.7 billion to +$700 million.

D. If the data are partitioned or modified, provide the average annual zero deductible statewide personal and commercial residential hurricane 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 hurricane loss costs in additional copies of Form S-5, Average Annual Zero Deductible Statewide Hurricane Loss Costs – Historical versus Modeled.

The data has not been partitioned or modified.

E. Include Form S-5, Average Annual Zero Deductible Statewide Hurricane 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.

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 "FormV1Input21.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 building and contents damage ratios and time element loss 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 hurricane loss to all structures in the ZIP Codes subjected to that individual windspeed range, excluding demand surge and flood (including hurricane 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 hurricane 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 flood (including hurricane storm surge). Subject Exposure is all exposures of that specific construction type in all of the ZIP Codes.

One reference structure for each of the construction types is to be placed at the population centroid of the ZIP Codes. Do not include appurtenant structure, contents, or time element coverages in the building damage ratios. Do not include building, appurtenant structure, or time element coverages in the contents damage ratios. Do not include building, appurtenant structure, or contents coverages in the time element loss ratios.

Reference Frame Structure: *One story* *Unbraced gable end roof* *ASTM D3161 Class D or ASTM D7158 Class D 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 D or ASTM D7158 Class D 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, one-minute sustained 10-meter)	Estimated Building Damage/Subject Building Exposure	Estimated Contents Damage/Subject Contents Exposure	Estimated Time Element Loss/ Subject Time Element Exposure
41 – 50	0.13%	0.02%	0.00%
51 – 60	0.32%	0.05%	0.01%
61 – 70	1.39%	0.26%	0.08%
71 – 80	3.07%	0.66%	0.29%
81 – 90	6.46%	1.65%	0.83%
91 – 100	13.27%	4.09%	2.45%
101 – 110	23.46%	9.16%	6.60%
111 – 120	44.97%	26.89%	26.68%
121 – 130	58.10%	42.23%	43.88%
131 – 140	77.30%	68.76%	58.03%
141 – 150	86.27%	85.69%	68.04%
151 – 160	90.02%	90.69%	72.50%
161 – 170	93.86%	95.83%	75.40%

Part B

Table 34: Damage ratios summarized by construction type

Construction Type	Estimated Building Damage/Subject Building Exposure	Estimated Contents Damage/Subject Contents Exposure	Estimated Time Element Loss/ Subject Time Element Exposure
Wood Frame	35.78%	31.49%	26.62%
Masonry	34.48%	30.18%	25.69%
Manufactured Home	36.07%	33.16%	25.65%
Concrete	20.72%	19.77%	14.48%

C. Provide separate plots of the Estimated Damage/Subject Exposure (y-axis) versus Windspeed (x-axis) for the Building, Contents, and Time Element data in Part A.

Figure 67: Ratio of estimated building damage and subject exposure versus 1-minute wind speed

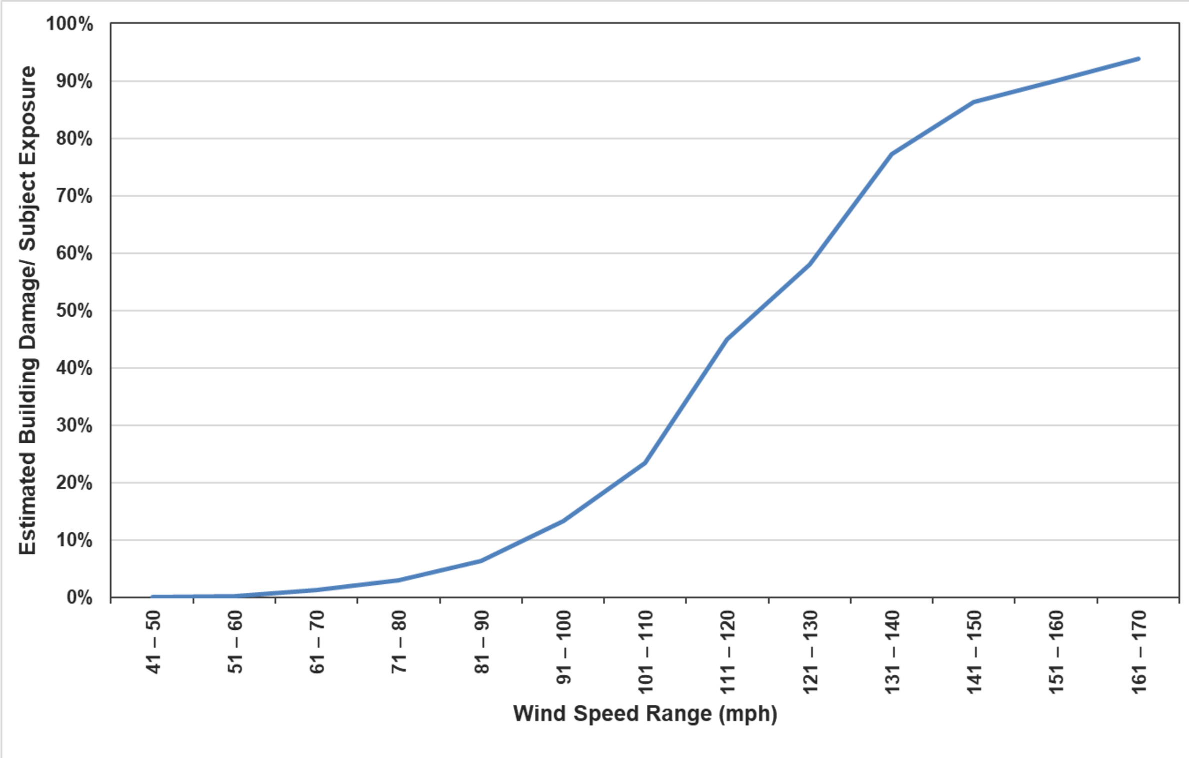


Figure 68: Ratio of estimated contents damage and subject exposure versus 1-minute wind speed

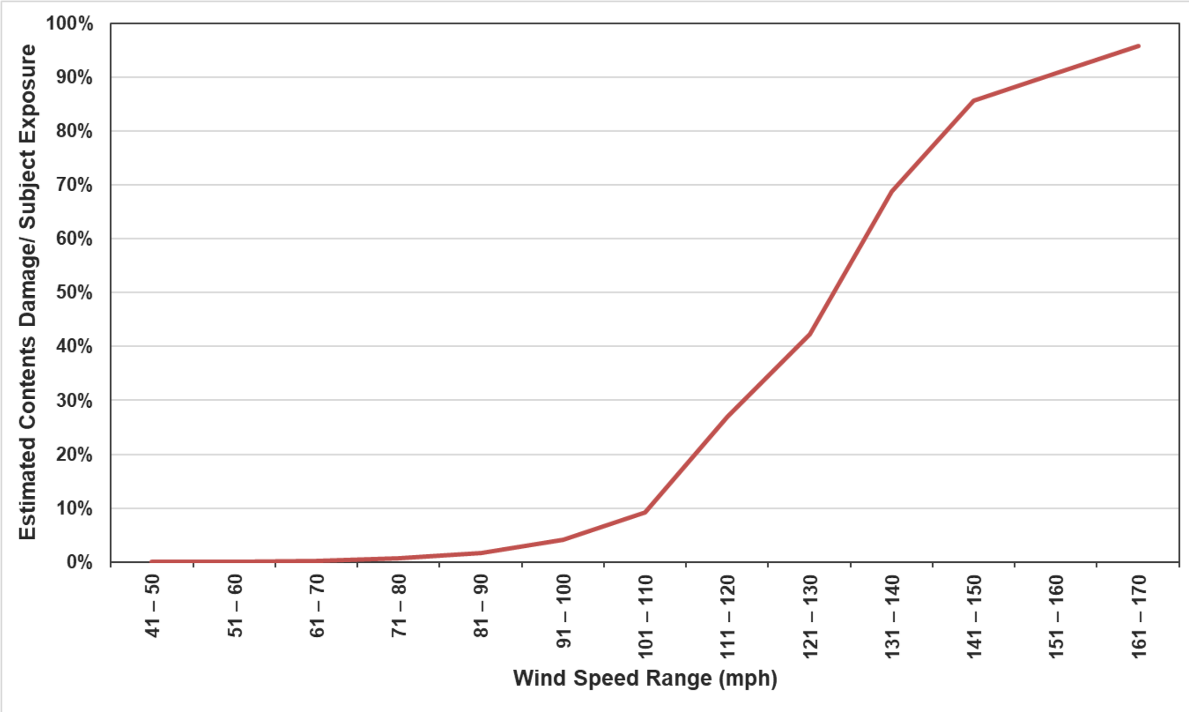
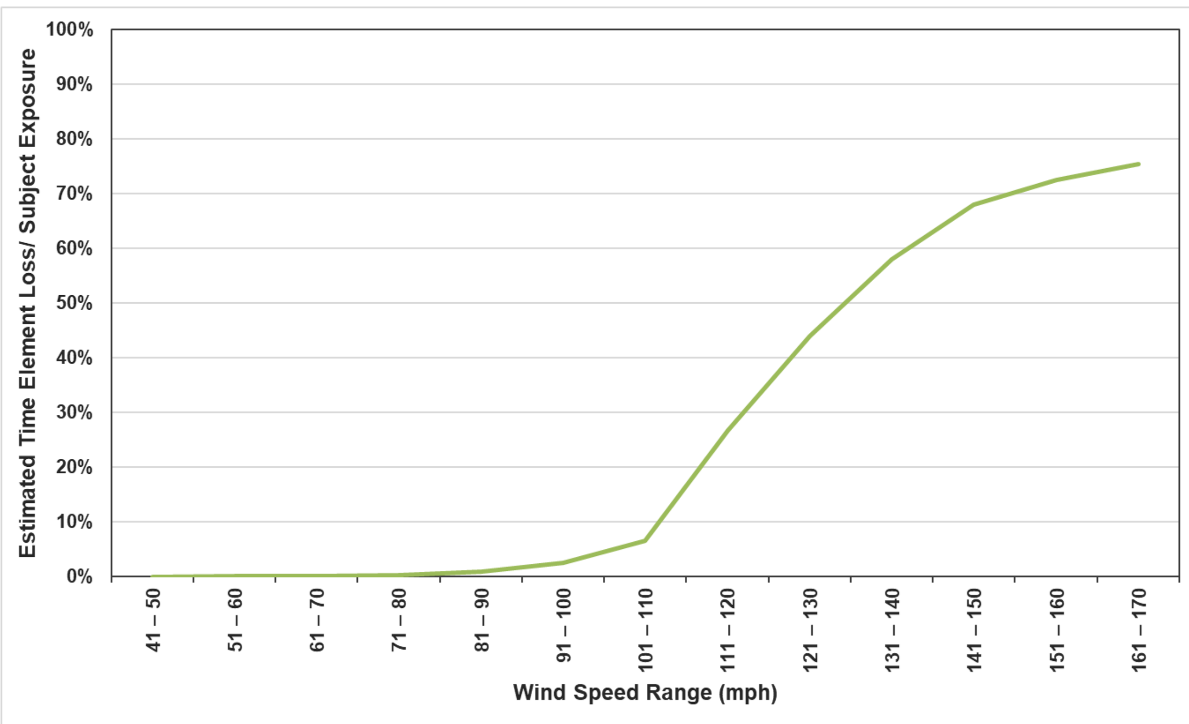


Figure 69: Ratio of estimated time element loss and subject exposure versus 1-minute wind speed



D. Include Form V-1, One Hypothetical Event, in a submission appendix.

Form V-2: Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage

A. Explain how the hurricane vulnerability functions for the two reference structures are developed. Demonstrate that the hurricane vulnerability function for each reference structure is related to one of the hurricane model's standard building structure vulnerability functions for frame and masonry constructions.

The vulnerability functions for the two reference structures are developed with the same methodology used for other structures in the model. This methodology is detailed in Disclosure V-1.5. The fact that the hurricane vulnerability function for each reference structure is related to one of the hurricane model's standard building structure vulnerability functions for frame and masonry constructions can be demonstrated at the on-site audit if necessary.

B. Provide the change in the zero deductible personal residential reference building structure damage ratio (not hurricane loss cost) for each individual hurricane mitigation measure and secondary characteristic listed in Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage, as well as for the combination of the four hurricane mitigation measures and secondary characteristics provided for the Mitigated Frame Building and the Mitigated Masonry Building below.

C. If additional assumptions are necessary to complete this form (for example, regarding duration or surface roughness), provide the rationale for the assumptions as well as a detailed description of how they are included.

D. Provide an explanation for cells filled with "0" or blank cells.

Mitigation measures in the form are captured via secondary modifiers. As described in Disclosure V-4.7, The amount of increase or decrease in building damage for each modifier option varies by wind speed and building attributes. For some combinations of building attribute and wind speed, secondary modifiers do not increase or decrease the base vulnerability functions at all, hence the presence of some cells filled with a 0 in the form.

E. Provide this form in Excel format without truncation. The file name should include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage, in a submission appendix.

F. Place the reference building at the population centroid for ZIP Code 33921 in Lee County.

Reference Frame Building:	***Reference Masonry Building:***
One story *Unbraced gable end roof* *ASTM D3161 Class D or* *ASTM D7158 Class D 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*	*One story* *Unbraced gable end roof* *ASTM D3161 Class D or* *ASTM D7158 Class D 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*

No skylight covers *Constructed in 1995*	*Constructed in 1995*
<u>Mitigated Frame Building</u>: *ASTM D7158 Class H shingles* *8d nails deck to roof members* *Truss straps at roof* *Structural wood panel shutters*	***<u>Mitigated Masonry Building:</u>*** *ASTM D7158 Class H shingles* *8d nails deck to roof members* *Truss straps at roof* *Structural wood panel shutters*

The required information is provided in the file RMS21FormV2.xlsx at the link provided to the FCHLPM and appears below.

To prepare this form, Moody's RMS has used the following gust wind speeds in its models for each of the requested 1-minute wind speeds in this form: (shown as 1-minute wind speed -> 3-sec gust) 60 -> 75; 85 -> 105; 110 -> 135; 135 -> 165; 160 -> 195.

Figure 70: Percent change in damage for various hurricane mitigation measures and secondary characteristics (RiskLink 23.0)

INDIVIDUAL HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS			PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) * 100									
			FRAME BUILDING					MASONRY BUILDING				
			WINDSPEED (MPH)*					WINDSPEED (MPH)*				
			60	85	110	135	160	60	85	110	135	160
	Reference Building											
Roof Strength	Braced Gable		1.8%	0.0%	0.9%	0.0%	0.0%	1.8%	0.0%	0.9%	0.0%	0.0%
	Hip		30.9%	39.4%	36.9%	16.2%	0.0%	30.9%	39.4%	36.9%	16.2%	0.0%
Roof Covering	Metal		21.2%	13.1%	10.9%	0.0%	0.0%	21.2%	13.1%	10.9%	0.0%	0.0%
	ASTM D7158 Class H Shingles		37.4%	20.3%	2.0%	0.0%	0.0%	37.4%	20.3%	2.0%	0.0%	0.0%
	Membrane		17.3%	6.0%	4.0%	0.0%	0.0%	17.3%	6.0%	4.0%	0.0%	0.0%
	Nailing of Deck	8d Nails	22.5%	53.9%	44.4%	17.0%	7.5%	22.5%	53.9%	44.4%	17.0%	7.5%
Roof-Wall Strength	Clips		13.0%	21.0%	23.3%	20.0%	16.7%	13.0%	21.0%	23.3%	20.0%	16.7%
	Straps		17.4%	43.4%	43.3%	29.6%	16.7%	17.4%	43.4%	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	Larger Anchor 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%	9.6%	25.9%	15.1%	0.0%	2.0%	9.6%	25.9%	15.1%	0.0%
		Metal	5.9%	20.5%	39.8%	19.8%	0.0%	5.9%	20.5%	39.8%	19.8%	0.0%
	Door and Skylight Cover		21.6%	35.4%	44.4%	24.5%	0.0%	21.6%	35.4%	44.4%	24.5%	0.0%
Window, Door, Skylight Strength	Windows	Impact Rated	11.8%	28.5%	44.4%	24.5%	0.0%	11.8%	28.5%	44.4%	24.5%	0.0%
	Entry Doors	Meets Windborne Debris Requirements	2.0%	6.6%	16.7%	8.5%	0.0%	2.0%	6.6%	16.7%	8.5%	0.0%
	Garage Doors		2.0%	6.6%	16.7%	8.5%	0.0%	2.0%	6.6%	16.7%	8.5%	0.0%
	Sliding Glass Doors		2.0%	4.7%	21.3%	10.4%	0.0%	2.0%	4.7%	21.3%	10.4%	0.0%
	Skylight	Impact Rated	2.0%	4.7%	21.3%	10.4%	0.0%	2.0%	4.7%	21.3%	10.4%	0.0%

HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS IN COMBINATION		PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) * 100									
		FRAME BUILDING					MASONRY BUILDING				
		WINDSPEED (MPH)*					WINDSPEED (MPH)*				
		60	85	110	135	160	60	85	110	135	160
Building	Mitigated Building	60.7%	83.9%	77.1%	50.4%	23.0%	60.7%	83.9%	77.1%	50.4%	23.0%

**Windspeeds are one-minute sustained 10-meter.*

Figure 71: Percent change in damage for various hurricane mitigation measures and secondary characteristics (Risk Modeler 2.27.0)

INDIVIDUAL HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS			PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) * 100									
			FRAME BUILDING					MASONRY BUILDING				
			WINDSPEED (MPH)*					WINDSPEED (MPH)*				
			60	85	110	135	160	60	85	110	135	160
	Reference Building											
Roof Strength	Braced Gable		1.8%	0.0%	0.9%	0.0%	0.0%	1.8%	0.0%	0.9%	0.0%	0.0%
	Hip		30.9%	39.4%	36.9%	16.2%	0.0%	30.9%	39.4%	36.9%	16.2%	0.0%
Roof Covering	Metal		21.2%	13.1%	10.9%	0.0%	0.0%	21.2%	13.1%	10.9%	0.0%	0.0%
	ASTM D7158 Class H Shingles		37.4%	20.3%	2.0%	0.0%	0.0%	37.4%	20.3%	2.0%	0.0%	0.0%
	Membrane		17.3%	6.0%	4.0%	0.0%	0.0%	17.3%	6.0%	4.0%	0.0%	0.0%
	Nailing of Deck	8d Nails	22.5%	53.9%	44.4%	17.0%	7.5%	22.5%	53.9%	44.4%	17.0%	7.5%
Roof-Wall Strength	Clips		13.0%	21.0%	23.3%	20.0%	16.7%	13.0%	21.0%	23.3%	20.0%	16.7%
	Straps		17.4%	43.4%	43.3%	29.6%	16.7%	17.4%	43.4%	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	Larger Anchor 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%	9.6%	25.9%	15.1%	0.0%	2.0%	9.6%	25.9%	15.1%	0.0%
		Metal	5.9%	20.5%	39.8%	19.8%	0.0%	5.9%	20.5%	39.8%	19.8%	0.0%
	Door and Skylight Cover		21.6%	35.4%	44.4%	24.5%	0.0%	21.6%	35.4%	44.4%	24.5%	0.0%
Window, Door, Skylight Strength	Windows	Impact Rated	11.8%	28.5%	44.4%	24.5%	0.0%	11.8%	28.5%	44.4%	24.5%	0.0%
	Entry Doors	Meets Windborne Debris Requirements	2.0%	6.6%	16.7%	8.5%	0.0%	2.0%	6.6%	16.7%	8.5%	0.0%
	Garage Doors		2.0%	6.6%	16.7%	8.5%	0.0%	2.0%	6.6%	16.7%	8.5%	0.0%
	Sliding Glass Doors		2.0%	4.7%	21.3%	10.4%	0.0%	2.0%	4.7%	21.3%	10.4%	0.0%
	Skylight	Impact Rated	2.0%	4.7%	21.3%	10.4%	0.0%	2.0%	4.7%	21.3%	10.4%	0.0%

HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS IN COMBINATION		PERCENTAGE CHANGES IN DAMAGE ((REFERENCE DAMAGE RATIO - MITIGATED DAMAGE RATIO) / REFERENCE DAMAGE RATIO) * 100									
		FRAME BUILDING					MASONRY BUILDING				
		WINDSPEED (MPH)*					WINDSPEED (MPH)*				
		60	85	110	135	160	60	85	110	135	160
Building	Mitigated Building	60.7%	83.9%	77.1%	50.4%	23.0%	60.7%	83.9%	77.1%	50.4%	23.0%

**Windspeeds are one-minute sustained 10-meter.*

Form V-3: Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane 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 V-4: Differences in Hurricane Mitigation Measures and Secondary Characteristics

A. Provide the differences between the values reported in Form V-2, Hurricane Mitigation Measures and Secondary Characteristics, Range of Changes in Damage, relative to the equivalent data compiled from the currently-accepted hurricane model.

See Figure 72 below.

B. Provide a list and describe any assumptions made to complete this form.

No assumptions were necessary.

C. Provide a summary description of the differences.

The differences shown in Form V-4 are due to the updates to the vulnerability curves and damage ratios being capped at 100% at 160 mph when the mitigation and secondary characteristics are applied as well as updates to the credits and penalties associated with the Roof Age secondary modifier.

D. Provide this form in Excel format without truncation. The file name should include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include Form V-4, Differences in Hurricane Mitigation Measures and Secondary Characteristics, in a submission appendix.

The required information is provided in the file RMS21FormV4.xlsx at the link provided to the FCHLPM and appears below.

Figure 72: Differences between values reported in Form V-2 relative to the equivalent data compiled from the currently-accepted hurricane model

INDIVIDUAL HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS			DIFFERENCES FROM FORM V-2 RELATIVE TO PREVIOUSLY-ACCEPTED HURRICANE MODEL									
			FRAME BUILDING					MASONRY BUILDING				
			WINDSPEED (MPH)*					WINDSPEED (MPH)*				
			60	85	110	135	160	60	85	110	135	160
	Reference Building											
Roof Strength	Braced Gable		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Hip		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Roof Covering	Metal		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	ASTM D7158 Class H Shingles		-11.0%	-7.7%	-4.9%	0.0%	0.0%	-11.0%	-7.7%	-4.9%	0.0%	0.0%
	Membrane		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Nailing of Deck	8d Nails	0.0%	0.0%	0.0%	0.0%	3.5%	0.0%	0.0%	0.0%	0.0%	0.0%
Roof-Wall Strength	Clips		0.0%	0.0%	0.0%	0.0%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	Straps		0.0%	0.0%	0.0%	0.0%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Wall-Floor Strength	Ties or Clips		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Straps		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wall-Foundation Strength	Larger Anchor or Closer Spacing		0.0%	0.0%	0.0%	0.0%	0.0%					
	Straps		0.0%	0.0%	0.0%	0.0%	0.0%					
	Vertical Reinforcing							0.0%	0.0%	0.0%	0.0%	0.0%
Opening Protection	Window Shutters	Structural Wood Panel	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		Metal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Door and Skylight Cover		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Window, Door, Skylight Strength	Windows	Impact Rated	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Entry Doors	Meets Windborne Debris Requirements	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Garage Doors		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sliding Glass Doors		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Skylight	Impact Rated	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

HURRICANE MITIGATION MEASURES AND SECONDARY CHARACTERISTICS IN COMBINATION		DIFFERENCES FROM FORM V-2 RELATIVE TO PREVIOUSLY-ACCEPTED HURRICANE MODEL									
		FRAME BUILDING					MASONRY BUILDING				
		WINDSPEED (MPH)*					WINDSPEED (MPH)*				
		60	85	110	135	160	60	85	110	135	160
Building	Mitigated Building	-6.9%	-1.6%	-1.1%	0.0%	2.9%	-6.9%	-1.6%	-1.1%	0.0%	0.0%

**Windspeeds are one-minute sustained 10-meter.*

Form V-5: Differences in Hurricane Mitigation Measures and Secondary Characteristics, Mean Damage Ratios and Hurricane 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 Hurricane Loss Costs by ZIP Code

A. Provide three maps, color-coded by ZIP Code (with a minimum of seven value ranges), displaying zero deductible personal residential hurricane loss costs per $1,000 of exposure for frame owners, masonry owners, and manufactured homes.

B. Create exposure sets for these exhibits by modeling the frame and masonry buildings and manufactured homes from Notional Set 3 described in the file "NotionalInput21.xlsx" geocoded to each ZIP Code centroid in the state, as provided in the hurricane model. Provide the predominant County name and the Federal Information Processing Standards (FIPS) code (Figure 12) associated with each ZIP Code centroid. Refer to the Notional Hurricane Policy Specifications below for additional modeling information. Explain any assumptions, deviations, and differences from the prescribed exposure information.

C. Describe how Law and Ordinance is included in the hurricane loss cost data.

The impacts of law and ordinance coverage, such as the roof replacement rule in the Florida Building Code, is implicitly included in the base vulnerability functions for personal residential properties. In addition, the impact of the statutory required 25 percent and 50 percent coverage options for personal residential properties is factored into the post-event loss amplification (PLA).

D. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

No additional assumption was necessary to complete this form.

E. Provide, in the format given in the file named "2021FormA1.xlsx" in both Excel and PDF format, the underlying hurricane loss cost data, rounded to three decimal places, used for A. above. The file name should include the abbreviated name of the modeling organization, the hurricane standards year, and the form name.

This information is provided in Excel format in the file RMS21FormA1.xlsx and in PDF format in the file RMS21FormA1.pdf at the link provided to the FCHLPM. The three maps color-coded by ZIP Code appear below.

Notional Hurricane Policy Specifications

Policy Type ***Assumptions***

Owners ***Coverage A = Building***
- *Replacement Cost included subject to Coverage A limit*
- *Law and Ordinance included*

Coverage B = Appurtenant Structure
- *Replacement Cost included subject to Coverage B limit*
- *Law and Ordinance included*

Coverage C = Contents
- *Replacement Cost included subject to Coverage C limit*

Coverage D = Time Element
- *Time limit = 12 months*
- *Per diem = $300.00/day per policy, if used*

  ✧ *Hurricane loss costs per $1,000 should be related to the Coverage A limit*

Manufactured Homes ***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 = $300.00/day per policy, if used*

    ✧ *Hurricane loss costs per $1,000 should be related to the Coverage A limit*

Figure 73: Zero deductible hurricane loss costs by 5-digit ZIP Code for frame

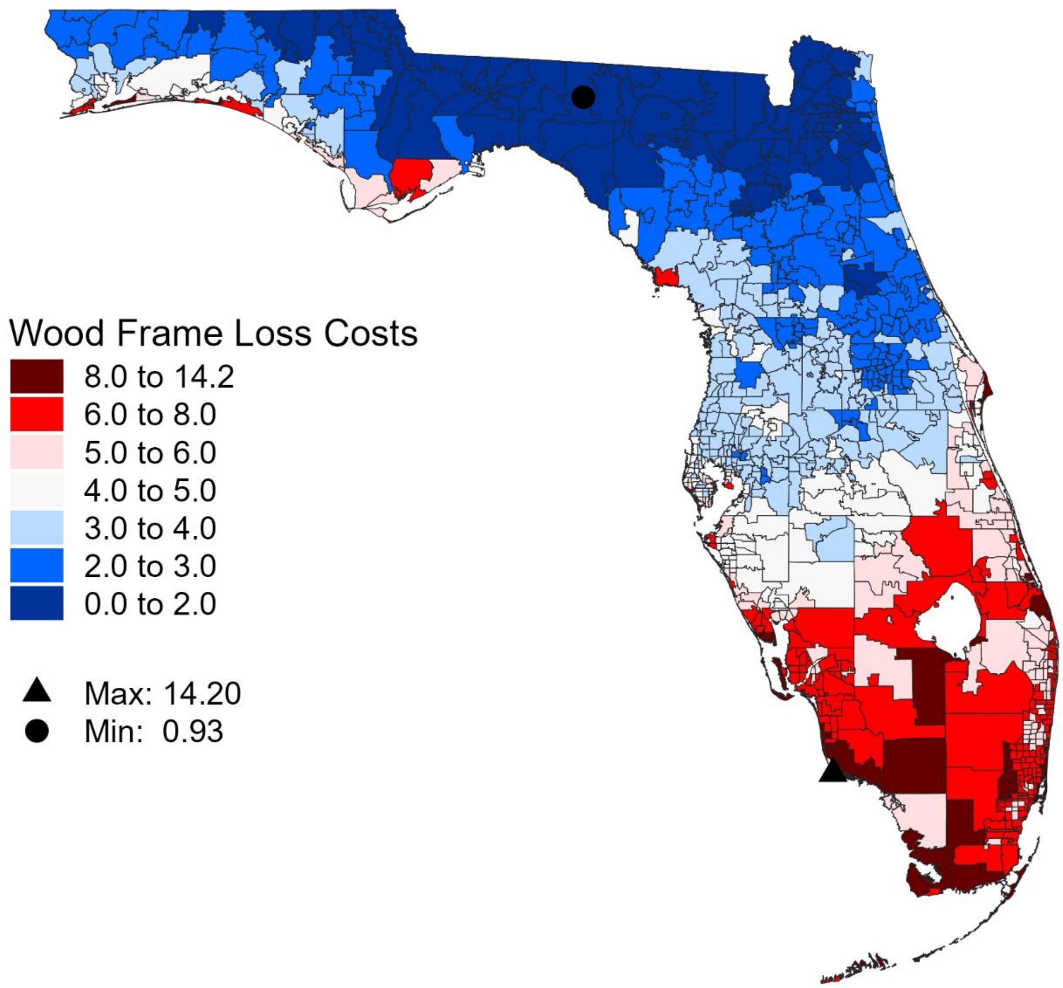


Figure 74: Zero deductible hurricane loss costs by 5-digit ZIP Code for masonry

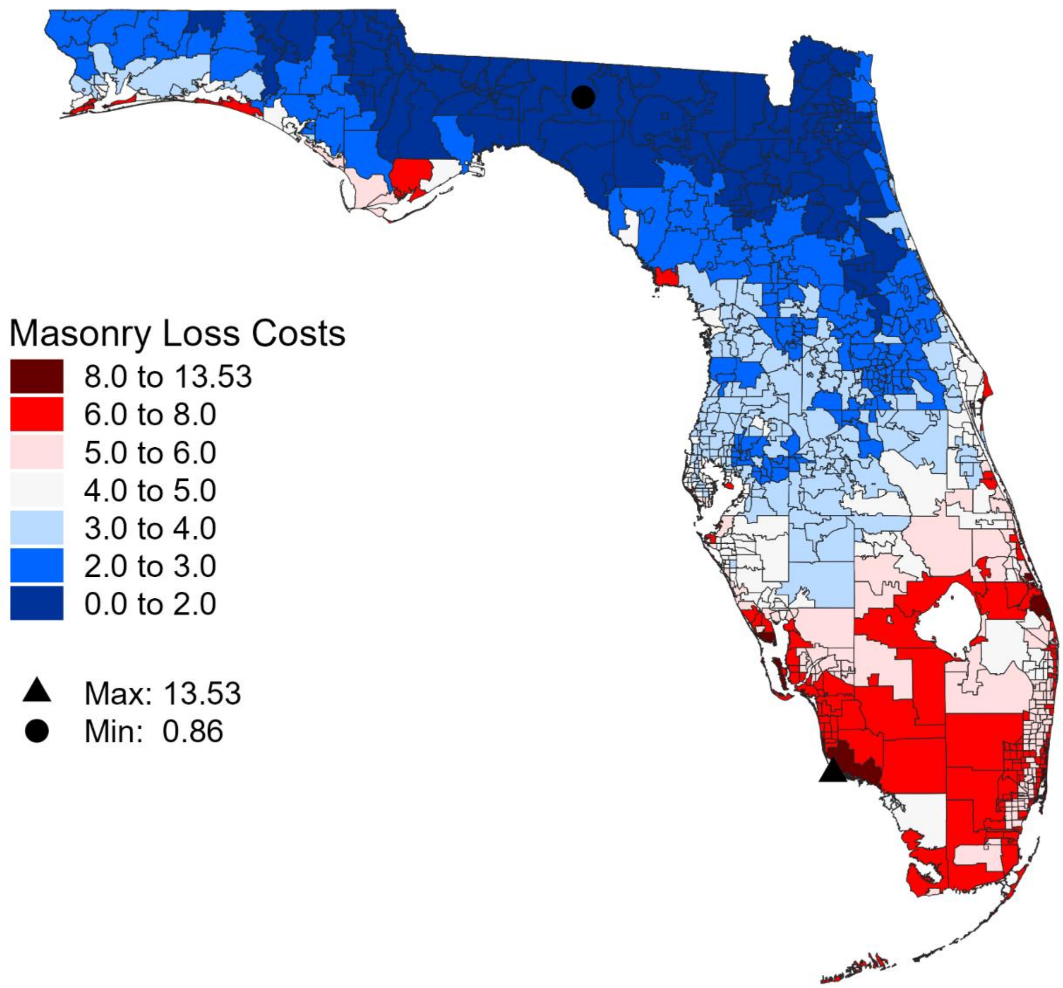
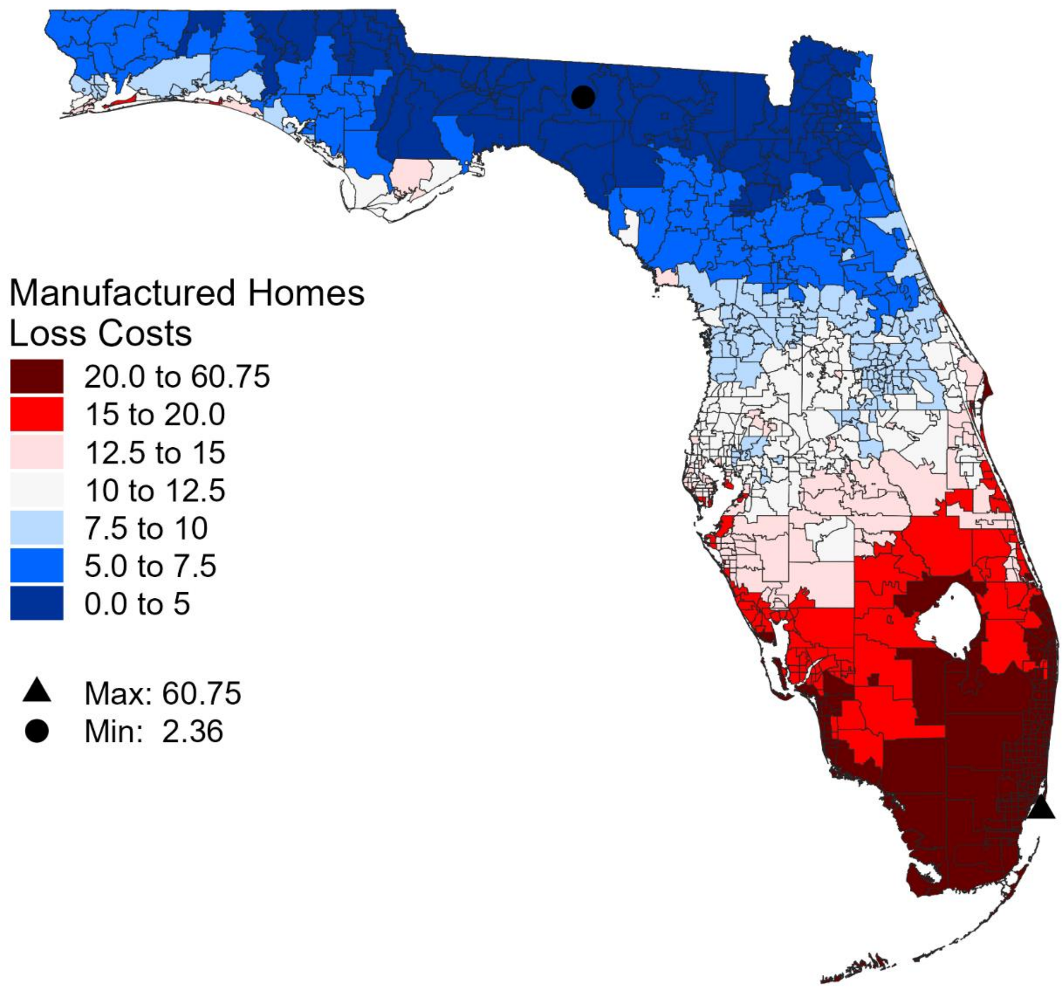


Figure 75: Zero deductible hurricane loss costs by 5-digit ZIP Code for manufactured home



Form A-2: Base Hurricane Storm Set Statewide Hurricane Losses

A. Provide the total insured hurricane loss assuming zero deductible policies for individual historical hurricanes using the Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data found in the file named "hlpm2017c.zip." The list of hurricanes in this form should include all Florida and by-passing hurricanes in the modeling organization Base Hurricane Storm Set, as defined in Hurricane Standard M-1, Base Hurricane Storm Set.

The table below contains the hurricanes from HURDAT2 based on the 121-year period 1900-2020. As defined in Hurricane Standard M-1, Base Hurricane Storm Set, the modeling organization's Base Hurricane Storm Set may exclude hurricanes that had zero modeled impact, or it may include additional hurricanes when there is clear justification for the additions. The modeling organization should populate the table with its own version of the Base Hurricane Storm Set, including any justified modifications. Each hurricane has been assigned an ID number. For hurricanes resulting in zero loss, the table entry should be left blank. Additional hurricanes included in the hurricane model Base Hurricane Storm Set should be added to the table in order of year and assigned an intermediate ID number within the bounding ID numbers.

As defined, a by-passing hurricane (ByP) is a hurricane which does not make landfall on Florida, but produces minimum damaging windspeeds or greater on Florida. For the by-passing hurricanes included in the table only, the hurricane intensity entered is the maximum windspeed at closest approach to Florida as a hurricane, not the windspeed over Florida.

B. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

No additional assumption was necessary to complete this form.

C. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include Form A-2, Base Hurricane Storm Set Statewide Hurricane 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 2017 FHCF aggregate exposure data in the file RMS21FormA2.xlsx at the link provided to the FCHLPM and appears below.

Table 35: Base hurricane storm set average annual zero deductible – statewide hurricane loss costs

ID	Hurricane Landfall/ Closest Approach Date	Year	Name	Region as defined in Figure 1-Category	Personal and Commercial Residential Insured Hurricane Losses ($)
001	9/6/1900	1900	NotNamed-1900	ByP-1	68,616,684
005	8/15/1901	1901	NoName04-1901	F-1/ByP-1	36,558,299
010	9/11/1903	1903	NoName03-1903	C-1/A-1	1,305,200,004
015	10/17/1904	1904	NoName04-1904	C-1	583,578,772
020	6/17/1906	1906	NoName02-1906	B-1/C-1	233,812,764
025	9/27/1906	1906	NoName06-1906	F-2/ByP-2	2,833,723,151
030	10/18/1906	1906	NoName08-1906	B-3/C-3	6,111,609,756
035	10/11/1909	1909	NoName11-1909	B-3	104,582,039
040	10/18/1910	1910	NoName05-1910	B-2	13,989,221,494

ID	Hurricane Landfall/ Closest Approach Date	Year	Name	Region as defined in Figure 1-Category	Personal and Commercial Residential Insured Hurricane Losses ($)
045	8/11/1911	1911	NoName02-1911	A-1	114,995,268
046	8/29/1911	1911	NotNamed-1911	ByP-2	33,114,387
050	9/14/1912	1912	NoName04-1912	F-1/ByP-1	87,914,945
055	8/1/1915	1915	NoName01-1915	D-1	379,098,993
056	8/16/1915	1915	NotNamed-1915	ByP-4	20,114,848
060	9/4/1915	1915	NoName04-1915	A-1	95,498,457
065	7/5/1916	1916	NoName02-1916	F-3/ByP-3	472,221,590
070	10/18/1916	1916	NoName14-1916	A-2	1,213,384,911
075	9/29/1917	1917	NoName04-1917	A-3	2,049,783,611
080	9/10/1919	1919	NoName02-1919	B-4	1,339,466
085	10/25/1921	1921	TampaBay06-1921	B-3	8,582,869,552
086	10/17/1923	1923	NotNamed-1923	ByP-1	30,714,133
090	9/15/1924	1924	NoName05-1924	A-1	74,923,978
095	10/21/1924	1924	NoName10-1924	B-1	780,094,293
100	7/28/1926	1926	NoName01-1926	D-2	2,610,014,148
105	9/18/1926	1926	GreatMiami07-1926	C-4/A-3	62,160,354,949
110	10/21/1926	1926	NoName10-1926	ByP-3	450,107,757
115	8/8/1928	1928	NoName01-1928	C-2	1,866,936,961
120	9/17/1928	1928	LakeOkeechobee04 -1928	C-4	45,185,399,440
125	9/28/1929	1929	NoName02-1929	C-3/A-1	1,593,595,380
130	9/1/1932	1932	NoName03-1932	F-1/ByP-1	136,652,435
135	7/30/1933	1933	NoName05-1933	C-1	200,823,322
140	9/4/1933	1933	NoName11-1933	C-3	4,897,144,759
141	10/6/1933	1933	NotNamed-1933	ByP-2	26,952,775
145	9/3/1935	1935	LaborDay03-1935	C-5/A-2	25,199,048,784
146	9/29/1935	1935	NotNamed-1935	ByP-4	427,743,989
150	11/4/1935	1935	NoName07-1935	C-2	1,708,270,782
155	7/31/1936	1936	NoName05-1936	A-2	697,183,360
160	8/11/1939	1939	NoName02-1939	C-1/A-1	398,693,496
165	10/6/1941	1941	NoName05-1941	C-2/A-1	2,907,988,844
170	10/19/1944	1944	NoName13-1944	B-3	18,627,219,404
175	6/24/1945	1945	NoName01-1945	A-1	336,628,999
180	9/15/1945	1945	NoName09-1945	C-4	8,832,141,335
185	10/8/1946	1946	NoName06-1946	B-1	1,953,087,027
190	9/17/1947	1947	NoName04-1947	C-4	12,125,098,418
195	10/12/1947	1947	NoName09-1947	B-1/E-2	719,958,417

ID	Hurricane Landfall/ Closest Approach Date	Year	Name	Region as defined in Figure 1-Category	Personal and Commercial Residential Insured Hurricane Losses ($)
200	9/22/1948	1948	NoName08-1948	B-4	2,873,177,206
205	10/5/1948	1948	NoName09-1948	B-2	650,142,154
210	8/26/1949	1949	NoName02-1949	C-4	13,220,810,332
215	8/31/1950	1950	Baker-1950	F-1/ByP-1	80,520,473
220	9/5/1950	1950	Easy-1950	A-3	1,133,946,355
225	10/18/1950	1950	King-1950	C-4	6,863,149,473
230	9/26/1953	1953	Florence-1953	A-1	379,306,606
235	10/9/1953	1953	Hazel-1953	B-1	217,844,594
240	9/25/1956	1956	Flossy-1956	A-1	410,330,985
245	9/10/1960	1960	Donna-1960	B-4	9,628,320,750
250	9/15/1960	1960	Ethel-1960	F-1	
255	8/27/1964	1964	Cleo-1964	C-2	5,195,662,761
260	9/10/1964	1964	Dora-1964	D-2	833,844,032
261	10/3/1964	1964	Hilda-1964	ByP-2	2,236,380
265	10/14/1964	1964	Isbell-1964	B-2	270,898,046
270	9/8/1965	1965	Betsy-1965	C-3	2,055,687,789
275	6/9/1966	1966	Alma-1966	A-1	741,014,150
280	10/4/1966	1966	Inez-1966	C-1	107,801,030
281	6/6/1968	1968	Abby-1968	ByP-1	70,174,895
285	10/19/1968	1968	Gladys-1968	A-1	286,619,585
290	8/18/1969	1969	Camille-1969	F-5	
295	6/19/1972	1972	Agnes-1972	A-1	3,842,660
300	9/23/1975	1975	Eloise-1975	A-3	1,433,360,140
305	9/4/1979	1979	David-1979	C-2/E-2	497,484,962
310	9/13/1979	1979	Frederic-1979	F-3/ByP-4	388,371,740
315	9/2/1985	1985	Elena-1985	F-3/ByP-3	577,212,522
320	11/21/1985	1985	Kate-1985	A-2	230,060,385
325	10/12/1987	1987	Floyd-1987	B-1	15,292,438
330	8/24/1992	1992	Andrew-1992	C-5	31,829,870,536
335	8/3/1995	1995	Erin-1995	C-1/A-1	770,167,403
340	10/4/1995	1995	Opal-1995	A-3	1,634,372,775
345	7/19/1997	1997	Danny-1997	F-1/ByP-1	6,286,245
350	9/3/1998	1998	Earl-1998	A-1	187,552,390
355	9/25/1998	1998	Georges-1998	B-2/F-2	210,999,954
357	9/17/1999	1999	Floyd-1999	ByP-3	29,393,368
360	10/15/1999	1999	Irene-1999	B-1	556,257,290

ID	Hurricane Landfall/ Closest Approach Date	Year	Name	Region as defined in Figure 1-Category	Personal and Commercial Residential Insured Hurricane Losses ($)
361	9/19/2000	2000	Gordon-2000	ByP-1	5,593,334
362	11/5/2001	2001	Michelle-2001	ByP-1	3,112,329
365	8/13/2004	2004	Charley-2004	B-4	8,595,438,276
370	9/5/2004	2004	Frances-2004	C-2	3,785,902,286
375	9/16/2004	2004	Ivan-2004	F-3/ByP-3	1,641,389,717
380	9/26/2004	2004	Jeanne-2004	C-3	6,979,551,740
385	7/10/2005	2005	Dennis-2005	A-3	717,635,946
390	8/25/2005	2005	Katrina-2005	C-1	744,078,814
395	9/20/2005	2005	Rita-2005	ByP-2	15,204,564
400	10/24/2005	2005	Wilma-2005	B-3	10,507,505,725
401	9/11/2008	2008	Ike-2008	ByP-1	2,211,692
405	9/2/2016	2016	Hermine-2016	A-1	11,112,328
410	10/7/2016	2016	Matthew-2016	ByP-3	566,876,791
415	9/10/2017	2017	Irma-2017	B-4	7,590,870,335
420	10/8/2017	2017	Nate-2017	F-1/ByP-1	611,784
425	10/10/2018	2018	Michael-2018	A-5	3,221,095,147
430	9/4/2019	2019	Dorian-2019	ByP-2	1,908,529
435	9/16/2020	2020	Sally-2020	F-2/ByP-2	595,276,855
440	10/28/2020	2020	Zeta-2020	ByP-2	22,414,848
			Total		360,663,819,619

Form A-3: Hurricane Losses

A. One or more automated programs or scripts should be used to generate and arrange the data in Form A-3, Hurricane Losses.

B. Provide the percentage of residential zero deductible hurricane total loss, rounded to four decimal places, and the modeled loss from Hurricane Hermine (2016), Hurricane Matthew (2016), Hurricane Irma (2017), and Hurricane Michael (2018) for each affected ZIP Code.

Use the 2017 Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data provided in the file named "hlpm2017c.zip."

Rather than using directly a specified published windfield, the winds underlying the hurricane loss cost calculations must be produced by the hurricane model being evaluated and should be the same hurricane parameters as used in completing Form A-2, Base Hurricane Storm Set Statewide Hurricane Losses.

C. Provide maps color-coded by ZIP Code depicting the percentage of total residential hurricane loss from each hurricane, Hurricane Hermine (2016), Hurricane Matthew (2016), Hurricane Irma (2017), and Hurricane Michael (2018), using the following interval coding:

Red	***≥5%***
Light Red	***≥2% to 5%***
Pink	***≥1% to 2%***
Light Pink	***≥0.5% to 1%***
Light Blue	***≥0.2% to 0.5%***
Medium Blue	***≥0.1% to 0.2%***
Blue Below	***>0% to 0.1%***
White	***0%***

D. Plot the relevant storm track on each map.

E. Provide this form in both Excel and PDF format. The file name should include the abbreviated name of the modeling organization, the hurricane standards year, and the form name.

The contribution and percentage of losses from the prescribed set of storms for each ZIP Code for personal residential and commercial residential policies from the 2017 FHCF aggregate exposure data are in RMS21FormA3.xlsx at the link provided to the FCHLPM and appear below.

Table 36: Hurricane Hermine (2016), Hurricane Matthew (2016), Hurricane Irma (2017), and Hurricane Michael (2018) percent of hurricane losses

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
32003	0	0.0000%	1,671,487	0.2949%	17,536,001	0.2310%	0	0.0000%
32004	0	0.0000%	4,981	0.0009%	9,594	0.0001%	0	0.0000%
32006	0	0.0000%	206	0.0000%	3,132	0.0000%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
32007	0	0.0000%	3,923	0.0007%	33,516	0.0004%	0	0.0000%
32008	157,337	1.4159%	0	0.0000%	862,501	0.0114%	0	0.0000%
32009	0	0.0000%	0	0.0000%	836,212	0.0110%	0	0.0000%
32011	0	0.0000%	0	0.0000%	3,539,196	0.0466%	0	0.0000%
32013	948	0.0085%	0	0.0000%	1,551	0.0000%	0	0.0000%
32024	603,529	5.4313%	0	0.0000%	3,001,138	0.0395%	0	0.0000%
32025	0	0.0000%	0	0.0000%	2,452,803	0.0323%	0	0.0000%
32026	0	0.0000%	0	0.0000%	2,888	0.0000%	0	0.0000%
32030	0	0.0000%	0	0.0000%	252	0.0000%	0	0.0000%
32033	0	0.0000%	680,620	0.1201%	1,752,262	0.0231%	0	0.0000%
32034	0	0.0000%	7,427,708	1.3103%	28,159,242	0.3710%	0	0.0000%
32035	0	0.0000%	1,741	0.0003%	6,150	0.0001%	0	0.0000%
32038	0	0.0000%	0	0.0000%	1,462,553	0.0193%	0	0.0000%
32040	0	0.0000%	0	0.0000%	1,547,449	0.0204%	0	0.0000%
32041	0	0.0000%	1,305	0.0002%	8,226	0.0001%	0	0.0000%
32042	0	0.0000%	0	0.0000%	43,124	0.0006%	0	0.0000%
32043	0	0.0000%	956,366	0.1687%	11,274,051	0.1485%	0	0.0000%
32044	0	0.0000%	0	0.0000%	432,211	0.0057%	0	0.0000%
32046	0	0.0000%	0	0.0000%	1,975,375	0.0260%	0	0.0000%
32050	0	0.0000%	0	0.0000%	4,005	0.0001%	0	0.0000%
32052	342,388	3.0812%	0	0.0000%	652,690	0.0086%	0	0.0000%
32053	328,434	2.9556%	0	0.0000%	318,494	0.0042%	0	0.0000%
32054	0	0.0000%	0	0.0000%	1,492,763	0.0197%	0	0.0000%
32055	0	0.0000%	0	0.0000%	1,530,539	0.0202%	0	0.0000%
32056	0	0.0000%	0	0.0000%	10,689	0.0001%	0	0.0000%
32058	0	0.0000%	0	0.0000%	797,113	0.0105%	0	0.0000%
32059	382,566	3.4428%	0	0.0000%	353,764	0.0047%	0	0.0000%
32060	1,084,541	9.7600%	0	0.0000%	2,767,984	0.0365%	0	0.0000%
32061	0	0.0000%	0	0.0000%	30,832	0.0004%	0	0.0000%
32062	104,875	0.9438%	0	0.0000%	359,480	0.0047%	0	0.0000%
32063	0	0.0000%	0	0.0000%	2,840,414	0.0374%	0	0.0000%
32064	277,235	2.4949%	0	0.0000%	710,293	0.0094%	0	0.0000%
32065	0	0.0000%	0	0.0000%	11,605,712	0.1529%	0	0.0000%
32066	219,466	1.9750%	0	0.0000%	508,487	0.0067%	0	0.0000%
32067	0	0.0000%	6	0.0000%	76	0.0000%	0	0.0000%
32068	0	0.0000%	0	0.0000%	15,095,252	0.1989%	0	0.0000%
32071	128,024	1.1521%	0	0.0000%	578,924	0.0076%	0	0.0000%
32072	0	0.0000%	0	0.0000%	22,085	0.0003%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
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32073	0	0.0000%	1,499,940	0.2646%	24,336,864	0.3206%	0	0.0000%
32079	0	0.0000%	0	0.0000%	72,767	0.0010%	0	0.0000%
32080	0	0.0000%	14,715,641	2.5959%	16,185,091	0.2132%	0	0.0000%
32081	0	0.0000%	1,156,509	0.2040%	2,794,049	0.0368%	0	0.0000%
32082	0	0.0000%	18,529,599	3.2687%	37,371,027	0.4923%	0	0.0000%
32083	0	0.0000%	0	0.0000%	187,786	0.0025%	0	0.0000%
32084	0	0.0000%	6,721,889	1.1858%	10,611,878	0.1398%	0	0.0000%
32085	0	0.0000%	2,993	0.0005%	4,683	0.0001%	0	0.0000%
32086	0	0.0000%	7,616,515	1.3436%	9,599,612	0.1265%	0	0.0000%
32087	0	0.0000%	0	0.0000%	490,365	0.0065%	0	0.0000%
32091	0	0.0000%	0	0.0000%	4,523,800	0.0596%	0	0.0000%
32092	0	0.0000%	2,070,309	0.3652%	8,829,811	0.1163%	0	0.0000%
32094	101,693	0.9151%	0	0.0000%	395,691	0.0052%	0	0.0000%
32095	0	0.0000%	1,310,174	0.2311%	2,715,428	0.0358%	0	0.0000%
32096	84,599	0.7613%	0	0.0000%	284,498	0.0037%	0	0.0000%
32097	0	0.0000%	842,018	0.1485%	4,422,828	0.0583%	0	0.0000%
32099	0	0.0000%	0	0.0000%	2,396	0.0000%	0	0.0000%
32102	0	0.0000%	200,061	0.0353%	1,221,379	0.0161%	0	0.0000%
32105	0	0.0000%	2,401	0.0004%	9,053	0.0001%	0	0.0000%
32110	0	0.0000%	992,401	0.1751%	1,268,069	0.0167%	0	0.0000%
32111	0	0.0000%	0	0.0000%	48,057	0.0006%	0	0.0000%
32112	0	0.0000%	590,977	0.1043%	3,417,737	0.0450%	0	0.0000%
32113	0	0.0000%	0	0.0000%	2,243,055	0.0295%	0	0.0000%
32114	0	0.0000%	3,732,908	0.6585%	3,408,014	0.0449%	0	0.0000%
32115	0	0.0000%	1,737	0.0003%	1,641	0.0000%	0	0.0000%
32116	0	0.0000%	142	0.0000%	135	0.0000%	0	0.0000%
32117	0	0.0000%	4,798,371	0.8465%	4,212,208	0.0555%	0	0.0000%
32118	0	0.0000%	7,686,196	1.3559%	7,932,968	0.1045%	0	0.0000%
32119	0	0.0000%	6,515,833	1.1494%	6,320,106	0.0833%	0	0.0000%
32120	0	0.0000%	15	0.0000%	12	0.0000%	0	0.0000%
32121	0	0.0000%	8	0.0000%	7	0.0000%	0	0.0000%
32123	0	0.0000%	849	0.0001%	768	0.0000%	0	0.0000%
32124	0	0.0000%	518,965	0.0915%	551,789	0.0073%	0	0.0000%
32127	0	0.0000%	12,305,509	2.1708%	11,670,971	0.1538%	0	0.0000%
32128	0	0.0000%	4,922,109	0.8683%	5,218,112	0.0687%	0	0.0000%
32129	0	0.0000%	4,941,577	0.8717%	4,808,221	0.0633%	0	0.0000%
32130	0	0.0000%	529,200	0.0934%	1,324,883	0.0175%	0	0.0000%
32131	0	0.0000%	441,561	0.0779%	2,923,709	0.0385%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
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32132	0	0.0000%	2,724,147	0.4806%	2,464,293	0.0325%	0	0.0000%
32133	0	0.0000%	5,177	0.0009%	151,076	0.0020%	0	0.0000%
32134	0	0.0000%	0	0.0000%	4,189,651	0.0552%	0	0.0000%
32135	0	0.0000%	2,691	0.0005%	2,297	0.0000%	0	0.0000%
32136	0	0.0000%	9,955,695	1.7562%	5,630,109	0.0742%	0	0.0000%
32137	0	0.0000%	24,285,633	4.2841%	17,913,220	0.2360%	0	0.0000%
32138	0	0.0000%	1,573	0.0003%	33,880	0.0004%	0	0.0000%
32139	0	0.0000%	103,868	0.0183%	1,107,067	0.0146%	0	0.0000%
32140	0	0.0000%	41,266	0.0073%	724,762	0.0095%	0	0.0000%
32141	0	0.0000%	7,841,304	1.3833%	7,183,015	0.0946%	0	0.0000%
32143	0	0.0000%	348	0.0001%	184	0.0000%	0	0.0000%
32145	0	0.0000%	432,153	0.0762%	1,311,442	0.0173%	0	0.0000%
32147	0	0.0000%	12,128	0.0021%	173,016	0.0023%	0	0.0000%
32148	0	0.0000%	204,181	0.0360%	3,799,404	0.0501%	0	0.0000%
32157	0	0.0000%	13,217	0.0023%	102,420	0.0013%	0	0.0000%
32158	0	0.0000%	0	0.0000%	18,290	0.0002%	0	0.0000%
32159	0	0.0000%	0	0.0000%	30,638,365	0.4036%	0	0.0000%
32160	0	0.0000%	0	0.0000%	21,166	0.0003%	0	0.0000%
32162	0	0.0000%	0	0.0000%	22,682,155	0.2988%	0	0.0000%
32163	0	0.0000%	0	0.0000%	7,820,443	0.1030%	0	0.0000%
32164	0	0.0000%	9,144,769	1.6132%	7,678,716	0.1012%	0	0.0000%
32168	0	0.0000%	6,788,990	1.1976%	7,015,113	0.0924%	0	0.0000%
32169	0	0.0000%	15,430,989	2.7221%	11,167,918	0.1471%	0	0.0000%
32170	0	0.0000%	526	0.0001%	534	0.0000%	0	0.0000%
32173	0	0.0000%	2,017	0.0004%	1,709	0.0000%	0	0.0000%
32174	0	0.0000%	20,710,859	3.6535%	16,733,327	0.2204%	0	0.0000%
32175	0	0.0000%	1,627	0.0003%	1,463	0.0000%	0	0.0000%
32176	0	0.0000%	12,313,969	2.1723%	11,143,290	0.1468%	0	0.0000%
32177	0	0.0000%	1,304,700	0.2302%	11,574,738	0.1525%	0	0.0000%
32178	0	0.0000%	2,210	0.0004%	17,873	0.0002%	0	0.0000%
32179	0	0.0000%	0	0.0000%	5,620,074	0.0740%	0	0.0000%
32180	0	0.0000%	222,054	0.0392%	797,994	0.0105%	0	0.0000%
32181	0	0.0000%	207,545	0.0366%	1,636,620	0.0216%	0	0.0000%
32182	0	0.0000%	5,635	0.0010%	121,889	0.0016%	0	0.0000%
32183	0	0.0000%	958	0.0002%	28,059	0.0004%	0	0.0000%
32185	0	0.0000%	0	0.0000%	9,928	0.0001%	0	0.0000%
32187	0	0.0000%	153,014	0.0270%	886,758	0.0117%	0	0.0000%
32189	0	0.0000%	310,900	0.0548%	3,019,494	0.0398%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
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32190	0	0.0000%	65,714	0.0116%	269,949	0.0036%	0	0.0000%
32192	0	0.0000%	0	0.0000%	99,426	0.0013%	0	0.0000%
32193	0	0.0000%	105,500	0.0186%	1,128,604	0.0149%	0	0.0000%
32195	0	0.0000%	0	0.0000%	2,988,654	0.0394%	0	0.0000%
32201	0	0.0000%	1,816	0.0003%	16,778	0.0002%	0	0.0000%
32202	0	0.0000%	86,747	0.0153%	579,294	0.0076%	0	0.0000%
32203	0	0.0000%	74	0.0000%	560	0.0000%	0	0.0000%
32204	0	0.0000%	345,530	0.0610%	3,464,985	0.0456%	0	0.0000%
32205	0	0.0000%	1,543,675	0.2723%	18,541,869	0.2443%	0	0.0000%
32206	0	0.0000%	609,960	0.1076%	4,517,769	0.0595%	0	0.0000%
32207	0	0.0000%	2,947,923	0.5200%	20,031,046	0.2639%	0	0.0000%
32208	0	0.0000%	1,215,090	0.2143%	9,103,950	0.1199%	0	0.0000%
32209	0	0.0000%	655,653	0.1157%	5,475,027	0.0721%	0	0.0000%
32210	0	0.0000%	0	0.0000%	27,287,016	0.3595%	0	0.0000%
32211	0	0.0000%	1,999,182	0.3527%	10,058,370	0.1325%	0	0.0000%
32212	0	0.0000%	798	0.0001%	8,444	0.0001%	0	0.0000%
32214	0	0.0000%	185	0.0000%	2,454	0.0000%	0	0.0000%
32216	0	0.0000%	2,071,896	0.3655%	10,092,018	0.1329%	0	0.0000%
32217	0	0.0000%	1,724,982	0.3043%	10,703,629	0.1410%	0	0.0000%
32218	0	0.0000%	2,042,716	0.3603%	13,370,676	0.1761%	0	0.0000%
32219	0	0.0000%	0	0.0000%	2,510,488	0.0331%	0	0.0000%
32220	0	0.0000%	0	0.0000%	3,339,768	0.0440%	0	0.0000%
32221	0	0.0000%	0	0.0000%	7,752,594	0.1021%	0	0.0000%
32222	0	0.0000%	0	0.0000%	2,389,769	0.0315%	0	0.0000%
32223	0	0.0000%	3,379,429	0.5962%	24,018,645	0.3164%	0	0.0000%
32224	0	0.0000%	4,373,417	0.7715%	13,188,827	0.1737%	0	0.0000%
32225	0	0.0000%	8,116,821	1.4319%	26,545,331	0.3497%	0	0.0000%
32226	0	0.0000%	1,827,710	0.3224%	7,597,169	0.1001%	0	0.0000%
32227	0	0.0000%	7,731	0.0014%	16,721	0.0002%	0	0.0000%
32228	0	0.0000%	276	0.0000%	617	0.0000%	0	0.0000%
32231	0	0.0000%	258	0.0000%	1,820	0.0000%	0	0.0000%
32232	0	0.0000%	342	0.0001%	3,174	0.0000%	0	0.0000%
32233	0	0.0000%	6,049,207	1.0671%	15,000,536	0.1976%	0	0.0000%
32234	0	0.0000%	0	0.0000%	1,828,001	0.0241%	0	0.0000%
32235	0	0.0000%	4,618	0.0008%	16,363	0.0002%	0	0.0000%
32236	0	0.0000%	117	0.0000%	1,560	0.0000%	0	0.0000%
32239	0	0.0000%	1,105	0.0002%	5,409	0.0001%	0	0.0000%
32240	0	0.0000%	256	0.0000%	529	0.0000%	0	0.0000%

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32241	0	0.0000%	170	0.0000%	731	0.0000%	0	0.0000%
32244	0	0.0000%	0	0.0000%	17,171,821	0.2262%	0	0.0000%
32245	0	0.0000%	46	0.0000%	203	0.0000%	0	0.0000%
32246	0	0.0000%	3,085,496	0.5443%	11,596,928	0.1528%	0	0.0000%
32247	0	0.0000%	3,421	0.0006%	18,534	0.0002%	0	0.0000%
32250	0	0.0000%	7,694,578	1.3574%	19,040,233	0.2508%	0	0.0000%
32254	0	0.0000%	226,242	0.0399%	2,279,244	0.0300%	0	0.0000%
32255	0	0.0000%	816	0.0001%	3,696	0.0000%	0	0.0000%
32256	0	0.0000%	2,209,515	0.3898%	9,406,789	0.1239%	0	0.0000%
32257	0	0.0000%	3,025,822	0.5338%	17,061,210	0.2248%	0	0.0000%
32258	0	0.0000%	1,836,116	0.3239%	7,917,653	0.1043%	0	0.0000%
32259	0	0.0000%	3,137,554	0.5535%	16,556,796	0.2181%	0	0.0000%
32260	0	0.0000%	0	0.0000%	2	0.0000%	0	0.0000%
32266	0	0.0000%	2,910,720	0.5135%	7,639,320	0.1006%	0	0.0000%
32277	0	0.0000%	2,492,152	0.4396%	13,837,015	0.1823%	0	0.0000%
32301	0	0.0000%	0	0.0000%	0	0.0000%	2,092,903	0.0650%
32302	0	0.0000%	0	0.0000%	0	0.0000%	1,865	0.0001%
32303	0	0.0000%	0	0.0000%	0	0.0000%	7,082,373	0.2199%
32304	0	0.0000%	0	0.0000%	0	0.0000%	1,693,042	0.0526%
32305	432,633	3.8933%	0	0.0000%	0	0.0000%	1,299,459	0.0403%
32306	0	0.0000%	0	0.0000%	0	0.0000%	24	0.0000%
32307	0	0.0000%	0	0.0000%	0	0.0000%	1,066	0.0000%
32308	0	0.0000%	0	0.0000%	0	0.0000%	2,972,707	0.0923%
32309	0	0.0000%	0	0.0000%	0	0.0000%	5,690,556	0.1767%
32310	0	0.0000%	0	0.0000%	0	0.0000%	1,693,556	0.0526%
32311	734,524	6.6101%	0	0.0000%	0	0.0000%	1,584,038	0.0492%
32312	0	0.0000%	0	0.0000%	0	0.0000%	9,036,300	0.2805%
32313	0	0.0000%	0	0.0000%	0	0.0000%	505	0.0000%
32314	0	0.0000%	0	0.0000%	0	0.0000%	339	0.0000%
32317	0	0.0000%	0	0.0000%	0	0.0000%	1,668,123	0.0518%
32320	0	0.0000%	0	0.0000%	0	0.0000%	4,601,583	0.1429%
32321	0	0.0000%	0	0.0000%	0	0.0000%	13,402,633	0.4161%
32322	144,335	1.2989%	0	0.0000%	0	0.0000%	1,044,468	0.0324%
32323	15,137	0.1362%	0	0.0000%	8,486	0.0001%	85,298	0.0026%
32324	0	0.0000%	0	0.0000%	0	0.0000%	14,342,563	0.4453%
32326	1,473	0.0133%	0	0.0000%	0	0.0000%	4,642	0.0001%
32327	709,383	6.3839%	0	0.0000%	0	0.0000%	1,808,421	0.0561%
32328	217,711	1.9592%	0	0.0000%	0	0.0000%	7,633,192	0.2370%

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32330	0	0.0000%	0	0.0000%	0	0.0000%	260,927	0.0081%
32331	166,305	1.4966%	0	0.0000%	224,642	0.0030%	0	0.0000%
32332	0	0.0000%	0	0.0000%	0	0.0000%	598,023	0.0186%
32333	0	0.0000%	0	0.0000%	0	0.0000%	3,796,658	0.1179%
32334	0	0.0000%	0	0.0000%	0	0.0000%	1,324,351	0.0411%
32336	59,974	0.5397%	0	0.0000%	69,361	0.0009%	0	0.0000%
32337	3,501	0.0315%	0	0.0000%	5,493	0.0001%	5,901	0.0002%
32340	1,041,681	9.3743%	0	0.0000%	1,067,863	0.0141%	0	0.0000%
32341	5,194	0.0467%	0	0.0000%	5,379	0.0001%	0	0.0000%
32343	0	0.0000%	0	0.0000%	0	0.0000%	325,479	0.0101%
32344	507,489	4.5670%	0	0.0000%	813,903	0.0107%	604,199	0.0188%
32345	2,222	0.0200%	0	0.0000%	3,812	0.0001%	2,762	0.0001%
32346	301,749	2.7155%	0	0.0000%	176,453	0.0023%	796,797	0.0247%
32347	1,250,139	11.2502%	0	0.0000%	608,176	0.0080%	0	0.0000%
32348	1,231,479	11.0823%	0	0.0000%	617,561	0.0081%	0	0.0000%
32350	131,585	1.1842%	0	0.0000%	145,769	0.0019%	0	0.0000%
32351	0	0.0000%	0	0.0000%	0	0.0000%	10,667,936	0.3312%
32352	0	0.0000%	0	0.0000%	0	0.0000%	3,442,462	0.1069%
32353	0	0.0000%	0	0.0000%	0	0.0000%	16,270	0.0005%
32355	15,742	0.1417%	0	0.0000%	14,240	0.0002%	23,315	0.0007%
32356	3,296	0.0297%	0	0.0000%	4,266	0.0001%	0	0.0000%
32357	3,546	0.0319%	0	0.0000%	3,183	0.0000%	0	0.0000%
32358	0	0.0000%	0	0.0000%	0	0.0000%	450,338	0.0140%
32359	124,438	1.1198%	0	0.0000%	199,985	0.0026%	0	0.0000%
32360	0	0.0000%	0	0.0000%	0	0.0000%	53,436	0.0017%
32361	6,297	0.0567%	0	0.0000%	8,461	0.0001%	6,034	0.0002%
32362	3,354	0.0302%	0	0.0000%	3,034	0.0000%	5,633	0.0002%
32401	0	0.0000%	0	0.0000%	0	0.0000%	285,687,110	8.8693%
32402	0	0.0000%	0	0.0000%	0	0.0000%	47,269	0.0015%
32403	0	0.0000%	0	0.0000%	0	0.0000%	9,560,532	0.2968%
32404	0	0.0000%	0	0.0000%	0	0.0000%	952,574,756	29.5730%
32405	0	0.0000%	0	0.0000%	0	0.0000%	317,911,298	9.8697%
32407	0	0.0000%	0	0.0000%	0	0.0000%	35,521,560	1.1028%
32408	0	0.0000%	0	0.0000%	0	0.0000%	139,610,799	4.3343%
32409	0	0.0000%	0	0.0000%	0	0.0000%	34,762,385	1.0792%
32410	0	0.0000%	0	0.0000%	0	0.0000%	18,713,433	0.5810%
32411	0	0.0000%	0	0.0000%	0	0.0000%	710,248	0.0220%
32413	0	0.0000%	0	0.0000%	0	0.0000%	32,240,592	1.0009%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
32417	0	0.0000%	0	0.0000%	0	0.0000%	30,814	0.0010%
32420	0	0.0000%	0	0.0000%	0	0.0000%	17,375,469	0.5394%
32421	0	0.0000%	0	0.0000%	0	0.0000%	32,225,777	1.0005%
32422	0	0.0000%	0	0.0000%	0	0.0000%	558	0.0000%
32423	0	0.0000%	0	0.0000%	0	0.0000%	6,684,772	0.2075%
32424	0	0.0000%	0	0.0000%	0	0.0000%	57,392,824	1.7818%
32425	0	0.0000%	0	0.0000%	0	0.0000%	3,832,812	0.1190%
32426	0	0.0000%	0	0.0000%	0	0.0000%	1,884,230	0.0585%
32427	0	0.0000%	0	0.0000%	0	0.0000%	207,486	0.0064%
32428	0	0.0000%	0	0.0000%	0	0.0000%	37,762,564	1.1724%
32430	0	0.0000%	0	0.0000%	0	0.0000%	15,026,689	0.4665%
32431	0	0.0000%	0	0.0000%	0	0.0000%	16,503,167	0.5123%
32432	0	0.0000%	0	0.0000%	0	0.0000%	334,852	0.0104%
32433	0	0.0000%	0	0.0000%	0	0.0000%	631,964	0.0196%
32434	0	0.0000%	0	0.0000%	0	0.0000%	624	0.0000%
32435	0	0.0000%	0	0.0000%	0	0.0000%	450,299	0.0140%
32437	0	0.0000%	0	0.0000%	0	0.0000%	149,885	0.0047%
32438	0	0.0000%	0	0.0000%	0	0.0000%	12,827,686	0.3982%
32439	0	0.0000%	0	0.0000%	0	0.0000%	1,671,505	0.0519%
32440	0	0.0000%	0	0.0000%	0	0.0000%	3,968,820	0.1232%
32442	0	0.0000%	0	0.0000%	0	0.0000%	26,639,372	0.8270%
32443	0	0.0000%	0	0.0000%	0	0.0000%	14,014,328	0.4351%
32444	0	0.0000%	0	0.0000%	0	0.0000%	295,578,011	9.1763%
32445	0	0.0000%	0	0.0000%	0	0.0000%	5,554,015	0.1724%
32446	0	0.0000%	0	0.0000%	0	0.0000%	65,396,293	2.0303%
32447	0	0.0000%	0	0.0000%	0	0.0000%	71,867	0.0022%
32448	0	0.0000%	0	0.0000%	0	0.0000%	33,125,812	1.0284%
32449	0	0.0000%	0	0.0000%	0	0.0000%	6,438,443	0.1999%
32452	0	0.0000%	0	0.0000%	0	0.0000%	4,931	0.0002%
32455	0	0.0000%	0	0.0000%	0	0.0000%	424,991	0.0132%
32456	0	0.0000%	0	0.0000%	0	0.0000%	455,347,836	14.1364%
32457	0	0.0000%	0	0.0000%	0	0.0000%	101,070	0.0031%
32459	0	0.0000%	0	0.0000%	0	0.0000%	12,112,732	0.3760%
32460	0	0.0000%	0	0.0000%	0	0.0000%	39,079,875	1.2132%
32461	0	0.0000%	0	0.0000%	0	0.0000%	1,416,981	0.0440%
32462	0	0.0000%	0	0.0000%	0	0.0000%	1,444,798	0.0449%
32463	0	0.0000%	0	0.0000%	0	0.0000%	226,817	0.0070%
32464	0	0.0000%	0	0.0000%	0	0.0000%	208,825	0.0065%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
32465	0	0.0000%	0	0.0000%	0	0.0000%	59,393,166	1.8439%
32466	0	0.0000%	0	0.0000%	0	0.0000%	53,279,048	1.6541%
32540	0	0.0000%	0	0.0000%	0	0.0000%	4,597	0.0001%
32541	0	0.0000%	0	0.0000%	0	0.0000%	4,531,997	0.1407%
32542	0	0.0000%	0	0.0000%	0	0.0000%	958	0.0000%
32548	0	0.0000%	0	0.0000%	0	0.0000%	1,053,008	0.0327%
32549	0	0.0000%	0	0.0000%	0	0.0000%	1,763	0.0001%
32550	0	0.0000%	0	0.0000%	0	0.0000%	4,392,494	0.1364%
32578	0	0.0000%	0	0.0000%	0	0.0000%	3,582,940	0.1112%
32579	0	0.0000%	0	0.0000%	0	0.0000%	994,153	0.0309%
32580	0	0.0000%	0	0.0000%	0	0.0000%	250,613	0.0078%
32588	0	0.0000%	0	0.0000%	0	0.0000%	194	0.0000%
32601	0	0.0000%	0	0.0000%	2,659,382	0.0350%	0	0.0000%
32602	0	0.0000%	0	0.0000%	2,254	0.0000%	0	0.0000%
32603	0	0.0000%	0	0.0000%	633,277	0.0083%	0	0.0000%
32604	0	0.0000%	0	0.0000%	3,977	0.0001%	0	0.0000%
32605	0	0.0000%	0	0.0000%	7,855,374	0.1035%	0	0.0000%
32606	0	0.0000%	0	0.0000%	5,032,627	0.0663%	0	0.0000%
32607	0	0.0000%	0	0.0000%	4,770,645	0.0628%	0	0.0000%
32608	0	0.0000%	0	0.0000%	7,209,931	0.0950%	0	0.0000%
32609	0	0.0000%	0	0.0000%	2,695,103	0.0355%	0	0.0000%
32610	0	0.0000%	0	0.0000%	3,859	0.0001%	0	0.0000%
32611	0	0.0000%	0	0.0000%	35	0.0000%	0	0.0000%
32612	0	0.0000%	0	0.0000%	131	0.0000%	0	0.0000%
32614	0	0.0000%	0	0.0000%	6	0.0000%	0	0.0000%
32615	0	0.0000%	0	0.0000%	3,467,845	0.0457%	0	0.0000%
32616	0	0.0000%	0	0.0000%	15,002	0.0002%	0	0.0000%
32617	0	0.0000%	0	0.0000%	2,033,468	0.0268%	0	0.0000%
32618	0	0.0000%	0	0.0000%	1,663,666	0.0219%	0	0.0000%
32619	0	0.0000%	0	0.0000%	696,245	0.0092%	0	0.0000%
32621	0	0.0000%	0	0.0000%	843,949	0.0111%	0	0.0000%
32622	0	0.0000%	0	0.0000%	294,403	0.0039%	0	0.0000%
32625	57,546	0.5179%	0	0.0000%	539,777	0.0071%	0	0.0000%
32626	0	0.0000%	0	0.0000%	1,325,331	0.0175%	0	0.0000%
32627	0	0.0000%	0	0.0000%	2,967	0.0000%	0	0.0000%
32628	57,646	0.5188%	0	0.0000%	293,127	0.0039%	0	0.0000%
32631	0	0.0000%	0	0.0000%	369,185	0.0049%	0	0.0000%
32633	0	0.0000%	0	0.0000%	43,721	0.0006%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
32634	0	0.0000%	0	0.0000%	29,549	0.0004%	0	0.0000%
32635	0	0.0000%	0	0.0000%	1,746	0.0000%	0	0.0000%
32639	0	0.0000%	0	0.0000%	12,083	0.0002%	0	0.0000%
32640	0	0.0000%	0	0.0000%	5,218,470	0.0687%	0	0.0000%
32641	0	0.0000%	0	0.0000%	2,000,531	0.0264%	0	0.0000%
32643	0	0.0000%	0	0.0000%	1,998,444	0.0263%	0	0.0000%
32644	0	0.0000%	0	0.0000%	7,680	0.0001%	0	0.0000%
32648	35,397	0.3185%	0	0.0000%	75,739	0.0010%	0	0.0000%
32653	0	0.0000%	0	0.0000%	3,852,347	0.0507%	0	0.0000%
32654	0	0.0000%	0	0.0000%	13,767	0.0002%	0	0.0000%
32655	0	0.0000%	0	0.0000%	6,349	0.0001%	0	0.0000%
32656	0	0.0000%	0	0.0000%	8,231,560	0.1084%	0	0.0000%
32658	0	0.0000%	0	0.0000%	40,868	0.0005%	0	0.0000%
32662	0	0.0000%	0	0.0000%	2,793	0.0000%	0	0.0000%
32663	0	0.0000%	0	0.0000%	23,271	0.0003%	0	0.0000%
32664	0	0.0000%	0	0.0000%	413,595	0.0054%	0	0.0000%
32666	0	0.0000%	0	0.0000%	4,760,898	0.0627%	0	0.0000%
32667	0	0.0000%	0	0.0000%	1,655,388	0.0218%	0	0.0000%
32668	0	0.0000%	0	0.0000%	1,450,159	0.0191%	0	0.0000%
32669	0	0.0000%	0	0.0000%	2,759,509	0.0364%	0	0.0000%
32680	0	0.0000%	0	0.0000%	902,170	0.0119%	0	0.0000%
32681	0	0.0000%	0	0.0000%	96,758	0.0013%	0	0.0000%
32683	0	0.0000%	0	0.0000%	5,743	0.0001%	0	0.0000%
32686	0	0.0000%	0	0.0000%	2,024,722	0.0267%	0	0.0000%
32692	32,738	0.2946%	0	0.0000%	134,625	0.0018%	0	0.0000%
32693	0	0.0000%	0	0.0000%	1,610,054	0.0212%	0	0.0000%
32694	0	0.0000%	0	0.0000%	552,092	0.0073%	0	0.0000%
32696	0	0.0000%	0	0.0000%	2,801,469	0.0369%	0	0.0000%
32697	0	0.0000%	0	0.0000%	13,738	0.0002%	0	0.0000%
32701	0	0.0000%	818,761	0.1444%	5,955,220	0.0785%	0	0.0000%
32702	0	0.0000%	102,712	0.0181%	1,194,516	0.0157%	0	0.0000%
32703	0	0.0000%	1,435,097	0.2532%	14,054,005	0.1851%	0	0.0000%
32704	0	0.0000%	1,835	0.0003%	18,395	0.0002%	0	0.0000%
32706	0	0.0000%	6,202	0.0011%	15,308	0.0002%	0	0.0000%
32707	0	0.0000%	1,639,476	0.2892%	9,836,705	0.1296%	0	0.0000%
32708	0	0.0000%	2,959,504	0.5221%	15,821,690	0.2084%	0	0.0000%
32709	0	0.0000%	128,215	0.0226%	598,348	0.0079%	0	0.0000%
32710	0	0.0000%	65	0.0000%	961	0.0000%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
32712	0	0.0000%	1,915,164	0.3378%	18,262,304	0.2406%	0	0.0000%
32713	0	0.0000%	1,716,878	0.3029%	7,484,948	0.0986%	0	0.0000%
32714	0	0.0000%	1,202,386	0.2121%	9,807,034	0.1292%	0	0.0000%
32716	0	0.0000%	1	0.0000%	16	0.0000%	0	0.0000%
32718	0	0.0000%	0	0.0000%	2	0.0000%	0	0.0000%
32719	0	0.0000%	3,090	0.0005%	14,260	0.0002%	0	0.0000%
32720	0	0.0000%	2,252,460	0.3973%	7,603,754	0.1002%	0	0.0000%
32721	0	0.0000%	317	0.0001%	876	0.0000%	0	0.0000%
32722	0	0.0000%	724	0.0001%	2,271	0.0000%	0	0.0000%
32723	0	0.0000%	551	0.0001%	2,033	0.0000%	0	0.0000%
32724	0	0.0000%	3,000,623	0.5293%	7,789,702	0.1026%	0	0.0000%
32725	0	0.0000%	3,945,954	0.6961%	12,995,712	0.1712%	0	0.0000%
32726	0	0.0000%	933,404	0.1647%	14,323,575	0.1887%	0	0.0000%
32727	0	0.0000%	560	0.0001%	9,259	0.0001%	0	0.0000%
32728	0	0.0000%	2,094	0.0004%	9,475	0.0001%	0	0.0000%
32730	0	0.0000%	227,268	0.0401%	1,407,285	0.0185%	0	0.0000%
32732	0	0.0000%	568,136	0.1002%	2,016,688	0.0266%	0	0.0000%
32733	0	0.0000%	1,119	0.0002%	6,838	0.0001%	0	0.0000%
32735	0	0.0000%	245,877	0.0434%	4,955,469	0.0653%	0	0.0000%
32736	0	0.0000%	551,696	0.0973%	4,393,343	0.0579%	0	0.0000%
32738	0	0.0000%	3,671,913	0.6477%	9,565,371	0.1260%	0	0.0000%
32739	0	0.0000%	365	0.0001%	1,041	0.0000%	0	0.0000%
32744	0	0.0000%	348,495	0.0615%	848,325	0.0112%	0	0.0000%
32746	0	0.0000%	2,764,830	0.4877%	14,730,335	0.1941%	0	0.0000%
32747	0	0.0000%	1,257	0.0002%	6,255	0.0001%	0	0.0000%
32750	0	0.0000%	1,556,582	0.2746%	9,057,992	0.1193%	0	0.0000%
32751	0	0.0000%	1,592,454	0.2809%	12,222,896	0.1610%	0	0.0000%
32752	0	0.0000%	0	0.0000%	6	0.0000%	0	0.0000%
32754	0	0.0000%	1,892,901	0.3339%	3,139,357	0.0414%	0	0.0000%
32756	0	0.0000%	635	0.0001%	9,312	0.0001%	0	0.0000%
32757	0	0.0000%	1,329,739	0.2346%	16,887,422	0.2225%	0	0.0000%
32759	0	0.0000%	789,759	0.1393%	835,958	0.0110%	0	0.0000%
32762	0	0.0000%	574	0.0001%	2,470	0.0000%	0	0.0000%
32763	0	0.0000%	1,196,761	0.2111%	4,270,874	0.0563%	0	0.0000%
32764	0	0.0000%	259,794	0.0458%	765,221	0.0101%	0	0.0000%
32765	0	0.0000%	3,336,864	0.5886%	16,791,045	0.2212%	0	0.0000%
32766	0	0.0000%	927,288	0.1636%	4,015,314	0.0529%	0	0.0000%
32767	0	0.0000%	101,813	0.0180%	767,496	0.0101%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
32768	0	0.0000%	2,553	0.0005%	32,664	0.0004%	0	0.0000%
32771	0	0.0000%	3,054,894	0.5389%	12,608,046	0.1661%	0	0.0000%
32772	0	0.0000%	979	0.0002%	3,872	0.0001%	0	0.0000%
32773	0	0.0000%	1,171,213	0.2066%	5,475,523	0.0721%	0	0.0000%
32774	0	0.0000%	839	0.0001%	2,859	0.0000%	0	0.0000%
32775	0	0.0000%	9,999	0.0018%	15,045	0.0002%	0	0.0000%
32776	0	0.0000%	507,223	0.0895%	4,336,515	0.0571%	0	0.0000%
32777	0	0.0000%	9,065	0.0016%	116,275	0.0015%	0	0.0000%
32778	0	0.0000%	962,559	0.1698%	20,063,212	0.2643%	0	0.0000%
32779	0	0.0000%	2,672,494	0.4714%	19,534,181	0.2573%	0	0.0000%
32780	0	0.0000%	6,678,123	1.1781%	12,681,089	0.1671%	0	0.0000%
32781	0	0.0000%	4	0.0000%	8	0.0000%	0	0.0000%
32783	0	0.0000%	212	0.0000%	433	0.0000%	0	0.0000%
32784	0	0.0000%	458,300	0.0808%	6,383,550	0.0841%	0	0.0000%
32789	0	0.0000%	2,661,085	0.4694%	21,115,754	0.2782%	0	0.0000%
32790	0	0.0000%	4,701	0.0008%	40,159	0.0005%	0	0.0000%
32791	0	0.0000%	535	0.0001%	3,504	0.0000%	0	0.0000%
32792	0	0.0000%	1,911,209	0.3371%	13,128,784	0.1730%	0	0.0000%
32793	0	0.0000%	829	0.0001%	4,753	0.0001%	0	0.0000%
32794	0	0.0000%	9	0.0000%	87	0.0000%	0	0.0000%
32795	0	0.0000%	6	0.0000%	35	0.0000%	0	0.0000%
32796	0	0.0000%	4,078,309	0.7194%	7,272,884	0.0958%	0	0.0000%
32798	0	0.0000%	181,258	0.0320%	2,901,705	0.0382%	0	0.0000%
32801	0	0.0000%	316,414	0.0558%	3,098,901	0.0408%	0	0.0000%
32802	0	0.0000%	587	0.0001%	6,259	0.0001%	0	0.0000%
32803	0	0.0000%	1,152,901	0.2034%	10,136,276	0.1335%	0	0.0000%
32804	0	0.0000%	1,211,567	0.2137%	11,349,495	0.1495%	0	0.0000%
32805	0	0.0000%	323,323	0.0570%	3,566,172	0.0470%	0	0.0000%
32806	0	0.0000%	1,373,081	0.2422%	14,538,621	0.1915%	0	0.0000%
32807	0	0.0000%	811,532	0.1432%	6,600,044	0.0869%	0	0.0000%
32808	0	0.0000%	843,059	0.1487%	8,918,036	0.1175%	0	0.0000%
32809	0	0.0000%	0	0.0000%	7,695,333	0.1014%	0	0.0000%
32810	0	0.0000%	855,276	0.1509%	7,866,424	0.1036%	0	0.0000%
32811	0	0.0000%	310,135	0.0547%	3,839,188	0.0506%	0	0.0000%
32812	0	0.0000%	1,287,294	0.2271%	13,421,214	0.1768%	0	0.0000%
32814	0	0.0000%	198,496	0.0350%	1,163,766	0.0153%	0	0.0000%
32815	0	0.0000%	2,241	0.0004%	1,671	0.0000%	0	0.0000%
32816	0	0.0000%	17,009	0.0030%	84,218	0.0011%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
32817	0	0.0000%	1,309,804	0.2311%	8,333,527	0.1098%	0	0.0000%
32818	0	0.0000%	1,074,607	0.1896%	11,571,905	0.1524%	0	0.0000%
32819	0	0.0000%	0	0.0000%	20,703,925	0.2727%	0	0.0000%
32820	0	0.0000%	344,952	0.0609%	1,681,848	0.0222%	0	0.0000%
32821	0	0.0000%	0	0.0000%	5,843,617	0.0770%	0	0.0000%
32822	0	0.0000%	925,583	0.1633%	9,779,247	0.1288%	0	0.0000%
32824	0	0.0000%	0	0.0000%	10,442,597	0.1376%	0	0.0000%
32825	0	0.0000%	1,757,036	0.3100%	12,490,123	0.1645%	0	0.0000%
32826	0	0.0000%	653,038	0.1152%	4,040,788	0.0532%	0	0.0000%
32827	0	0.0000%	499,197	0.0881%	4,844,374	0.0638%	0	0.0000%
32828	0	0.0000%	1,745,116	0.3078%	10,368,072	0.1366%	0	0.0000%
32829	0	0.0000%	457,785	0.0808%	3,831,560	0.0505%	0	0.0000%
32830	0	0.0000%	0	0.0000%	135,196	0.0018%	0	0.0000%
32831	0	0.0000%	731	0.0001%	8,299	0.0001%	0	0.0000%
32832	0	0.0000%	620,751	0.1095%	5,342,457	0.0704%	0	0.0000%
32833	0	0.0000%	435,894	0.0769%	2,499,457	0.0329%	0	0.0000%
32835	0	0.0000%	1,004,537	0.1772%	13,109,211	0.1727%	0	0.0000%
32836	0	0.0000%	0	0.0000%	13,703,045	0.1805%	0	0.0000%
32837	0	0.0000%	0	0.0000%	16,898,655	0.2226%	0	0.0000%
32839	0	0.0000%	467,739	0.0825%	6,038,436	0.0795%	0	0.0000%
32853	0	0.0000%	12	0.0000%	117	0.0000%	0	0.0000%
32854	0	0.0000%	26	0.0000%	263	0.0000%	0	0.0000%
32855	0	0.0000%	0	0.0000%	5	0.0000%	0	0.0000%
32856	0	0.0000%	550	0.0001%	6,794	0.0001%	0	0.0000%
32857	0	0.0000%	277	0.0000%	2,622	0.0000%	0	0.0000%
32859	0	0.0000%	18	0.0000%	231	0.0000%	0	0.0000%
32862	0	0.0000%	0	0.0000%	8	0.0000%	0	0.0000%
32867	0	0.0000%	2	0.0000%	14	0.0000%	0	0.0000%
32869	0	0.0000%	0	0.0000%	9	0.0000%	0	0.0000%
32872	0	0.0000%	1	0.0000%	11	0.0000%	0	0.0000%
32877	0	0.0000%	0	0.0000%	14	0.0000%	0	0.0000%
32878	0	0.0000%	180	0.0000%	976	0.0000%	0	0.0000%
32886	0	0.0000%	2	0.0000%	25	0.0000%	0	0.0000%
32901	0	0.0000%	2,692,418	0.4750%	6,819,954	0.0898%	0	0.0000%
32902	0	0.0000%	335	0.0001%	804	0.0000%	0	0.0000%
32903	0	0.0000%	4,267,900	0.7529%	10,177,069	0.1341%	0	0.0000%
32904	0	0.0000%	3,290,355	0.5804%	9,082,934	0.1197%	0	0.0000%
32905	0	0.0000%	3,053,504	0.5387%	7,966,853	0.1050%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
32907	0	0.0000%	4,416,686	0.7791%	14,782,868	0.1947%	0	0.0000%
32908	0	0.0000%	712,408	0.1257%	2,999,157	0.0395%	0	0.0000%
32909	0	0.0000%	2,619,707	0.4621%	9,256,172	0.1219%	0	0.0000%
32910	0	0.0000%	5	0.0000%	17	0.0000%	0	0.0000%
32912	0	0.0000%	16	0.0000%	45	0.0000%	0	0.0000%
32919	0	0.0000%	749	0.0001%	1,893	0.0000%	0	0.0000%
32920	0	0.0000%	5,497,049	0.9697%	5,027,287	0.0662%	0	0.0000%
32922	0	0.0000%	1,127,730	0.1989%	2,796,773	0.0368%	0	0.0000%
32925	0	0.0000%	18,624	0.0033%	14,533	0.0002%	0	0.0000%
32926	0	0.0000%	3,119,076	0.5502%	7,907,522	0.1042%	0	0.0000%
32927	0	0.0000%	3,787,775	0.6682%	8,314,075	0.1095%	0	0.0000%
32931	0	0.0000%	8,626,239	1.5217%	12,866,250	0.1695%	0	0.0000%
32932	0	0.0000%	236	0.0000%	415	0.0000%	0	0.0000%
32934	0	0.0000%	3,407,651	0.6011%	8,883,652	0.1170%	0	0.0000%
32935	0	0.0000%	6,252,896	1.1031%	15,737,993	0.2073%	0	0.0000%
32936	0	0.0000%	535	0.0001%	1,333	0.0000%	0	0.0000%
32937	0	0.0000%	8,397,927	1.4814%	17,231,087	0.2270%	0	0.0000%
32940	0	0.0000%	7,035,096	1.2410%	18,012,532	0.2373%	0	0.0000%
32941	0	0.0000%	48	0.0000%	135	0.0000%	0	0.0000%
32948	0	0.0000%	236,785	0.0418%	979,250	0.0129%	0	0.0000%
32949	0	0.0000%	770,175	0.1359%	1,709,537	0.0225%	0	0.0000%
32950	0	0.0000%	1,189,924	0.2099%	3,134,502	0.0413%	0	0.0000%
32951	0	0.0000%	5,897,054	1.0403%	12,740,963	0.1678%	0	0.0000%
32952	0	0.0000%	7,464,525	1.3168%	16,707,305	0.2201%	0	0.0000%
32953	0	0.0000%	6,197,751	1.0933%	11,438,785	0.1507%	0	0.0000%
32954	0	0.0000%	474	0.0001%	933	0.0000%	0	0.0000%
32955	0	0.0000%	5,880,356	1.0373%	15,296,705	0.2015%	0	0.0000%
32956	0	0.0000%	3	0.0000%	9	0.0000%	0	0.0000%
32957	0	0.0000%	9,435	0.0017%	22,367	0.0003%	0	0.0000%
32958	0	0.0000%	5,979,811	1.0549%	14,773,303	0.1946%	0	0.0000%
32959	0	0.0000%	21	0.0000%	52	0.0000%	0	0.0000%
32960	0	0.0000%	2,731,916	0.4819%	7,210,235	0.0950%	0	0.0000%
32961	0	0.0000%	4,902	0.0009%	14,201	0.0002%	0	0.0000%
32962	0	0.0000%	2,837,805	0.5006%	8,570,426	0.1129%	0	0.0000%
32963	0	0.0000%	10,918,898	1.9262%	23,552,123	0.3103%	0	0.0000%
32964	0	0.0000%	1,740	0.0003%	4,271	0.0001%	0	0.0000%
32965	0	0.0000%	555	0.0001%	1,565	0.0000%	0	0.0000%
32966	0	0.0000%	1,921,904	0.3390%	6,879,907	0.0906%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
32967	0	0.0000%	2,769,311	0.4885%	6,957,045	0.0917%	0	0.0000%
32968	0	0.0000%	1,737,386	0.3065%	5,800,168	0.0764%	0	0.0000%
32969	0	0.0000%	1,116	0.0002%	5,767	0.0001%	0	0.0000%
32970	0	0.0000%	2,337	0.0004%	5,526	0.0001%	0	0.0000%
32976	0	0.0000%	3,908,300	0.6894%	9,299,773	0.1225%	0	0.0000%
32978	0	0.0000%	273	0.0000%	622	0.0000%	0	0.0000%
33001	0	0.0000%	0	0.0000%	1,465,402	0.0193%	0	0.0000%
33002	0	0.0000%	0	0.0000%	43	0.0000%	0	0.0000%
33004	0	0.0000%	0	0.0000%	3,749,664	0.0494%	0	0.0000%
33008	0	0.0000%	0	0.0000%	621	0.0000%	0	0.0000%
33009	0	0.0000%	0	0.0000%	9,938,838	0.1309%	0	0.0000%
33010	0	0.0000%	0	0.0000%	3,741,483	0.0493%	0	0.0000%
33012	0	0.0000%	0	0.0000%	8,138,594	0.1072%	0	0.0000%
33013	0	0.0000%	0	0.0000%	4,016,856	0.0529%	0	0.0000%
33014	0	0.0000%	0	0.0000%	8,382,391	0.1104%	0	0.0000%
33015	0	0.0000%	0	0.0000%	13,214,779	0.1741%	0	0.0000%
33016	0	0.0000%	0	0.0000%	7,457,519	0.0982%	0	0.0000%
33017	0	0.0000%	0	0.0000%	590	0.0000%	0	0.0000%
33018	0	0.0000%	0	0.0000%	10,817,187	0.1425%	0	0.0000%
33019	0	0.0000%	0	0.0000%	10,132,189	0.1335%	0	0.0000%
33020	0	0.0000%	0	0.0000%	6,897,073	0.0909%	0	0.0000%
33021	0	0.0000%	0	0.0000%	14,526,188	0.1914%	0	0.0000%
33022	0	0.0000%	0	0.0000%	436	0.0000%	0	0.0000%
33023	0	0.0000%	0	0.0000%	14,246,374	0.1877%	0	0.0000%
33024	0	0.0000%	0	0.0000%	17,106,411	0.2254%	0	0.0000%
33025	0	0.0000%	0	0.0000%	12,656,091	0.1667%	0	0.0000%
33026	0	0.0000%	0	0.0000%	15,598,272	0.2055%	0	0.0000%
33027	0	0.0000%	0	0.0000%	18,720,177	0.2466%	0	0.0000%
33028	0	0.0000%	0	0.0000%	7,500,106	0.0988%	0	0.0000%
33029	0	0.0000%	0	0.0000%	27,010,386	0.3558%	0	0.0000%
33030	0	0.0000%	0	0.0000%	7,811,735	0.1029%	0	0.0000%
33031	0	0.0000%	0	0.0000%	4,961,238	0.0654%	0	0.0000%
33032	0	0.0000%	0	0.0000%	9,787,889	0.1289%	0	0.0000%
33033	0	0.0000%	0	0.0000%	11,153,545	0.1469%	0	0.0000%
33034	0	0.0000%	0	0.0000%	3,233,477	0.0426%	0	0.0000%
33035	0	0.0000%	0	0.0000%	3,063,927	0.0404%	0	0.0000%
33036	0	0.0000%	0	0.0000%	17,393,873	0.2291%	0	0.0000%
33037	0	0.0000%	0	0.0000%	26,745,957	0.3523%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
33039	0	0.0000%	0	0.0000%	1,635	0.0000%	0	0.0000%
33040	0	0.0000%	0	0.0000%	55,890,791	0.7363%	0	0.0000%
33041	0	0.0000%	0	0.0000%	3,902	0.0001%	0	0.0000%
33042	0	0.0000%	0	0.0000%	54,640,791	0.7198%	0	0.0000%
33043	0	0.0000%	0	0.0000%	44,799,607	0.5902%	0	0.0000%
33045	0	0.0000%	0	0.0000%	7,601	0.0001%	0	0.0000%
33050	0	0.0000%	0	0.0000%	57,843,079	0.7620%	0	0.0000%
33051	0	0.0000%	0	0.0000%	12,703,200	0.1673%	0	0.0000%
33052	0	0.0000%	0	0.0000%	418,327	0.0055%	0	0.0000%
33054	0	0.0000%	0	0.0000%	2,989,418	0.0394%	0	0.0000%
33055	0	0.0000%	0	0.0000%	7,624,536	0.1004%	0	0.0000%
33056	0	0.0000%	0	0.0000%	5,876,743	0.0774%	0	0.0000%
33060	0	0.0000%	0	0.0000%	8,077,021	0.1064%	0	0.0000%
33061	0	0.0000%	0	0.0000%	5,242	0.0001%	0	0.0000%
33062	0	0.0000%	0	0.0000%	15,189,653	0.2001%	0	0.0000%
33063	0	0.0000%	0	0.0000%	15,865,146	0.2090%	0	0.0000%
33064	0	0.0000%	0	0.0000%	15,937,187	0.2100%	0	0.0000%
33065	0	0.0000%	0	0.0000%	16,692,872	0.2199%	0	0.0000%
33066	0	0.0000%	0	0.0000%	5,559,211	0.0732%	0	0.0000%
33067	0	0.0000%	0	0.0000%	14,969,838	0.1972%	0	0.0000%
33068	0	0.0000%	0	0.0000%	10,316,865	0.1359%	0	0.0000%
33069	0	0.0000%	0	0.0000%	5,514,037	0.0726%	0	0.0000%
33070	0	0.0000%	0	0.0000%	12,463,642	0.1642%	0	0.0000%
33071	0	0.0000%	0	0.0000%	19,465,544	0.2564%	0	0.0000%
33072	0	0.0000%	0	0.0000%	3,958	0.0001%	0	0.0000%
33073	0	0.0000%	0	0.0000%	7,472,087	0.0984%	0	0.0000%
33074	0	0.0000%	0	0.0000%	423	0.0000%	0	0.0000%
33075	0	0.0000%	0	0.0000%	5,184	0.0001%	0	0.0000%
33076	0	0.0000%	0	0.0000%	15,729,823	0.2072%	0	0.0000%
33077	0	0.0000%	0	0.0000%	796	0.0000%	0	0.0000%
33081	0	0.0000%	0	0.0000%	3,304	0.0000%	0	0.0000%
33082	0	0.0000%	0	0.0000%	1,170	0.0000%	0	0.0000%
33084	0	0.0000%	0	0.0000%	1,743	0.0000%	0	0.0000%
33090	0	0.0000%	0	0.0000%	1,201	0.0000%	0	0.0000%
33092	0	0.0000%	0	0.0000%	902	0.0000%	0	0.0000%
33101	0	0.0000%	0	0.0000%	2,852	0.0000%	0	0.0000%
33102	0	0.0000%	0	0.0000%	98	0.0000%	0	0.0000%
33109	0	0.0000%	0	0.0000%	2,854,823	0.0376%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
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33112	0	0.0000%	0	0.0000%	6,676	0.0001%	0	0.0000%
33114	0	0.0000%	0	0.0000%	25,750	0.0003%	0	0.0000%
33116	0	0.0000%	0	0.0000%	401	0.0000%	0	0.0000%
33119	0	0.0000%	0	0.0000%	3,117	0.0000%	0	0.0000%
33122	0	0.0000%	0	0.0000%	41,676	0.0005%	0	0.0000%
33125	0	0.0000%	0	0.0000%	3,960,204	0.0522%	0	0.0000%
33126	0	0.0000%	0	0.0000%	4,494,975	0.0592%	0	0.0000%
33127	0	0.0000%	0	0.0000%	1,974,021	0.0260%	0	0.0000%
33128	0	0.0000%	0	0.0000%	212,082	0.0028%	0	0.0000%
33129	0	0.0000%	0	0.0000%	5,231,564	0.0689%	0	0.0000%
33130	0	0.0000%	0	0.0000%	2,174,428	0.0286%	0	0.0000%
33131	0	0.0000%	0	0.0000%	4,318,506	0.0569%	0	0.0000%
33132	0	0.0000%	0	0.0000%	2,306,385	0.0304%	0	0.0000%
33133	0	0.0000%	0	0.0000%	13,329,856	0.1756%	0	0.0000%
33134	0	0.0000%	0	0.0000%	11,500,299	0.1515%	0	0.0000%
33135	0	0.0000%	0	0.0000%	2,588,042	0.0341%	0	0.0000%
33136	0	0.0000%	0	0.0000%	663,552	0.0087%	0	0.0000%
33137	0	0.0000%	0	0.0000%	3,869,872	0.0510%	0	0.0000%
33138	0	0.0000%	0	0.0000%	7,805,201	0.1028%	0	0.0000%
33139	0	0.0000%	0	0.0000%	14,820,071	0.1952%	0	0.0000%
33140	0	0.0000%	0	0.0000%	15,337,462	0.2021%	0	0.0000%
33141	0	0.0000%	0	0.0000%	9,416,811	0.1241%	0	0.0000%
33142	0	0.0000%	0	0.0000%	3,194,898	0.0421%	0	0.0000%
33143	0	0.0000%	0	0.0000%	16,269,017	0.2143%	0	0.0000%
33144	0	0.0000%	0	0.0000%	4,746,084	0.0625%	0	0.0000%
33145	0	0.0000%	0	0.0000%	5,435,574	0.0716%	0	0.0000%
33146	0	0.0000%	0	0.0000%	7,773,427	0.1024%	0	0.0000%
33147	0	0.0000%	0	0.0000%	3,757,898	0.0495%	0	0.0000%
33149	0	0.0000%	0	0.0000%	15,464,242	0.2037%	0	0.0000%
33150	0	0.0000%	0	0.0000%	2,456,817	0.0324%	0	0.0000%
33152	0	0.0000%	0	0.0000%	103	0.0000%	0	0.0000%
33154	0	0.0000%	0	0.0000%	10,910,707	0.1437%	0	0.0000%
33155	0	0.0000%	0	0.0000%	12,480,123	0.1644%	0	0.0000%
33156	0	0.0000%	0	0.0000%	28,254,372	0.3722%	0	0.0000%
33157	0	0.0000%	0	0.0000%	27,714,966	0.3651%	0	0.0000%
33158	0	0.0000%	0	0.0000%	6,689,250	0.0881%	0	0.0000%
33160	0	0.0000%	0	0.0000%	13,335,419	0.1757%	0	0.0000%
33161	0	0.0000%	0	0.0000%	7,776,895	0.1025%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
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33162	0	0.0000%	0	0.0000%	6,750,519	0.0889%	0	0.0000%
33164	0	0.0000%	0	0.0000%	5,650	0.0001%	0	0.0000%
33165	0	0.0000%	0	0.0000%	15,128,031	0.1993%	0	0.0000%
33166	0	0.0000%	0	0.0000%	5,148,104	0.0678%	0	0.0000%
33167	0	0.0000%	0	0.0000%	2,260,868	0.0298%	0	0.0000%
33168	0	0.0000%	0	0.0000%	3,627,179	0.0478%	0	0.0000%
33169	0	0.0000%	0	0.0000%	6,031,382	0.0795%	0	0.0000%
33170	0	0.0000%	0	0.0000%	3,036,736	0.0400%	0	0.0000%
33172	0	0.0000%	0	0.0000%	4,716,843	0.0621%	0	0.0000%
33173	0	0.0000%	0	0.0000%	12,065,019	0.1589%	0	0.0000%
33174	0	0.0000%	0	0.0000%	5,615,055	0.0740%	0	0.0000%
33175	0	0.0000%	0	0.0000%	17,200,295	0.2266%	0	0.0000%
33176	0	0.0000%	0	0.0000%	24,748,732	0.3260%	0	0.0000%
33177	0	0.0000%	0	0.0000%	14,695,776	0.1936%	0	0.0000%
33178	0	0.0000%	0	0.0000%	10,441,646	0.1376%	0	0.0000%
33179	0	0.0000%	0	0.0000%	8,661,397	0.1141%	0	0.0000%
33180	0	0.0000%	0	0.0000%	9,152,749	0.1206%	0	0.0000%
33181	0	0.0000%	0	0.0000%	3,860,153	0.0509%	0	0.0000%
33182	0	0.0000%	0	0.0000%	4,772,783	0.0629%	0	0.0000%
33183	0	0.0000%	0	0.0000%	11,076,332	0.1459%	0	0.0000%
33184	0	0.0000%	0	0.0000%	5,937,373	0.0782%	0	0.0000%
33185	0	0.0000%	0	0.0000%	8,788,025	0.1158%	0	0.0000%
33186	0	0.0000%	0	0.0000%	27,969,124	0.3685%	0	0.0000%
33187	0	0.0000%	0	0.0000%	7,665,273	0.1010%	0	0.0000%
33188	0	0.0000%	0	0.0000%	4,682	0.0001%	0	0.0000%
33189	0	0.0000%	0	0.0000%	8,260,974	0.1088%	0	0.0000%
33190	0	0.0000%	0	0.0000%	2,695,148	0.0355%	0	0.0000%
33192	0	0.0000%	0	0.0000%	8	0.0000%	0	0.0000%
33193	0	0.0000%	0	0.0000%	12,400,864	0.1634%	0	0.0000%
33194	0	0.0000%	0	0.0000%	964,333	0.0127%	0	0.0000%
33195	0	0.0000%	0	0.0000%	263	0.0000%	0	0.0000%
33196	0	0.0000%	0	0.0000%	15,848,957	0.2088%	0	0.0000%
33197	0	0.0000%	0	0.0000%	1,813	0.0000%	0	0.0000%
33199	0	0.0000%	0	0.0000%	4	0.0000%	0	0.0000%
33231	0	0.0000%	0	0.0000%	675	0.0000%	0	0.0000%
33233	0	0.0000%	0	0.0000%	769	0.0000%	0	0.0000%
33234	0	0.0000%	0	0.0000%	2	0.0000%	0	0.0000%
33239	0	0.0000%	0	0.0000%	33	0.0000%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
33245	0	0.0000%	0	0.0000%	5	0.0000%	0	0.0000%
33256	0	0.0000%	0	0.0000%	205	0.0000%	0	0.0000%
33261	0	0.0000%	0	0.0000%	3,314	0.0000%	0	0.0000%
33266	0	0.0000%	0	0.0000%	10	0.0000%	0	0.0000%
33269	0	0.0000%	0	0.0000%	42	0.0000%	0	0.0000%
33301	0	0.0000%	0	0.0000%	7,347,109	0.0968%	0	0.0000%
33302	0	0.0000%	0	0.0000%	533	0.0000%	0	0.0000%
33303	0	0.0000%	0	0.0000%	7	0.0000%	0	0.0000%
33304	0	0.0000%	0	0.0000%	6,654,655	0.0877%	0	0.0000%
33305	0	0.0000%	0	0.0000%	5,808,343	0.0765%	0	0.0000%
33306	0	0.0000%	0	0.0000%	2,105,754	0.0277%	0	0.0000%
33307	0	0.0000%	0	0.0000%	124	0.0000%	0	0.0000%
33308	0	0.0000%	0	0.0000%	16,267,146	0.2143%	0	0.0000%
33309	0	0.0000%	0	0.0000%	9,092,531	0.1198%	0	0.0000%
33310	0	0.0000%	0	0.0000%	9,689	0.0001%	0	0.0000%
33311	0	0.0000%	0	0.0000%	8,237,935	0.1085%	0	0.0000%
33312	0	0.0000%	0	0.0000%	12,452,682	0.1640%	0	0.0000%
33313	0	0.0000%	0	0.0000%	8,936,183	0.1177%	0	0.0000%
33314	0	0.0000%	0	0.0000%	4,438,039	0.0585%	0	0.0000%
33315	0	0.0000%	0	0.0000%	4,260,990	0.0561%	0	0.0000%
33316	0	0.0000%	0	0.0000%	8,411,430	0.1108%	0	0.0000%
33317	0	0.0000%	0	0.0000%	14,789,459	0.1948%	0	0.0000%
33318	0	0.0000%	0	0.0000%	4,958	0.0001%	0	0.0000%
33319	0	0.0000%	0	0.0000%	12,936,285	0.1704%	0	0.0000%
33321	0	0.0000%	0	0.0000%	15,284,416	0.2014%	0	0.0000%
33322	0	0.0000%	0	0.0000%	14,807,986	0.1951%	0	0.0000%
33323	0	0.0000%	0	0.0000%	10,532,591	0.1388%	0	0.0000%
33324	0	0.0000%	0	0.0000%	17,129,251	0.2257%	0	0.0000%
33325	0	0.0000%	0	0.0000%	14,440,526	0.1902%	0	0.0000%
33326	0	0.0000%	0	0.0000%	21,596,093	0.2845%	0	0.0000%
33327	0	0.0000%	0	0.0000%	11,042,856	0.1455%	0	0.0000%
33328	0	0.0000%	0	0.0000%	13,494,329	0.1778%	0	0.0000%
33329	0	0.0000%	0	0.0000%	2,456	0.0000%	0	0.0000%
33330	0	0.0000%	0	0.0000%	9,977,752	0.1314%	0	0.0000%
33331	0	0.0000%	0	0.0000%	14,978,307	0.1973%	0	0.0000%
33332	0	0.0000%	0	0.0000%	8,749,131	0.1153%	0	0.0000%
33334	0	0.0000%	0	0.0000%	8,341,444	0.1099%	0	0.0000%
33335	0	0.0000%	0	0.0000%	1,968	0.0000%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
33338	0	0.0000%	0	0.0000%	42	0.0000%	0	0.0000%
33340	0	0.0000%	0	0.0000%	18	0.0000%	0	0.0000%
33345	0	0.0000%	0	0.0000%	60	0.0000%	0	0.0000%
33346	0	0.0000%	0	0.0000%	30	0.0000%	0	0.0000%
33351	0	0.0000%	0	0.0000%	9,588,959	0.1263%	0	0.0000%
33394	0	0.0000%	0	0.0000%	358	0.0000%	0	0.0000%
33401	0	0.0000%	469,877	0.0829%	6,060,082	0.0798%	0	0.0000%
33402	0	0.0000%	83	0.0000%	1,060	0.0000%	0	0.0000%
33403	0	0.0000%	227,866	0.0402%	2,245,036	0.0296%	0	0.0000%
33404	0	0.0000%	642,319	0.1133%	6,674,576	0.0879%	0	0.0000%
33405	0	0.0000%	357,514	0.0631%	6,280,391	0.0827%	0	0.0000%
33406	0	0.0000%	0	0.0000%	6,283,038	0.0828%	0	0.0000%
33407	0	0.0000%	442,662	0.0781%	5,037,081	0.0664%	0	0.0000%
33408	0	0.0000%	1,405,762	0.2480%	12,551,047	0.1653%	0	0.0000%
33409	0	0.0000%	0	0.0000%	5,485,514	0.0723%	0	0.0000%
33410	0	0.0000%	1,784,969	0.3149%	14,609,357	0.1925%	0	0.0000%
33411	0	0.0000%	0	0.0000%	21,380,334	0.2817%	0	0.0000%
33412	0	0.0000%	0	0.0000%	6,939,108	0.0914%	0	0.0000%
33413	0	0.0000%	0	0.0000%	2,992,204	0.0394%	0	0.0000%
33414	0	0.0000%	0	0.0000%	26,914,601	0.3546%	0	0.0000%
33415	0	0.0000%	0	0.0000%	7,519,423	0.0991%	0	0.0000%
33416	0	0.0000%	0	0.0000%	22,335	0.0003%	0	0.0000%
33417	0	0.0000%	0	0.0000%	7,339,079	0.0967%	0	0.0000%
33418	0	0.0000%	2,845,496	0.5020%	23,329,773	0.3073%	0	0.0000%
33419	0	0.0000%	907	0.0002%	9,229	0.0001%	0	0.0000%
33420	0	0.0000%	860	0.0002%	8,940	0.0001%	0	0.0000%
33422	0	0.0000%	218	0.0000%	2,919	0.0000%	0	0.0000%
33424	0	0.0000%	0	0.0000%	8,986	0.0001%	0	0.0000%
33425	0	0.0000%	0	0.0000%	100,141	0.0013%	0	0.0000%
33426	0	0.0000%	0	0.0000%	7,225,401	0.0952%	0	0.0000%
33427	0	0.0000%	0	0.0000%	591	0.0000%	0	0.0000%
33428	0	0.0000%	0	0.0000%	18,303,861	0.2411%	0	0.0000%
33429	0	0.0000%	0	0.0000%	2,160	0.0000%	0	0.0000%
33430	0	0.0000%	0	0.0000%	2,519,614	0.0332%	0	0.0000%
33431	0	0.0000%	0	0.0000%	9,887,733	0.1303%	0	0.0000%
33432	0	0.0000%	0	0.0000%	13,178,527	0.1736%	0	0.0000%
33433	0	0.0000%	0	0.0000%	23,604,901	0.3110%	0	0.0000%
33434	0	0.0000%	0	0.0000%	15,691,058	0.2067%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
33435	0	0.0000%	0	0.0000%	11,074,489	0.1459%	0	0.0000%
33436	0	0.0000%	0	0.0000%	18,009,220	0.2372%	0	0.0000%
33437	0	0.0000%	0	0.0000%	16,304,908	0.2148%	0	0.0000%
33438	0	0.0000%	0	0.0000%	149,376	0.0020%	0	0.0000%
33440	0	0.0000%	0	0.0000%	12,732,184	0.1677%	0	0.0000%
33441	0	0.0000%	0	0.0000%	8,290,312	0.1092%	0	0.0000%
33442	0	0.0000%	0	0.0000%	10,953,859	0.1443%	0	0.0000%
33443	0	0.0000%	0	0.0000%	2,445	0.0000%	0	0.0000%
33444	0	0.0000%	0	0.0000%	5,971,383	0.0787%	0	0.0000%
33445	0	0.0000%	0	0.0000%	13,392,029	0.1764%	0	0.0000%
33446	0	0.0000%	0	0.0000%	13,719,583	0.1807%	0	0.0000%
33448	0	0.0000%	0	0.0000%	13,389	0.0002%	0	0.0000%
33449	0	0.0000%	0	0.0000%	4,091,197	0.0539%	0	0.0000%
33454	0	0.0000%	0	0.0000%	67	0.0000%	0	0.0000%
33455	0	0.0000%	3,264,720	0.5759%	16,505,532	0.2174%	0	0.0000%
33458	0	0.0000%	2,556,614	0.4510%	16,297,131	0.2147%	0	0.0000%
33459	0	0.0000%	0	0.0000%	21,806	0.0003%	0	0.0000%
33460	0	0.0000%	0	0.0000%	6,583,394	0.0867%	0	0.0000%
33461	0	0.0000%	0	0.0000%	6,068,881	0.0799%	0	0.0000%
33462	0	0.0000%	0	0.0000%	12,307,998	0.1621%	0	0.0000%
33463	0	0.0000%	0	0.0000%	11,227,296	0.1479%	0	0.0000%
33464	0	0.0000%	0	0.0000%	4,503	0.0001%	0	0.0000%
33465	0	0.0000%	0	0.0000%	68	0.0000%	0	0.0000%
33466	0	0.0000%	0	0.0000%	2,926	0.0000%	0	0.0000%
33467	0	0.0000%	0	0.0000%	19,127,667	0.2520%	0	0.0000%
33468	0	0.0000%	2,083	0.0004%	11,409	0.0002%	0	0.0000%
33469	0	0.0000%	2,082,777	0.3674%	13,680,257	0.1802%	0	0.0000%
33470	0	0.0000%	0	0.0000%	9,358,674	0.1233%	0	0.0000%
33471	0	0.0000%	0	0.0000%	6,559,507	0.0864%	0	0.0000%
33472	0	0.0000%	0	0.0000%	8,551,018	0.1126%	0	0.0000%
33473	0	0.0000%	0	0.0000%	2,807,236	0.0370%	0	0.0000%
33474	0	0.0000%	0	0.0000%	5,246	0.0001%	0	0.0000%
33475	0	0.0000%	2,930	0.0005%	12,869	0.0002%	0	0.0000%
33476	0	0.0000%	0	0.0000%	976,631	0.0129%	0	0.0000%
33477	0	0.0000%	1,454,387	0.2566%	10,197,955	0.1343%	0	0.0000%
33478	0	0.0000%	731,960	0.1291%	6,184,638	0.0815%	0	0.0000%
33480	0	0.0000%	2,558,924	0.4514%	36,747,226	0.4841%	0	0.0000%
33481	0	0.0000%	0	0.0000%	369	0.0000%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
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33482	0	0.0000%	0	0.0000%	741	0.0000%	0	0.0000%
33483	0	0.0000%	0	0.0000%	10,295,242	0.1356%	0	0.0000%
33484	0	0.0000%	0	0.0000%	11,024,262	0.1452%	0	0.0000%
33486	0	0.0000%	0	0.0000%	12,780,920	0.1684%	0	0.0000%
33487	0	0.0000%	0	0.0000%	12,035,723	0.1586%	0	0.0000%
33493	0	0.0000%	0	0.0000%	495,721	0.0065%	0	0.0000%
33496	0	0.0000%	0	0.0000%	26,328,768	0.3468%	0	0.0000%
33497	0	0.0000%	0	0.0000%	4,775	0.0001%	0	0.0000%
33498	0	0.0000%	0	0.0000%	12,591,819	0.1659%	0	0.0000%
33503	0	0.0000%	0	0.0000%	17,825	0.0002%	0	0.0000%
33508	0	0.0000%	0	0.0000%	773	0.0000%	0	0.0000%
33509	0	0.0000%	0	0.0000%	28	0.0000%	0	0.0000%
33510	0	0.0000%	0	0.0000%	7,313,111	0.0963%	0	0.0000%
33511	0	0.0000%	0	0.0000%	12,303,933	0.1621%	0	0.0000%
33513	0	0.0000%	0	0.0000%	4,580,395	0.0603%	0	0.0000%
33514	0	0.0000%	0	0.0000%	858,694	0.0113%	0	0.0000%
33521	0	0.0000%	0	0.0000%	271,328	0.0036%	0	0.0000%
33523	0	0.0000%	0	0.0000%	6,516,974	0.0859%	0	0.0000%
33524	0	0.0000%	0	0.0000%	15,096	0.0002%	0	0.0000%
33525	0	0.0000%	0	0.0000%	9,936,585	0.1309%	0	0.0000%
33526	0	0.0000%	0	0.0000%	24,772	0.0003%	0	0.0000%
33527	0	0.0000%	0	0.0000%	4,039,398	0.0532%	0	0.0000%
33530	0	0.0000%	0	0.0000%	26,672	0.0004%	0	0.0000%
33534	0	0.0000%	0	0.0000%	1,313,514	0.0173%	0	0.0000%
33537	0	0.0000%	0	0.0000%	26,940	0.0004%	0	0.0000%
33538	0	0.0000%	0	0.0000%	2,073,414	0.0273%	0	0.0000%
33539	0	0.0000%	0	0.0000%	12,910	0.0002%	0	0.0000%
33540	0	0.0000%	0	0.0000%	5,521,520	0.0727%	0	0.0000%
33541	0	0.0000%	0	0.0000%	11,562,866	0.1523%	0	0.0000%
33542	0	0.0000%	0	0.0000%	13,068,904	0.1722%	0	0.0000%
33543	0	0.0000%	0	0.0000%	7,617,180	0.1003%	0	0.0000%
33544	0	0.0000%	0	0.0000%	3,904,089	0.0514%	0	0.0000%
33545	0	0.0000%	0	0.0000%	3,376,801	0.0445%	0	0.0000%
33547	0	0.0000%	0	0.0000%	7,926,959	0.1044%	0	0.0000%
33548	0	0.0000%	0	0.0000%	2,140,558	0.0282%	0	0.0000%
33549	0	0.0000%	0	0.0000%	3,892,742	0.0513%	0	0.0000%
33550	0	0.0000%	0	0.0000%	17,950	0.0002%	0	0.0000%
33556	0	0.0000%	0	0.0000%	4,407,089	0.0581%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
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33558	0	0.0000%	0	0.0000%	3,720,864	0.0490%	0	0.0000%
33559	0	0.0000%	0	0.0000%	2,533,141	0.0334%	0	0.0000%
33563	0	0.0000%	0	0.0000%	6,956,376	0.0916%	0	0.0000%
33564	0	0.0000%	0	0.0000%	16,007	0.0002%	0	0.0000%
33565	0	0.0000%	0	0.0000%	7,189,361	0.0947%	0	0.0000%
33566	0	0.0000%	0	0.0000%	8,597,068	0.1133%	0	0.0000%
33567	0	0.0000%	0	0.0000%	3,302,891	0.0435%	0	0.0000%
33568	0	0.0000%	0	0.0000%	7,041	0.0001%	0	0.0000%
33569	0	0.0000%	0	0.0000%	6,135,364	0.0808%	0	0.0000%
33570	0	0.0000%	0	0.0000%	3,604,472	0.0475%	0	0.0000%
33571	0	0.0000%	0	0.0000%	842	0.0000%	0	0.0000%
33572	0	0.0000%	0	0.0000%	5,996,166	0.0790%	0	0.0000%
33573	0	0.0000%	0	0.0000%	6,795,072	0.0895%	0	0.0000%
33574	0	0.0000%	0	0.0000%	5,176	0.0001%	0	0.0000%
33575	0	0.0000%	0	0.0000%	399	0.0000%	0	0.0000%
33576	0	0.0000%	0	0.0000%	1,611,480	0.0212%	0	0.0000%
33578	0	0.0000%	0	0.0000%	5,062,308	0.0667%	0	0.0000%
33579	0	0.0000%	0	0.0000%	3,965,897	0.0522%	0	0.0000%
33583	0	0.0000%	0	0.0000%	17	0.0000%	0	0.0000%
33584	0	0.0000%	0	0.0000%	7,100,248	0.0935%	0	0.0000%
33585	0	0.0000%	0	0.0000%	633,993	0.0084%	0	0.0000%
33586	0	0.0000%	0	0.0000%	925	0.0000%	0	0.0000%
33587	0	0.0000%	0	0.0000%	3,352	0.0000%	0	0.0000%
33592	0	0.0000%	0	0.0000%	2,113,465	0.0278%	0	0.0000%
33593	0	0.0000%	0	0.0000%	8,853	0.0001%	0	0.0000%
33594	0	0.0000%	0	0.0000%	9,668,921	0.1274%	0	0.0000%
33595	0	0.0000%	0	0.0000%	4,811	0.0001%	0	0.0000%
33596	0	0.0000%	0	0.0000%	10,489,630	0.1382%	0	0.0000%
33597	0	0.0000%	0	0.0000%	3,103,654	0.0409%	0	0.0000%
33598	0	0.0000%	0	0.0000%	2,429,704	0.0320%	0	0.0000%
33601	0	0.0000%	0	0.0000%	14,656	0.0002%	0	0.0000%
33602	0	0.0000%	0	0.0000%	1,536,644	0.0202%	0	0.0000%
33603	0	0.0000%	0	0.0000%	2,372,163	0.0313%	0	0.0000%
33604	0	0.0000%	0	0.0000%	3,725,577	0.0491%	0	0.0000%
33605	0	0.0000%	0	0.0000%	1,208,354	0.0159%	0	0.0000%
33606	0	0.0000%	0	0.0000%	4,419,523	0.0582%	0	0.0000%
33607	0	0.0000%	0	0.0000%	1,682,625	0.0222%	0	0.0000%
33608	0	0.0000%	0	0.0000%	72	0.0000%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
33609	0	0.0000%	0	0.0000%	3,781,635	0.0498%	0	0.0000%
33610	0	0.0000%	0	0.0000%	3,361,319	0.0443%	0	0.0000%
33611	0	0.0000%	0	0.0000%	6,054,635	0.0798%	0	0.0000%
33612	0	0.0000%	0	0.0000%	3,546,106	0.0467%	0	0.0000%
33613	0	0.0000%	0	0.0000%	3,712,437	0.0489%	0	0.0000%
33614	0	0.0000%	0	0.0000%	2,823,521	0.0372%	0	0.0000%
33615	0	0.0000%	0	0.0000%	4,416,494	0.0582%	0	0.0000%
33616	0	0.0000%	0	0.0000%	1,800,134	0.0237%	0	0.0000%
33617	0	0.0000%	0	0.0000%	6,019,597	0.0793%	0	0.0000%
33618	0	0.0000%	0	0.0000%	5,541,886	0.0730%	0	0.0000%
33619	0	0.0000%	0	0.0000%	3,407,081	0.0449%	0	0.0000%
33620	0	0.0000%	0	0.0000%	110	0.0000%	0	0.0000%
33621	0	0.0000%	0	0.0000%	5,570	0.0001%	0	0.0000%
33622	0	0.0000%	0	0.0000%	1,318	0.0000%	0	0.0000%
33623	0	0.0000%	0	0.0000%	25	0.0000%	0	0.0000%
33624	0	0.0000%	0	0.0000%	6,415,601	0.0845%	0	0.0000%
33625	0	0.0000%	0	0.0000%	2,445,023	0.0322%	0	0.0000%
33626	0	0.0000%	0	0.0000%	2,292,446	0.0302%	0	0.0000%
33629	0	0.0000%	0	0.0000%	8,171,171	0.1076%	0	0.0000%
33634	0	0.0000%	0	0.0000%	2,077,985	0.0274%	0	0.0000%
33635	0	0.0000%	0	0.0000%	1,285,513	0.0169%	0	0.0000%
33637	0	0.0000%	0	0.0000%	1,807,251	0.0238%	0	0.0000%
33646	0	0.0000%	0	0.0000%	10	0.0000%	0	0.0000%
33647	0	0.0000%	0	0.0000%	12,104,590	0.1595%	0	0.0000%
33655	0	0.0000%	0	0.0000%	490	0.0000%	0	0.0000%
33660	0	0.0000%	0	0.0000%	1,532	0.0000%	0	0.0000%
33672	0	0.0000%	0	0.0000%	432	0.0000%	0	0.0000%
33675	0	0.0000%	0	0.0000%	2,887	0.0000%	0	0.0000%
33679	0	0.0000%	0	0.0000%	2	0.0000%	0	0.0000%
33680	0	0.0000%	0	0.0000%	826	0.0000%	0	0.0000%
33682	0	0.0000%	0	0.0000%	2	0.0000%	0	0.0000%
33684	0	0.0000%	0	0.0000%	13	0.0000%	0	0.0000%
33685	0	0.0000%	0	0.0000%	1,049	0.0000%	0	0.0000%
33687	0	0.0000%	0	0.0000%	42	0.0000%	0	0.0000%
33688	0	0.0000%	0	0.0000%	9	0.0000%	0	0.0000%
33694	0	0.0000%	0	0.0000%	9	0.0000%	0	0.0000%
33701	0	0.0000%	0	0.0000%	1,299,453	0.0171%	0	0.0000%
33702	0	0.0000%	0	0.0000%	3,711,136	0.0489%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
33703	0	0.0000%	0	0.0000%	4,349,953	0.0573%	0	0.0000%
33704	0	0.0000%	0	0.0000%	3,278,373	0.0432%	0	0.0000%
33705	0	0.0000%	0	0.0000%	2,563,540	0.0338%	0	0.0000%
33706	0	0.0000%	0	0.0000%	3,980,019	0.0524%	0	0.0000%
33707	0	0.0000%	0	0.0000%	2,955,484	0.0389%	0	0.0000%
33708	0	0.0000%	0	0.0000%	2,263,597	0.0298%	0	0.0000%
33709	0	0.0000%	0	0.0000%	1,554,207	0.0205%	0	0.0000%
33710	0	0.0000%	0	0.0000%	3,342,667	0.0440%	0	0.0000%
33711	0	0.0000%	0	0.0000%	1,336,065	0.0176%	0	0.0000%
33712	0	0.0000%	0	0.0000%	1,574,076	0.0207%	0	0.0000%
33713	0	0.0000%	0	0.0000%	2,302,339	0.0303%	0	0.0000%
33714	0	0.0000%	0	0.0000%	832,547	0.0110%	0	0.0000%
33715	0	0.0000%	0	0.0000%	3,183,301	0.0419%	0	0.0000%
33716	0	0.0000%	0	0.0000%	373,899	0.0049%	0	0.0000%
33730	0	0.0000%	0	0.0000%	3	0.0000%	0	0.0000%
33731	0	0.0000%	0	0.0000%	1	0.0000%	0	0.0000%
33732	0	0.0000%	0	0.0000%	17	0.0000%	0	0.0000%
33733	0	0.0000%	0	0.0000%	283	0.0000%	0	0.0000%
33734	0	0.0000%	0	0.0000%	22	0.0000%	0	0.0000%
33738	0	0.0000%	0	0.0000%	1	0.0000%	0	0.0000%
33740	0	0.0000%	0	0.0000%	76	0.0000%	0	0.0000%
33741	0	0.0000%	0	0.0000%	79	0.0000%	0	0.0000%
33743	0	0.0000%	0	0.0000%	24	0.0000%	0	0.0000%
33744	0	0.0000%	0	0.0000%	5	0.0000%	0	0.0000%
33747	0	0.0000%	0	0.0000%	2	0.0000%	0	0.0000%
33755	0	0.0000%	0	0.0000%	1,987,861	0.0262%	0	0.0000%
33756	0	0.0000%	0	0.0000%	3,075,565	0.0405%	0	0.0000%
33758	0	0.0000%	0	0.0000%	44	0.0000%	0	0.0000%
33759	0	0.0000%	0	0.0000%	1,452,906	0.0191%	0	0.0000%
33760	0	0.0000%	0	0.0000%	968,590	0.0128%	0	0.0000%
33761	0	0.0000%	0	0.0000%	2,013,806	0.0265%	0	0.0000%
33762	0	0.0000%	0	0.0000%	1,215,635	0.0160%	0	0.0000%
33763	0	0.0000%	0	0.0000%	1,101,576	0.0145%	0	0.0000%
33764	0	0.0000%	0	0.0000%	2,415,326	0.0318%	0	0.0000%
33765	0	0.0000%	0	0.0000%	840,943	0.0111%	0	0.0000%
33766	0	0.0000%	0	0.0000%	18	0.0000%	0	0.0000%
33767	0	0.0000%	0	0.0000%	2,355,564	0.0310%	0	0.0000%
33769	0	0.0000%	0	0.0000%	49	0.0000%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
33770	0	0.0000%	0	0.0000%	2,255,633	0.0297%	0	0.0000%
33771	0	0.0000%	0	0.0000%	1,386,504	0.0183%	0	0.0000%
33772	0	0.0000%	0	0.0000%	2,379,118	0.0313%	0	0.0000%
33773	0	0.0000%	0	0.0000%	1,363,034	0.0180%	0	0.0000%
33774	0	0.0000%	0	0.0000%	1,913,670	0.0252%	0	0.0000%
33775	0	0.0000%	0	0.0000%	3,233	0.0000%	0	0.0000%
33776	0	0.0000%	0	0.0000%	1,766,145	0.0233%	0	0.0000%
33777	0	0.0000%	0	0.0000%	1,690,290	0.0223%	0	0.0000%
33778	0	0.0000%	0	0.0000%	1,125,901	0.0148%	0	0.0000%
33779	0	0.0000%	0	0.0000%	248	0.0000%	0	0.0000%
33780	0	0.0000%	0	0.0000%	1,083	0.0000%	0	0.0000%
33781	0	0.0000%	0	0.0000%	1,403,931	0.0185%	0	0.0000%
33782	0	0.0000%	0	0.0000%	1,781,354	0.0235%	0	0.0000%
33784	0	0.0000%	0	0.0000%	226	0.0000%	0	0.0000%
33785	0	0.0000%	0	0.0000%	1,166,519	0.0154%	0	0.0000%
33786	0	0.0000%	0	0.0000%	686,509	0.0090%	0	0.0000%
33801	0	0.0000%	0	0.0000%	21,169,614	0.2789%	0	0.0000%
33802	0	0.0000%	0	0.0000%	100,413	0.0013%	0	0.0000%
33803	0	0.0000%	0	0.0000%	27,463,065	0.3618%	0	0.0000%
33804	0	0.0000%	0	0.0000%	10,431	0.0001%	0	0.0000%
33805	0	0.0000%	0	0.0000%	9,906,737	0.1305%	0	0.0000%
33806	0	0.0000%	0	0.0000%	12,354	0.0002%	0	0.0000%
33807	0	0.0000%	0	0.0000%	7,061	0.0001%	0	0.0000%
33809	0	0.0000%	0	0.0000%	26,042,891	0.3431%	0	0.0000%
33810	0	0.0000%	0	0.0000%	28,653,721	0.3775%	0	0.0000%
33811	0	0.0000%	0	0.0000%	12,791,934	0.1685%	0	0.0000%
33812	0	0.0000%	0	0.0000%	11,866,700	0.1563%	0	0.0000%
33813	0	0.0000%	0	0.0000%	43,208,830	0.5692%	0	0.0000%
33815	0	0.0000%	0	0.0000%	3,808,770	0.0502%	0	0.0000%
33820	0	0.0000%	0	0.0000%	241,354	0.0032%	0	0.0000%
33823	0	0.0000%	0	0.0000%	33,662,234	0.4435%	0	0.0000%
33825	0	0.0000%	0	0.0000%	27,808,683	0.3663%	0	0.0000%
33826	0	0.0000%	0	0.0000%	293	0.0000%	0	0.0000%
33827	0	0.0000%	0	0.0000%	4,939,726	0.0651%	0	0.0000%
33830	0	0.0000%	0	0.0000%	28,430,725	0.3745%	0	0.0000%
33831	0	0.0000%	0	0.0000%	3,553	0.0000%	0	0.0000%
33834	0	0.0000%	0	0.0000%	2,575,263	0.0339%	0	0.0000%
33835	0	0.0000%	0	0.0000%	214,834	0.0028%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
33836	0	0.0000%	0	0.0000%	37,702	0.0005%	0	0.0000%
33837	0	0.0000%	0	0.0000%	13,437,036	0.1770%	0	0.0000%
33838	0	0.0000%	0	0.0000%	2,549,140	0.0336%	0	0.0000%
33839	0	0.0000%	0	0.0000%	3,125,552	0.0412%	0	0.0000%
33840	0	0.0000%	0	0.0000%	66,170	0.0009%	0	0.0000%
33841	0	0.0000%	0	0.0000%	8,192,417	0.1079%	0	0.0000%
33843	0	0.0000%	0	0.0000%	12,814,924	0.1688%	0	0.0000%
33844	0	0.0000%	0	0.0000%	25,748,347	0.3392%	0	0.0000%
33845	0	0.0000%	0	0.0000%	88,858	0.0012%	0	0.0000%
33846	0	0.0000%	0	0.0000%	221,400	0.0029%	0	0.0000%
33847	0	0.0000%	0	0.0000%	298,533	0.0039%	0	0.0000%
33848	0	0.0000%	0	0.0000%	131,106	0.0017%	0	0.0000%
33849	0	0.0000%	0	0.0000%	375,568	0.0049%	0	0.0000%
33850	0	0.0000%	0	0.0000%	9,443,580	0.1244%	0	0.0000%
33851	0	0.0000%	0	0.0000%	694,771	0.0092%	0	0.0000%
33852	0	0.0000%	0	0.0000%	44,824,539	0.5905%	0	0.0000%
33853	0	0.0000%	0	0.0000%	10,807,876	0.1424%	0	0.0000%
33854	0	0.0000%	0	0.0000%	352,712	0.0046%	0	0.0000%
33855	0	0.0000%	0	0.0000%	1,571,252	0.0207%	0	0.0000%
33856	0	0.0000%	0	0.0000%	8,131	0.0001%	0	0.0000%
33857	0	0.0000%	0	0.0000%	1,980,770	0.0261%	0	0.0000%
33858	0	0.0000%	0	0.0000%	45,318	0.0006%	0	0.0000%
33859	0	0.0000%	0	0.0000%	10,167,012	0.1339%	0	0.0000%
33860	0	0.0000%	0	0.0000%	13,026,242	0.1716%	0	0.0000%
33862	0	0.0000%	0	0.0000%	6,699	0.0001%	0	0.0000%
33863	0	0.0000%	0	0.0000%	22,290	0.0003%	0	0.0000%
33865	0	0.0000%	0	0.0000%	434,565	0.0057%	0	0.0000%
33867	0	0.0000%	0	0.0000%	187,189	0.0025%	0	0.0000%
33868	0	0.0000%	0	0.0000%	10,510,721	0.1385%	0	0.0000%
33870	0	0.0000%	0	0.0000%	26,650,863	0.3511%	0	0.0000%
33871	0	0.0000%	0	0.0000%	10,283	0.0001%	0	0.0000%
33872	0	0.0000%	0	0.0000%	30,092,818	0.3964%	0	0.0000%
33873	0	0.0000%	0	0.0000%	8,667,605	0.1142%	0	0.0000%
33875	0	0.0000%	0	0.0000%	19,676,527	0.2592%	0	0.0000%
33876	0	0.0000%	0	0.0000%	9,664,855	0.1273%	0	0.0000%
33877	0	0.0000%	0	0.0000%	238,853	0.0031%	0	0.0000%
33880	0	0.0000%	0	0.0000%	37,035,471	0.4879%	0	0.0000%
33881	0	0.0000%	0	0.0000%	38,976,209	0.5135%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
33882	0	0.0000%	0	0.0000%	26,822	0.0004%	0	0.0000%
33883	0	0.0000%	0	0.0000%	14,015	0.0002%	0	0.0000%
33884	0	0.0000%	0	0.0000%	46,347,595	0.6106%	0	0.0000%
33885	0	0.0000%	0	0.0000%	1,367	0.0000%	0	0.0000%
33888	0	0.0000%	0	0.0000%	1,185	0.0000%	0	0.0000%
33890	0	0.0000%	0	0.0000%	4,570,693	0.0602%	0	0.0000%
33896	0	0.0000%	0	0.0000%	3,891,675	0.0513%	0	0.0000%
33897	0	0.0000%	0	0.0000%	9,843,457	0.1297%	0	0.0000%
33898	0	0.0000%	0	0.0000%	19,443,750	0.2561%	0	0.0000%
33901	0	0.0000%	0	0.0000%	13,243,334	0.1745%	0	0.0000%
33902	0	0.0000%	0	0.0000%	7,760	0.0001%	0	0.0000%
33903	0	0.0000%	0	0.0000%	19,617,307	0.2584%	0	0.0000%
33904	0	0.0000%	0	0.0000%	37,348,849	0.4920%	0	0.0000%
33905	0	0.0000%	0	0.0000%	29,300,618	0.3860%	0	0.0000%
33906	0	0.0000%	0	0.0000%	286	0.0000%	0	0.0000%
33907	0	0.0000%	0	0.0000%	13,099,547	0.1726%	0	0.0000%
33908	0	0.0000%	0	0.0000%	43,629,475	0.5748%	0	0.0000%
33909	0	0.0000%	0	0.0000%	10,096,896	0.1330%	0	0.0000%
33910	0	0.0000%	0	0.0000%	179	0.0000%	0	0.0000%
33911	0	0.0000%	0	0.0000%	109	0.0000%	0	0.0000%
33912	0	0.0000%	0	0.0000%	29,619,657	0.3902%	0	0.0000%
33913	0	0.0000%	0	0.0000%	30,922,432	0.4074%	0	0.0000%
33914	0	0.0000%	0	0.0000%	25,767,041	0.3394%	0	0.0000%
33915	0	0.0000%	0	0.0000%	5,995	0.0001%	0	0.0000%
33916	0	0.0000%	0	0.0000%	5,235,548	0.0690%	0	0.0000%
33917	0	0.0000%	0	0.0000%	29,896,866	0.3939%	0	0.0000%
33918	0	0.0000%	0	0.0000%	6,699	0.0001%	0	0.0000%
33919	0	0.0000%	0	0.0000%	35,426,792	0.4667%	0	0.0000%
33920	0	0.0000%	0	0.0000%	11,837,467	0.1559%	0	0.0000%
33921	0	0.0000%	0	0.0000%	4,839,557	0.0638%	0	0.0000%
33922	0	0.0000%	0	0.0000%	2,670,767	0.0352%	0	0.0000%
33924	0	0.0000%	0	0.0000%	2,900,117	0.0382%	0	0.0000%
33927	0	0.0000%	0	0.0000%	259	0.0000%	0	0.0000%
33928	0	0.0000%	0	0.0000%	34,621,871	0.4561%	0	0.0000%
33929	0	0.0000%	0	0.0000%	32,580	0.0004%	0	0.0000%
33930	0	0.0000%	0	0.0000%	928,431	0.0122%	0	0.0000%
33931	0	0.0000%	0	0.0000%	20,202,182	0.2661%	0	0.0000%
33932	0	0.0000%	0	0.0000%	38,222	0.0005%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
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33935	0	0.0000%	0	0.0000%	25,267,495	0.3329%	0	0.0000%
33936	0	0.0000%	0	0.0000%	38,390,716	0.5057%	0	0.0000%
33944	0	0.0000%	0	0.0000%	262,412	0.0035%	0	0.0000%
33945	0	0.0000%	0	0.0000%	5,846	0.0001%	0	0.0000%
33946	0	0.0000%	0	0.0000%	1,879,570	0.0248%	0	0.0000%
33947	0	0.0000%	0	0.0000%	2,339,526	0.0308%	0	0.0000%
33948	0	0.0000%	0	0.0000%	6,151,557	0.0810%	0	0.0000%
33950	0	0.0000%	0	0.0000%	25,950,945	0.3419%	0	0.0000%
33951	0	0.0000%	0	0.0000%	3,244	0.0000%	0	0.0000%
33952	0	0.0000%	0	0.0000%	13,266,014	0.1748%	0	0.0000%
33953	0	0.0000%	0	0.0000%	1,859,008	0.0245%	0	0.0000%
33954	0	0.0000%	0	0.0000%	3,559,458	0.0469%	0	0.0000%
33955	0	0.0000%	0	0.0000%	6,982,201	0.0920%	0	0.0000%
33956	0	0.0000%	0	0.0000%	3,725,513	0.0491%	0	0.0000%
33957	0	0.0000%	0	0.0000%	13,902,956	0.1832%	0	0.0000%
33960	0	0.0000%	0	0.0000%	1,062,125	0.0140%	0	0.0000%
33965	0	0.0000%	0	0.0000%	865	0.0000%	0	0.0000%
33966	0	0.0000%	0	0.0000%	8,768,444	0.1155%	0	0.0000%
33967	0	0.0000%	0	0.0000%	27,538,887	0.3628%	0	0.0000%
33970	0	0.0000%	0	0.0000%	19,316	0.0003%	0	0.0000%
33971	0	0.0000%	0	0.0000%	12,600,155	0.1660%	0	0.0000%
33972	0	0.0000%	0	0.0000%	15,266,496	0.2011%	0	0.0000%
33973	0	0.0000%	0	0.0000%	2,962,749	0.0390%	0	0.0000%
33974	0	0.0000%	0	0.0000%	10,080,658	0.1328%	0	0.0000%
33975	0	0.0000%	0	0.0000%	102,463	0.0013%	0	0.0000%
33976	0	0.0000%	0	0.0000%	6,135,012	0.0808%	0	0.0000%
33980	0	0.0000%	0	0.0000%	7,421,314	0.0978%	0	0.0000%
33981	0	0.0000%	0	0.0000%	3,265,313	0.0430%	0	0.0000%
33982	0	0.0000%	0	0.0000%	11,048,446	0.1455%	0	0.0000%
33983	0	0.0000%	0	0.0000%	11,996,545	0.1580%	0	0.0000%
33990	0	0.0000%	0	0.0000%	20,931,891	0.2758%	0	0.0000%
33991	0	0.0000%	0	0.0000%	8,788,288	0.1158%	0	0.0000%
33993	0	0.0000%	0	0.0000%	7,428,343	0.0979%	0	0.0000%
33994	0	0.0000%	0	0.0000%	3,529	0.0000%	0	0.0000%
34101	0	0.0000%	0	0.0000%	35,204	0.0005%	0	0.0000%
34102	0	0.0000%	0	0.0000%	41,412,352	0.5456%	0	0.0000%
34103	0	0.0000%	0	0.0000%	29,067,249	0.3829%	0	0.0000%
34104	0	0.0000%	0	0.0000%	32,256,285	0.4249%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
34105	0	0.0000%	0	0.0000%	36,742,737	0.4840%	0	0.0000%
34106	0	0.0000%	0	0.0000%	411	0.0000%	0	0.0000%
34107	0	0.0000%	0	0.0000%	23	0.0000%	0	0.0000%
34108	0	0.0000%	0	0.0000%	53,260,830	0.7016%	0	0.0000%
34109	0	0.0000%	0	0.0000%	35,683,413	0.4701%	0	0.0000%
34110	0	0.0000%	0	0.0000%	46,687,534	0.6150%	0	0.0000%
34112	0	0.0000%	0	0.0000%	41,148,170	0.5421%	0	0.0000%
34113	0	0.0000%	0	0.0000%	41,070,414	0.5411%	0	0.0000%
34114	0	0.0000%	0	0.0000%	33,371,315	0.4396%	0	0.0000%
34116	0	0.0000%	0	0.0000%	31,470,487	0.4146%	0	0.0000%
34117	0	0.0000%	0	0.0000%	25,657,862	0.3380%	0	0.0000%
34119	0	0.0000%	0	0.0000%	61,966,185	0.8163%	0	0.0000%
34120	0	0.0000%	0	0.0000%	60,521,585	0.7973%	0	0.0000%
34133	0	0.0000%	0	0.0000%	4,912	0.0001%	0	0.0000%
34134	0	0.0000%	0	0.0000%	46,026,860	0.6063%	0	0.0000%
34135	0	0.0000%	0	0.0000%	61,078,226	0.8046%	0	0.0000%
34136	0	0.0000%	0	0.0000%	7,234	0.0001%	0	0.0000%
34137	0	0.0000%	0	0.0000%	123,945	0.0016%	0	0.0000%
34138	0	0.0000%	0	0.0000%	909,662	0.0120%	0	0.0000%
34139	0	0.0000%	0	0.0000%	1,626,438	0.0214%	0	0.0000%
34140	0	0.0000%	0	0.0000%	1,137,503	0.0150%	0	0.0000%
34141	0	0.0000%	0	0.0000%	165,293	0.0022%	0	0.0000%
34142	0	0.0000%	0	0.0000%	12,776,085	0.1683%	0	0.0000%
34143	0	0.0000%	0	0.0000%	80,973	0.0011%	0	0.0000%
34145	0	0.0000%	0	0.0000%	88,937,266	1.1716%	0	0.0000%
34146	0	0.0000%	0	0.0000%	246,043	0.0032%	0	0.0000%
34201	0	0.0000%	0	0.0000%	1,026,270	0.0135%	0	0.0000%
34202	0	0.0000%	0	0.0000%	4,898,847	0.0645%	0	0.0000%
34203	0	0.0000%	0	0.0000%	3,459,100	0.0456%	0	0.0000%
34204	0	0.0000%	0	0.0000%	560	0.0000%	0	0.0000%
34205	0	0.0000%	0	0.0000%	2,769,967	0.0365%	0	0.0000%
34206	0	0.0000%	0	0.0000%	1,424	0.0000%	0	0.0000%
34207	0	0.0000%	0	0.0000%	1,765,651	0.0233%	0	0.0000%
34208	0	0.0000%	0	0.0000%	2,895,282	0.0381%	0	0.0000%
34209	0	0.0000%	0	0.0000%	8,395,640	0.1106%	0	0.0000%
34210	0	0.0000%	0	0.0000%	1,785,877	0.0235%	0	0.0000%
34211	0	0.0000%	0	0.0000%	1,515,517	0.0200%	0	0.0000%
34212	0	0.0000%	0	0.0000%	3,166,944	0.0417%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
34215	0	0.0000%	0	0.0000%	224,405	0.0030%	0	0.0000%
34216	0	0.0000%	0	0.0000%	769,357	0.0101%	0	0.0000%
34217	0	0.0000%	0	0.0000%	2,464,787	0.0325%	0	0.0000%
34218	0	0.0000%	0	0.0000%	3,936	0.0001%	0	0.0000%
34219	0	0.0000%	0	0.0000%	4,335,923	0.0571%	0	0.0000%
34220	0	0.0000%	0	0.0000%	592	0.0000%	0	0.0000%
34221	0	0.0000%	0	0.0000%	5,158,624	0.0680%	0	0.0000%
34222	0	0.0000%	0	0.0000%	1,702,207	0.0224%	0	0.0000%
34223	0	0.0000%	0	0.0000%	4,966,476	0.0654%	0	0.0000%
34224	0	0.0000%	0	0.0000%	3,653,025	0.0481%	0	0.0000%
34228	0	0.0000%	0	0.0000%	4,070,927	0.0536%	0	0.0000%
34229	0	0.0000%	0	0.0000%	2,411,996	0.0318%	0	0.0000%
34230	0	0.0000%	0	0.0000%	730	0.0000%	0	0.0000%
34231	0	0.0000%	0	0.0000%	5,472,859	0.0721%	0	0.0000%
34232	0	0.0000%	0	0.0000%	4,638,528	0.0611%	0	0.0000%
34233	0	0.0000%	0	0.0000%	2,394,118	0.0315%	0	0.0000%
34234	0	0.0000%	0	0.0000%	1,480,022	0.0195%	0	0.0000%
34235	0	0.0000%	0	0.0000%	2,328,471	0.0307%	0	0.0000%
34236	0	0.0000%	0	0.0000%	2,479,632	0.0327%	0	0.0000%
34237	0	0.0000%	0	0.0000%	1,046,240	0.0138%	0	0.0000%
34238	0	0.0000%	0	0.0000%	3,775,897	0.0497%	0	0.0000%
34239	0	0.0000%	0	0.0000%	2,851,333	0.0376%	0	0.0000%
34240	0	0.0000%	0	0.0000%	3,687,488	0.0486%	0	0.0000%
34241	0	0.0000%	0	0.0000%	4,202,753	0.0554%	0	0.0000%
34242	0	0.0000%	0	0.0000%	3,275,941	0.0432%	0	0.0000%
34243	0	0.0000%	0	0.0000%	4,139,709	0.0545%	0	0.0000%
34250	0	0.0000%	0	0.0000%	206,245	0.0027%	0	0.0000%
34251	0	0.0000%	0	0.0000%	2,061,130	0.0272%	0	0.0000%
34264	0	0.0000%	0	0.0000%	9	0.0000%	0	0.0000%
34265	0	0.0000%	0	0.0000%	14,588	0.0002%	0	0.0000%
34266	0	0.0000%	0	0.0000%	18,020,260	0.2374%	0	0.0000%
34267	0	0.0000%	0	0.0000%	26,544	0.0003%	0	0.0000%
34268	0	0.0000%	0	0.0000%	36,002	0.0005%	0	0.0000%
34269	0	0.0000%	0	0.0000%	3,588,308	0.0473%	0	0.0000%
34270	0	0.0000%	0	0.0000%	3,048	0.0000%	0	0.0000%
34272	0	0.0000%	0	0.0000%	575	0.0000%	0	0.0000%
34274	0	0.0000%	0	0.0000%	699	0.0000%	0	0.0000%
34275	0	0.0000%	0	0.0000%	4,225,268	0.0557%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
34276	0	0.0000%	0	0.0000%	1,054	0.0000%	0	0.0000%
34277	0	0.0000%	0	0.0000%	6,462	0.0001%	0	0.0000%
34278	0	0.0000%	0	0.0000%	424	0.0000%	0	0.0000%
34280	0	0.0000%	0	0.0000%	29	0.0000%	0	0.0000%
34281	0	0.0000%	0	0.0000%	4,628	0.0001%	0	0.0000%
34282	0	0.0000%	0	0.0000%	1,276	0.0000%	0	0.0000%
34284	0	0.0000%	0	0.0000%	30	0.0000%	0	0.0000%
34285	0	0.0000%	0	0.0000%	3,199,795	0.0422%	0	0.0000%
34286	0	0.0000%	0	0.0000%	3,169,792	0.0418%	0	0.0000%
34287	0	0.0000%	0	0.0000%	5,878,086	0.0774%	0	0.0000%
34288	0	0.0000%	0	0.0000%	1,803,080	0.0238%	0	0.0000%
34289	0	0.0000%	0	0.0000%	359,498	0.0047%	0	0.0000%
34290	0	0.0000%	0	0.0000%	2,018	0.0000%	0	0.0000%
34291	0	0.0000%	0	0.0000%	918,632	0.0121%	0	0.0000%
34292	0	0.0000%	0	0.0000%	2,905,244	0.0383%	0	0.0000%
34293	0	0.0000%	0	0.0000%	7,136,510	0.0940%	0	0.0000%
34420	0	0.0000%	0	0.0000%	9,564,819	0.1260%	0	0.0000%
34421	0	0.0000%	0	0.0000%	20,875	0.0003%	0	0.0000%
34423	0	0.0000%	0	0.0000%	5,270	0.0001%	0	0.0000%
34428	0	0.0000%	0	0.0000%	2,853,815	0.0376%	0	0.0000%
34429	0	0.0000%	0	0.0000%	3,961,467	0.0522%	0	0.0000%
34430	0	0.0000%	0	0.0000%	21,066	0.0003%	0	0.0000%
34431	0	0.0000%	0	0.0000%	3,029,799	0.0399%	0	0.0000%
34432	0	0.0000%	0	0.0000%	4,968,566	0.0655%	0	0.0000%
34433	0	0.0000%	0	0.0000%	1,979,253	0.0261%	0	0.0000%
34434	0	0.0000%	0	0.0000%	2,510,660	0.0331%	0	0.0000%
34436	0	0.0000%	0	0.0000%	3,806,338	0.0501%	0	0.0000%
34442	0	0.0000%	0	0.0000%	6,511,413	0.0858%	0	0.0000%
34445	0	0.0000%	0	0.0000%	13,097	0.0002%	0	0.0000%
34446	0	0.0000%	0	0.0000%	6,716,210	0.0885%	0	0.0000%
34447	0	0.0000%	0	0.0000%	1,796	0.0000%	0	0.0000%
34448	0	0.0000%	0	0.0000%	3,259,718	0.0429%	0	0.0000%
34449	0	0.0000%	0	0.0000%	620,809	0.0082%	0	0.0000%
34450	0	0.0000%	0	0.0000%	6,304,820	0.0831%	0	0.0000%
34451	0	0.0000%	0	0.0000%	3,010	0.0000%	0	0.0000%
34452	0	0.0000%	0	0.0000%	6,416,132	0.0845%	0	0.0000%
34453	0	0.0000%	0	0.0000%	3,834,018	0.0505%	0	0.0000%
34460	0	0.0000%	0	0.0000%	1,328	0.0000%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
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34461	0	0.0000%	0	0.0000%	3,983,470	0.0525%	0	0.0000%
34464	0	0.0000%	0	0.0000%	1,690	0.0000%	0	0.0000%
34465	0	0.0000%	0	0.0000%	6,904,717	0.0910%	0	0.0000%
34470	0	0.0000%	0	0.0000%	8,965,212	0.1181%	0	0.0000%
34471	0	0.0000%	0	0.0000%	17,106,911	0.2254%	0	0.0000%
34472	0	0.0000%	0	0.0000%	13,599,622	0.1792%	0	0.0000%
34473	0	0.0000%	0	0.0000%	6,287,678	0.0828%	0	0.0000%
34474	0	0.0000%	0	0.0000%	4,249,376	0.0560%	0	0.0000%
34475	0	0.0000%	0	0.0000%	2,331,055	0.0307%	0	0.0000%
34476	0	0.0000%	0	0.0000%	10,858,441	0.1430%	0	0.0000%
34477	0	0.0000%	0	0.0000%	11,813	0.0002%	0	0.0000%
34478	0	0.0000%	0	0.0000%	25,613	0.0003%	0	0.0000%
34479	0	0.0000%	0	0.0000%	7,007,350	0.0923%	0	0.0000%
34480	0	0.0000%	0	0.0000%	12,680,448	0.1670%	0	0.0000%
34481	0	0.0000%	0	0.0000%	7,405,423	0.0976%	0	0.0000%
34482	0	0.0000%	0	0.0000%	7,966,055	0.1049%	0	0.0000%
34483	0	0.0000%	0	0.0000%	3,133	0.0000%	0	0.0000%
34484	0	0.0000%	0	0.0000%	1,775,736	0.0234%	0	0.0000%
34487	0	0.0000%	0	0.0000%	865	0.0000%	0	0.0000%
34488	0	0.0000%	0	0.0000%	4,406,642	0.0581%	0	0.0000%
34489	0	0.0000%	0	0.0000%	7,055	0.0001%	0	0.0000%
34491	0	0.0000%	0	0.0000%	19,494,813	0.2568%	0	0.0000%
34492	0	0.0000%	0	0.0000%	16,053	0.0002%	0	0.0000%
34498	0	0.0000%	0	0.0000%	268,517	0.0035%	0	0.0000%
34601	0	0.0000%	0	0.0000%	4,788,513	0.0631%	0	0.0000%
34602	0	0.0000%	0	0.0000%	3,268,934	0.0431%	0	0.0000%
34603	0	0.0000%	0	0.0000%	2,277	0.0000%	0	0.0000%
34604	0	0.0000%	0	0.0000%	1,740,705	0.0229%	0	0.0000%
34605	0	0.0000%	0	0.0000%	925	0.0000%	0	0.0000%
34606	0	0.0000%	0	0.0000%	5,635,665	0.0742%	0	0.0000%
34607	0	0.0000%	0	0.0000%	2,381,073	0.0314%	0	0.0000%
34608	0	0.0000%	0	0.0000%	6,605,077	0.0870%	0	0.0000%
34609	0	0.0000%	0	0.0000%	7,809,529	0.1029%	0	0.0000%
34610	0	0.0000%	0	0.0000%	2,162,907	0.0285%	0	0.0000%
34611	0	0.0000%	0	0.0000%	1,452	0.0000%	0	0.0000%
34613	0	0.0000%	0	0.0000%	5,285,386	0.0696%	0	0.0000%
34614	0	0.0000%	0	0.0000%	1,133,370	0.0149%	0	0.0000%
34636	0	0.0000%	0	0.0000%	6,320	0.0001%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
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34637	0	0.0000%	0	0.0000%	880,357	0.0116%	0	0.0000%
34638	0	0.0000%	0	0.0000%	2,584,059	0.0340%	0	0.0000%
34639	0	0.0000%	0	0.0000%	5,323,066	0.0701%	0	0.0000%
34652	0	0.0000%	0	0.0000%	2,724,000	0.0359%	0	0.0000%
34653	0	0.0000%	0	0.0000%	2,460,216	0.0324%	0	0.0000%
34654	0	0.0000%	0	0.0000%	2,201,393	0.0290%	0	0.0000%
34655	0	0.0000%	0	0.0000%	4,408,325	0.0581%	0	0.0000%
34656	0	0.0000%	0	0.0000%	254	0.0000%	0	0.0000%
34660	0	0.0000%	0	0.0000%	5,936	0.0001%	0	0.0000%
34661	0	0.0000%	0	0.0000%	32,951	0.0004%	0	0.0000%
34667	0	0.0000%	0	0.0000%	5,274,596	0.0695%	0	0.0000%
34668	0	0.0000%	0	0.0000%	4,199,886	0.0553%	0	0.0000%
34669	0	0.0000%	0	0.0000%	1,515,091	0.0200%	0	0.0000%
34674	0	0.0000%	0	0.0000%	9	0.0000%	0	0.0000%
34677	0	0.0000%	0	0.0000%	2,418,443	0.0319%	0	0.0000%
34679	0	0.0000%	0	0.0000%	3,643	0.0000%	0	0.0000%
34680	0	0.0000%	0	0.0000%	66	0.0000%	0	0.0000%
34681	0	0.0000%	0	0.0000%	306,826	0.0040%	0	0.0000%
34682	0	0.0000%	0	0.0000%	107	0.0000%	0	0.0000%
34683	0	0.0000%	0	0.0000%	4,738,238	0.0624%	0	0.0000%
34684	0	0.0000%	0	0.0000%	2,918,680	0.0384%	0	0.0000%
34685	0	0.0000%	0	0.0000%	2,180,521	0.0287%	0	0.0000%
34688	0	0.0000%	0	0.0000%	1,241,025	0.0163%	0	0.0000%
34689	0	0.0000%	0	0.0000%	2,687,152	0.0354%	0	0.0000%
34690	0	0.0000%	0	0.0000%	1,033,797	0.0136%	0	0.0000%
34691	0	0.0000%	0	0.0000%	1,645,973	0.0217%	0	0.0000%
34695	0	0.0000%	0	0.0000%	2,743,125	0.0361%	0	0.0000%
34698	0	0.0000%	0	0.0000%	4,376,572	0.0577%	0	0.0000%
34705	0	0.0000%	0	0.0000%	1,935,962	0.0255%	0	0.0000%
34711	0	0.0000%	0	0.0000%	30,163,874	0.3974%	0	0.0000%
34712	0	0.0000%	0	0.0000%	10,241	0.0001%	0	0.0000%
34713	0	0.0000%	0	0.0000%	7	0.0000%	0	0.0000%
34714	0	0.0000%	0	0.0000%	5,944,147	0.0783%	0	0.0000%
34715	0	0.0000%	0	0.0000%	7,931,036	0.1045%	0	0.0000%
34729	0	0.0000%	0	0.0000%	54,924	0.0007%	0	0.0000%
34731	0	0.0000%	0	0.0000%	9,564,529	0.1260%	0	0.0000%
34734	0	0.0000%	151,324	0.0267%	1,905,594	0.0251%	0	0.0000%
34736	0	0.0000%	0	0.0000%	10,615,639	0.1398%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
34737	0	0.0000%	0	0.0000%	3,181,140	0.0419%	0	0.0000%
34739	0	0.0000%	28,072	0.0050%	716,620	0.0094%	0	0.0000%
34740	0	0.0000%	1,493	0.0003%	29,311	0.0004%	0	0.0000%
34741	0	0.0000%	0	0.0000%	8,547,335	0.1126%	0	0.0000%
34742	0	0.0000%	0	0.0000%	1,539	0.0000%	0	0.0000%
34743	0	0.0000%	0	0.0000%	13,775,187	0.1815%	0	0.0000%
34744	0	0.0000%	0	0.0000%	19,896,827	0.2621%	0	0.0000%
34745	0	0.0000%	0	0.0000%	1,448	0.0000%	0	0.0000%
34746	0	0.0000%	0	0.0000%	17,998,323	0.2371%	0	0.0000%
34747	0	0.0000%	0	0.0000%	10,063,177	0.1326%	0	0.0000%
34748	0	0.0000%	0	0.0000%	35,222,492	0.4640%	0	0.0000%
34749	0	0.0000%	0	0.0000%	64,692	0.0009%	0	0.0000%
34753	0	0.0000%	0	0.0000%	1,889,611	0.0249%	0	0.0000%
34755	0	0.0000%	0	0.0000%	52,161	0.0007%	0	0.0000%
34756	0	0.0000%	0	0.0000%	2,961,372	0.0390%	0	0.0000%
34758	0	0.0000%	0	0.0000%	9,438,557	0.1243%	0	0.0000%
34759	0	0.0000%	0	0.0000%	10,421,020	0.1373%	0	0.0000%
34760	0	0.0000%	52,670	0.0093%	880,337	0.0116%	0	0.0000%
34761	0	0.0000%	1,292,839	0.2281%	13,971,016	0.1841%	0	0.0000%
34762	0	0.0000%	0	0.0000%	594,100	0.0078%	0	0.0000%
34769	0	0.0000%	0	0.0000%	11,548,204	0.1521%	0	0.0000%
34770	0	0.0000%	519	0.0001%	12,156	0.0002%	0	0.0000%
34771	0	0.0000%	567,619	0.1001%	7,918,537	0.1043%	0	0.0000%
34772	0	0.0000%	0	0.0000%	9,992,999	0.1316%	0	0.0000%
34773	0	0.0000%	0	0.0000%	967,239	0.0127%	0	0.0000%
34777	0	0.0000%	82	0.0000%	1,016	0.0000%	0	0.0000%
34778	0	0.0000%	117	0.0000%	2,464	0.0000%	0	0.0000%
34785	0	0.0000%	0	0.0000%	6,344,814	0.0836%	0	0.0000%
34786	0	0.0000%	0	0.0000%	31,899,324	0.4202%	0	0.0000%
34787	0	0.0000%	0	0.0000%	22,954,673	0.3024%	0	0.0000%
34788	0	0.0000%	747,225	0.1318%	19,236,725	0.2534%	0	0.0000%
34789	0	0.0000%	830	0.0001%	19,212	0.0003%	0	0.0000%
34797	0	0.0000%	0	0.0000%	2,260,284	0.0298%	0	0.0000%
34945	0	0.0000%	318,847	0.0562%	1,738,221	0.0229%	0	0.0000%
34946	0	0.0000%	521,557	0.0920%	1,723,333	0.0227%	0	0.0000%
34947	0	0.0000%	391,172	0.0690%	1,383,471	0.0182%	0	0.0000%
34948	0	0.0000%	6	0.0000%	24	0.0000%	0	0.0000%
34949	0	0.0000%	2,543,250	0.4486%	7,402,891	0.0975%	0	0.0000%

	Hurricane Hermine (2016)		Hurricane Matthew (2016)		Hurricane Irma (2017)		Hurricane Michael (2018)	
Zip Code	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)	Personal & Commercial Residential Modeled Loss ($)	Percent of Total Loss (%)
34950	0	0.0000%	622,664	0.1098%	2,342,991	0.0309%	0	0.0000%
34951	0	0.0000%	1,852,252	0.3267%	6,355,736	0.0837%	0	0.0000%
34952	0	0.0000%	3,433,842	0.6058%	16,995,414	0.2239%	0	0.0000%
34953	0	0.0000%	2,911,478	0.5136%	17,486,587	0.2304%	0	0.0000%
34954	0	0.0000%	131	0.0000%	398	0.0000%	0	0.0000%
34956	0	0.0000%	92,021	0.0162%	1,952,568	0.0257%	0	0.0000%
34957	0	0.0000%	2,901,236	0.5118%	12,037,323	0.1586%	0	0.0000%
34958	0	0.0000%	1,757	0.0003%	8,122	0.0001%	0	0.0000%
34972	0	0.0000%	0	0.0000%	10,317,533	0.1359%	0	0.0000%
34973	0	0.0000%	0	0.0000%	42,542	0.0006%	0	0.0000%
34974	0	0.0000%	0	0.0000%	35,317,206	0.4653%	0	0.0000%
34979	0	0.0000%	174	0.0000%	969	0.0000%	0	0.0000%
34981	0	0.0000%	296,111	0.0522%	1,219,572	0.0161%	0	0.0000%
34982	0	0.0000%	2,121,090	0.3742%	8,672,163	0.1142%	0	0.0000%
34983	0	0.0000%	2,793,223	0.4927%	12,950,033	0.1706%	0	0.0000%
34984	0	0.0000%	1,080,040	0.1905%	5,954,250	0.0784%	0	0.0000%
34985	0	0.0000%	309	0.0001%	1,562	0.0000%	0	0.0000%
34986	0	0.0000%	1,802,545	0.3180%	9,168,235	0.1208%	0	0.0000%
34987	0	0.0000%	444,699	0.0784%	2,789,961	0.0368%	0	0.0000%
34990	0	0.0000%	3,224,488	0.5688%	21,147,099	0.2786%	0	0.0000%
34991	0	0.0000%	681	0.0001%	3,505	0.0000%	0	0.0000%
34992	0	0.0000%	908	0.0002%	3,856	0.0001%	0	0.0000%
34994	0	0.0000%	1,149,064	0.2027%	5,606,330	0.0739%	0	0.0000%
34995	0	0.0000%	240	0.0000%	1,036	0.0000%	0	0.0000%
34996	0	0.0000%	2,698,130	0.4760%	10,626,511	0.1400%	0	0.0000%
34997	0	0.0000%	3,988,313	0.7036%	21,305,563	0.2807%	0	0.0000%

Figure 76: Percentage of residential hurricane losses from Hurricane Hermine (2016) by ZIP Code

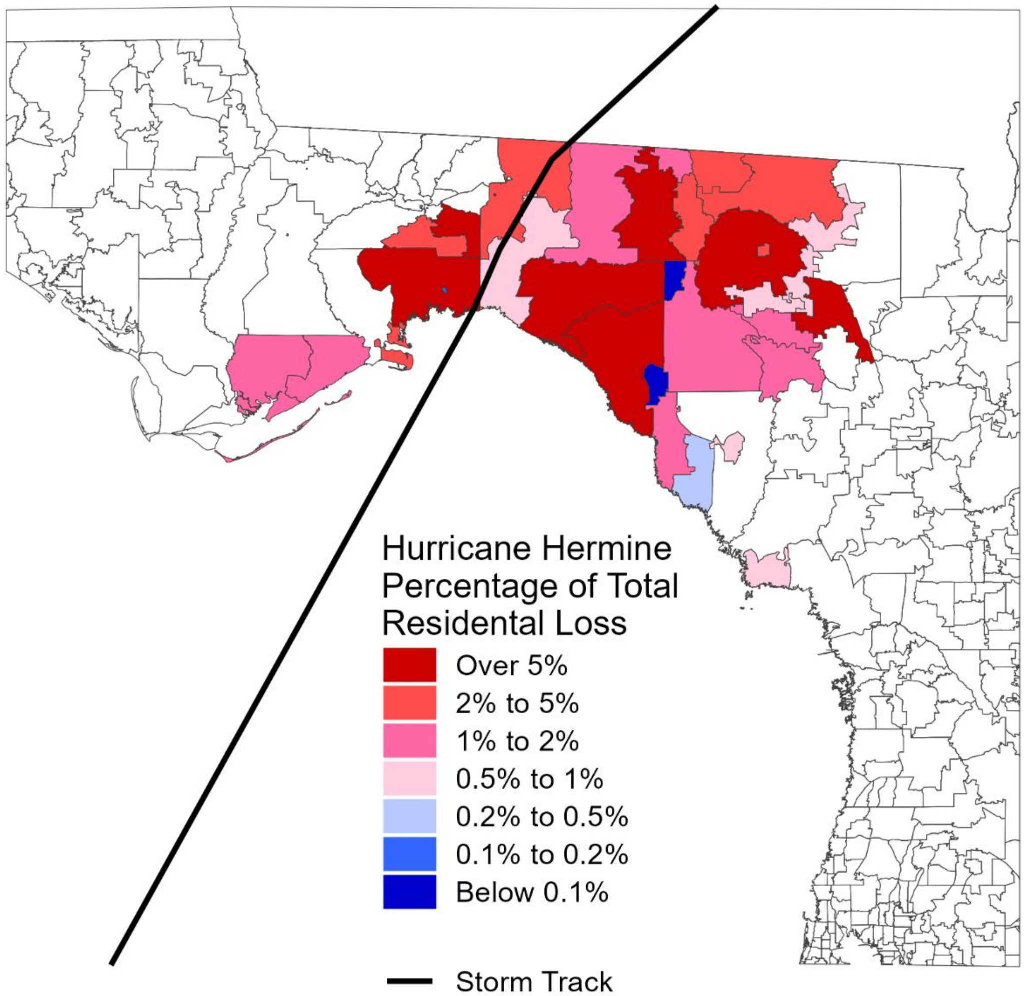


Figure 77: Percentage of residential hurricane losses from Hurricane Matthew (2016) by ZIP Code

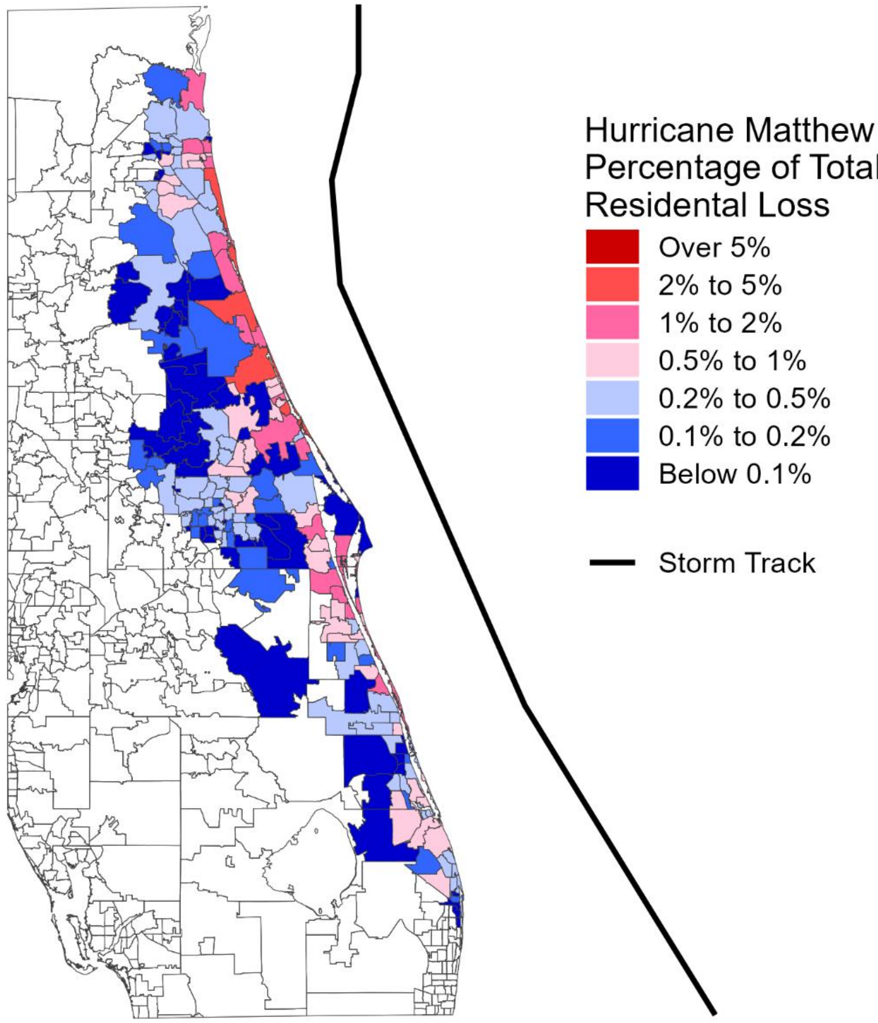


Figure 78: Percentage of residential hurricane losses from Hurricane Irma (2017) by ZIP Code

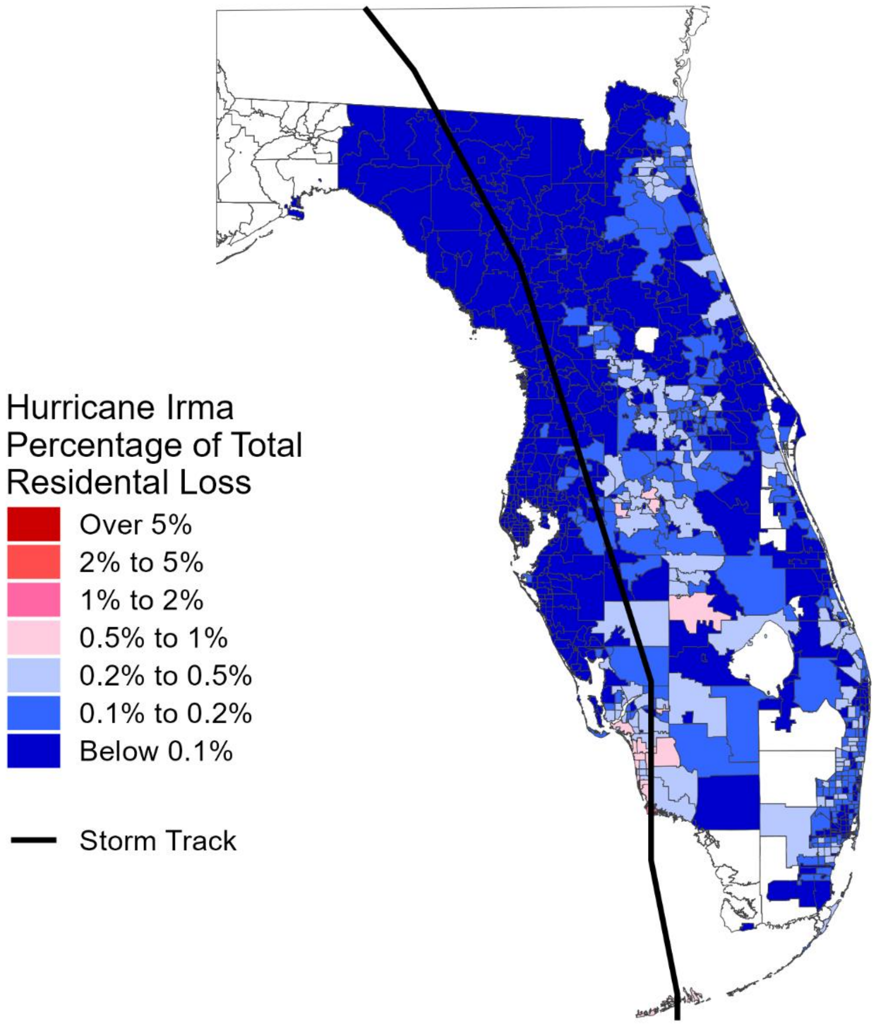
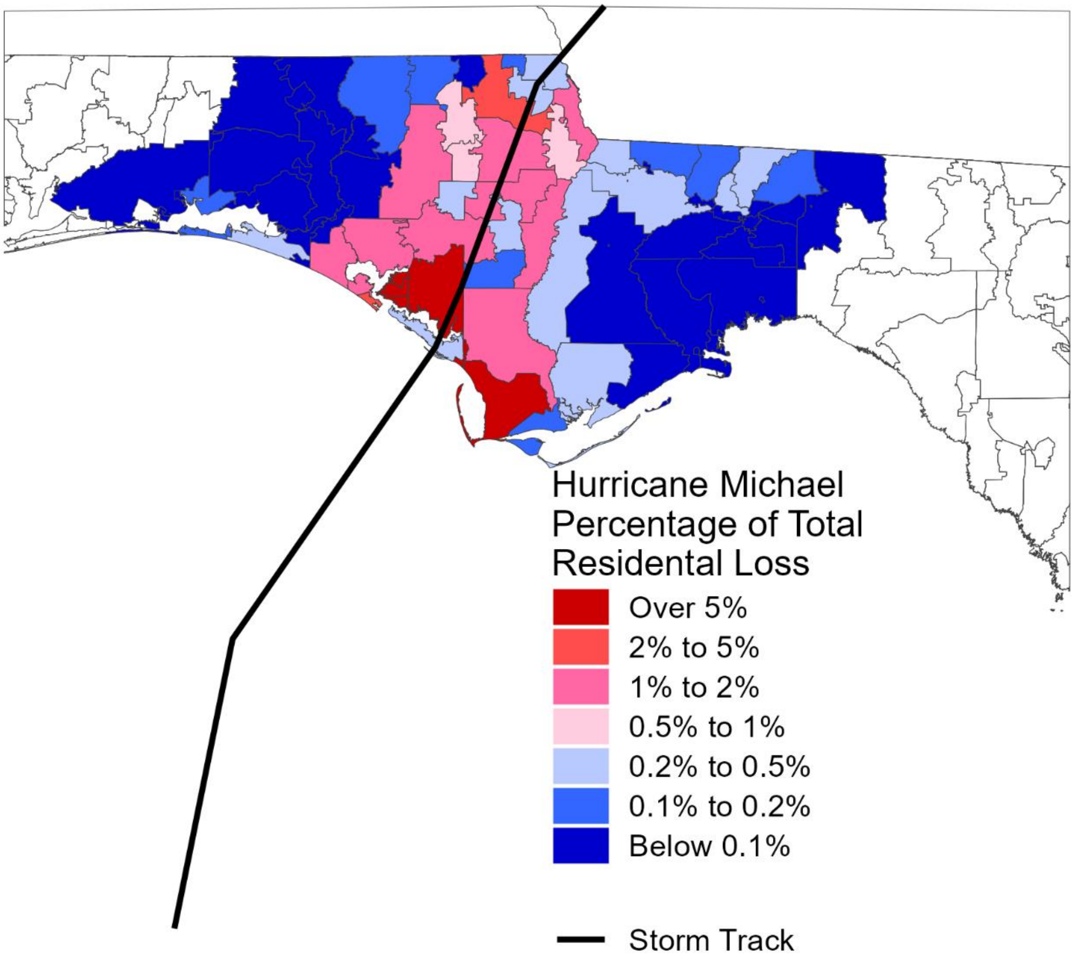


Figure 79: Percentage of residential hurricane losses from Hurricane Michael (2018) by ZIP Code



Form A-4: Hurricane Output Ranges

A. One or more automated programs or scripts should be used to generate the personal and commercial residential hurricane output ranges in the format shown in the file named "2021FormA4.xlsx."

B. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include Form A-4, Hurricane Output Ranges, in a submission appendix.

C. Provide hurricane loss costs, rounded to three decimal places, by county (Figure 13). Within each county, hurricane loss costs should 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 homes, and commercial residential. For each of these categories using ZIP Code centroids, the hurricane output range should show the highest hurricane loss cost, the lowest hurricane loss cost, and the weighted average hurricane loss cost. The aggregate residential exposure data for this form is to be developed from the information in the file named "hlpm2017c.zip," except for insured values and deductibles information. Insured values are to be based on the hurricane output range specifications given below. Deductible amounts of 0% and as specified in the hurricane output range specifications given below are to be assumed to be uniformly applied to all risks. When calculating the weighted average hurricane loss costs, weight the hurricane loss costs by the total insured value calculated above. Include the statewide range of hurricane loss costs (i.e., low, high, and weighted average).

D. If a modeling organization has hurricane loss costs for a ZIP Code for which there is no exposure, give the hurricane 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.

E. If a modeling organization does not have hurricane loss costs for a ZIP Code for which there is some exposure, do not assume such hurricane loss costs are zero, but use only the exposures for which there are hurricane loss costs in calculating the weighted average hurricane loss costs. Provide a list in the submission document of the ZIP Codes where this occurs.

F. NA should be used in cells to signify no exposure.

G. Indicate if per diem is used in producing hurricane loss costs for Coverage D (Time Element) in the personal residential hurricane output ranges. If a per diem rate is used, a rate of $300 per day per policy is to be used.

H. Describe how Law and Ordinance is included in the hurricane output ranges.

The impacts of law and ordinance coverage, such as the roof replacement rule in the Florida Building Code, is implicitly included in the base vulnerability functions for personal residential properties. In addition, the impact of the statutory required 25 percent and 50 percent coverage options for personal residential properties is factored into the post-event loss amplification (PLA).

I. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

No additional assumption was necessary to complete this form.

The required file is provided in Excel format in the file RMS21FormA4.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.

Hurricane 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 included*

Coverage B = Appurtenant Structure

- *Coverage B limit = 10% of Coverage A limit*
- *Replacement Cost included subject to Coverage B limit*
- *Law and Ordinance 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 = $300/day per policy, if used*

  - ✧ *Dominant Coverage = A*
  - ✧ *Hurricane loss costs per $1,000 should be related to the Coverage A limit*
  - ✧ *Hurricane loss costs for the various specified deductibles should be determined based on annual deductibles*
  - ✧ *2% Deductible of Coverage A*
  - ✧ *All-other perils deductible = $500*

Renters ***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 = $300/day per policy, if used*

  - ✧ *Dominate Coverage = C*
  - ✧ *Hurricane loss costs per $1,000 should be related to the Coverage C limit*
  - ✧ *Hurricane loss costs for the various specified deductibles should 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 = $300/day per policy, if used*

  - ✧ *Dominant Coverage = C*
  - ✧ *Hurricane loss costs per $1,000 should be related to the Coverage C limit*
  - ✧ *Hurricane loss costs for the various specified deductibles should be determined based on annual deductibles*
  - ✧ *2% Deductible of Coverage C*
  - ✧ *All-other perils deductible = $500*

Manufactured Homes ***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 = $300/day per policy, if used*

  - ✧ *Dominant Coverage = A*
  - ✧ *Hurricane loss costs per $1,000 should be related to the Coverage A limit*
  - ✧ *Hurricane loss costs for the various specified deductibles should be determined based on annual deductibles*
  - ✧ *2% Deductible of Coverage A*
  - ✧ *All-other perils deductible = $500*

Commercial Residential

Coverage A = Building

- *Coverage A limit = $25,000,000*
- *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 = $300/day per policy, if used*

  - ✧ *Dominant Coverage = A*
  - ✧ *Hurricane loss costs per $1,000 should be related to the Coverage A limit*
  - ✧ *Hurricane loss costs for the various specified deductibles should be determined based on annual deductibles*
  - ✧ *3% Deductible of Coverage A*
  - ✧ *All-other perils deductible = $5,000*

Table 37: Hurricane loss costs per $1000 for 0% deductible using 2017 FHCF exposure data

County	Hurricane Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Alachua	LOW	0.257	0.203	3.038	0.090	0.056	0.114	0.073	0.209
	AVERAGE	1.342	1.675	4.160	0.272	0.278	0.393	0.373	0.671
	HIGH	3.191	2.958	6.651	0.758	0.703	0.863	0.802	1.494
Baker	LOW	0.166	0.175	2.094	0.052	0.058	NA	NA	0.336
	AVERAGE	0.771	0.883	2.320	0.205	0.188	NA	NA	0.336
	HIGH	1.438	1.316	3.325	0.260	0.241	NA	NA	0.336
Bay	LOW	0.371	0.402	3.885	0.233	0.197	0.333	0.243	0.492
	AVERAGE	2.514	2.823	6.041	0.683	0.679	1.480	0.825	2.091
	HIGH	6.092	5.743	11.794	1.848	1.718	2.163	2.106	3.074
Bradford	LOW	0.217	0.225	2.687	0.082	0.078	NA	NA	NA
	AVERAGE	1.277	1.438	3.013	0.298	0.260	NA	NA	NA
	HIGH	1.931	1.773	4.381	0.384	0.357	NA	NA	NA
Brevard	LOW	0.584	0.565	7.912	0.343	0.279	0.475	0.309	0.755
	AVERAGE	3.805	3.002	12.144	1.287	1.301	1.870	2.158	3.502
	HIGH	9.455	8.948	22.895	3.959	3.696	4.931	4.615	6.957
Broward	LOW	0.866	0.711	16.702	0.557	0.405	0.712	0.483	0.973
	AVERAGE	5.596	4.498	20.263	1.726	1.916	3.011	2.520	4.605
	HIGH	12.750	11.753	30.035	5.933	5.732	7.438	7.185	10.524
Calhoun	LOW	0.258	0.316	3.044	0.092	0.102	NA	NA	NA
	AVERAGE	1.508	1.583	3.589	0.326	0.303	NA	NA	NA
	HIGH	2.410	2.217	5.364	0.481	0.446	NA	NA	NA
Charlotte	LOW	0.660	0.617	12.443	0.414	0.340	0.581	0.366	0.815
	AVERAGE	4.803	3.353	14.525	1.368	1.310	2.574	1.616	2.925
	HIGH	10.046	9.498	19.279	3.537	3.300	4.426	4.131	6.868
Citrus	LOW	0.489	0.426	6.012	0.222	0.165	0.328	0.311	0.508
	AVERAGE	3.376	2.392	7.061	0.702	0.666	1.179	1.108	2.114
	HIGH	5.065	4.718	11.046	1.260	1.168	1.573	1.459	2.674
Clay	LOW	0.169	0.156	2.508	0.057	0.054	0.071	0.072	0.173
	AVERAGE	0.888	1.189	3.123	0.228	0.225	0.218	0.211	0.498
	HIGH	2.646	2.433	5.454	0.472	0.437	0.581	0.538	1.097

County	Hurricane Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Collier	LOW	0.955	0.935	13.767	0.630	0.423	0.801	0.392	1.051
	AVERAGE	5.249	3.566	18.545	1.733	1.734	3.041	2.609	3.858
	HIGH	15.755	15.006	27.343	6.793	6.531	8.628	8.245	11.265
Columbia	LOW	0.209	0.177	2.381	0.063	0.079	0.366	0.143	0.263
	AVERAGE	1.113	1.214	3.240	0.250	0.254	0.389	0.346	0.263
	HIGH	2.309	2.130	5.043	0.492	0.457	0.413	0.383	0.263
DeSoto	LOW	0.607	0.566	8.607	0.356	0.291	0.580	0.397	0.861
	AVERAGE	3.692	3.061	9.957	1.111	0.854	1.078	1.198	2.145
	HIGH	5.687	5.313	15.154	1.508	1.406	1.902	1.773	3.397
Dixie	LOW	0.425	0.412	4.256	0.185	0.501	0.265	0.252	0.501
	AVERAGE	2.241	2.014	4.654	0.590	0.629	0.537	0.518	1.013
	HIGH	5.508	5.173	9.900	0.693	0.702	0.924	0.708	2.976
Duval	LOW	0.160	0.155	2.133	0.054	0.059	0.085	0.060	0.168
	AVERAGE	1.250	1.445	3.170	0.268	0.277	0.276	0.308	0.536
	HIGH	3.273	3.037	6.892	0.803	1.069	0.993	0.923	1.648
Escambia	LOW	0.313	0.296	3.817	0.140	0.156	0.357	0.262	0.577
	AVERAGE	3.105	3.587	6.970	1.027	1.044	1.976	1.396	2.605
	HIGH	8.598	8.117	14.909	2.939	2.770	3.601	3.390	4.905
Flagler	LOW	0.309	0.285	3.887	0.146	0.119	0.180	0.127	0.318
	AVERAGE	2.095	1.310	5.957	0.436	0.383	1.087	0.543	0.862
	HIGH	5.016	4.670	10.004	1.298	1.206	1.604	1.492	2.561
Franklin	LOW	0.933	0.885	8.123	0.636	0.667	0.695	0.667	1.918
	AVERAGE	3.999	5.133	9.321	1.602	1.643	1.223	1.883	2.392
	HIGH	8.025	7.541	14.584	2.557	2.035	3.134	2.923	4.419
Gadsden	LOW	0.153	0.145	1.912	0.059	0.065	NA	NA	0.185
	AVERAGE	0.900	1.005	2.186	0.247	0.233	NA	NA	0.518
	HIGH	1.564	1.435	3.607	0.316	0.275	NA	NA	0.663
Gilchrist	LOW	0.404	0.377	4.155	0.165	0.212	NA	NA	NA
	AVERAGE	1.703	1.868	4.535	0.526	0.530	NA	NA	NA
	HIGH	3.044	2.824	6.332	0.715	0.664	NA	NA	NA
Glades	LOW	1.053	0.975	12.817	0.639	0.704	NA	NA	2.384
	AVERAGE	6.066	3.994	14.636	2.168	1.804	NA	NA	3.667
	HIGH	7.792	7.316	19.747	2.338	2.179	NA	NA	4.950

County	Hurricane Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Gulf	LOW	0.346	0.364	3.959	0.175	0.510	0.697	0.441	1.135
	AVERAGE	2.809	3.903	5.879	1.350	1.366	1.121	0.768	2.079
	HIGH	6.079	5.681	11.583	1.794	1.664	2.215	2.061	3.172
Hamilton	LOW	0.153	0.149	1.903	0.058	0.070	NA	NA	NA
	AVERAGE	0.926	1.055	2.276	0.243	0.232	NA	NA	NA
	HIGH	1.527	1.402	3.451	0.303	0.281	NA	NA	NA
Hardee	LOW	0.562	0.457	7.879	0.229	0.218	1.212	NA	NA
	AVERAGE	3.248	2.716	8.589	0.844	0.777	1.212	NA	NA
	HIGH	4.717	4.396	13.006	1.208	1.127	1.212	NA	NA
Hendry	LOW	0.806	0.755	12.071	0.439	0.418	1.185	1.129	5.496
	AVERAGE	5.580	4.561	14.565	1.965	1.538	3.389	2.467	5.755
	HIGH	8.972	8.442	22.203	2.853	2.659	3.596	3.355	5.841
Hernando	LOW	0.447	0.406	6.242	0.184	0.175	0.587	0.220	0.646
	AVERAGE	2.648	2.042	7.686	0.532	0.549	0.975	0.955	1.709
	HIGH	4.152	3.871	11.366	1.065	0.993	1.338	1.249	2.421
Highlands	LOW	0.700	0.577	9.524	0.334	0.319	0.464	0.442	0.763
	AVERAGE	3.803	3.285	10.549	1.155	1.078	1.579	1.428	2.541
	HIGH	6.340	5.938	16.515	1.828	1.705	2.193	2.047	3.779
Hillsborough	LOW	0.430	0.381	7.111	0.172	0.141	0.229	0.171	0.418
	AVERAGE	2.396	2.412	8.955	0.614	0.617	0.785	0.861	1.527
	HIGH	6.375	5.985	15.258	1.871	2.078	2.358	2.200	3.801
Holmes	LOW	0.258	0.243	3.010	0.093	0.104	NA	NA	0.779
	AVERAGE	1.407	1.576	3.298	0.392	0.364	NA	NA	0.779
	HIGH	2.359	2.183	5.000	0.529	0.491	NA	NA	0.779
Indian River	LOW	0.797	0.752	10.230	0.553	0.260	0.698	0.461	0.946
	AVERAGE	4.423	2.247	12.018	1.797	1.400	2.664	2.288	3.663
	HIGH	6.577	6.201	22.842	3.775	3.530	4.707	4.397	6.685
Jackson	LOW	0.231	0.238	2.758	0.090	0.086	NA	NA	0.213
	AVERAGE	1.416	1.526	3.229	0.336	0.322	NA	NA	0.551
	HIGH	2.216	2.042	4.891	0.476	0.442	NA	NA	0.825
Jefferson	LOW	0.173	0.164	1.821	0.067	0.075	NA	NA	NA
	AVERAGE	0.773	0.811	1.920	0.226	0.222	NA	NA	NA
	HIGH	1.391	1.286	2.740	0.278	0.266	NA	NA	NA

County	Hurricane Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Lafayette	LOW	0.250	0.236	2.654	0.387	0.107	NA	NA	NA
	AVERAGE	1.241	1.267	2.991	0.387	0.308	NA	NA	NA
	HIGH	1.804	1.662	3.993	0.387	0.358	NA	NA	NA
Lake	LOW	0.308	0.285	4.477	0.153	0.078	0.234	0.187	0.368
	AVERAGE	1.988	1.599	7.862	0.453	0.444	0.990	0.799	1.347
	HIGH	4.522	4.210	12.590	1.133	1.057	1.302	1.216	2.390
Lee	LOW	0.846	0.818	13.509	0.486	0.343	0.632	0.381	0.868
	AVERAGE	5.152	3.070	16.246	1.163	1.233	3.029	1.817	2.951
	HIGH	14.294	13.566	31.863	9.142	8.566	12.636	11.813	16.601
Leon	LOW	0.155	0.144	1.895	0.061	0.049	0.076	0.048	0.141
	AVERAGE	0.894	0.956	2.535	0.184	0.174	0.176	0.205	0.296
	HIGH	2.068	1.919	4.314	0.420	0.389	0.367	0.397	0.700
Levy	LOW	0.465	0.394	4.112	0.235	0.223	1.083	1.040	1.630
	AVERAGE	2.708	2.326	5.585	0.731	0.770	2.188	2.089	2.212
	HIGH	7.556	7.124	13.322	2.521	2.344	3.124	2.900	4.429
Liberty	LOW	0.290	0.268	3.062	0.120	0.392	NA	NA	NA
	AVERAGE	1.316	1.441	3.304	0.331	0.392	NA	NA	NA
	HIGH	2.032	1.868	4.579	0.423	0.392	NA	NA	NA
Madison	LOW	0.152	0.140	1.697	0.054	0.064	NA	NA	NA
	AVERAGE	0.949	0.985	2.172	0.209	0.214	NA	NA	NA
	HIGH	1.603	1.474	3.596	0.330	0.306	NA	NA	NA
Manatee	LOW	0.643	0.619	9.986	0.363	0.281	0.459	0.245	0.670
	AVERAGE	4.149	2.730	11.688	1.069	1.064	2.248	1.835	1.869
	HIGH	12.110	11.496	29.155	5.231	4.975	6.535	6.642	9.597
Marion	LOW	0.348	0.289	3.973	0.144	0.126	0.187	0.149	0.334
	AVERAGE	2.459	1.602	5.732	0.446	0.400	0.700	0.602	0.973
	HIGH	5.126	4.739	8.395	1.121	0.755	1.021	0.945	1.809
Martin	LOW	1.009	0.993	13.077	0.789	0.650	1.000	0.506	1.300
	AVERAGE	6.330	4.137	17.312	1.916	2.075	4.171	3.121	5.030
	HIGH	11.158	10.587	22.596	4.375	4.089	5.449	5.093	7.809
Miami-Dade	LOW	0.872	0.746	17.201	0.590	0.425	0.798	0.522	0.997
	AVERAGE	5.755	4.643	19.393	2.079	2.535	3.706	3.462	5.608
	HIGH	14.535	13.890	25.574	13.507	12.973	16.633	15.999	21.195

County	Hurricane Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Monroe	LOW	0.000	2.144	33.440	2.490	2.192	3.051	2.205	2.965
	AVERAGE	5.986	6.099	35.659	6.673	6.473	8.123	7.525	10.631
	HIGH	12.278	11.738	50.524	10.483	10.779	12.984	13.062	16.119
Nassau	LOW	0.156	0.144	1.990	0.050	0.048	0.293	0.177	0.434
	AVERAGE	1.297	1.329	3.021	0.381	0.352	0.705	0.651	0.925
	HIGH	3.431	3.189	6.972	0.885	0.821	1.097	1.017	1.767
Okaloosa	LOW	0.280	0.299	3.378	0.127	0.148	0.203	0.349	0.393
	AVERAGE	3.047	3.168	4.874	1.002	0.963	1.942	1.261	2.560
	HIGH	7.962	7.512	13.982	2.634	2.511	3.221	3.074	4.524
Okeechobee	LOW	0.960	0.890	12.857	0.677	0.644	0.744	1.119	1.790
	AVERAGE	5.603	4.506	15.122	2.063	1.749	2.042	3.035	4.178
	HIGH	8.536	8.039	20.825	2.795	2.605	3.511	3.278	5.616
Orange	LOW	0.385	0.353	6.577	0.161	0.086	0.205	0.117	0.380
	AVERAGE	1.841	2.031	7.834	0.414	0.434	0.575	0.595	1.139
	HIGH	6.336	5.930	16.623	1.788	1.667	1.198	1.175	2.238
Osceola	LOW	0.381	0.337	5.474	0.153	0.145	0.204	0.181	0.370
	AVERAGE	1.652	1.854	8.843	0.394	0.444	0.536	0.487	0.958
	HIGH	4.889	4.569	13.066	1.360	1.186	1.542	1.439	2.943
Palm Beach	LOW	0.707	0.606	13.013	0.502	0.303	0.606	0.378	1.001
	AVERAGE	5.327	3.482	18.476	1.674	1.671	3.266	2.439	3.899
	HIGH	11.267	10.696	28.368	5.487	5.451	6.834	6.789	9.798
Pasco	LOW	0.481	0.448	8.006	0.225	0.215	0.283	0.225	0.549
	AVERAGE	2.092	2.373	9.687	0.488	0.619	0.827	1.051	2.065
	HIGH	4.848	4.524	13.094	1.246	1.163	1.551	1.448	2.688
Pinellas	LOW	0.467	0.447	8.819	0.236	0.214	0.343	0.216	0.574
	AVERAGE	4.310	3.998	10.271	0.971	1.164	1.980	1.745	2.904
	HIGH	8.928	8.414	18.580	6.024	5.771	7.504	7.191	10.671
Polk	LOW	0.393	0.371	7.366	0.172	0.155	0.215	0.110	0.413
	AVERAGE	2.548	2.150	8.952	0.555	0.640	0.723	0.818	1.279
	HIGH	6.003	5.618	13.974	1.681	1.568	1.853	1.730	3.061
Putnam	LOW	0.294	0.242	3.316	0.103	0.095	0.150	0.142	0.230
	AVERAGE	1.925	1.894	4.357	0.409	0.391	0.521	0.444	0.866
	HIGH	3.425	3.151	7.577	0.670	0.621	0.830	0.770	1.489

County	Hurricane Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
St. Johns	LOW	0.234	0.220	3.337	0.095	0.047	0.118	0.073	0.222
	AVERAGE	1.162	1.477	4.597	0.424	0.398	0.653	0.741	1.044
	HIGH	4.267	3.970	8.598	1.098	1.020	1.356	1.261	2.173
St. Lucie	LOW	0.771	0.754	11.237	0.503	0.480	0.637	0.422	0.983
	AVERAGE	4.850	2.317	13.232	1.199	1.155	2.920	3.058	3.967
	HIGH	8.369	7.882	28.973	6.001	5.741	7.415	7.112	9.837
Santa Rosa	LOW	0.329	0.359	3.979	0.177	0.202	0.623	0.386	0.389
	AVERAGE	2.646	2.832	6.433	1.188	1.102	2.870	1.649	2.450
	HIGH	10.741	10.204	19.913	3.655	3.428	4.472	4.199	6.079
Sarasota	LOW	0.616	0.594	10.227	0.342	0.239	0.432	0.270	0.782
	AVERAGE	4.477	2.926	12.593	1.171	1.145	2.293	2.061	2.436
	HIGH	9.118	8.587	25.848	6.118	5.863	7.604	7.294	10.752
Seminole	LOW	0.329	0.309	6.650	0.137	0.116	0.171	0.128	0.357
	AVERAGE	2.075	1.993	7.027	0.444	0.430	0.587	0.601	1.077
	HIGH	3.618	5.113	10.208	0.885	1.437	1.105	1.032	2.021
Sumter	LOW	0.343	0.316	6.047	0.142	0.091	0.177	0.115	0.335
	AVERAGE	0.731	0.693	7.087	0.238	0.224	0.566	0.317	0.570
	HIGH	3.800	3.529	10.865	0.900	0.840	0.829	0.774	1.621
Suwannee	LOW	0.225	0.212	2.644	0.082	0.071	NA	NA	0.194
	AVERAGE	1.235	1.253	3.071	0.289	0.302	NA	NA	0.631
	HIGH	2.431	2.247	5.228	0.540	0.502	NA	NA	1.136
Taylor	LOW	0.243	0.262	1.835	0.112	0.092	0.126	NA	NA
	AVERAGE	1.489	1.553	3.109	0.354	0.355	0.166	NA	NA
	HIGH	2.170	2.006	4.666	0.501	0.464	0.186	NA	NA
Union	LOW	0.209	0.232	2.522	0.087	0.096	NA	NA	NA
	AVERAGE	1.052	1.192	2.989	0.251	0.282	NA	NA	NA
	HIGH	2.037	1.873	4.563	0.352	0.327	NA	NA	NA
Volusia	LOW	0.344	0.301	4.671	0.143	0.136	0.198	0.140	0.321
	AVERAGE	2.646	2.037	6.813	0.587	0.613	1.369	1.157	1.544
	HIGH	6.631	6.254	12.929	2.282	2.220	2.823	2.745	4.262
Wakulla	LOW	0.282	0.269	2.859	0.142	0.136	0.204	1.885	0.341
	AVERAGE	1.258	1.598	3.487	0.430	0.576	1.039	1.885	1.095
	HIGH	5.407	5.066	10.173	1.650	1.536	2.018	1.885	2.928

County	Hurricane Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Walton	LOW	0.307	0.400	3.504	0.218	0.181	0.455	0.325	0.653
	AVERAGE	2.491	2.371	5.915	1.284	1.102	3.144	1.501	2.859
	HIGH	8.667	8.192	14.669	4.018	3.712	4.853	4.484	5.758
Washington	LOW	0.244	0.219	2.843	0.134	0.114	0.242	NA	0.307
	AVERAGE	1.641	1.981	3.933	0.723	0.691	0.242	NA	0.585
	HIGH	3.057	2.846	6.011	1.022	0.954	0.242	NA	1.287
Statewide	LOW	0.122	0.113	1.623	0.039	0.036	0.060	0.038	0.081
	AVERAGE	2.724	3.423	9.209	0.873	1.292	1.726	2.365	3.241
	HIGH	18.063	17.182	50.747	15.220	14.047	18.656	17.222	21.540

Table 38: Hurricane loss costs per $1000 with specified deductibles using 2017 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	0.182	0.136	2.655	0.063	0.036	0.083	0.049	0.149
	AVERAGE	1.134	1.428	3.680	0.224	0.230	0.334	0.315	0.555
	HIGH	2.791	2.582	5.989	0.666	0.616	0.763	0.706	1.290
Baker	LOW	0.113	0.120	1.823	0.034	0.038	NA	NA	0.264
	AVERAGE	0.634	0.734	2.025	0.166	0.151	NA	NA	0.264
	HIGH	1.219	1.112	2.941	0.214	0.197	NA	NA	0.264
Bay	LOW	0.278	0.307	3.409	0.190	0.157	0.280	0.200	0.392
	AVERAGE	2.188	2.469	5.399	0.601	0.596	1.347	0.728	1.830
	HIGH	5.441	5.125	10.710	1.681	1.558	1.981	1.922	2.728
Bradford	LOW	0.147	0.157	2.348	0.057	0.053	NA	NA	NA
	AVERAGE	1.072	1.215	2.638	0.246	0.212	NA	NA	NA
	HIGH	1.654	1.514	3.885	0.324	0.299	NA	NA	NA
Brevard	LOW	0.437	0.427	7.108	0.280	0.224	0.399	0.254	0.610
	AVERAGE	3.318	2.602	11.076	1.149	1.163	1.698	1.970	3.110
	HIGH	8.552	8.085	21.265	3.673	3.421	4.615	4.309	6.332
Broward	LOW	0.681	0.551	15.355	0.467	0.333	0.608	0.400	0.803
	AVERAGE	4.938	3.941	18.755	1.553	1.727	2.765	2.300	4.125
	HIGH	11.685	10.748	28.121	5.548	5.348	7.008	6.756	9.678
Calhoun	LOW	0.181	0.229	2.652	0.065	0.073	NA	NA	NA
	AVERAGE	1.268	1.337	3.140	0.270	0.250	NA	NA	NA
	HIGH	2.062	1.892	4.743	0.409	0.377	NA	NA	NA
Charlotte	LOW	0.498	0.464	11.297	0.338	0.272	0.485	0.293	0.648
	AVERAGE	4.197	2.886	13.237	1.208	1.154	2.339	1.440	2.549
	HIGH	9.075	8.568	17.790	3.240	3.015	4.093	3.811	6.205
Citrus	LOW	0.363	0.316	5.366	0.174	0.126	0.265	0.251	0.398
	AVERAGE	2.934	2.054	6.327	0.607	0.574	1.047	0.979	1.832
	HIGH	4.484	4.167	10.065	1.124	1.038	1.417	1.311	2.346
Clay	LOW	0.110	0.102	2.190	0.037	0.035	0.047	0.049	0.122
	AVERAGE	0.736	1.002	2.740	0.186	0.183	0.177	0.172	0.404
	HIGH	2.274	2.085	4.843	0.400	0.369	0.505	0.465	0.925

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Collier	LOW	0.734	0.727	12.566	0.526	0.350	0.681	0.316	0.846
	AVERAGE	4.630	3.101	17.093	1.553	1.553	2.790	2.381	3.417
	HIGH	14.529	13.827	25.563	6.372	6.112	8.163	7.782	10.360
Columbia	LOW	0.148	0.121	2.077	0.043	0.056	0.311	0.112	0.200
	AVERAGE	0.933	1.025	2.854	0.206	0.210	0.332	0.292	0.200
	HIGH	1.993	1.833	4.502	0.423	0.391	0.352	0.325	0.200
DeSoto	LOW	0.454	0.420	7.692	0.283	0.226	0.485	0.321	0.692
	AVERAGE	3.171	2.614	8.942	0.968	0.735	0.940	1.050	1.834
	HIGH	4.974	4.636	13.828	1.329	1.235	1.698	1.578	2.967
Dixie	LOW	0.330	0.320	3.799	0.149	0.439	0.220	0.208	0.409
	AVERAGE	1.955	1.745	4.162	0.515	0.550	0.472	0.454	0.863
	HIGH	4.975	4.667	9.046	0.606	0.623	0.830	0.631	2.645
Duval	LOW	0.106	0.102	1.858	0.035	0.039	0.060	0.040	0.117
	AVERAGE	1.054	1.228	2.796	0.221	0.229	0.229	0.258	0.436
	HIGH	2.868	2.655	6.185	0.706	0.951	0.884	0.818	1.423
Escambia	LOW	0.225	0.215	3.356	0.107	0.120	0.301	0.217	0.467
	AVERAGE	2.713	3.165	6.273	0.920	0.934	1.813	1.258	2.294
	HIGH	7.821	7.379	13.707	2.717	2.552	3.355	3.148	4.418
Flagler	LOW	0.222	0.202	3.420	0.109	0.087	0.140	0.094	0.240
	AVERAGE	1.808	1.109	5.318	0.373	0.325	0.973	0.472	0.721
	HIGH	4.448	4.135	9.053	1.165	1.079	1.455	1.349	2.253
Franklin	LOW	0.776	0.734	7.323	0.560	0.585	0.616	0.590	1.665
	AVERAGE	3.546	4.583	8.428	1.459	1.494	1.110	1.728	2.098
	HIGH	7.237	6.797	13.335	2.351	1.858	2.904	2.703	3.956
Gadsden	LOW	0.100	0.093	1.666	0.040	0.046	NA	NA	0.135
	AVERAGE	0.751	0.844	1.905	0.203	0.190	NA	NA	0.418
	HIGH	1.326	1.212	3.174	0.261	0.225	NA	NA	0.540
Gilchrist	LOW	0.314	0.292	3.693	0.132	0.172	NA	NA	NA
	AVERAGE	1.459	1.607	4.042	0.455	0.458	NA	NA	NA
	HIGH	2.662	2.465	5.706	0.625	0.579	NA	NA	NA
Glades	LOW	0.828	0.765	11.606	0.537	0.594	NA	NA	2.052
	AVERAGE	5.329	3.465	13.308	1.948	1.609	NA	NA	3.226
	HIGH	6.907	6.473	18.139	2.105	1.957	NA	NA	4.400

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Gulf	LOW	0.257	0.279	3.475	0.138	0.437	0.614	0.379	0.964
	AVERAGE	2.455	3.443	5.233	1.222	1.235	1.011	0.681	1.817
	HIGH	5.418	5.059	10.490	1.637	1.514	2.039	1.893	2.809
Hamilton	LOW	0.104	0.100	1.656	0.039	0.049	NA	NA	NA
	AVERAGE	0.772	0.885	1.992	0.201	0.190	NA	NA	NA
	HIGH	1.302	1.191	3.061	0.254	0.233	NA	NA	NA
Hardee	LOW	0.423	0.329	7.022	0.172	0.163	1.065	NA	NA
	AVERAGE	2.785	2.316	7.679	0.727	0.664	1.065	NA	NA
	HIGH	4.104	3.815	11.791	1.058	0.983	1.065	NA	NA
Hendry	LOW	0.619	0.577	10.890	0.355	0.337	1.036	0.984	4.914
	AVERAGE	4.880	3.979	13.234	1.761	1.366	3.106	2.236	5.153
	HIGH	8.010	7.526	20.460	2.592	2.409	3.302	3.072	5.233
Hernando	LOW	0.330	0.295	5.530	0.137	0.130	0.497	0.168	0.512
	AVERAGE	2.264	1.729	6.872	0.449	0.464	0.854	0.835	1.463
	HIGH	3.608	3.356	10.313	0.935	0.869	1.190	1.106	2.106
Highlands	LOW	0.535	0.429	8.556	0.266	0.252	0.382	0.363	0.609
	AVERAGE	3.293	2.833	9.513	1.014	0.943	1.409	1.268	2.209
	HIGH	5.581	5.216	15.109	1.632	1.517	1.978	1.842	3.328
Hillsborough	LOW	0.312	0.274	6.343	0.127	0.102	0.176	0.126	0.318
	AVERAGE	2.045	2.059	8.056	0.524	0.527	0.681	0.749	1.301
	HIGH	5.652	5.296	13.972	1.677	1.867	2.137	1.989	3.364
Holmes	LOW	0.182	0.173	2.630	0.067	0.075	NA	NA	0.640
	AVERAGE	1.183	1.335	2.895	0.331	0.306	NA	NA	0.640
	HIGH	2.042	1.885	4.464	0.456	0.421	NA	NA	0.640
Indian River	LOW	0.623	0.586	9.283	0.471	0.211	0.604	0.390	0.784
	AVERAGE	3.892	1.928	10.982	1.630	1.259	2.452	2.099	3.273
	HIGH	5.896	5.551	21.297	3.498	3.264	4.401	4.102	6.084
Jackson	LOW	0.154	0.165	2.399	0.063	0.060	NA	NA	0.151
	AVERAGE	1.186	1.286	2.821	0.278	0.265	NA	NA	0.440
	HIGH	1.901	1.748	4.332	0.405	0.373	NA	NA	0.677
Jefferson	LOW	0.122	0.116	1.592	0.050	0.056	NA	NA	NA
	AVERAGE	0.649	0.686	1.684	0.190	0.186	NA	NA	NA
	HIGH	1.202	1.109	2.431	0.237	0.225	NA	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	0.180	0.172	2.328	0.329	0.080	NA	NA	NA
	AVERAGE	1.050	1.076	2.634	0.329	0.259	NA	NA	NA
	HIGH	1.551	1.425	3.550	0.329	0.303	NA	NA	NA
Lake	LOW	0.218	0.196	3.929	0.110	0.048	0.177	0.138	0.269
	AVERAGE	1.669	1.329	6.999	0.373	0.366	0.862	0.687	1.132
	HIGH	3.920	3.642	11.384	0.989	0.918	1.148	1.067	2.065
Lee	LOW	0.651	0.633	12.228	0.398	0.274	0.532	0.306	0.697
	AVERAGE	4.507	2.633	14.848	1.022	1.083	2.775	1.629	2.572
	HIGH	13.048	12.367	29.783	8.605	8.050	11.991	11.190	15.374
Leon	LOW	0.102	0.094	1.661	0.044	0.034	0.056	0.032	0.099
	AVERAGE	0.754	0.811	2.236	0.151	0.142	0.145	0.171	0.234
	HIGH	1.806	1.672	3.854	0.363	0.336	0.315	0.344	0.587
Levy	LOW	0.349	0.291	3.650	0.187	0.177	0.973	0.934	1.410
	AVERAGE	2.370	2.019	4.997	0.642	0.678	2.022	1.927	1.951
	HIGH	6.889	6.491	12.282	2.327	2.159	2.910	2.694	4.011
Liberty	LOW	0.209	0.191	2.680	0.089	0.328	NA	NA	NA
	AVERAGE	1.103	1.217	2.891	0.275	0.328	NA	NA	NA
	HIGH	1.733	1.589	4.044	0.356	0.328	NA	NA	NA
Madison	LOW	0.106	0.096	1.478	0.038	0.045	NA	NA	NA
	AVERAGE	0.796	0.829	1.900	0.172	0.176	NA	NA	NA
	HIGH	1.370	1.255	3.190	0.278	0.256	NA	NA	NA
Manatee	LOW	0.489	0.473	9.009	0.294	0.225	0.380	0.191	0.530
	AVERAGE	3.626	2.354	10.628	0.944	0.939	2.051	1.662	1.615
	HIGH	11.058	10.483	27.326	4.860	4.613	6.120	6.224	8.785
Marion	LOW	0.255	0.202	3.475	0.104	0.088	0.139	0.108	0.247
	AVERAGE	2.099	1.345	5.075	0.374	0.333	0.604	0.516	0.808
	HIGH	4.470	4.123	7.495	0.982	0.657	0.905	0.834	1.563
Martin	LOW	0.800	0.796	11.937	0.683	0.558	0.878	0.427	1.094
	AVERAGE	5.627	3.636	15.980	1.737	1.885	3.877	2.879	4.524
	HIGH	10.178	9.647	21.032	4.065	3.791	5.103	4.761	7.121
Miami-Dade	LOW	0.687	0.583	15.846	0.499	0.353	0.688	0.436	0.818
	AVERAGE	5.081	4.072	17.938	1.890	2.313	3.431	3.199	5.063
	HIGH	13.253	12.667	23.843	12.821	12.295	15.879	15.253	19.788

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Monroe	LOW	1.912	1.849	31.442	2.293	1.997	2.829	2.008	2.616
	AVERAGE	5.293	5.397	33.589	6.260	6.063	7.673	7.092	9.755
	HIGH	11.166	10.678	48.070	9.918	10.214	12.364	12.441	14.946
Nassau	LOW	0.102	0.095	1.732	0.033	0.031	0.242	0.139	0.339
	AVERAGE	1.101	1.133	2.665	0.326	0.300	0.623	0.572	0.781
	HIGH	3.017	2.799	6.282	0.786	0.726	0.985	0.910	1.538
Okaloosa	LOW	0.200	0.220	2.978	0.098	0.116	0.165	0.294	0.316
	AVERAGE	2.684	2.806	4.362	0.900	0.862	1.782	1.135	2.260
	HIGH	7.226	6.815	12.849	2.427	2.303	2.991	2.843	4.064
Okeechobee	LOW	0.752	0.696	11.686	0.574	0.545	0.637	0.980	1.528
	AVERAGE	4.939	3.948	13.812	1.860	1.568	1.848	2.778	3.714
	HIGH	7.637	7.183	19.213	2.543	2.364	3.228	3.006	5.037
Orange	LOW	0.270	0.246	5.818	0.115	0.057	0.152	0.080	0.277
	AVERAGE	1.543	1.712	6.986	0.340	0.357	0.484	0.502	0.946
	HIGH	5.560	5.195	15.172	1.589	1.476	1.050	1.032	1.925
Osceola	LOW	0.264	0.237	4.827	0.108	0.102	0.152	0.126	0.263
	AVERAGE	1.380	1.559	7.923	0.322	0.366	0.449	0.404	0.787
	HIGH	4.281	3.993	11.871	1.202	1.037	1.372	1.276	2.576
Palm Beach	LOW	0.541	0.460	11.912	0.417	0.244	0.512	0.309	0.822
	AVERAGE	4.697	3.029	17.063	1.504	1.498	3.005	2.221	3.471
	HIGH	10.296	9.764	26.496	5.117	5.071	6.420	6.364	8.961
Pasco	LOW	0.358	0.330	7.136	0.173	0.164	0.224	0.174	0.429
	AVERAGE	1.773	2.023	8.718	0.410	0.529	0.718	0.924	1.781
	HIGH	4.228	3.936	11.911	1.098	1.017	1.380	1.284	2.337
Pinellas	LOW	0.346	0.333	7.949	0.185	0.167	0.280	0.166	0.455
	AVERAGE	3.773	3.490	9.314	0.854	1.031	1.800	1.576	2.555
	HIGH	7.970	7.500	17.197	5.625	5.376	7.060	6.751	9.809
Polk	LOW	0.274	0.260	6.557	0.124	0.112	0.160	0.073	0.307
	AVERAGE	2.171	1.820	8.020	0.467	0.542	0.621	0.706	1.075
	HIGH	5.277	4.930	12.702	1.494	1.389	1.663	1.547	2.680
Putnam	LOW	0.208	0.169	2.897	0.071	0.065	0.109	0.103	0.162
	AVERAGE	1.635	1.609	3.829	0.342	0.326	0.443	0.373	0.720
	HIGH	2.955	2.713	6.763	0.578	0.533	0.726	0.670	1.275

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
St. Johns	LOW	0.162	0.153	2.936	0.069	0.031	0.088	0.050	0.163
	AVERAGE	0.982	1.263	4.077	0.364	0.340	0.574	0.656	0.887
	HIGH	3.772	3.505	7.760	0.981	0.908	1.225	1.135	1.904
St. Lucie	LOW	0.601	0.592	10.236	0.425	0.405	0.548	0.352	0.816
	AVERAGE	4.273	1.993	12.126	1.070	1.030	2.700	2.832	3.561
	HIGH	7.481	7.038	27.179	5.637	5.380	7.012	6.712	9.060
Santa Rosa	LOW	0.239	0.273	3.511	0.140	0.163	0.544	0.329	0.303
	AVERAGE	2.309	2.491	5.784	1.072	0.992	2.661	1.508	2.165
	HIGH	9.791	9.297	18.423	3.386	3.169	4.173	3.912	5.490
Sarasota	LOW	0.465	0.450	9.247	0.275	0.189	0.353	0.214	0.625
	AVERAGE	3.915	2.522	11.476	1.037	1.012	2.090	1.871	2.123
	HIGH	8.128	7.644	24.141	5.714	5.463	7.154	6.848	9.877
Seminole	LOW	0.226	0.213	5.905	0.096	0.079	0.124	0.088	0.260
	AVERAGE	1.750	1.679	6.255	0.369	0.356	0.497	0.509	0.893
	HIGH	3.118	4.470	9.196	0.766	1.268	0.970	0.903	1.733
Sumter	LOW	0.239	0.217	5.342	0.100	0.059	0.128	0.077	0.242
	AVERAGE	0.576	0.545	6.294	0.184	0.172	0.477	0.253	0.447
	HIGH	3.272	3.032	9.788	0.776	0.720	0.715	0.664	1.380
Suwannee	LOW	0.158	0.150	2.322	0.059	0.049	NA	NA	0.141
	AVERAGE	1.043	1.061	2.707	0.241	0.252	NA	NA	0.519
	HIGH	2.107	1.942	4.677	0.467	0.432	NA	NA	0.969
Taylor	LOW	0.173	0.193	1.601	0.086	0.069	0.097	NA	NA
	AVERAGE	1.273	1.333	2.744	0.301	0.302	0.132	NA	NA
	HIGH	1.883	1.737	4.166	0.433	0.400	0.150	NA	NA
Union	LOW	0.148	0.167	2.202	0.062	0.069	NA	NA	NA
	AVERAGE	0.876	1.002	2.622	0.206	0.233	NA	NA	NA
	HIGH	1.746	1.601	4.054	0.296	0.273	NA	NA	NA
Volusia	LOW	0.243	0.209	4.112	0.104	0.099	0.152	0.102	0.235
	AVERAGE	2.281	1.744	6.097	0.509	0.531	1.234	1.035	1.329
	HIGH	5.936	5.590	11.827	2.082	2.019	2.598	2.520	3.809
Wakulla	LOW	0.205	0.198	2.520	0.113	0.108	0.168	1.727	0.270
	AVERAGE	1.078	1.386	3.094	0.375	0.509	0.941	1.728	0.947
	HIGH	4.839	4.531	9.247	1.503	1.395	1.854	1.728	2.598

County	Loss Costs	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Walton	LOW	0.271	0.397	3.311	0.200	0.188	0.425	0.454	0.658
	AVERAGE	2.327	2.288	5.746	1.025	0.961	2.365	1.367	2.435
	HIGH	8.162	7.709	14.193	2.852	2.680	3.494	3.294	4.634
Washington	LOW	0.240	0.220	2.757	0.119	0.113	0.262	NA	0.299
	AVERAGE	1.487	1.794	3.748	0.505	0.478	0.262	NA	0.485
	HIGH	2.929	2.722	6.036	0.746	0.690	0.262	NA	0.955
Statewide	LOW	0.100	0.093	1.478	0.033	0.031	0.047	0.032	0.099
	AVERAGE	2.131	2.554	8.108	0.598	1.003	1.254	1.986	2.700
	HIGH	14.529	13.827	48.070	12.821	12.295	15.879	15.253	19.788

Form A-5: Percentage Change in Hurricane Output Ranges

A. One or more automated programs or scripts should be used to generate and arrange the data in Form A-5, Percentage Change in Hurricane Output Ranges.

B. Provide summaries of the percentage change in average hurricane loss cost output range data compiled in Form A-4, Hurricane Output Ranges, relative to the equivalent data compiled from the currently accepted hurricane model in the format shown in the file named "2021FormA5.xlsx."

For the change in hurricane output range exhibit, provide the summary by:

- ***Statewide (overall percentage change),***
- ***By region, as defined in Figure 14 – North, Central and South, and***
- ***By county, as defined in Figure 15 – Coastal and Inland.***

C. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include all tables in Form A-5, Percentage Change in Hurricane Output Ranges, in a submission appendix.

D. Provide color-coded maps by county reflecting the percentage changes in the average hurricane loss costs with specified deductibles for frame owners, masonry owners, frame renters, masonry renters, frame condo unit owners, masonry condo unit owners, manufactured homes, and commercial residential from the hurricane output ranges from the currently accepted hurricane model.

Counties with a negative percentage change (reduction in hurricane loss costs) should be indicated with shades of blue, counties with a positive percentage change (increase in hurricane loss costs) should be indicated with shades of red, and counties with no percentage change should 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

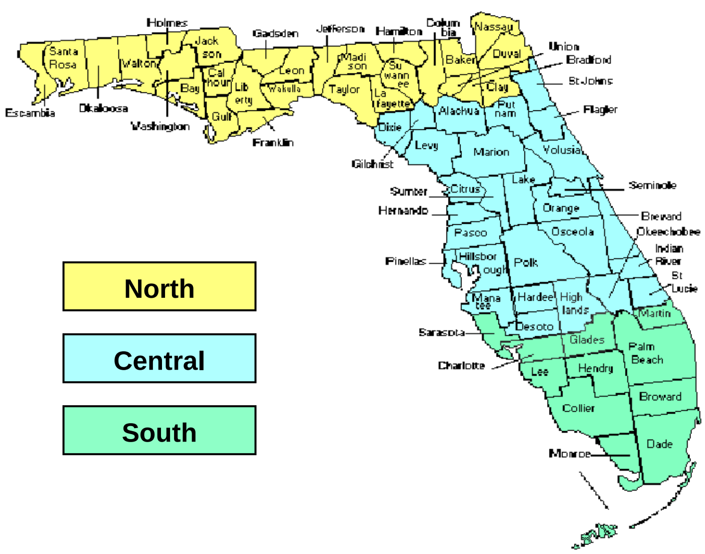
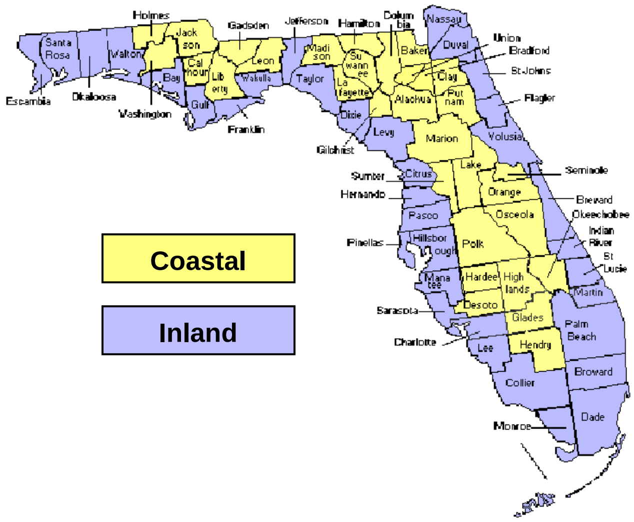


Figure 15

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 RMS21FormA5.xlsx at the link provided to the FCHLPM and appears below.

Table 39: Percentage change in $0 deductible hurricane output ranges

Region	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Coastal	-9.42%	-13.61%	-2.55%	-20.81%	-11.42%	-19.07%	-7.47%	-5.38%
Inland	-9.85%	-13.86%	-2.53%	-22.85%	-21.58%	-22.93%	-22.11%	-14.10%
North	2.81%	1.27%	4.15%	-21.19%	-17.41%	-19.59%	-3.01%	-8.50%
Central	-14.23%	-14.40%	-3.27%	-23.48%	-19.68%	-20.71%	-13.23%	-10.05%
South	-14.87%	-13.76%	-2.46%	-16.53%	-8.25%	-18.26%	-6.43%	-4.29%
Statewide	-9.51%	-13.65%	-2.54%	-21.22%	-12.51%	-19.52%	-7.76%	-5.63%

Table 40: Percentage change in specified deductible hurricane output ranges

Region	Frame Owners	Masonry Owners	Manufactured Homes	Frame Renters	Masonry Renters	Frame Condo Unit	Masonry Condo Unit	Commercial Residential
Coastal	-9.52%	-13.70%	-2.29%	-21.54%	-11.66%	-19.45%	-7.34%	-4.86%
Inland	-9.98%	-14.08%	-2.17%	-24.48%	-23.06%	-24.29%	-23.36%	-14.45%
North	2.97%	1.59%	4.61%	-22.40%	-18.49%	-20.47%	-3.47%	-8.85%
Central	-14.42%	-14.55%	-2.93%	-24.55%	-20.45%	-21.28%	-13.26%	-9.67%
South	-15.01%	-13.85%	-2.29%	-17.01%	-8.42%	-18.51%	-6.28%	-3.76%
Statewide	-9.61%	-13.76%	-2.25%	-22.10%	-12.83%	-19.98%	-7.64%	-5.12%

Figure 80: 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 hurricane model

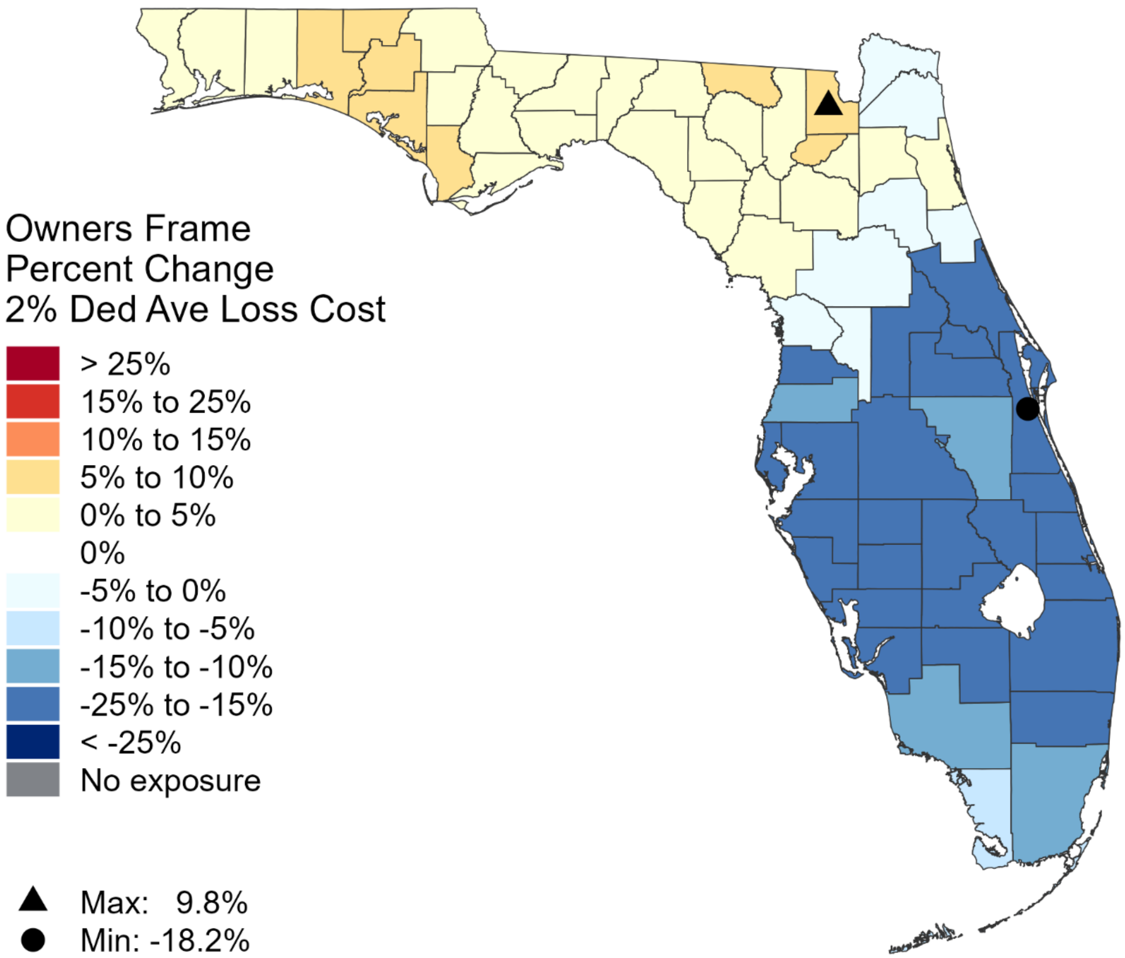


Figure 81: Map by county reflecting the percentage changes in the average loss costs with specified deductibles for masonry owners from the output ranges from the previously-accepted hurricane model

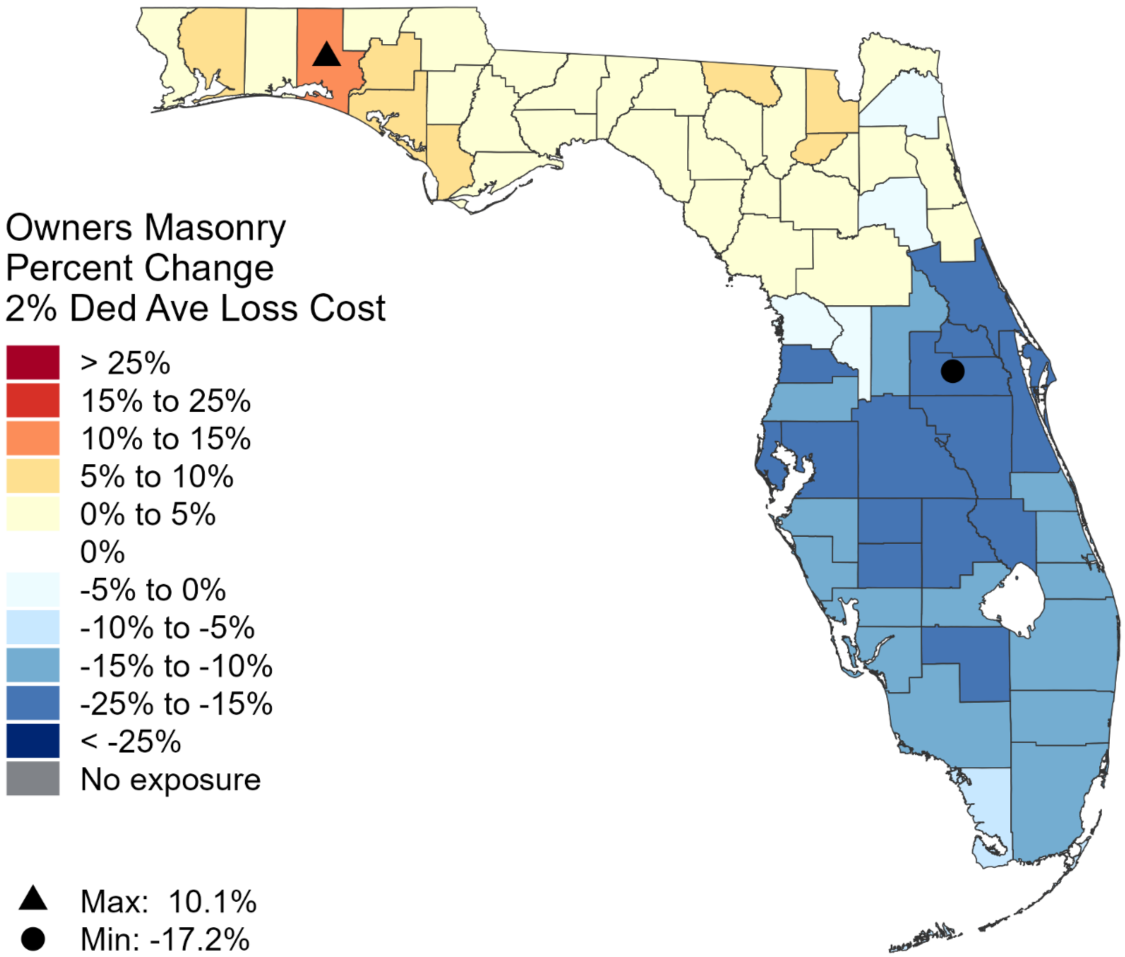


Figure 82: Map by county reflecting the percentage changes in the average loss costs with specified deductibles for manufactured home from the output ranges from the previously-accepted hurricane model

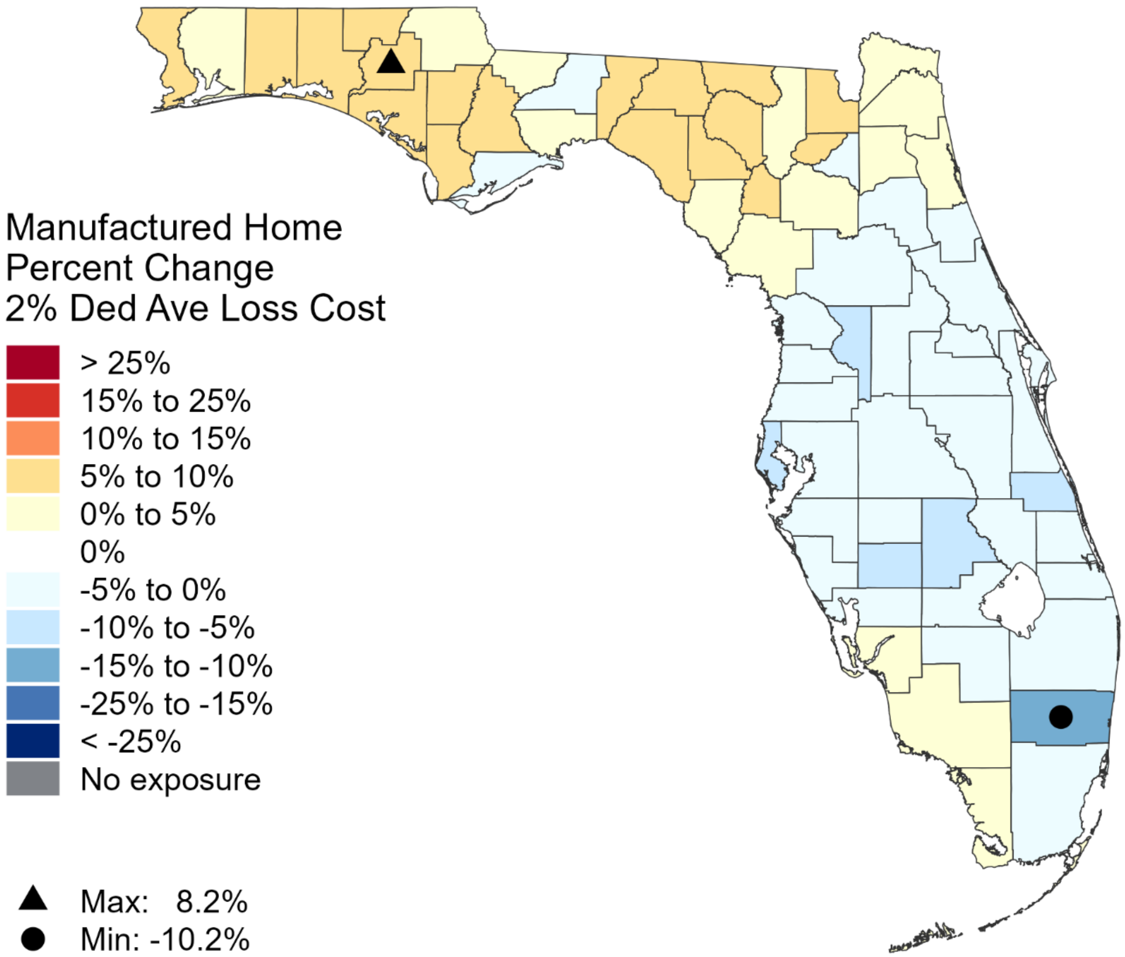


Figure 83: Map by county reflecting the percentage changes in the average loss costs with specified deductibles for frame renters from the output ranges from the previously-accepted hurricane model

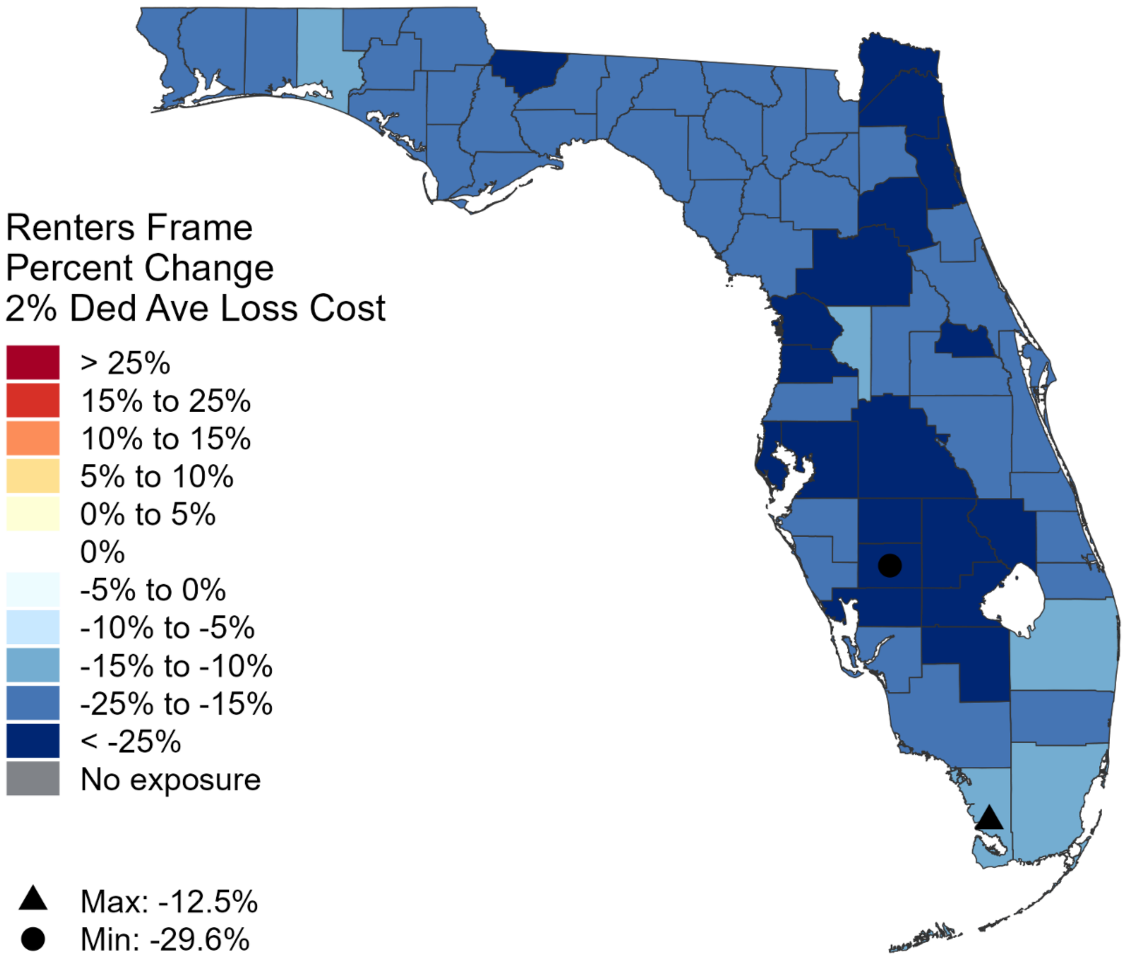


Figure 84: Map by county reflecting the percentage changes in the average loss costs with specified deductibles for masonry renters from the output ranges from the previously-accepted hurricane model

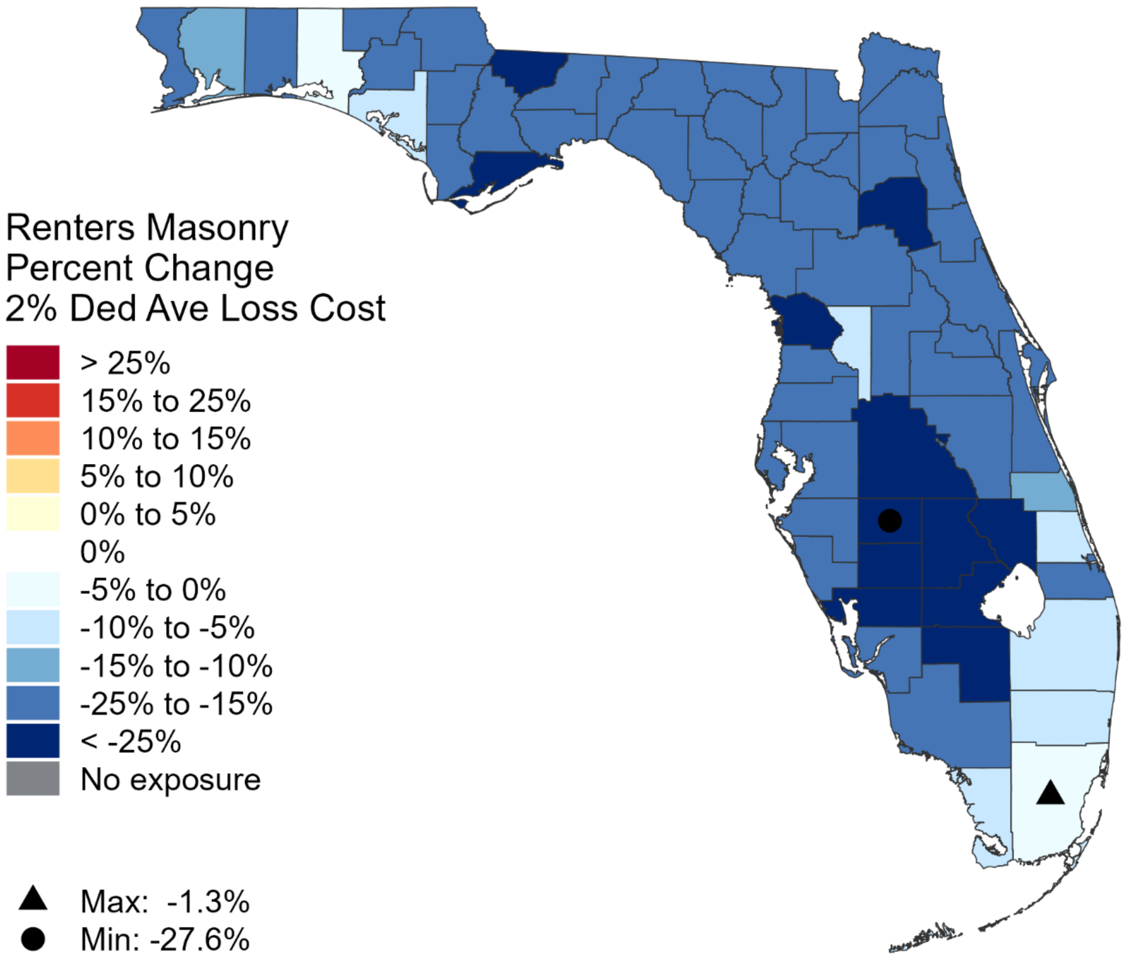


Figure 85: Map by county reflecting the percentage changes in the average loss costs with specified deductibles for frame condo unit owners from the output ranges from the previously-accepted hurricane model

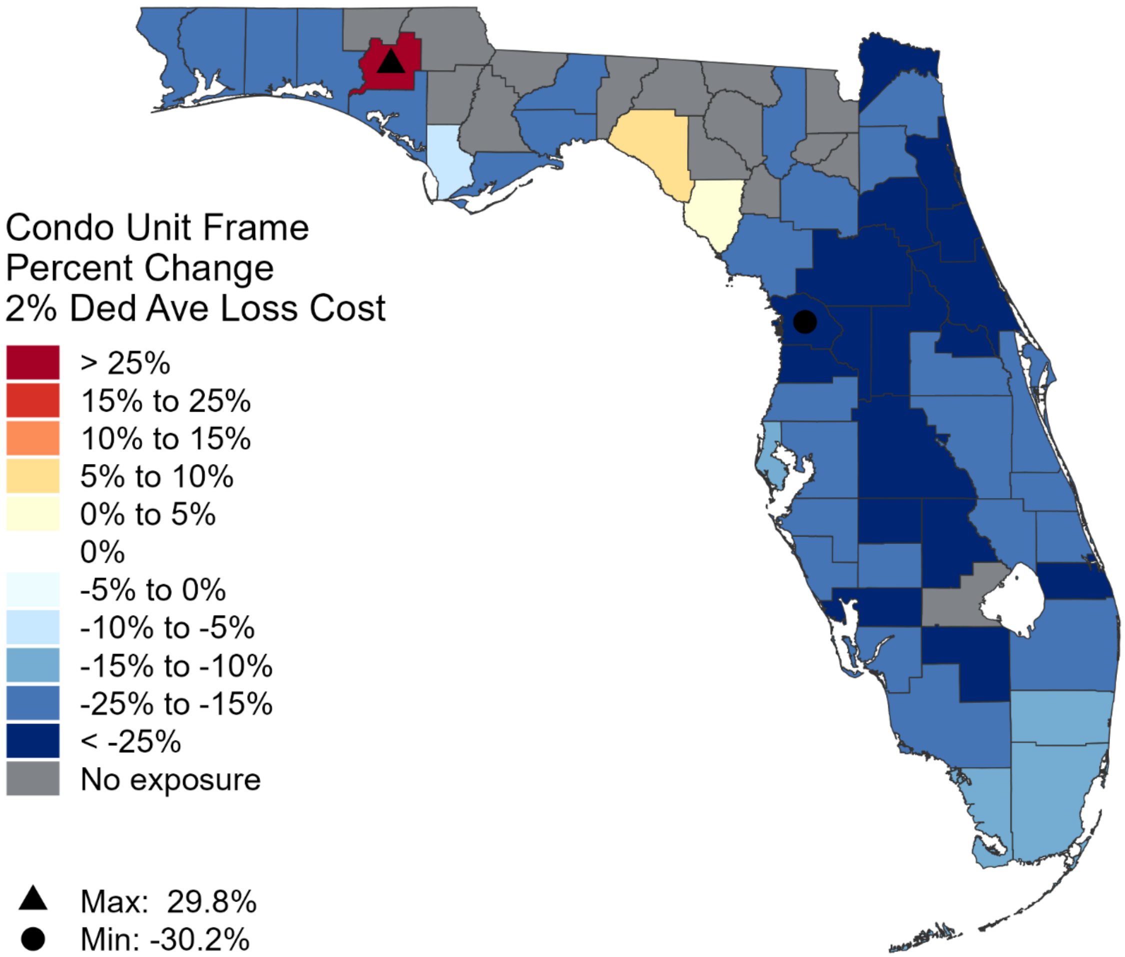


Figure 86: Map by county reflecting the percentage changes in the average loss costs with specified deductibles for masonry condo unit owners from the output ranges from the previously-accepted hurricane model

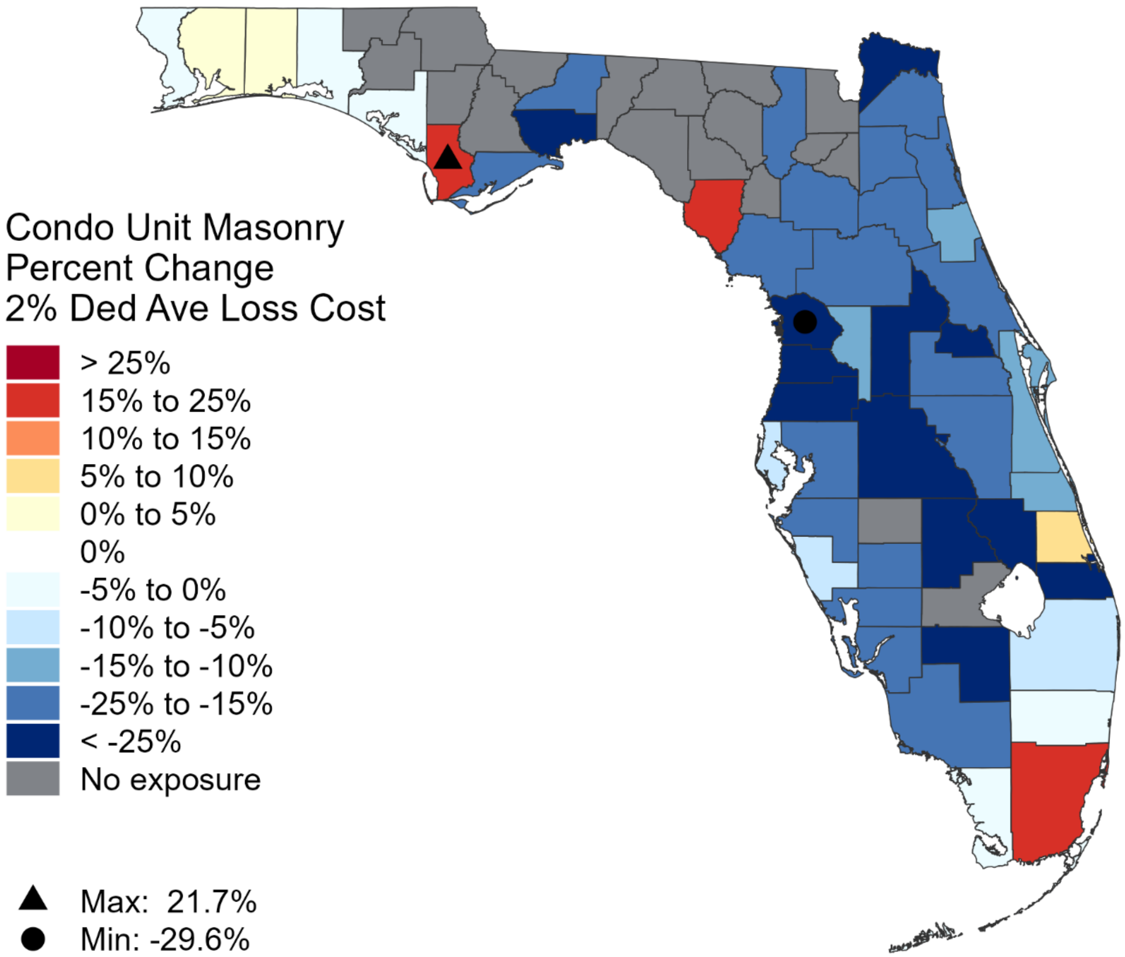
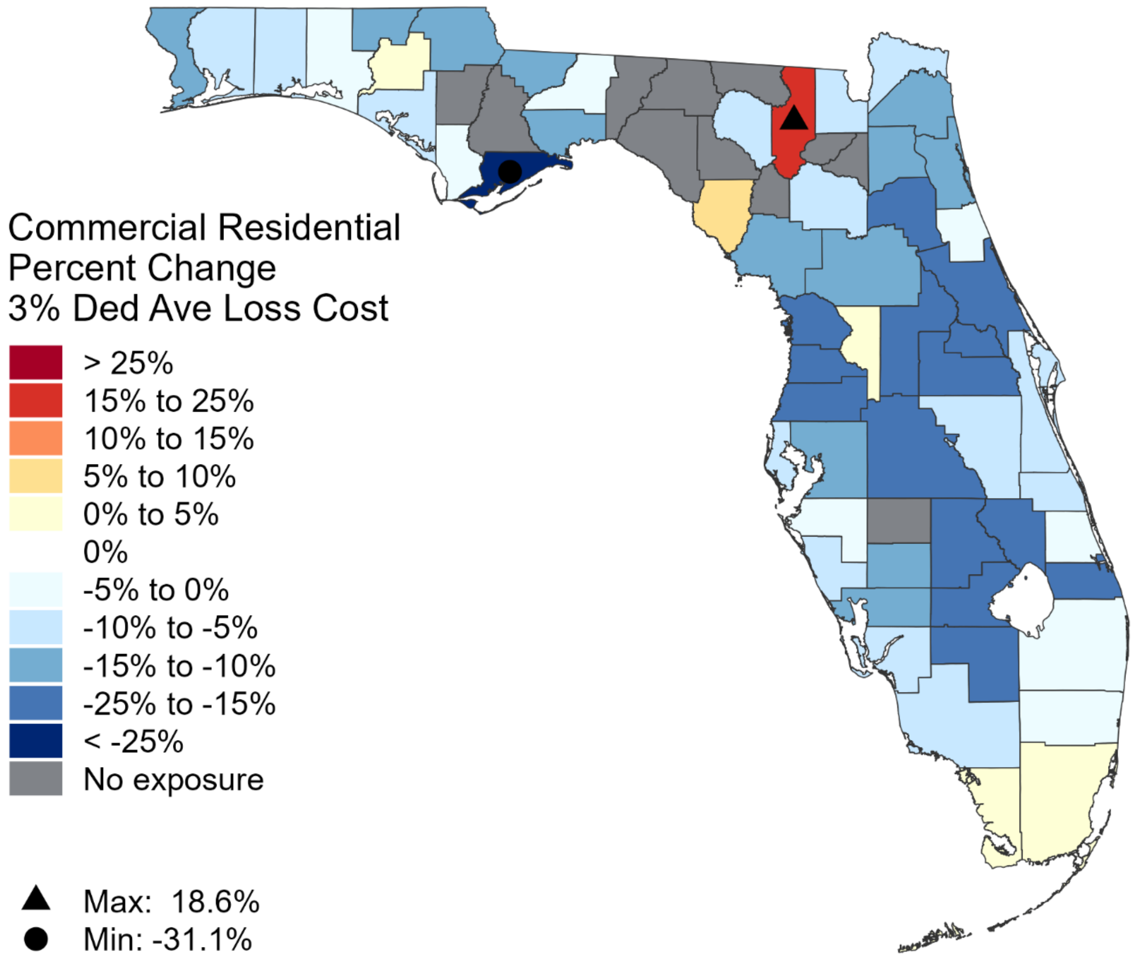


Figure 87: Map by county reflecting the percentage changes in the average loss costs with specified deductibles for commercial residential from the output ranges from the previously-accepted hurricane model



Form A-6: Logical Relationships to Hurricane 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 Relationships to Hurricane Risk

A. One or more automated programs or scripts should be used to generate the exhibits in Form A-7, Percentage Change in Logical Relationships to Hurricane Risk

B. Provide summaries of the percentage change in logical relationship to hurricane risk exhibits from the currently accepted hurricane model in the format shown in the file named "2021FormA7.xlsx."

C. 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 "NotionalInput21.xlsx." Refer to the Notional Hurricane Policy Specifications provided in Form A-6, Logical Relationships to Hurricane Risk (Trade Secret Item), for additional modeling information.

Exhibit	*Notional Set*
Deductible Sensitivity	*Set 1*
Policy Form Sensitivity	*Set 2*
Construction Sensitivity	*Set 3*
Coverage Sensitivity	*Set 4*
Year Built Sensitivity	*Set 5*
Building Strength Sensitivity	*Set 6*
Number of Stories Sensitivity	*Set 7*

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. This is described in Disclosure V-1.11.

D. Hurricane models are to treat points in "Location Grid B" as coordinates that would result from a geocoding process. Hurricane models should treat points by simulating hurricane loss at exact location or by using the nearest modeled parcel/street/cell in the hurricane model .Provide the results statewide (overall percentage change) and by the regions defined in Form A-5, Percentage Change in Hurricane Output Ranges.

E. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include all exhibits in Form A-7, Percentage Change in Logical Relationships to Hurricane Risk, in a submission appendix.

The results are provided in Excel format in the file RMS21FormA7.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 loss cost values in Form A-6 and the percent changes based on those loss cost values throughout Form A-7 are driven by the model changes described in Disclosure G-1.7.

Table 41: Percentage change in logical relationship to hurricane risk – deductible

Construction / Policy	Region	Percent Change in Hurricane Loss Cost					
		$0	$500	1%	2%	5%	10%
Frame Owners	Coastal	-14.2%	-14.2%	-14.2%	-14.2%	-14.1%	-13.8%
	Inland	-13.7%	-13.8%	-13.8%	-13.8%	-13.7%	-13.4%
	North	2.1%	2.2%	2.3%	2.4%	2.9%	3.6%
	Central	-16.2%	-16.3%	-16.3%	-16.3%	-16.2%	-15.9%
	South	-15.4%	-15.5%	-15.5%	-15.5%	-15.5%	-15.2%
	Statewide	-14.1%	-14.1%	-14.1%	-14.1%	-14.0%	-13.7%
Masonry Owners	Coastal	-14.0%	-14.0%	-14.0%	-14.0%	-13.9%	-13.5%
	Inland	-13.9%	-13.9%	-13.9%	-13.9%	-13.8%	-13.4%
	North	2.2%	2.3%	2.4%	2.5%	3.0%	3.8%
	Central	-16.2%	-16.3%	-16.3%	-16.3%	-16.2%	-15.8%
	South	-15.2%	-15.2%	-15.3%	-15.2%	-15.2%	-14.9%
	Statewide	-14.0%	-14.0%	-14.0%	-14.0%	-13.9%	-13.5%
Manufactured Homes	Coastal	-0.4%	-0.3%	-0.3%	-0.2%	0.1%	0.6%
	Inland	-0.3%	-0.1%	-0.1%	0.1%	0.6%	1.4%
	North	4.6%	4.8%	4.8%	4.9%	5.4%	6.1%
	Central	-0.9%	-0.7%	-0.7%	-0.5%	0.0%	0.8%
	South	-0.8%	-0.7%	-0.7%	-0.6%	-0.4%	0.0%
	Statewide	-0.4%	-0.3%	-0.3%	-0.2%	0.2%	0.7%
Frame Renters	Coastal	-2.9%	-2.3%	-2.3%	-1.9%	-0.7%	0.9%
	Inland	-22.6%	-22.9%	-22.9%	-22.9%	-22.4%	-21.6%
	North	-13.2%	-13.1%	-13.1%	-12.8%	-12.2%	-11.2%
	Central	-15.5%	-15.3%	-15.3%	-15.0%	-14.1%	-12.7%
	South	1.6%	2.2%	2.2%	2.7%	3.9%	5.5%
	Statewide	-5.6%	-5.1%	-5.1%	-4.6%	-3.6%	-2.0%
Masonry Renters	Coastal	-4.0%	-3.4%	-3.4%	-3.0%	-1.9%	-0.4%
	Inland	-24.4%	-24.9%	-24.9%	-24.9%	-24.6%	-23.8%
	North	-14.9%	-14.9%	-14.9%	-14.8%	-14.2%	-13.3%
	Central	-17.2%	-17.0%	-17.0%	-16.8%	-15.9%	-14.6%
	South	0.9%	1.5%	1.5%	2.0%	3.1%	4.7%
	Statewide	-6.9%	-6.4%	-6.4%	-6.0%	-4.9%	-3.4%
Frame Condo Unit	Coastal	-19.0%	-19.2%	-19.2%	-19.2%	-19.3%	-19.2%
	Inland	-28.5%	-29.2%	-29.2%	-29.5%	-29.9%	-30.2%
	North	-23.8%	-24.3%	-24.3%	-24.6%	-25.0%	-25.4%
	Central	-25.2%	-25.6%	-25.6%	-25.7%	-25.9%	-25.8%
	South	-16.8%	-16.9%	-16.9%	-17.0%	-17.0%	-16.9%
	Statewide	-20.4%	-20.6%	-20.6%	-20.7%	-20.7%	-20.6%

Construction / Policy	Region	Percent Change in Hurricane Loss Cost					
		$0	$500	1%	2%	5%	10%
Masonry Condo Unit	Coastal	-19.8%	-20.0%	-20.0%	-20.0%	-20.1%	-20.0%
	Inland	-30.0%	-30.8%	-30.8%	-31.1%	-31.7%	-32.1%
	North	-25.3%	-25.9%	-25.9%	-26.2%	-26.7%	-27.2%
	Central	-26.5%	-27.0%	-27.0%	-27.1%	-27.3%	-27.4%
	South	-17.3%	-17.4%	-17.4%	-17.5%	-17.5%	-17.4%
	Statewide	-21.3%	-21.5%	-21.5%	-21.6%	-21.7%	-21.6%

Construction / Policy	Region	Percent Change in Hurricane Loss Cost					
		$0	2%	3%	5%	10%	
Commercial Residential	Coastal	-5.3%	-4.6%	-4.2%	-3.4%	-1.4%	
	Inland	-20.7%	-22.3%	-22.6%	-23.0%	-22.9%	
	North	-10.7%	-11.4%	-11.5%	-11.3%	-10.1%	
	Central	-16.8%	-17.3%	-17.3%	-17.2%	-16.2%	
	South	-1.3%	-0.3%	0.1%	1.0%	3.2%	
	Statewide	-7.6%	-7.1%	-6.8%	-6.2%	-4.2%	

Table 42: Percentage change in logical relationship to hurricane risk – policy form

Policy Form	Region	Percent Change in Hurricane Loss Cost		
		Masonry	Frame	Manufactured Homes
Owners	Coastal	-14.0%	-14.2%	
	Inland	-13.9%	-13.7%	
	North	2.2%	2.1%	
	Central	-16.2%	-16.2%	
	South	-15.2%	-15.4%	
	Statewide	-14.0%	-14.1%	
Renters	Coastal	-4.0%	-2.9%	
	Inland	-24.4%	-22.6%	
	North	-14.9%	-13.2%	
	Central	-17.2%	-15.5%	
	South	0.9%	1.6%	
	Statewide	-6.9%	-5.6%	
Condo Unit	Coastal	-19.8%	-19.0%	
	Inland	-30.0%	-28.5%	
	North	-25.3%	-23.8%	
	Central	-26.5%	-25.2%	
	South	-17.3%	-16.8%	
	Statewide	-21.3%	-20.4%	
Policy Form	**Region**	**Percent Change in Hurricane Loss Cost**		
		Concrete		
Commercial Residential	Coastal	-5.3%		
	Inland	-20.7%		
	North	-10.7%		
	Central	-16.8%		
	South	-1.3%		
	Statewide	-7.6%		

Table 43: Percentage change in logical relationship to hurricane risk – construction

Region	Percent Change in Hurricane Loss Cost		
	Frame Owners	Masonry Owners	Manufactured Homes
Coastal	-14.2%	-14.0%	-0.4%
Inland	-13.7%	-13.9%	-0.3%
North	2.1%	2.2%	4.6%
Central	-16.2%	-16.2%	-0.9%
South	-15.4%	-15.2%	-0.8%
Statewide	-14.1%	-14.0%	-0.4%

Table 44: Percentage change in logical relationship to hurricane risk – coverage

Construction / Policy	Region	Percent Change in Hurricane Loss Cost			
		Coverage A	Coverage B	Coverage C	Coverage D
Frame Owners	Coastal	-13.8%	-13.8%	-17.9%	-11.3%
	Inland	-13.4%	-13.4%	-18.1%	-12.2%
	North	2.5%	2.5%	-1.8%	5.8%
	Central	-15.8%	-15.8%	-20.7%	-14.4%
	South	-15.1%	-15.1%	-19.1%	-12.7%
	Statewide	-13.7%	-13.7%	-17.9%	-11.5%
Masonry Owners	Coastal	-13.7%	-13.7%	-17.6%	-10.9%
	Inland	-13.5%	-13.5%	-18.2%	-12.0%
	North	2.5%	2.5%	-1.7%	6.3%
	Central	-15.9%	-15.9%	-20.7%	-14.1%
	South	-14.9%	-14.9%	-18.9%	-12.4%
	Statewide	-13.6%	-13.6%	-17.7%	-11.1%
Manufactured Homes	Coastal	-0.4%	-0.4%	-2.3%	5.4%
	Inland	-0.3%	-0.3%	-2.1%	6.3%
	North	4.9%	4.9%	1.4%	6.6%
	Central	-0.9%	-0.9%	-2.7%	6.2%
	South	-0.8%	-0.8%	-2.5%	5.0%
	Statewide	-0.4%	-0.4%	-2.3%	5.5%
Frame Renters	Coastal			-5.7%	7.5%
	Inland			-25.0%	-13.6%
	North			-15.3%	-5.2%
	Central			-18.1%	-5.6%
	South			-1.2%	12.2%
	Statewide			-8.3%	4.5%

Construction / Policy	Region	Percent Change in Hurricane Loss Cost			
		Coverage A	Coverage B	Coverage C	Coverage D
Masonry Renters	Coastal			-6.7%	6.1%
	Inland			-26.9%	-15.6%
	North			-17.0%	-7.1%
	Central			-19.8%	-7.4%
	South			-1.9%	11.2%
	Statewide			-9.5%	3.0%
Frame Condo Unit	Coastal	-18.3%		-20.1%	-14.7%
	Inland	-26.9%		-29.3%	-26.1%
	North	-21.0%		-24.6%	-22.4%
	Central	-24.2%		-26.3%	-20.5%
	South	-16.4%		-17.8%	-12.9%
	Statewide	-19.6%		-21.5%	-16.1%
Masonry Condo Unit	Coastal	-19.0%		-20.8%	-15.8%
	Inland	-28.4%		-30.8%	-28.1%
	North	-22.3%		-26.1%	-24.3%
	Central	-25.5%		-27.6%	-22.3%
	South	-16.8%		-18.3%	-13.6%
	Statewide	-20.4%		-22.3%	-17.2%
Commercial Residential	Coastal	-6.3%		-10.7%	32.4%
	Inland	-21.2%		-27.1%	-1.1%
	North	-11.6%		-16.3%	20.3%
	Central	-17.5%		-22.8%	10.3%
	South	-2.4%		-6.8%	39.1%
	Statewide	-8.5%		-13.0%	27.7%

Table 45: Percentage change in logical relationship to hurricane risk – year built

Construction / Policy	Region	Percent Change in Hurricane Loss Cost				
		Year Built 1980	Year Built 1989	Year Built 1998	Year Built 2004	Year Built 2019
Frame Owners	Coastal	-14.2%	-14.2%	-9.7%	0.4%	-2.0%
	Inland	-13.7%	-13.7%	-6.5%	8.0%	4.2%
	North	2.1%	2.1%	4.1%	17.0%	13.2%
	Central	-16.2%	-16.2%	-9.7%	2.8%	0.4%
	South	-15.4%	-15.4%	-11.0%	-1.9%	-4.6%
	Statewide	-14.1%	-14.1%	-9.1%	1.6%	-1.1%
Masonry Owners	Coastal	-14.0%	-14.0%	-4.7%	3.2%	1.2%
	Inland	-13.9%	-13.9%	0.1%	12.8%	8.9%
	North	2.2%	2.2%	14.5%	25.6%	21.6%
	Central	-16.2%	-16.2%	-3.2%	9.4%	6.9%
	South	-15.2%	-15.2%	-7.7%	-2.1%	-4.1%
	Statewide	-14.0%	-14.0%	-3.9%	4.7%	2.4%
Construction / Policy	Region	Percent Change in Hurricane Loss Cost				
		Year Built 1989	Year Built 1972	Year Built 1992	Year Built 2004	Year Built 2019
Manufactured Homes	Coastal	-0.4%	-0.4%	-0.4%	-0.7%	-0.7%
	Inland	-0.3%	-0.3%	-0.3%	-0.4%	-0.4%
	North	4.6%	4.5%	4.6%	4.9%	4.9%
	Central	-0.9%	-0.9%	-0.9%	-1.0%	-1.0%
	South	-0.8%	-0.7%	-0.8%	-1.2%	-1.2%
	Statewide	-0.4%	-0.4%	-0.4%	-0.6%	-0.6%
Construction / Policy	Region	Percent Change in Hurricane Loss Cost				
		Year Built 1980	Year Built 1989	Year Built 1998	Year Built 2004	Year Built 2019
Frame Renters	Coastal	-2.9%	-2.9%	8.4%	28.2%	32.1%
	Inland	-22.6%	-22.6%	-4.6%	24.6%	27.2%
	North	-13.2%	-13.2%	4.0%	27.4%	30.5%
	Central	-15.5%	-15.5%	3.9%	31.3%	35.0%
	South	1.6%	1.6%	8.9%	26.1%	30.1%
	Statewide	-5.6%	-5.6%	7.0%	27.8%	31.6%
Masonry Renters	Coastal	-4.0%	-4.0%	26.5%	46.4%	51.3%
	Inland	-24.4%	-24.4%	4.0%	35.6%	38.1%
	North	-14.9%	-14.9%	18.6%	47.6%	50.5%
	Central	-17.2%	-17.2%	15.8%	47.7%	51.9%
	South	0.9%	0.9%	29.2%	43.5%	48.5%
	Statewide	-6.9%	-6.9%	23.7%	45.2%	49.7%

Construction / Policy	Region	Percent Change in Hurricane Loss Cost				
		Year Built 1980	Year Built 1989	Year Built 1998	Year Built 2004	Year Built 2019
Frame Condo Unit	Coastal	-19.0%	-19.0%	-12.2%	3.9%	6.8%
	Inland	-28.5%	-28.5%	-16.0%	7.3%	9.5%
	North	-23.8%	-23.8%	-13.3%	5.9%	8.2%
	Central	-25.2%	-25.2%	-12.6%	9.4%	12.4%
	South	-16.8%	-16.8%	-12.7%	1.5%	4.2%
	Statewide	-20.4%	-20.4%	-12.7%	4.3%	7.1%
Masonry Condo Unit	Coastal	-19.8%	-19.8%	-0.8%	14.4%	17.8%
	Inland	-30.0%	-30.0%	-10.0%	14.7%	17.0%
	North	-25.3%	-25.3%	-3.5%	18.2%	20.7%
	Central	-26.5%	-26.5%	-4.8%	19.6%	23.0%
	South	-17.3%	-17.3%	0.0%	11.1%	14.5%
	Statewide	-21.3%	-21.3%	-2.0%	14.4%	17.7%
Commercial Residential	Coastal	-5.3%	-5.3%	53.7%	96.0%	95.7%
	Inland	-20.7%	-20.7%	32.6%	74.9%	73.1%
	North	-10.7%	-10.7%	42.2%	79.6%	76.7%
	Central	-16.8%	-16.8%	38.9%	81.8%	80.9%
	South	-1.3%	-1.3%	59.1%	101.8%	101.8%
	Statewide	-7.6%	-7.6%	50.8%	93.1%	92.6%

Table 46: Percentage change in logical relationship to hurricane risk – building strength

Construction / Policy	Region	Percent Change in Hurricane Loss Cost		
		Weak	Medium	Strong
Frame Owners	Coastal	-14.9%	-9.7%	2.7%
	Inland	-14.3%	-6.5%	11.7%
	North	1.5%	4.1%	19.8%
	Central	-16.7%	-9.7%	5.9%
	South	-16.1%	-11.0%	0.0%
	Statewide	-14.8%	-9.1%	4.1%
Masonry Owners	Coastal	-14.7%	-4.7%	5.5%
	Inland	-14.4%	0.1%	15.1%
	North	1.6%	14.5%	27.2%
	Central	-16.7%	-3.2%	11.4%
	South	-15.9%	-7.7%	0.1%
	Statewide	-14.6%	-3.9%	7.0%
Manufactured Homes	Coastal	-0.3%	-0.4%	-0.7%
	Inland	-0.3%	-0.3%	-0.4%
	North	4.5%	4.6%	4.9%
	Central	-0.9%	-0.9%	-1.0%
	South	-0.6%	-0.8%	-1.2%
	Statewide	-0.3%	-0.4%	-0.6%
Frame Renters	Coastal	-5.6%	8.4%	26.1%
	Inland	-25.1%	-4.6%	25.2%
	North	-18.6%	4.0%	27.0%
	Central	-18.3%	3.9%	29.9%
	South	-0.5%	8.9%	24.0%
	Statewide	-8.4%	7.0%	26.0%
Masonry Renters	Coastal	-6.6%	26.5%	45.9%
	Inland	-27.1%	4.0%	34.4%
	North	-20.3%	18.6%	46.2%
	Central	-20.0%	15.8%	45.8%
	South	-1.0%	29.2%	43.7%
	Statewide	-9.6%	23.7%	44.6%
Frame Condo Unit	Coastal	-20.2%	-12.2%	3.8%
	Inland	-30.4%	-16.0%	9.4%
	North	-25.6%	-13.3%	7.0%
	Central	-27.0%	-12.6%	10.1%
	South	-17.7%	-12.7%	1.1%
	Statewide	-21.7%	-12.7%	4.4%

Construction / Policy	Region	Percent Change in Hurricane Loss Cost		
		Weak	Medium	Strong
Masonry Condo Unit	Coastal	-21.1%	-0.8%	14.9%
	Inland	-32.1%	-10.0%	15.6%
	North	-27.3%	-3.5%	19.1%
	Central	-28.4%	-4.8%	19.8%
	South	-18.4%	0.0%	11.8%
	Statewide	-22.7%	-2.0%	15.0%
Commercial Residential	Coastal	-5.3%	53.7%	94.7%
	Inland	-20.8%	32.6%	76.7%
	North	-10.9%	42.2%	79.3%
	Central	-16.9%	38.9%	82.2%
	South	-1.4%	59.1%	100.3%
	Statewide	-7.6%	50.8%	92.0%

Table 47: Percentage change in logical relationship to hurricane risk – number of stories

Construction / Policy	Region	Percent Change in Hurricane Loss Cost		
		1 Story	2 Story	
Frame Owners	Coastal	-14.2%	-21.8%	
	Inland	-13.7%	-18.5%	
	North	2.1%	-5.4%	
	Central	-16.2%	-21.6%	
	South	-15.4%	-23.8%	
	Statewide	-14.1%	-21.2%	
Masonry Owners	Coastal	-14.0%	-21.7%	
	Inland	-13.9%	-18.8%	
	North	2.2%	-5.5%	
	Central	-16.2%	-21.7%	
	South	-15.2%	-23.7%	
	Statewide	-14.0%	-21.2%	
Frame Renters	Coastal	-2.9%	-19.4%	
	Inland	-22.6%	-28.8%	
	North	-13.2%	-24.3%	
	Central	-15.5%	-25.6%	
	South	1.6%	-17.1%	
	Statewide	-5.6%	-20.7%	
Masonry Renters	Coastal	-4.0%	-20.1%	
	Inland	-24.4%	-30.3%	
	North	-14.9%	-25.8%	
	Central	-17.2%	-26.9%	
	South	0.9%	-17.6%	
	Statewide	-6.9%	-21.6%	
Construction / Policy	**Region**	**Percent Change in Hurricane Loss Cost**		
		5 Story	**10 Story**	**20 Story**
Commercial Residential	Coastal	-0.9%	-0.7%	-5.3%
	Inland	-12.6%	-13.4%	-20.7%
	North	-5.3%	-5.1%	-10.7%
	Central	-9.7%	-10.2%	-16.8%
	South	2.2%	2.6%	-1.3%
	Statewide	-2.8%	-2.7%	-7.6%

Form A-8: Hurricane Probable Maximum Loss for Florida

A. One or more automated programs or scripts should be used to generate and arrange the data in Form A-8, Hurricane Probable Maximum Loss for Florida.

B. Provide a detailed explanation of how the Expected Annual Hurricane Losses and Return Periods are calculated.

C. Complete Part A showing the personal and commercial residential hurricane probable maximum loss for Florida. For the Expected Annual Hurricane Losses column, provide personal and commercial residential, zero deductible statewide hurricane loss costs based on the 2017 Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data found in the file named "hlpm2017c.zip."

In the column, Return Period (Years), provide the return period associated with the average hurricane loss within the ranges indicated on a cumulative basis.

For example, if the average hurricane loss is $4,705 million for the range $4,501 - $5,000 million, provide the return period associated with a hurricane loss that is $4,705 million or greater.

For each hurricane loss range in millions ($1,001-$1,500, $1,501-$2,000, $2,001-$2,500) the average hurricane loss within that range should be identified and then the return period associated with that hurricane loss calculated. The return period is then the reciprocal of the probability of the hurricane loss equaling or exceeding this average hurricane loss size.

The probability of equaling or exceeding the average of each range should be smaller as the ranges increase (and the average hurricane losses within the ranges increase). Therefore, the return period associated with each range and average hurricane loss within that range should be larger as the ranges increase. Return periods should be based on cumulative probabilities.

A return period for an average hurricane loss of $4,705 million within the $4,501-$5,000 million range should be lower than the return period for an average hurricane loss of $5,455 million associated with a $5,001- $6,000 million range.

D. Provide a graphical comparison of the current hurricane model Residential Return Periods hurricane loss curve to the currently accepted hurricane model Residential Return Periods hurricane loss curve. Residential Return Period (Years) should be shown on the y-axis on a log-10 scale with Hurricane Losses in Billions shown on the x-axis. The legend should indicate the corresponding hurricane model with a solid line representing the current year and a dotted line representing the currently accepted hurricane model.

E. Provide the expected hurricane loss and 10% (lower bound) and 90% (upper bound) hurricane loss levels 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 in hurricane vulnerability functions has been propagated to the uncertainty in portfolio loss and how it relates to the 10% and 90% hurricane loss levels.

F. If additional assumptions are necessary to complete this form, provide the rationale for the assumptions as well as a detailed description of how they are included.

No additional assumption was necessary to complete this form.

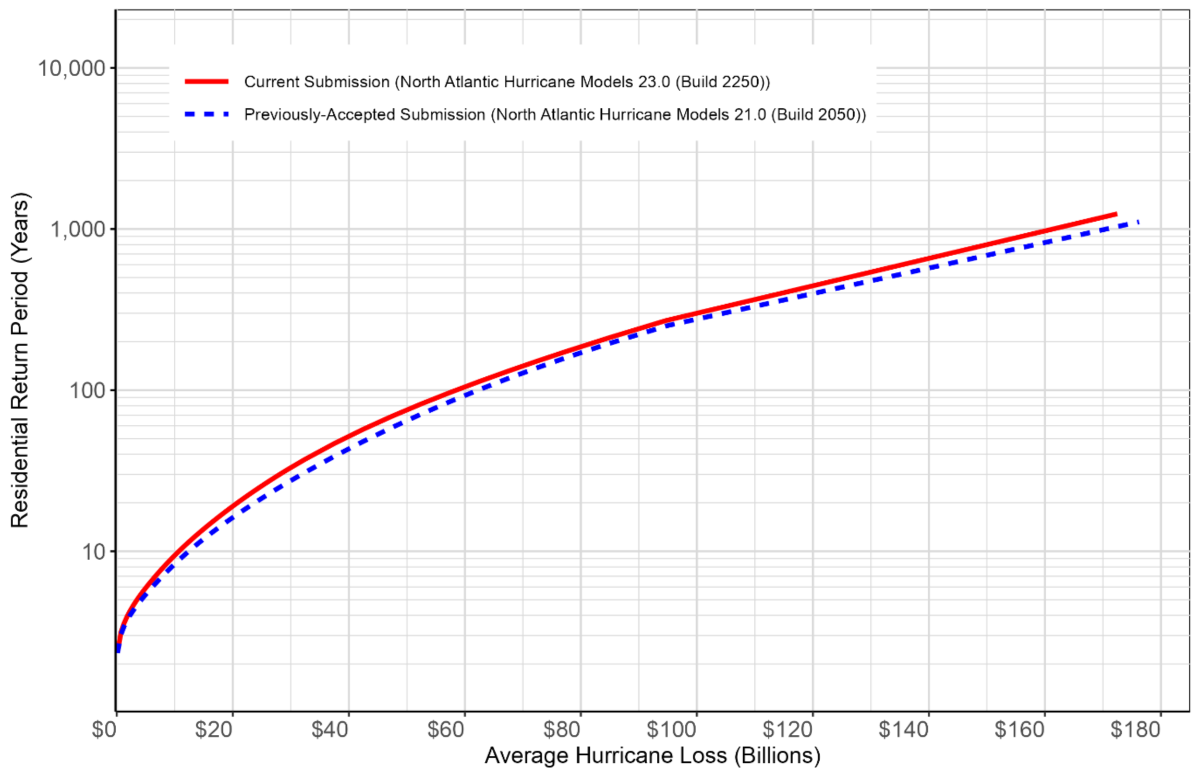
G. Provide this form in Excel format. The file name should include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include Form A-8, Hurricane Probable Maximum Loss for Florida, in a submission appendix.

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 10 percent / 90 percent 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 RMS21FormA8.xlsx at the link provided to the FCHLPM and appear in the following tables.

Figure 88: Comparison of current submission return times to the prior year's submission return time



Part A – Personal and Commercial Residential Hurricane Probable Maximum Loss for Florida

Table 48: Distribution of hurricanes by size of loss for the 2017 FHCF combined personal and commercial residential aggregate exposure data

HURRICANE LOSS RANGE (MILLIONS)					TOTAL HURRICANE LOSS	AVERAGE HURRICANE LOSS (MILLIONS)	NUMBER OF HURRICANES	EXPECTED ANNUAL HURRICANE LOSSES*	RETURN PERIOD (YEARS)
$	->0	to	$	500	$741,296	$114	6,528	$49,526,444	2
$	501	to	$	1,000	$916,364	$724	1,265	$59,724,632	3
$	1,001	to	$	1,500	$1,003,771	$1,235	813	$51,631,155	4
$	1,501	to	$	2,000	$1,087,467	$1,743	624	$65,220,187	4
$	2,001	to	$	2,500	$1,279,708	$2,245	570	$68,532,287	4
$	2,501	to	$	3,000	$1,454,718	$2,760	527	$73,595,180	5
$	3,001	to	$	3,500	$1,451,276	$3,239	448	$60,763,521	5
$	3,501	to	$	4,000	$1,805,318	$3,745	482	$55,274,682	5
$	4,001	to	$	4,500	$1,749,221	$4,246	412	$47,751,231	5
$	4,501	to	$	5,000	$1,700,406	$4,750	358	$48,702,804	6
$	5,001	to	$	6,000	$3,507,912	$5,498	638	$89,837,505	6
$	6,001	to	$	7,000	$3,346,815	$6,499	515	$119,056,036	7
$	7,001	to	$	8,000	$3,377,256	$7,522	449	$171,581,727	8
$	8,001	to	$	9,000	$3,808,073	$8,500	448	$162,556,471	8
$	9,001	to	$	10,000	$4,083,466	$9,496	430	$76,980,392	9
$	10,001	to	$	11,000	$3,708,165	$10,475	354	$113,530,756	10
$	11,001	to	$	12,000	$3,402,500	$11,495	296	$105,113,665	11
$	12,001	to	$	13,000	$3,467,350	$12,472	278	$78,098,354	11
$	13,001	to	$	14,000	$2,870,360	$13,539	212	$60,188,023	12
$	14,001	to	$	15,000	$3,300,227	$14,475	228	$73,900,350	13
$	15,001	to	$	16,000	$3,036,721	$15,493	196	$72,928,404	14
$	16,001	to	$	17,000	$3,166,414	$16,492	192	$72,756,757	15
$	17,001	to	$	18,000	$2,882,171	$17,468	165	$63,926,223	16
$	18,001	to	$	19,000	$3,090,192	$18,504	167	$53,269,508	17
$	19,001	to	$	20,000	$2,968,994	$19,533	152	$59,684,017	19
$	20,001	to	$	21,000	$3,013,551	$20,500	147	$81,015,349	20
$	21,001	to	$	22,000	$2,860,287	$21,506	133	$105,104,883	21
$	22,001	to	$	23,000	$2,906,520	$22,531	129	$76,133,695	22
$	23,001	to	$	24,000	$2,563,822	$23,521	109	$44,588,113	23
$	24,001	to	$	25,000	$2,724,828	$24,548	111	$44,845,578	25
$	25,001	to	$	26,000	$2,677,874	$25,504	105	$36,832,728	26
$	26,001	to	$	27,000	$2,484,577	$26,432	94	$37,563,581	28
$	27,001	to	$	28,000	$2,531,246	$27,514	92	$39,432,253	29

HURRICANE LOSS RANGE (MILLIONS)			TOTAL HURRICANE LOSS	AVERAGE HURRICANE LOSS (MILLIONS)	NUMBER OF HURRICANES	EXPECTED ANNUAL HURRICANE LOSSES*	RETURN PERIOD (YEARS)
$ 28,001	to	$ 29,000	$2,253,402	$28,524	79	$50,332,430	31
$ 29,001	to	$ 30,000	$2,391,507	$29,525	81	$37,651,700	32
$ 30,001	to	$ 35,000	$12,496,704	$32,459	385	$194,967,637	37
$ 35,001	to	$ 40,000	$10,709,529	$37,446	286	$152,952,928	47
$ 40,001	to	$ 45,000	$10,458,672	$42,515	246	$118,486,345	57
$ 45,001	to	$ 50,000	$9,418,946	$47,331	199	$85,223,309	69
$ 50,001	to	$ 55,000	$9,063,167	$52,388	173	$103,496,180	82
$ 55,001	to	$ 60,000	$7,351,404	$57,433	128	$93,252,880	97
$ 60,001	to	$ 65,000	$7,940,262	$62,522	127	$64,192,659	113
$ 65,001	to	$ 70,000	$5,874,626	$67,524	87	$72,623,109	131
$ 70,001	to	$ 75,000	$5,644,919	$72,371	78	$53,208,384	151
$ 75,001	to	$ 80,000	$5,412,046	$77,315	70	$44,537,408	173
$ 80,001	to	$ 90,000	$10,174,514	$84,788	120	$69,172,402	211
$ 90,001	to	$ 100,000	$8,992,975	$94,663	95	$48,315,870	270
$ 100,001	to	$ Maximum	$78,303,066	$172,474	454	$364,390,731	1,242
Total			$271,454,608	$13,389	20,275	$3,972,450,465	12

**Personal and commercial residential zero deductible statewide hurricane loss using the 2017 Florida Hurricane Catastrophe Fund personal and commercial residential zero deductible exposure data found in the file named: hlpm2017c.zip.*

Part B – Personal and Commercial Residential Hurricane Probable Maximum Loss for Florida - Annual Aggregate

Table 49: Estimated loss for each of the return periods given for the 2017 FHCF combined personal and commercial residential aggregate exposure data

Return Period (Years)	Expected Hurricane Loss Level	10% Loss Level	90% Loss Level
Top Event	778,159,890,193	601,976,968,099	962,171,695,458
1,000	159,200,989,403	99,206,408,574	226,547,584,706
500	122,051,387,835	74,379,139,328	175,129,517,797
250	91,507,393,225	48,958,661,187	140,304,084,243
100	58,516,253,094	32,087,508,987	88,578,002,881
50	39,157,006,096	17,074,695,867	65,385,207,074
20	20,807,300,684	13,094,957,902	29,388,286,364
10	10,702,864,398	6,581,622,304	15,303,605,534
5	3,478,822,180	866,103,641	6,873,986,203

Part C – Personal and Commercial Residential Hurricane Probable Maximum Loss for Florida - Annual Occurrence

Table 50: Estimated loss for each of the return periods given for the 2017 FHCF combined personal and commercial residential occurrence exposure data

Return Period (Years)	Expected Hurricane Loss Level	10% Loss Level	90% Loss Level
Top Event	778,159,890,193	601,976,968,099	962,171,695,458
1,000	154,028,906,170	96,187,930,521	219,611,493,235
500	117,209,802,496	69,890,633,256	170,122,745,601
250	87,144,428,215	60,689,867,948	116,051,034,750
100	54,799,608,111	35,973,130,620	75,624,310,385
50	36,160,096,217	29,404,410,799	43,274,078,060
20	19,067,977,229	9,979,126,644	29,513,726,781
10	9,819,941,812	3,272,486,073	17,953,621,167
5	3,220,465,291	2,200,157,036	4,331,972,557

APPENDIX B – MOODY'S RMS TECHNICAL STAFF

Yasuyuki Akita, PhD, Lead Modeler, Model Development

Since joining Moody's RMS in April 2015, Yasu has been involved in several projects as geospatial modeling specialist. 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 BS and MS degrees 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

Florian Arfeuille, PhD, Catastrophe Risk Modeler, Model Development

Florian Arfeuille joined Moody's RMS in March 2018, working on the North Atlantic Hurricane Models. He also did,
in 2017, a 4-month internship at Moody's RMS working on the European Windstorm and Pacific Typhoon models. Prior to starting at Moody's RMS, Florian held a postdoctoral position in atmospheric modeling in Zurich and a postdoctoral position in climate modeling at the University of Bern. Florian holds a PhD in atmospheric science from ETH Zurich, and an MSc in climate science from the University of Versailles.

Hurricane Project Responsibilities: Updating the modeled hurricane landfall rates, development of historical reconstructions

Karen Argonza, Senior Science Writer and Editor, Model Content and Data Experience

Karen has been a technical content developer in the software industry for over 30 years, 15 of which she has led the development of methodology and change management documents for catastrophe risk models, and produced crisis communications to clients in response to natural catastrophes. From 2004 to 2009, Karen led the documentation effort for Moody's RMS FCHLPM submissions as a consultant, and rejoined Moody's RMS as a full-time employee in February 2020. She holds a BS in journalism from San Francisco State University. Karen works with regulatory experts at Moody's RMS to develop ownership of U.S. regulatory documentation for North Atlantic Hurricane Models and data, and management of procedures for updating and delivering submissions to U.S. regulators.

Hurricane Project Responsibilities: Coordination of the editorial process and production of Moody's RMS submission to the FCHLPM.

Ed Bannister, PhD, Senior Catastrophe Risk Modeler, Model Development

Dr. Bannister joined Moody's RMS in 2022 and has worked on tropical cyclone and winter storm modeling in the U.S. and Europe. He is responsible for the modelling and development of atmospheric surface-layer processes in all Moody's RMS wind models. Prior to joining Moody's RMS, Dr. Bannister practiced as an intellectual property lawyer, before retraining in meteorology and atmospheric sciences. He holds a PhD in boundary-layer meteorology and an MSc in meteorology and climatology, both from the University of Birmingham, and an BSc in physical chemistry from University College London.

Hurricane Project Responsibilities: Updating the land-cover data and modelling the effects of terrain on large-scale wind fields.

Enrica Bellone, PhD, Senior Director, Model Development

Dr. Bellone is responsible for researching and implementing advanced modeling techniques and leads the development of tropical cyclone models. Prior to joining Moody’s 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, review of the model from a statistical point of view, and development lead across all components

Suman Kumar Bhattacharya, Director, Software Development

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 Moody’s 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, Software QE Engineer III, Software Development

Masha obtained her bachelor’s degrees in economics and management in Ukraine from the Polytechnic University in Lvov. Masha joined Moody’s 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, Vice President, Model Development

Dr. Boissonnade was the original architect of the Moody’s 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 Moody’s 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

Jason Bryngelson, Director, Model Development

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 Moody's RMS in 1995 as a consultant and was hired full time in 1997 and during his tenure has gained significant knowledge of the core Moody's 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 Moody's RMS geocoding software and data. He joined Moody's RMS in 2006 to manage the Moody's RMS weather risk business, taking the role of managing geocoding in 2008. Before joining Moody's 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, Software Development

Mr. Carttar has BA degrees in geography and architectural studies from the University of Kansas, and a master's of city planning degree from the University of California at Berkeley. For Moody's 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

Umesh Chander, Manager, Software Development

Umesh has an MS degree in computer science from Northwestern Polytechnic University, Fremont, CA. He has been with Moody's RMS for over 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

Abhijeet Chhatry, M.Tech, Senior Analyst, Model Development

Abhijeet joined Moody's RMS in 2020 and has worked primarily on the development and quality assurance of land use and land cover for multiple geographies. Before joining Moody's RMS, Abhijeet worked as a junior research fellow at the Remote Sensing Lab at the Indian Institute of Technology Bombay, India. Abhijeet holds an MTech in Remote Sensing and GIS from the National Institute of Technology Surathkal, India.

Hurricane Project Responsibility: Development of land use land cover data

Tommy Chou, Senior Manager, Software Development

Tommy joined Moody's 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 Moody's RMS catastrophe models on EGC/HPC and RDP platform

Peter Datin, PhD, Senior Director, Model Development

Since joining Moody's 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), Matthew (2016), Harvey (2017), Irma (2017), Maria (2017), and Michael (2018), as well as the Moore, OK tornado outbreak (2013). He now leads the climate vulnerability group at Moody's RMS. Peter has taught a graduate level course (Fundamentals and Application of Wind Engineering) at Stanford University as a part-time lecturer. Prior to joining Moody's 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 lead for the vulnerability component of the North Atlantic Hurricane Models

Sushil Dhyani, Principal Software Development Engineer, Software Development

Sushil joined Moody's RMS in March 2004, he worked on RiskLink and other Moody's RMS projects and developed several utilities for model certification. Currently he is responsible for RiskLink 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

Alison Dobbin, PhD, Senior Principal Catastrophe Risk Modeler, Model Development

Alison joined Moody's RMS in September 2011 and has worked on tropical cyclone and severe convective storm modelling in the U.S, Europe, and Asia. She is responsible for surface wind modelling in all Moody's RMS wind models. Prior to joining Moody's RMS, Alison worked as a post doctoral researcher at the National Oceanographic and Atmospheric Administration in Colorado, and at the British Antarctic Survey. Alison holds a PhD in atmospheric physics from University College London, and an MSc is geophysics from the University of Leeds.

Hurricane Project Responsibilities: Updating the land cover data and modelling the terrain effects on large scale model winds.

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 Moody's 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 Moody's RMS full-time.

Hurricane Project Responsibilities: Review of the hazard model

Laura Eads, PhD, Lead Modeler, Model Development

Since joining Moody's 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 Moody's RMS, she was a research and 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

Greg Fanoe, Actuary, Merlinos and Associates, Inc.

Greg Fanoe is an independent actuary from Merlinos and Associates, Inc., engaged by Moody's RMS to review the North Atlantic Hurricane Models submission. Mr. Fanoe has been in the actuarial field since 2005. His experience includes preparation of rate filings for a wide variety of personal and commercial lines of insurance, performing competitive and analytic analysis to determine rate structures and develop rate indications, reviews of rate filings for state insurance departments (including filings proposing or utilizing catastrophe modeling), development of rate structures, rates, reinsurance requirements, and capital requirements for alternative risk transfer mechanisms, and analysis of catastrophe reinsurance programs. This has included extensive experience utilizing and reviewing predictive models, including catastrophe models.

Mr. Fanoe is a Fellow of the Casualty Actuarial Society and a member of the American Academy of Actuaries and has a BS in mathematics and computer sciences from the University of Richmond.

Hurricane Project Responsibilities: Lead actuary for actuarial review of the North Atlantic Hurricane Models

Philip Feiner, Manager, Regulatory Analytics

Phil holds a MS degree in meteorology from the Pennsylvania State University, where his research involved observing and modeling atmospheric oxidation processes taking place over forests in the southeastern United States. He joined Moody's RMS in June 2015 as a member of the knowledge center, providing frontline support helping clients to understand and derive value from Moody's RMS models. Later, Phil was responsible for the management and execution of technical engagements supporting the Moody's RMS suite of climate peril models both internally for Moody's RMS model development, and externally for Moody's RMS clients. Currently, Phil manages the Regulatory Analytics team, overseeing the process of generating and defending the analytical collateral that complies with required regulatory submissions for Moody's RMS.

Hurricane Project Responsibilities: Historical reconstructions, generation and QA of actuarial, statistical, and vulnerability forms

Paul Ferrara, Actuary, Merlinos and Associates, Inc.

Paul Ferrara, PhD CERA CSPA is an independent actuary from Merlinos and Associates, Inc. assisting with the actuarial review of the North Atlantic Hurricane Models submission. Dr. Ferrara has been in the actuarial field since 1999. His current interests are Enterprise Risk Management (ERM), and the leveraging of data analytics across all lines-of-business, and all business units, for direct insurers, captives, and reinsurers.

Prior to joining Merlinos & Associates Dr. Ferrara was AVP of Research and Business Development for Tokio Marine Technologies (TMTech), where much of his focus was on the development of methodologies to support the implementation of in-house portfolio aggregation, marginal pricing, and capital modeling software (equivalent to MetaRisk). A significant portion of his efforts involved natural CAT exposures, including the development of bespoke parametric Insurance-linked Securities (ILWs) based on the output of multiple CAT vendor models, as well as the analytical and geo-spatial methodologies to facilitate the automatic generation of variable-resolution grids (VRGs) tailored to targeted exposures (and hazards) within the insurer/reinsurer's portfolio, and the subsequent aggregation of the location-level vendor model losses (dis-aggregation of zip-code level losses) relative to the VRG. He also developed methodologies for under-modeled perils such as Pacific-West Typhoon, and European Wind/Hail. Ferrara also has experience developing Cyber Risk models, pricing software for Non-CAT reinsurance treaties, and with Casualty Catastrophe modeling. He also has experience with modeling to support the asset-side of the balance-sheet, including calibration and validation of the Economic Scenario Generators (ESG) and Asset Models of the most widely utilized asset model software vendors within the insurance/reinsurance industry.

Dr. Ferrara is a Fellow of the Society of Actuaries, a Chartered Enterprise Risk Analyst, a Certified Specialist in Predictive Analytics (CSPA). He is also, an Affiliate Member of the Institute & Faculty of Actuaries UK (IFoA), Dr. Ferrara also holds a PhD in Mathematical Statistics from The University of Virginia.

Hurricane Project Responsibilities: Actuarial review of North Atlantic Hurricane Models

David Gatey, PhD, Director, Model Development

Dr. Gatey joined Moody's 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 Moody's 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 BS degree in civil and structural engineering from the University of Western Ontario.

Hurricane Project Responsibilities: Updating the land-use land-cover data and hazard aggregation and validation

Zachary Gellis, Model Analyst, Model Development

Zach Gellis joined Moody's RMS in 2016 after obtaining a BS degree in meteorology with a focus in weather risk management from the Pennsylvania State University. Zach currently works as a model analyst, a part of the model specialist team, where he supports and enables clients to understand and derive value from Moody's RMS models and data products.

Hurricane Project Responsibilities: QA of exposure generation for actuarial forms, flow chart creation

David Glaubman, Senior Director, Software Development

Mr. Glaubman joined Moody's RMS in October 2004 as a lead software developer. His responsibilities have included management of the team responsible for application infrastructure. Prior to joining Moody's 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

Olga Goldin, Software QA Engineer III, Software Development

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 Moody's RMS in April 1996 as a contractor and became a full time employee in September 1996. She is responsible for testing different aspects of RiskLink and Risk Browser applications including user interface, business components, functionalities, and databases.

Hurricane Project Responsibilities: Testing of the software related to the hurricane model

Kian Greene, Senior Analyst, Regulatory Analytics

Kian obtained her bachelor's degrees in Environmental Studies and Biological Anthropology from the University of California, Santa Barbara. She joined Moody's RMS in 2019 on the Risk Analytics team as a Senior Analyst where she has completed product acceptance testing on various models and has contributed largely to data engineering and automation advancements. In 2022, Kian joined the Regulatory Analytics team where she continues those pursuits in data engineering for regulatory submissions.

Hurricane Project Responsibilities: Generation, automation, and QA of actuarial, statistical, and vulnerability forms

Nathalie Grima, Senior Principal Software Engineer, Software Development

Ms. Grima joined Moody's RMS in November 2004 as a financial modeler. Her responsibilities include development and quality assurance of new financial model related features. Prior to joining Moody's 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

Valerie Harper, Actuarial Consultant, Merlinos and Associates, Inc.

Valerie Harper is an independent actuarial consultant from Merlinos and Associates, Inc. assisting with the actuarial review of the North Atlantic Hurricane Models submission. She has an MS in mathematics with a concentration in statistics and decision sciences from Georgia State University. Valerie has been in the actuarial field since 1991 and her experience includes assistance with loss and loss expense reserve analysis for insurance companies and self-insured funds, funding studies for captives and self-insured funds, reviewing various rate filings for state insurance departments, assistance on financial examinations for state insurance departments, and preparation of rate filings for personal and commercial lines of business.

Hurricane Project Responsibilities: Support actuarial review of Hurricane Model

Sarah Hartley, Senior Modeler, Model Development

Sarah joined the Moody’s RMS London model development team in 2013 working as part of the Moody’s RMS event response team. Sarah was responsible for monitoring and evaluating events as they occur in real time and developing the processes by which Moody’s RMS supports clients in the days prior to and weeks following major storms. Prior to Moody’s 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

Jara Imbers Quintana, PhD, Principal Modeler, Model Development

Jara Imbers Quintana joined the Moody’s RMS model development team in October of 2012. In her role as a senior catastrophe modeler Jara has worked on various components of the Moody’s 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 Moody’s 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, Staff Software Development Engineer, Software Development

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 Moody’s 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, Senior Principal Modeler, Model Development

Jo joined Moody’s 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 Moody’s RMS, Jo has worked on the Japan Typhoon Model and the North Atlantic Hurricane Models.

Hurricane Project Responsibilities: Historical reconstructions, hazard model validation

Mahmoud Kamalzare, PhD, Modeler, Model Development

Mahmoud joined the Model Certification team at Moody’s RMS as a Catastrophe Modeler in June 2018 and was involved in RiskLink analyses and QA of actuarial forms for the FCHLPM project. Mahmoud has three MSc in Structural, Earthquake, and Electrical Engineering and a PhD in civil and environmental engineering from University of Southern California where he developed numerical algorithms for fast computational analysis of nonlinear systems with uncertainties. Mahmoud has published many journal and conference papers in the field of Structural Control and is a licensed Professional Engineer in state of California.

Hurricane Project Responsibilities: QA of actuarial forms

Vidya Karthigeyan, Supervisor Software Development

Mrs. Karthigeyan has a MSc 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 Moody's 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

Anfisa Kashkenova, Analyst, Regulatory Analytics

Anfisa earned a B.S. degree in Earth Science and Policy with Energy option from Pennsylvania State University. Her undergraduate research involved data processing for the East African Rift Tephra Database. She joined Moody's RMS as a Regulatory Analytics Analyst in June 2022 where her main role concerns generating analytical collateral for required regulatory submissions for Moody's RMS.

Hurricane Project Responsibilities: Generation and QA of actuarial, statistical, and vulnerability forms

Chana Keating, Modeler, Model Development

Chana joined Moody's RMS in 2015 as part of the acquisition of HWind Scientific, LLC. With Moody's RMS, Chana is still a part of the HWind group and manages the real-time HWind operations. Chana has assisted with Historical Reconstructions for the North Atlantic Hurricane Models. Chana earned a BS degree in Meteorology from North Carolina State University and an MSc degree in meteorology from Florida State University.

Hurricane Project Responsibilities: Development of historical footprints

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 Moody's RMS Japan Typhoon Model upgrade. Prior to joining Moody's 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 Development

Veena received her MSc in physics from Madurai Kamaraj University. She has been with Moody's RMS since 2010 in the analytics QA department working on the financial model QA team.

Hurricane Project Responsibilities: Quality assurance for RiskLink

Jenny Lu, Senior Software Development Engineer, Software Development

Ms. Jenny Lu has an MS degree in computer science specialization in software design and development. Jenny joined Moody’s RMS in 2013. Prior to Moody’s RMS, she has more than 15-years industry experience. For Moody’s 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, Model Development

Mr. Masuda has a BS and an ME degree in engineering from Kobe University, and an MS in civil engineering from Stanford University. For Moody’s 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 Moody’s RMS London model development team in March 2012. In his role as lead catastrophe risk modeler Joss has worked on the Moody’s RMS North Atlantic and North West Pacific tropical cyclone models. Prior to starting at Moody’s 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 Development

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 Moody’s RMS in 2000 and is primarily responsible for implementation, validations, and data management for various models. Prior to joining Moody’s 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, Lead Modeler, Model Development

Akwasi joined Moody’s 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 Moody’s 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 Moody’s RMS field reconnaissance team, he also investigated the impacts of hurricane Matthew (2016) in Florida and Georgia, Harvey (2017) in Houston, and Maria (2017) in Puerto Rico.

Hurricane Project Responsibilities: Research on secondary modifiers and vulnerability development; implementation of secondary modifiers; claim analysis; testing of the vulnerability component of software

Charles Menun, Consultant, Model Development

Dr. Menun joined Moody's 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 Moody's RMS include overseeing the development of hurricane and earthquake vulnerability models. Since July 2009, Dr. Menun has provided his services to Moody's 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

Christos Mitas, PhD, Vice President, Model Development

Based in London, Christos leads the Moody's RMS climate hazards-dry and cyber risk modeling teams researching and developing modeling frameworks and solutions for the re/insurance industry.

He has worked at Moody's RMS since 2006 developing mathematical models of catastrophic risk from natural and man-made perils, including the Cyber Accumulation Management System (2016, 2017), Cyber Solutions (2018), typhoon models for South Korea and Taiwan (2016), probabilistic flood maps for Taiwan (2015) and South Korea (2014), the Europe Windstorm Models (2011), and the U.S. and Canada Winterstorm Models (2008). He has also researched and developed efficient and scalable computational modeling frameworks.

Before joining Moody's RMS, Christos worked as a post-doctoral associate and an assistant scientist at the University of Miami's Rosenstiel School of Marine and Atmospheric Science (RSMAS) from 2003 to 2006. He holds a PhD in atmospheric sciences from the Dept. of Atmospheric Sciences of the University of Illinois at Urbana-Champaign. He earned a MSc degree from the Dept. of Atmospheric Sciences of the University of Wyoming. Christos' bachelor's degree is in mathematics from the Aristotle University of Thessaloniki, Greece.

Hurricane Project Responsibilities: Review of model components

Rakesh Mohindra, PhD, Director, Model Development

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 (Moody's 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 Moody's RMS/RMSI, Dr. Mohindra played a key role in the development of the Moody's RMS fire following earthquake model for the U.S. and Canada, and the India Earthquake Model. Besides Moody's 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, Vice President, Model Development

Dr. Molas is leading the model certification and model implementation teams within model development at Moody’s RMS. His primary technical duties are to develop earthquake and climate stochastic models. He is also actively involved in several technical aspects of Moody’s 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 Moody’s 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: Responsible for model certification and testing

Robert Muir-Wood, PhD, Chief Research Officer, Science and Technology Research

Robert Muir-Wood heads up research and development efforts at Moody’s RMS. Robert joined Moody’s 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, Senior Modeler, Model Product Management

Ms. Nair has an MS degree in statistics from Delhi University, India. She joined Moody’s 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 Moody’s RMS models and solutions. He previously supported the product marketing and business development activities for the Moody’s RMS U.S. and Canada climate hazard peril models and derivative products and serves as lead contact for Moody’s 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 Moody’s RMS since September of 2005.

Hurricane Project Responsibilities: Lead contact for Moody’s RMS with the Florida Commission on Hurricane Loss Projection Methodologies.

Geoffrey R. Overton, Senior Modeler, Software Development

Geoffrey has a diploma in geography from the University of Nebraska, Omaha. For Moody’s 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 Development

Mr. Pandey joined Moody's 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, Software Development

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 Moody's RMSI in 2006, Mr. Parasram worked as software manager for the business services group at Moody's RMS, managing software development for the application logic and workflow layer in RiskLink and Risk Browser 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 Moody's 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

Viraj Patil, Staff Software Development Engineer, Software Development

Viraj has an MS degree in Computer Science from California State University Long Beach. He joined Moody's RMS in 2016. He has a total of 12 years of programming experience. Viraj works on the detailed loss models and infrastructure related development of RiskLink and RiskBrowser.

Hurricane Project Responsibilities: Financial model implementation

Sudha Raghavan, Senior Director, Software Product Management

Sudha is a senior SQL server database administrator and developer who joined Moody's RMS in 2008. She is involved in database data model implementation and database optimization, performance and scalability efforts. Prior to Moody's 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, Chief Risk Modeling Officer and Executive Vice President

Mohsen leads the model development team responsible for the creation of catastrophe models at Moody's RMS. He has participated in and been project lead in the development of many Moody's 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, Model Development

Rajesh has a master's of technology in geophysics from Andhra University, Visakhapatnam, India and has been working with Moody's RMS / Moody's RMSI since 1996. For Moody's 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

Agustín Rodríguez, Director, Model Development

Mr. Rodríguez joined Moody's 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 Moody's 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

Emilie Scherer, PhD, Consultant, Model Development

Dr. Scherer has been involved in various components of the hazard model including historical reconstructions and model validation. Prior to joining Moody's 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. Currently, Dr. Scherer consults to Moody's RMS full-time.

Hurricane Project Responsibilities: Development of historical footprints, hazard model validation, binary hazard files creation, hazard aggregation and updating the modeled hurricane landfall rates

Richa Sharma, Senior Software Development Engineer, Software Development

Richa joined Moody's RMS in September 2010. She has a bachelor's degree in information technology from Uttar Pradesh Technical University, India. Since joining Moody's 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

Tyler Sherrod, MS, Tropical Cyclone Modeler, HWind

Tyler joined Moody's RMS in March 2021 as a contingent worker while working on his MS degree in Meteorology at Florida State University. His research focused on determining if flash droughts could develop in the wake of landfalling Atlantic tropical cyclones. In July 2022, Tyler was hired as a full-time employee. He works on the HWind team, leading analysts to deliver HWind Snapshot and Footprint products during real-time events and supporting the development and maintenance of HWind products.

Hurricane Project Responsibilities: Preparing HWind storm parameters for model validation, assisting with Historical Reconstructions

Nilesh Shome, PhD, Vice President, Model Development

Nilesh joined Moody's 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 Moody's 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 several 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

Kim Shuss, Principal, Program Management - Technical

Kim joined Moody's RMS in 2013. She is responsible for the coordination and delivery of climate models such as: Europe windstorm, North Atlantic hurricane, and other projects. Prior to joining Moody's RMS, she was a senior supply chain manager at Oracle, and Operational Planning Manager at Sun Microsystems.

Hurricane Project Responsibilities: Project Management for model release

Bronislava Sigal, PhD, Director, Model Development

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 Moody's RMS in March of 2009. After joining Moody's RMS as a part of the model development team Ms. Sigal worked on projects related to terrorism, account fire, and offshore platform Moody's RMS models. Currently Ms. Sigal is a part of the financial modeling group. Prior to joining Moody's 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 Moody's RMS and joined Moody's RMS in 2002. He has been involved in the development of hazard, vulnerability, and financial models for these perils. At Moody's 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 and 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, Staff Product Manager, Software Product Management

Ms. Sinha has a bachelor's degree in electrical engineering from Nagpur University, India. Puja joined Moody's RMS in 2007. Prior to joining Moody's RMS, she has 3 years of experience in software development. At Moody's RMS, Ms. Sinha works on RiskLink, RiskBrowser, RiskTools, and RiskOnline. Her responsibilities include software planning, designing, and implementation.

Hurricane Project Responsibilities: Software development

Mohan Smith, PhD, Modeler, Model Development

Dr. Smith joined Moody's RMS in December 2021. Since joining Moody's RMS, Dr Smith works on the development of historical footprints for the North Atlantic Hurricane Model. Dr Smith has an integrated master's degree (MSci) in geophysics and a PhD in atmospheric physics, both from Imperial College London. Prior to joining Moody's RMS, Dr Smith worked as a data scientist for Royal Dutch Shell focused on renewable energy.

Hurricane Project Responsibilities: Development of historical footprints.

Jayant Srivastava, Vice President, Software Development

Mr. Srivastava has an MS in computer science from the Institute of Management and Technology, India. For Moody's 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, Model Product Management

Beth joined Moody's 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 Moody's RMS submission to the FCHLPM

Carlin Starrs, Senior Analyst – Modeling, Risk Analytics

Carlin received her Master of Forestry degree from the University of California, Berkeley. Her research explored annual wildfire probability in California across ownership, firefighting, and land management strategies. Prior to receiving her masters, Carlin worked for the Society of American Foresters in certification, outreach, and education and at Berkeley Forests as a policy analyst in forest carbon and wildfire. Carlin joined Moody's RMS in 2018 on the risk analytics team, where she primarily works on data engineering and analytics to support model development and customer success.

Hurricane Project Responsibilities: Generation, automation, and documentation of actuarial, statistical, and vulnerability forms

Derek Stedman, Principal Modeler, Model Development

Derek joined Moody's RMS in February 2014. He has since worked on the North Atlantic Hurricane Models and the Moody's 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 hurricanes Matthew (2016), Harvey (2017), Irma (2017), Florence (2018) and Michael (2018). Prior to joining Moody's 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; implementation of the vulnerability functions; testing of the vulnerability component of software

Lindsay Stone, Model Specialist, Regulatory Analytics

Lindsay Stone holds a MS degree in Geography with a specialization in hydrology from Wilfrid Laurier University, where she studied the impact of permafrost degradation on seasonal peatland flooding in the Canadian Northwest Territories. She joined Moody's RMS in 2018 as a model analyst in the knowledge center, where she addressed client inquiries on the Moody's RMS suite of global Flood models and the North Atlantic Hurricane model. Lindsay also supported multiple consulting engagements with financial entities on understanding the residential risk to flooding in the United States. Lindsay currently works in the Regulatory Analytics team and is responsible for creating and defending collateral in support of Moody's RMS regulatory submissions.

Hurricane Project Responsibilities: Generation, automation, and QA of actuarial, statistical, and vulnerability forms

Anudeep Sure, PhD, Lead Modeler, Model Development

Anudeep joined Moody's RMS in September 2021 and has been working on land use land cover development using multiple datasets at the country level for multi-peril model development and exposure downscaling. Anudeep is primarily responsible for the development of the product with the highest level of accuracy. Before joining Moody's RMS, Anudeep worked in two organizations, an international research organization, CIMMYT-CGIAR, and a private organization - Skymet Weather Services, where he focused his work on machine learning-based agriculture models for climate-smart agriculture and the insurance-banking sector. Anudeep has done his PhD in remote sensing-based soil moisture assessment from the Indian Institute of Technology Kanpur, India, and an MTech in remote sensing from the Indian Institute of Remote Sensing, ISRO, India.

Hurricane Project Responsibilities: Preparation and quality assessment of land use and land cover data for multiple geographies

Avinash Takale, Manager, Software Development

Mr. Takale has a master's of computer applications from Shivaji University, Maharashtra, India. Prior to Moody's RMS, he has worked for seven years for software companies developing various desktop and enterprise applications. For Moody's 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, Director, Model Development

Mr. Taylor has a BS degree in mathematics from Bradley University, Peoria, Illinois. He joined Moody's 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

Srinivas Thupakula, Lead Modeler, Software Development

Mr. Srinivas has a BS degree in civil engineering from the Indian Institute of Technology Kanpur, India. He joined Moody's RMS in September, 2011. Prior to joining Moody's 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 Moody's 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, Manager, Software Development

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

Barrett Travis, Senior Analyst, Risk Analytics

Barrett joined Moody's RMS in 2018 after earning his MS in civil and environmental engineering at Stanford University with a focus on environmental fluid mechanics and hydrology. As a senior analyst with the risk analytics team he has contributed to a number of internal model development/validation and client engagement projects involving the Moody's RMS U.S. Flood HD Model and the North Atlantic Hurricane Models.

Hurricane Project Responsibilities: Generation, automation, and documentation of actuarial, statistical, and vulnerability forms

Vahid Valamanesh, Lead Modeler, Model Development

Vahid joined the Americas' climate peril vulnerability group at Moody's 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 Moody's 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

Yogesh Vani, Director, Software Development

Yogesh has an MS in telecommunication systems from California State University, Hayward. For Moody's 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, Vice President, Model Development

Raj leads the engineering and exposure groups worldwide for Moody's RMS property models – hurricane, storm surge, offshore wind and wave, tornado, hail, flood, wildfire, and earthquake risks. Over the last 11 years, Raj has been involved in the design and development of several probabilistic risk models and model components at Moody's 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), Irma (2017), 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 North Atlantic Hurricane Models version 17.0; vulnerability signatory (Version 15.0 and Version 17.0)

Jeffrey Waters, Staff Product Manager, Model Product Management

Jeff joined Moody's RMS in 2011 upon completion of an MS degree in meteorology from The Pennsylvania State University, where he studied large-scale diagnostics of tropical cyclogenesis potential in the Atlantic Basin using environmental variability metrics and logistic regression models. As the product manager of the North Atlantic Hurricane Models, he is responsible for ensuring the product's commercial success and technical specifications. Prior to his role as a product manager for the hurricane models, Jeff was product manager of the Moody's RMS U.S. and Canada Severe Convective Storm and Winterstorm models, as well as the Moody's RMS HWind suite of real-time tropical cyclone analytics. Jeff is a member of the American Meteorological Society and the U.S. Reinsurance Under 40s Group, Inc.

Hurricane Project Responsibilities: Product management of Moody's RMS North Atlantic Hurricane Models

Hugo Winter, Senior Cyclone Hazard Modeler

Hugo holds a PhD from Lancaster University in Statistics and Operational Research. His PhD focused on developing new statistical methodology for extreme value modelling of heatwaves across Europe and Australia. He joined Moody's RMS as a Cyclone Hazard modeler in July 2020 where his main role has been researching and building statistical models for tropical cyclones in the Model Development team.

Hurricane Project Responsibilities: Assisting with preparation of submission material for statistical forms

Xiaoning Wu, PhD, Modeler, Model Development

Dr Wu joined Moody's RMS in 2021 upon completing her PhD studies. Her research expertise includes the statistical and numerical modelling of tropical cyclones, particularly with high-resolution global climate models. For the North Atlantic Hurricane Model, she contributes to developing and implementing the Historical Reconstructions. Dr Wu holds a PhD in marine and atmospheric science from the State University of New York at Stony Brook, US, an MSc in geography specializing in natural hazards from Beijing Normal University, China, and a BSc in atmospheric science from Sun Yat-sen University, China.

Hurricane Project Responsibilities: Development of historical footprints

Michael Young, Vice President, 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 has worked in commercial wind tunnel laboratories doing studies on wind loads for a variety of buildings. Before joining Moody's 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 Moody's RMS climatic models including the North Atlantic Hurricane Models, oversees regulatory certification process

Christine Ziehmann, PhD, Vice President, 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 Moody's 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 Moody's 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

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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.

2

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.

4

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. Summary

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 – USER INTERFACE SCREEN SHOTS

Figure 89: Screen shot of RiskLink model location input form (part 1)

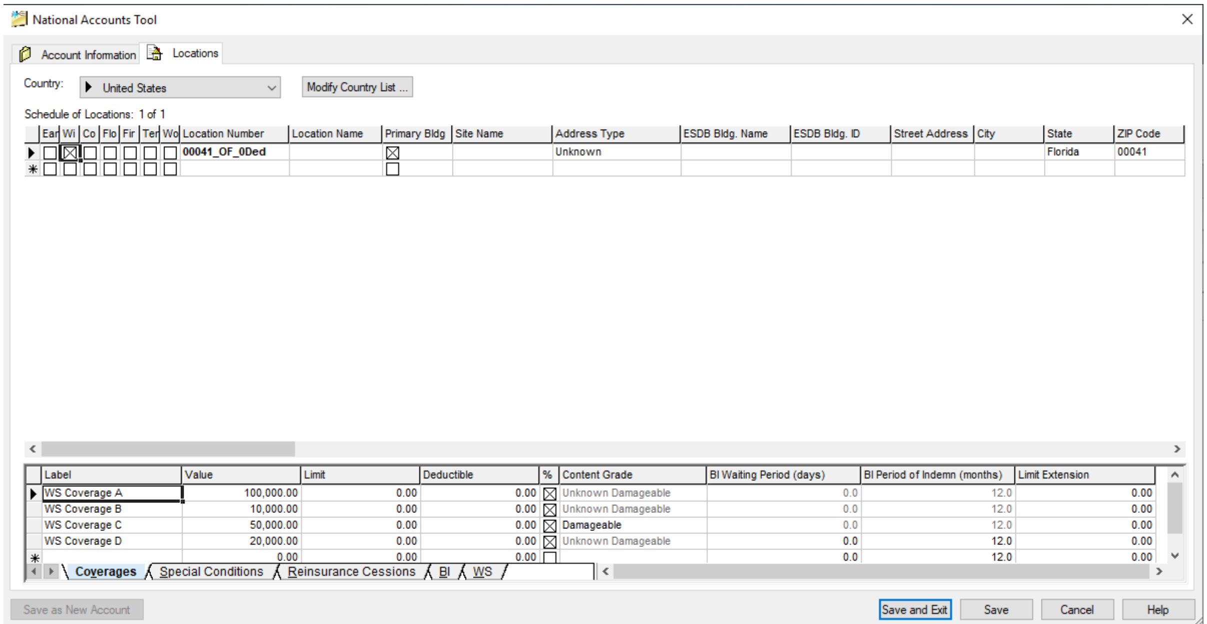

Figure 90: Screen shot of RiskLink model location input form (part 2)

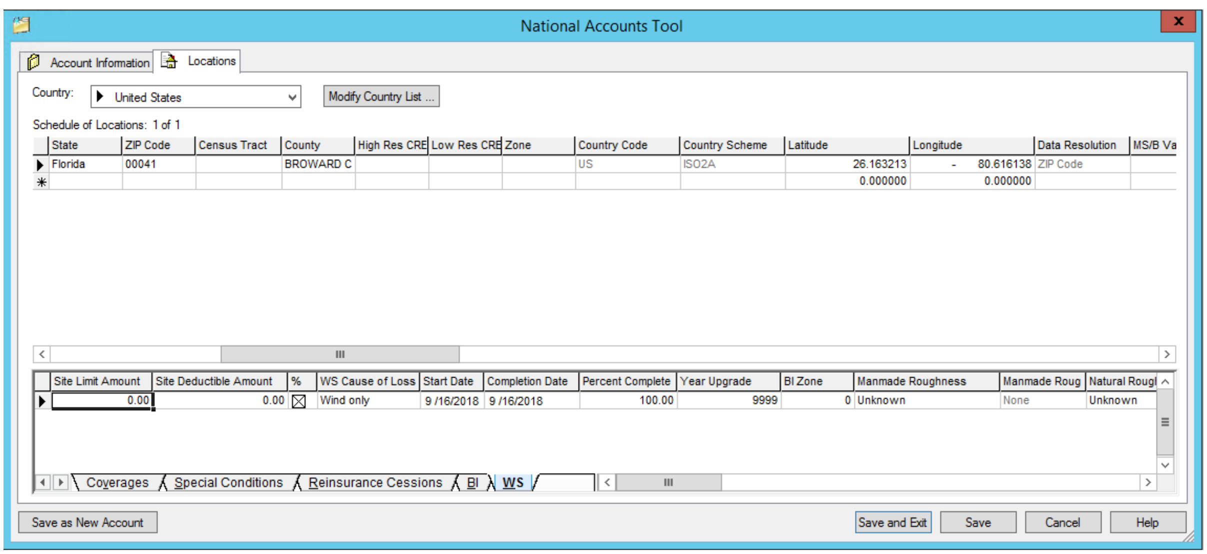

Figure 91: Screen shot of RiskLink model location input form (part 3)

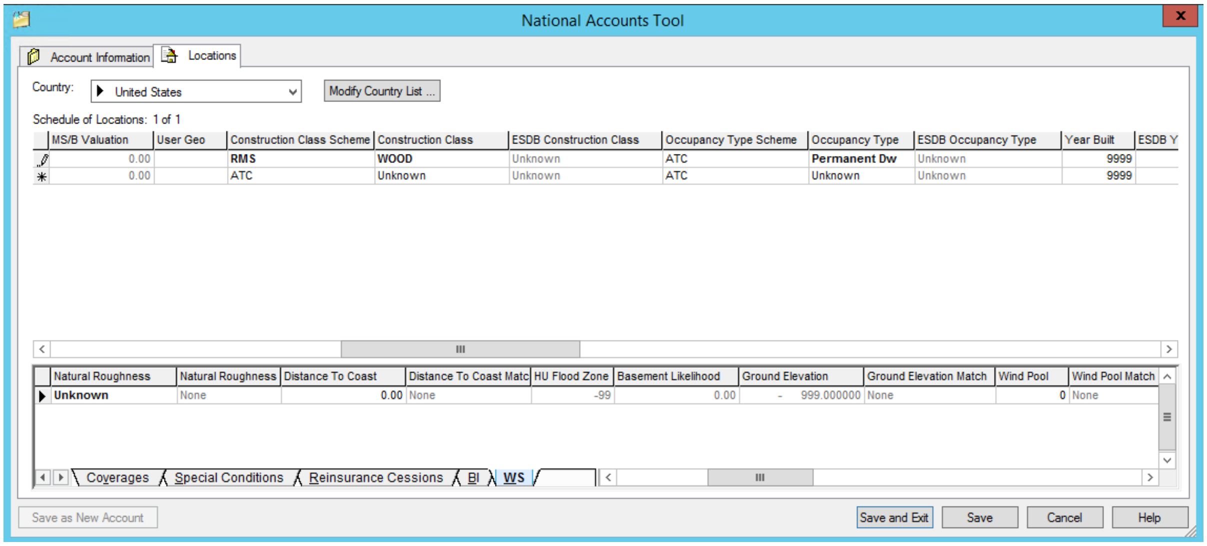

Figure 92: Screen shot of RiskLink model location input form (part 4)

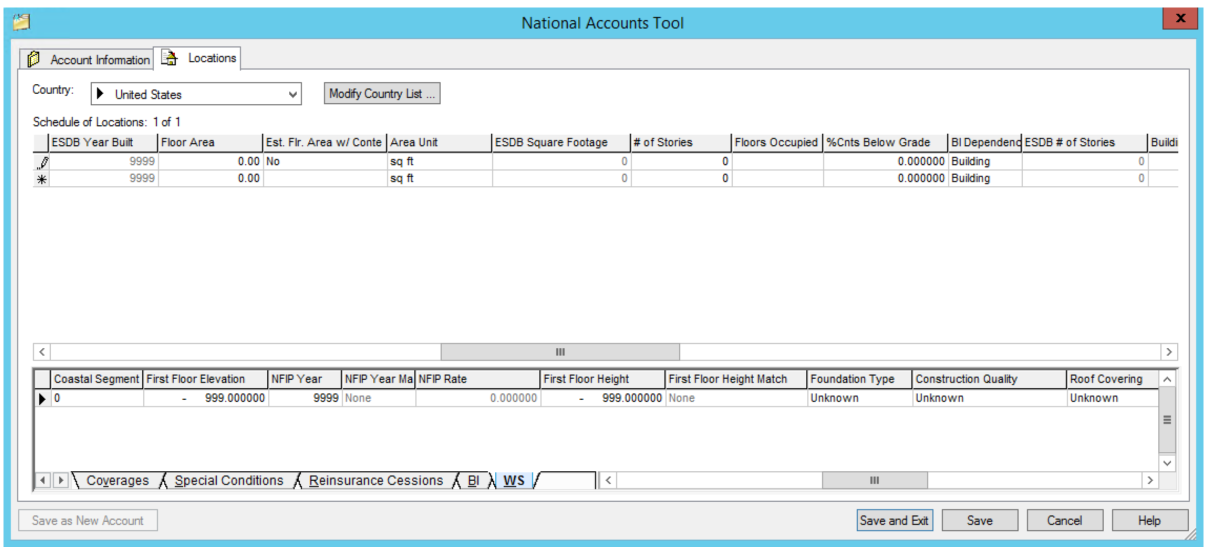

Figure 93: Screen shot of RiskLink model location input form (part 5)

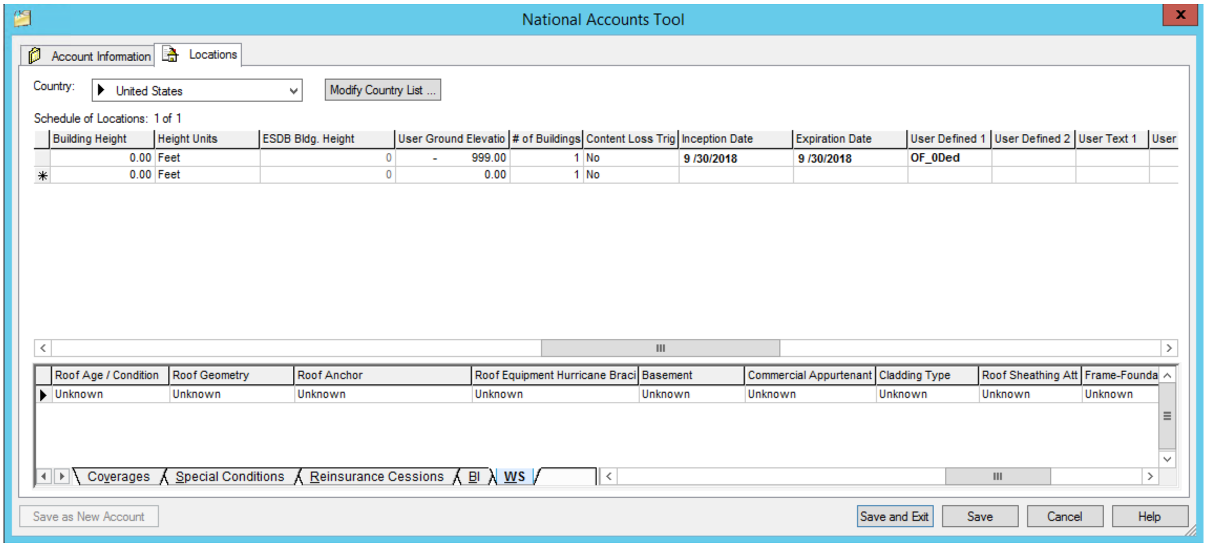

Figure 94: Screen shot of RiskLink model location input form (part 6)

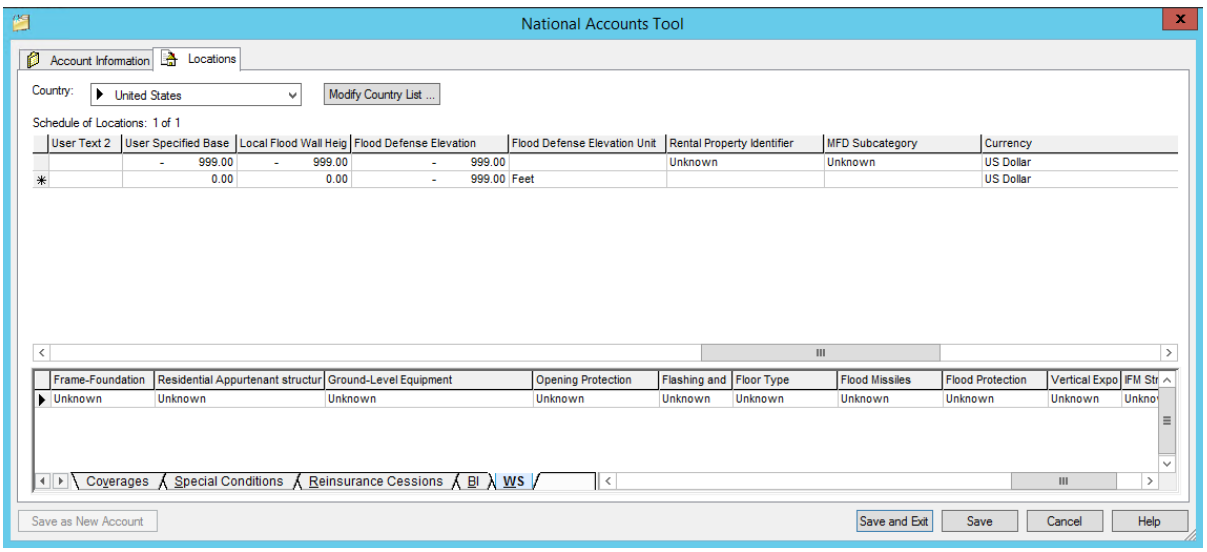

Figure 95: Screen shot of RiskLink model location input form (part 7)

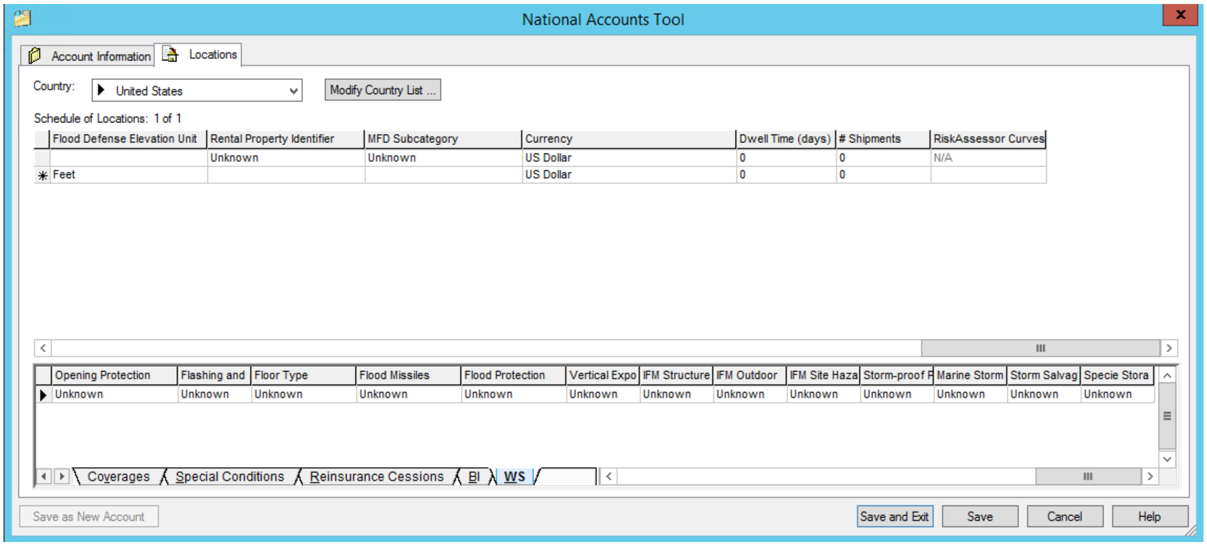

Figure 96: Screen shot of the about RiskLink screen, showing software name and version number

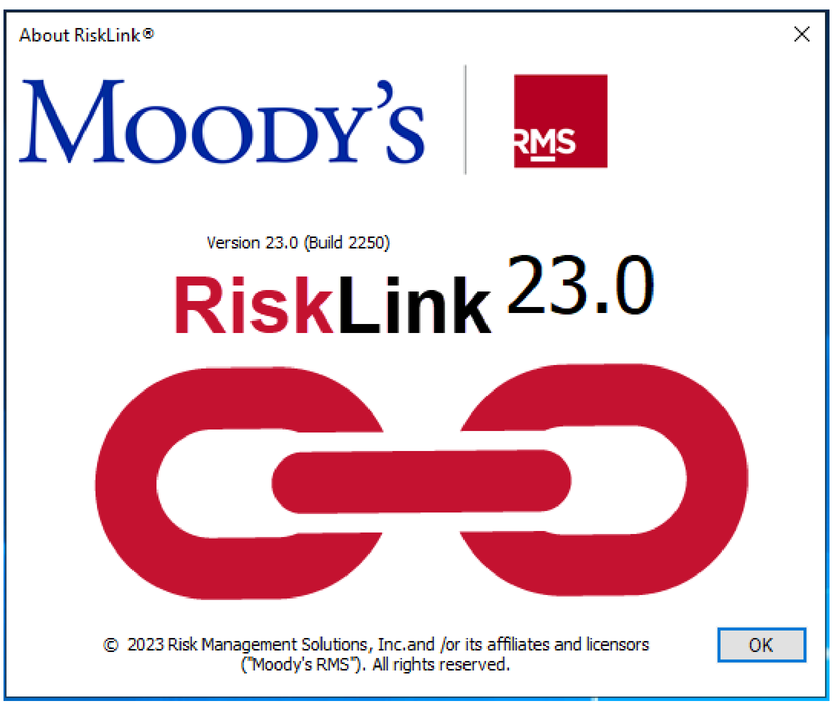

Figure 97: Screen shot of Risk Modeler model location input form (part 1)

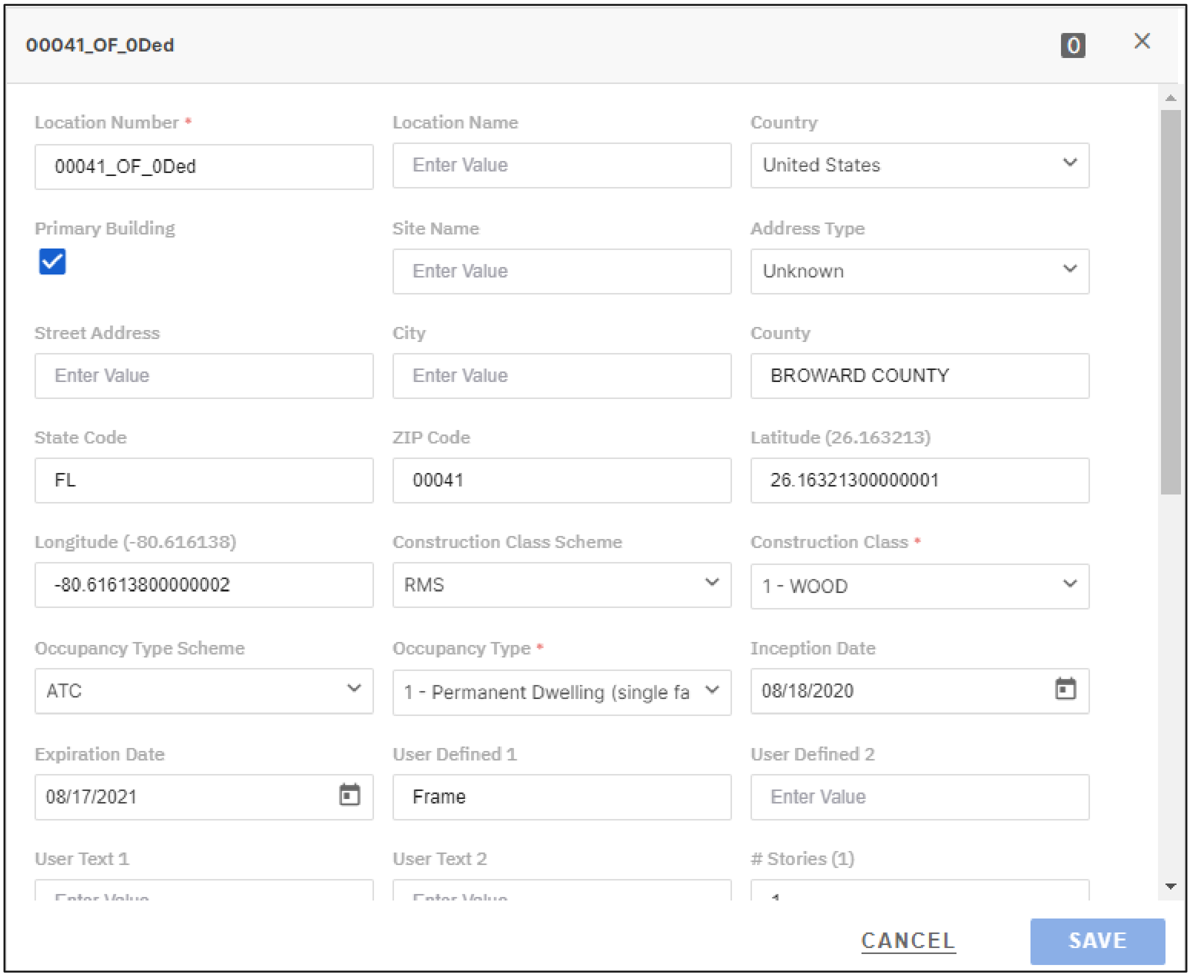

Figure 98: Screen shot of Risk Modeler model location input form (part 2)

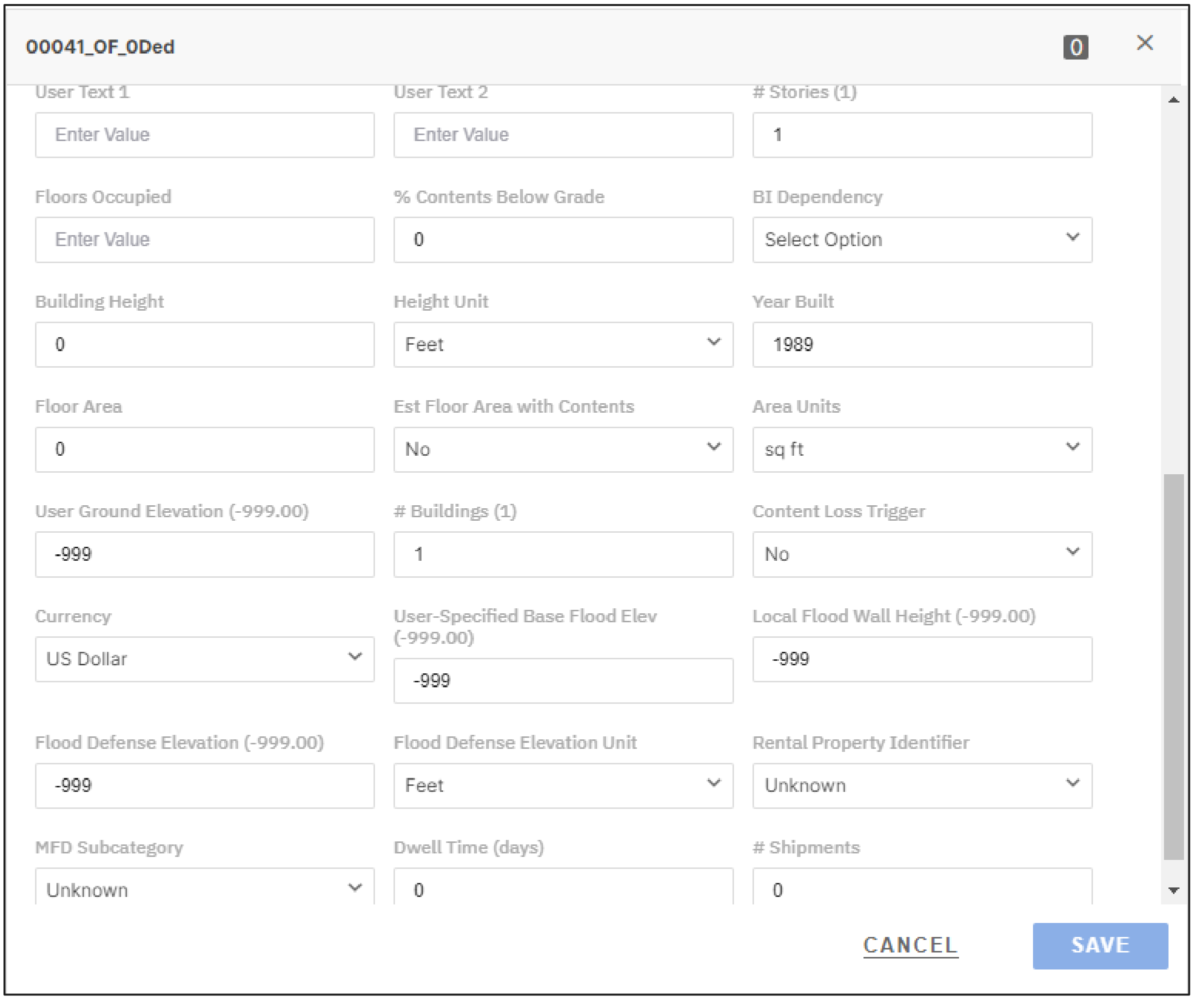

Figure 99: Screen shot of Risk Modeler model location input form (part 3)

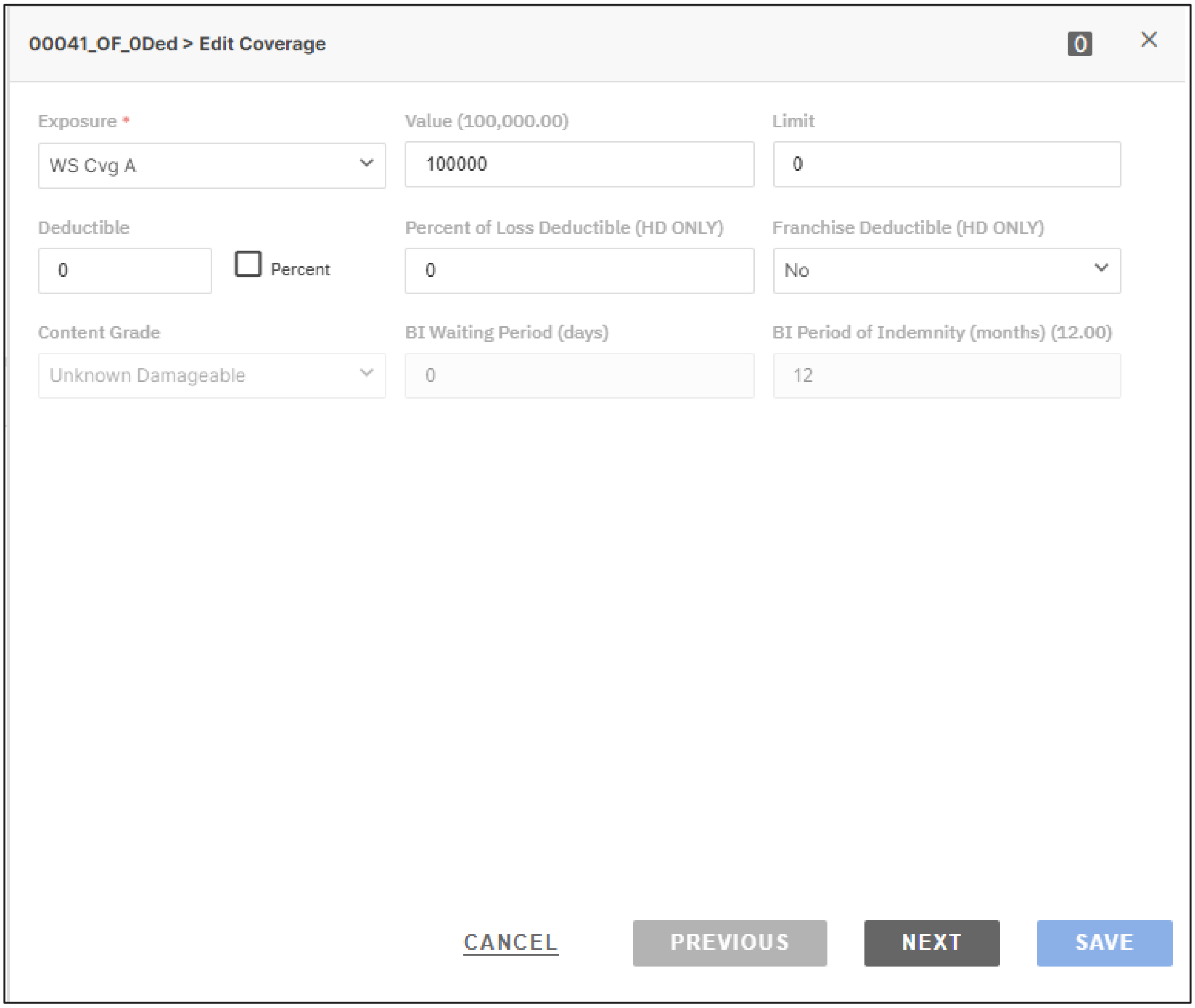

Figure 100: Screen shot of Risk Modeler model location input form (part 4)

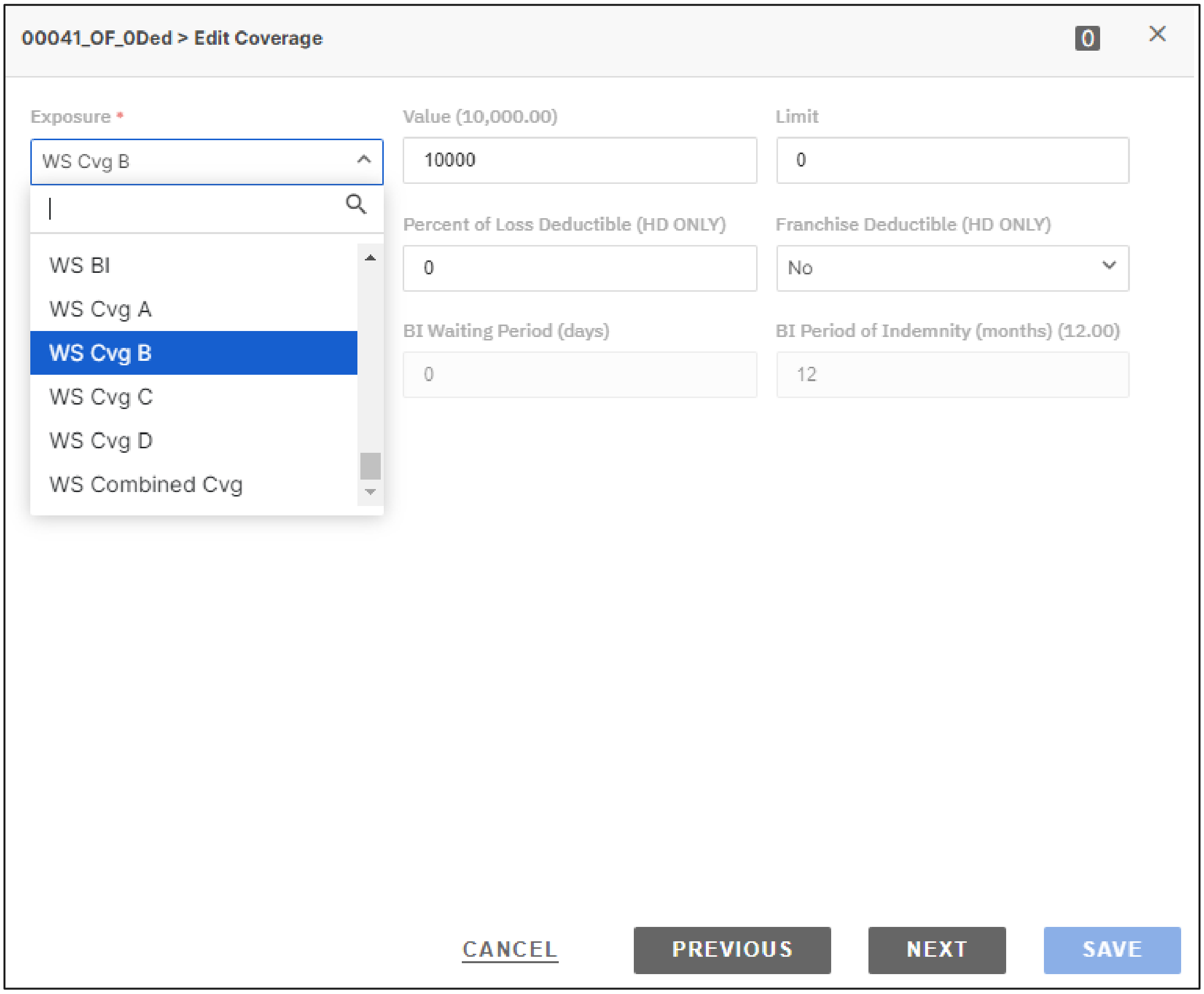

Figure 101: Screen shot of Risk Modeler model location input form (part 5)

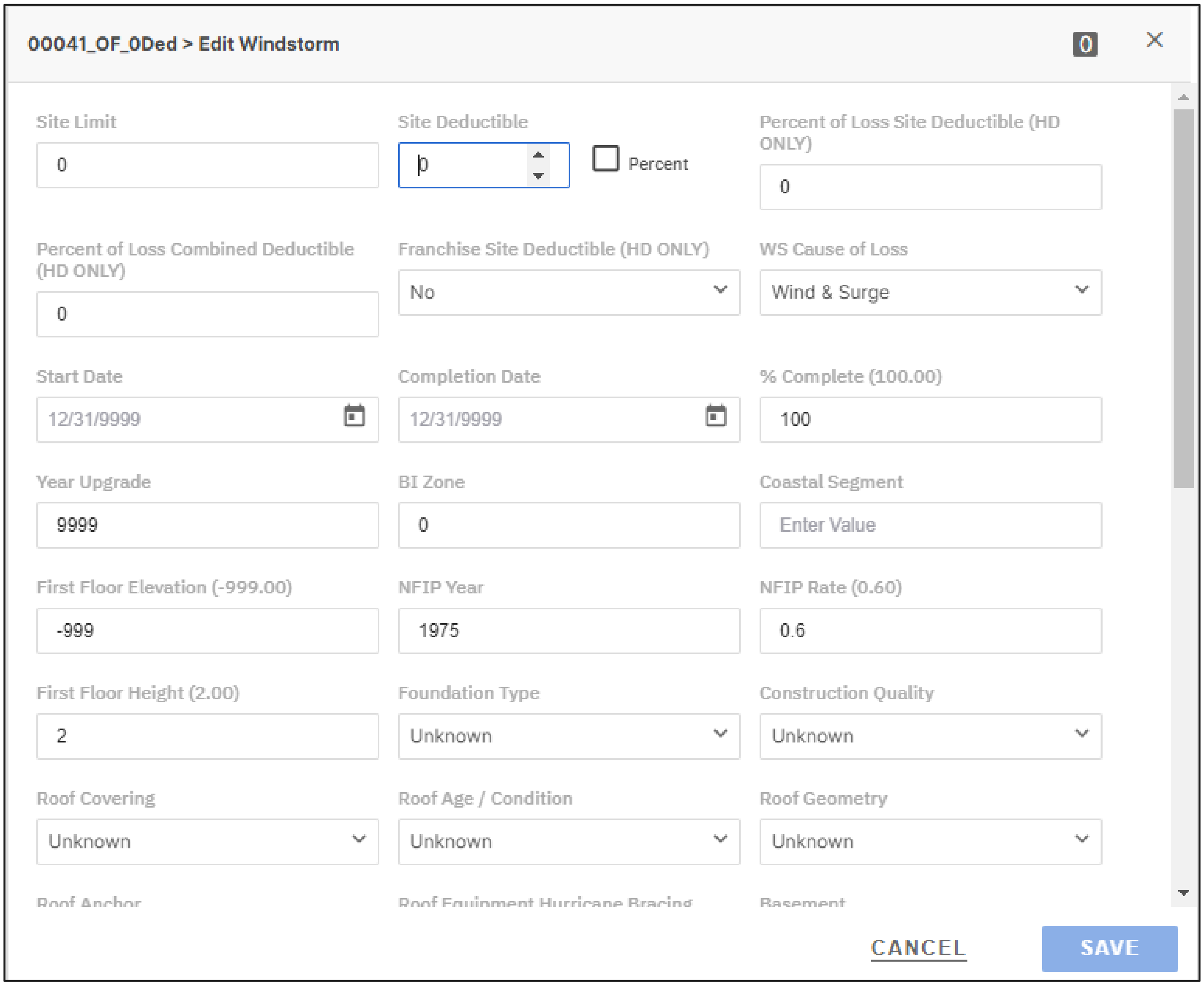

Figure 102: Screen shot of Risk Modeler model location input form (part 6)

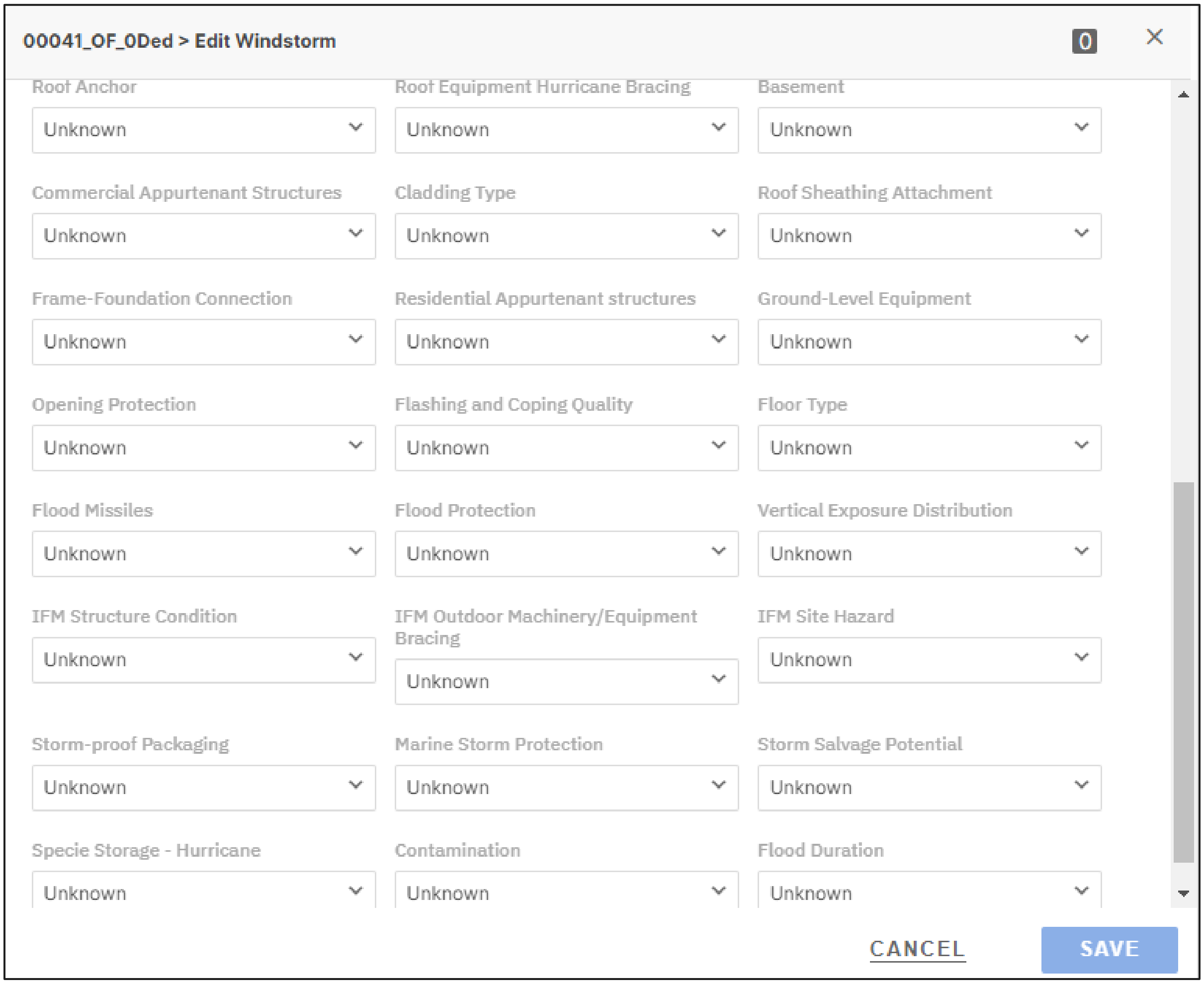

Figure 103: Screen shot of the Risk Modeler Global Menu, showing platform name and version number

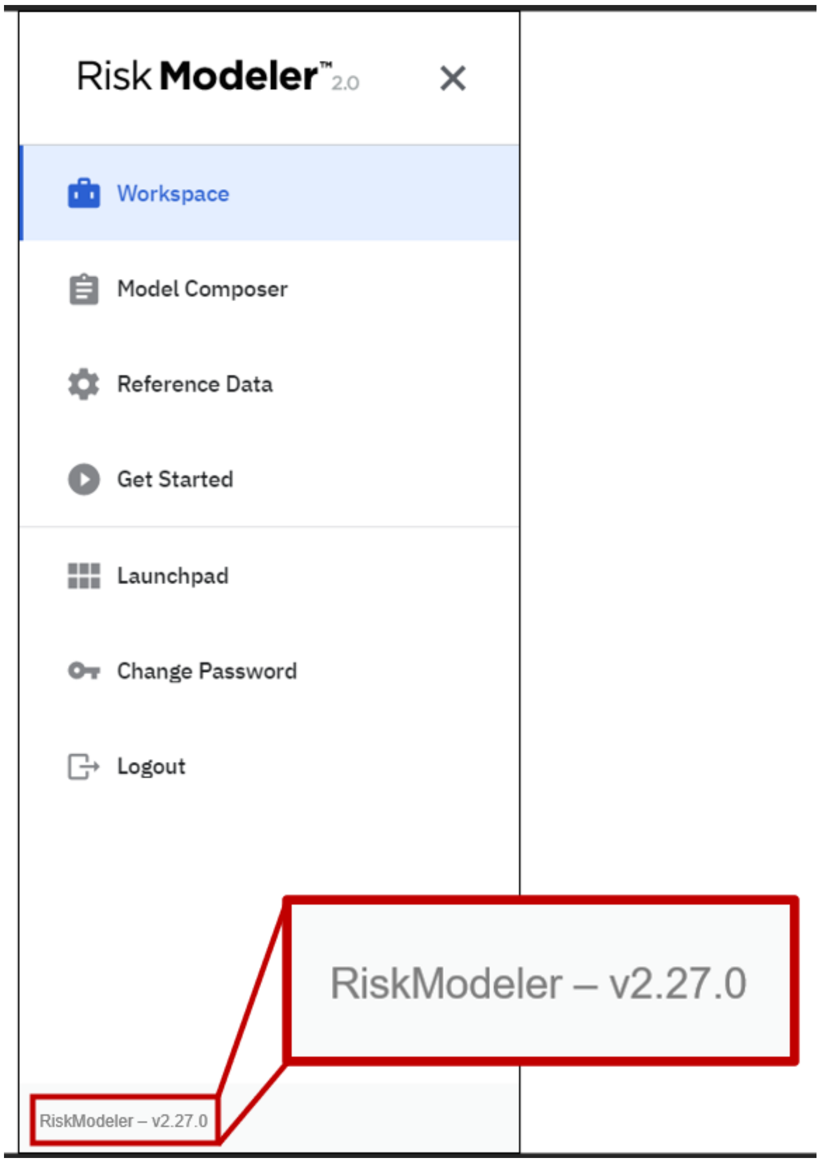

Figure 104: Screen shot of the Moody's RMS Peril Models List for Risk Modeler showing model version and build number

North Atlantic	Canada Caribbean Central America Mexico Offshore US - Gulf of Mexico United States	RL23	23.0 (Build 2250)		2022/V22.0	Submitted to the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) for certification for use in residential rate filings with the Florida Office of Insurance Regulation under the 2021 Report of Activities.
		RL22	22.0 (Build 2150)	Jun-28-22	2021/V21.0	The Florida Commission on Hurricane Loss Projection Methodology (FCHLPM) has approved version 21 (Build 2050) in both RiskLink and Risk Modeler, for use in residential rate filings with the Florida Office of Insurance Regulation. Approval was granted in a public meeting held in Tallahassee on June 1st, 2021. Since then, model versions 21.0.1 (Build 2050) and 21.0.2 (Build 2050) and all Risk Modeler updates were released and approved by the FCHLPM as functionally equivalent to model version 21.0 (Build 2050).
		RL21	21.0.2 (Build 2050)	Dec-15-21		For RL21, detailed version number 21.0.2 replaces version number 21.0.1 (released Nov-9-21) on Dec-15-21. See Version 2.14.0 December 15, 2021. See Updates to Peril Models and Data Products Version 21
		RL18.1	18.1.1 (Build 1945)	Jul-13-20	2019/V18.1	See Updates to Peril Models and Data Products in RiskLink 18.1
		RL18	18.0 (Build 1930)	Jul-13-20	2018/V18.0	See Updates to Peril Models and Data Products in Version 18.0

APPENDIX F – REPORTS

Figure 105: RiskLink analysis summary report (page 1 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
0 Unknown	4869	100.00

BASEMENT	# Locations	% of Locations
0 w/ Unknown Flood Protection	4869	100.00

ROOF COVERING	# Locations	% of Locations
0 Unknown	4869	100.00

ROOF GEOMETRY	# Locations	% of Locations
0 Unknown	4869	100.00

ROOF ANCHOR	# Locations	% of Locations
0 Unknown	4869	100.00

ROOF AGE	# Locations	% of Locations
0 Unknown	4869	100.00

ROOF EQUIPMENT HURRICANE BRACING	# Locations	% of Locations
0 Unknown	4,869.00	100.00

FLASHING AND COPING QUALITY	# Locations	% of Locations
0 Unknown	4,869.00	100.00

COMMERCIAL APPURTENANT STRUCTURES	# Locations	% of Locations
0 Unknown	4869	100.00

CLADDING TYPE	# Locations	% of Locations
0 Unknown	4869	100.00

ROOF SHEATHING ATTACHMENT	# Locations	% of Locations
0 Unknown	4869	100.00

FRAME-FOUNDATION CONNECTION	# Locations	% of Locations
0 Unknown	4869	100.00

RESIDENTIAL APPURTENANT STRUCTURES	# Locations	% of Locations
0 Unknown	4869	100.00

MEC./ ELEC. EQPT - GROUND	# Locations	% of Locations
0 Unknown	4869	100.00

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

Risk Management Solutions, Inc.
7575 Gateway Blvd
Newark, CA 94560 U.S.A
Phone:(510) 505-2500 Fax: (510) 505-2501

Page 2 of 3

Figure 106: RiskLink 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:

	# Locations	% of Locations		# Locations	% of Locations
CONSTRUCTION QUALITY	**# Locations**	**% of Locations**	**BASEMENT**	**# Locations**	**% of Locations**
0 Unknown	4869	100.00	0 w/ Unknown Flood Protection	4869	100.00
ROOF COVERING	**# Locations**	**% of Locations**	**ROOF GEOMETRY**	**# Locations**	**% of Locations**
0 Unknown	4869	100.00	0 Unknown	4869	100.00
ROOF ANCHOR	**# Locations**	**% of Locations**	**ROOF AGE**	**# Locations**	**% of Locations**
0 Unknown	4869	100.00	0 Unknown	4869	100.00
ROOF EQUIPMENT HURRICANE BRACING	**# Locations**	**% of Locations**	**FLASHING AND COPING QUALITY**	**# Locations**	**% of Locations**
0 Unknown	4,869.00	100.00	0 Unknown	4,869.00	100.00
COMMERCIAL APPURTENANT STRUCTURES	**# Locations**	**% of Locations**	**CLADDING TYPE**	**# Locations**	**% of Locations**
0 Unknown	4869	100.00	0 Unknown	4869	100.00
ROOF SHEATHING ATTACHMENT	**# Locations**	**% of Locations**	**FRAME-FOUNDATION CONNECTION**	**# Locations**	**% of Locations**
0 Unknown	4869	100.00	0 Unknown	4869	100.00
RESIDENTIAL APPURTENANT STRUCTURES	**# Locations**	**% of Locations**	**MEC./ ELEC. EQPT - GROUND**	**# Locations**	**% of Locations**
0 Unknown	4869	100.00	0 Unknown	4869	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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Figure 107: RiskLink analysis summary report (page 3 of 3)

OPENING PROTECTION	# Locations	% of Locatio
0 Unknown	4869	100.00

WS DETAIL VALID FLAG	# Locations	% of Locations	ADDRESS MATCH LEVEL	# Locations	% of Locations
1 Valid	4869	100.00	5 Postal Code	4869	100.00

NUMBER OF BUILDINGS	# Locations	% of Locations	NUMBER OF STORIES	# Locations	% of Locations
1	4869	100.00	1	4869	100.00

YEAR BUILT	# Locations	% of Locations	LOCATION VALID FLAG	# Locations	% of Locations
1989 1973 - Present	4869	100.00	1 Valid	4869	100.00

COVERAGE DAMAGEABILITY GRADE	# Locations Coverages	% of Locations Coverages
0 Unknown	14607	75.00
3 Damageable	4869	25.00

CONSTRUCTION CLASS

Schema	Class	# Locations	% of Locations
RMS	Manufactured/Mobile Home with Tie-Downs	1623	33.33
RMS	MASONRY	1623	33.33
RMS	WOOD	1623	33.33

OCCUPANCY TYPE

Schema	Class	# Locations	% of Locations
ATC	Permanent Dwelling (single family housing)	4869	100.00

SQUARE FOOT BANDS

Square Foot Bands	# Locations	% of Locations
Unknown	4,869	100.00
< 1507	0	0.00
BETWEEN 1507 AND 2507	0	0.00
BETWEEN 2508 AND 5005	0	0.00
BETWEEN 5006 AND 10010	0	0.00
>10010	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 108: RiskLink post import summary (page 1 of 4)

Post Import Summary

MOODY'S

Saturday, April 22, 2023

Version 23.0 (Build 2250)

EDM Database : RMS_EDM

Portfolio Name : *Form A-1*

Peril : *Wind*

Location:

Location Coverage Values and Limits :

Valid	Loc Cov Count	Loc Cov Limits	Loc Cov Values
Yes	19,476	0.00	730,350,000.00
Total	**19,476**	**0.00**	**730,350,000.00**

Valid Location Coverage Values and Limits :

Loss Type	Loc Cov Count	Valid Loc Cov Value	Min Value	Max Value	Average Value
Building	9,738	446,325,000.00	5,000.00	100,000.00	45,833.33
Content	4,869	202,875,000.00	25,000.00	50,000.00	41,666.67
BI/ALE	4,869	81,150,000.00	10,000.00	20,000.00	16,666.67
Total	**19476**	**730,350,000.00**			

Loss Type	Loc Cov Count	Valid Loc Cov Limit	Min Limit	Max Limit	Average Limit
Total					

Valid Location Coverage Law and Ordinance Limit Extensions :

Loss Type	Loc Cov Count	Valid Loc Cov Value	Min Value	Max Value	Average Value
Total					

Geocoded Values and Limits :

Geocoded	Loc Count	Loc Cov Values	Loc Cov Limits
Yes	4,869	730,350,000.00	0.00
Total	**4,869**	**730,350,000.00**	**0.00**

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposur for this report.

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Figure 109: RiskLink post import summary (page 2 of 4)

Site:

Site Limits :

Valid	Loc Count	Site Limits
Yes	4,869	0.00
Total	4,869	0.00

Valid Site Limits:

Min Site Limit	Max Site Limit	Average Site Limit

Account and Policy:

Account :

Valid	Account Count	Loc Cov Values
Yes	4,869	730,350,000.00
Total	4,869	730,350,000.00

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
No		
Yes		
Total	0.00	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	

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposur for this report.

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Figure 110: RiskLink post import summary (page 3 of 4)

Construction Class:

Schema	Class	Valid Loc Cov Values
RMS	Manufactured/Mobile Home with Tie-Downs	146,070,000.00
RMS	MASONRY	292,140,000.00
RMS	WOOD	292,140,000.00
	Total	**730,350,000.00**

Occupancy Class:

Schema	Class	Valid Loc Cov Values
ATC	Permanent Dwelling (single family housing)	730,350,000.00
	Total	**730,350,000.00**

Geocoding Resolution:

Resolution	Location Count	Loc Cov Values
Postcode	4,869	730,350,000.00
Total	**4,869**	**730,350,000.00**

Area :

Country	State/Cresta	Valid Loc Cov Value
US	FL	730,350,000.00
Total		**730,350,000.00**

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				730,350,000.00

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposur for this report.

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Figure 111: RiskLink 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		3,462	519,300,000.00
			Total	*3,462*	*519,300,000.00*
	All Tier 1 Counties				
		Postcode		3,462	519,300,000.00
	Total for Tier 1 Counties			3462	519,300,000.00
Tier 2					
	FL				
		Postcode		1,239	185,850,000.00
			Total	*1,239*	*185,850,000.00*
	All Tier 2 Counties				
		Postcode		1,239	185,850,000.00
	Total for Tier 2 Counties			1239	185,850,000.00
Total for Tier 1 and Tier 2 counties					**705,150,000.00**

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

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposur for this report.

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Figure 112: Risk Modeler analysis summary report (page 1 of 7)

Analysis Summary

RMS Default FCHLPM Certified Hurricane Losses 23

Risk Modeler v2.27.0

Wednesday April 26, 2023

Analysis Settings

Analysis Name	RMS Default FCHLPM Certified Hurricane Losses 23
Analysis ID	3913
Analysis Type	Exceedance Probability
Analysis Mode	Distributed
Model Version	23.0
Date	2023-04-26 17:39:22.0
Engine	DLM
Peril	Windstorm
Region	North Atlantic (including Hawaii)
Model Profile	RMS Default FCHLPM Certified Hurricane Losses 23
Output Profile	RMS Default FCHLPM Certified Hurricane Losses 23
Event Rate Set	RMS 2023 Historical Event Rates

Currency

Currency	USD
Currency Scheme	RMS
Currency Version	RL22

Exposure

Data Source Name	FormA1_RL23_Geo_EDM
Exposure Type	Portfolio
Exposure Source	1
Portfolio Name	Form A-1
Geocoding Version	23.0
Hazard Version	23.0

Windstorm Settings

Calculate Losses From Sub-Peril(s)	Wind Only
Modifications to Ground Up Storm Surge (Applies to US Only)	None
Loss Amplification	
Building and Appurtenant Structures	Yes
Contents	Yes
Business Interruption/Time Element	Yes
PLA Scale Factor	1.00
Vulnerability	Vulnerability - Default
Use RiskAssessor Curves	No

Exposure Modifications

Assume "Unknown" for the following primary characteristics	
Construction Class	No
Occupancy Class	No
Year Built	No
Number of Stories	No
Floor Area	No
Floors Occupied	No
Assume "Unknown" for secondary modifiers	No
Ignore local flood defenses	No
Reset all user entered building elevation values to RMS default	No
Scale Exposure Values	
Building and Appurtenant Structures	1.00
Contents	1.00
Business Interruptions/Time Element	1.00
Assume 2% deductible when "Unknown"	Yes
Non-Modeled Damage Factors:	
Building and Appurtenant Structures	1.00
Contents	1.00
Business Interruption/Time Element	1.00

RMS Default FCHLPM Certified Hurricane Losses v23 - Wednesday April 26, 2023

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report. Analysis Metadata that are missing from this analysis are indicated by 'N/A'.

Risk Modeler v2.27.0

1 of 7

Figure 113: Risk Modeler analysis summary report (page 2 of 7)

Exposure Data Summary Statistics (USD)

150,000.00	0.00	0.00
Average Location Value	Average Location Limit	Average Location Deductible

Exposure Data Detail Statistics

Construction Quality	# of Locations	% of Locations
0 Unknown	4,869	100.00

Basement	# of Locations	% of Locations
0 Unknown	4,869	100.00

Roof Covering	# of Locations	% of Locations
0 Unknown	4,869	100.00

Roof Geometry	# of Locations	% of Locations
0 Unknown	4,869	100.00

Roof Anchor	# of Locations	% of Locations
0 Unknown	4,869	100.00

Roof Age	# of Locations	% of Locations
0 Unknown	4,869	100.00

Roof Equipment Hurricane Bracing	# of Locations	% of Locations
0 Unknown	4,869	100.00

Flashing and Coping Quality	# of Locations	% of Locations

RMS Default FCHLPM Certified Hurricane Losses v23 - Wednesday April 26, 2023

Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report. Analysis Metadata that are missing from this analysis are indicated by 'N/A'.

Risk Modeler v2.27.0

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Figure 114: Risk Modeler analysis summary report (page 3 of 7)

	# of Locations	% of Locations
0 Unknown	4,869	100.00

Commercial Appurtenant Structures	# of Locations	% of Locations
0 Unknown	4,869	100.00

Cladding Type	# of Locations	% of Locations
0 Unknown	4,869	100.00

Roof Sheathing Attachment	# of Locations	% of Locations
0 Unknown	4,869	100.00

Frame Foundation Connection	# of Locations	% of Locations
0 Unknown	4,869	100.00

Residential Appurtenant Structures	# of Locations	% of Locations
0 Unknown	4,869	100.00

Mec./Elec. Eqpt - Ground	# of Locations	% of Locations
0 Unknown	4,869	100.00

RMS Default FCHLPM Certified Hurricane Losses v23 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report. Analysis Metadata that are missing from this analysis are indicated by 'N/A'.

Risk Modeler v2.27.0
3 of 7

Figure 115: Risk Modeler analysis summary report (page 4 of 7)

Opening Protection	# of Locations	% of Locations
0 Unknown	4,869	100.00

WS Detail Valid Flag	# of Locations	% of Locations
1 Valid	4,869	100.00

Address Match Level	# of Locations	% of Locations
5 Postal Code	4,869	100.00

Number of Buildings	# of Locations	% of Locations
1	4,869	100.00

Number of Stories	# of Locations	% of Locations
1	4,869	100.00

Year Built	# of Locations	% of Locations
1973 - Present	4,869	100.00

Location Valid Flag	# of Locations	% of Locations
1 Valid	4,869	100.00

Coverage Damageability Grade	# of Locations	% of Locations
0 Unknown Damageable	14,607	75.00
3 Damageable	4,869	25.00

RMS Default FCHLPM Certified Hurricane Losses v23 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report. Analysis Metadata that are missing from this analysis are indicated by 'N/A'.

Risk Modeler v2.27.0
4 of 7

Figure 116: Risk Modeler analysis summary report (page 5 of 7)

Construction Class

Scheme	Class	# of Locations	% of Locations
RMS	MASONRY	1,623	33.33
RMS	Manufactured/Mobile Home with Tie-Downs	1,623	33.33
RMS	WOOD	1,623	33.33

Figure 117: Risk Modeler analysis summary report (page 6 of 7)

Occupancy Type

Scheme	Class	# of Locations	% of Locations
ATC	Permanent Dwelling (single family housing)	4,869	100.00

RMS Default FCHLPM Certified Hurricane Losses v23 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report. Analysis Metadata that are missing from this analysis are indicated by 'N/A'.

Risk Modeler v2.27.0
6 of 7

Figure 118: Risk Modeler analysis summary report (page 7 of 7)

Square Foot Bands

Square Foot Bands	# of Locations	% of Locations
UNKNOWN	4,869	100.00

RMS Default FCHLPM Certified Hurricane Losses v23 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report. Analysis Metadata that are missing from this analysis are indicated by 'N/A'.

Risk Modeler v2.27.0
7 of 7

Figure 119: Risk Modeler post import summary (page 1 of 8)

Exposure Summary

Risk Modeler v2.27.0

Form A-1

Wednesday April 26, 2023

Windstorm	730.35 M	4,869	0	4,869
Peril	TIV	Accounts	Policies	Locations

Portfolio Number	Form A-1	**TIV**	730,350,000.00	**Geocoding Version**	23.0
Database Name	FORMA1_RL23_GEO_ED-M_EPC			**Hazard Version**	23.0

Location

Location Coverage Values and Limits

Valid	Location Coverage Count	Location Coverage Value	Location Coverage Limit
Yes	19,476	730,350,000.00	0.00
Total	**19,476**	**730,350,000.00**	**0.00**

Valid Location Coverage Values

Loss Type	Location Coverage Count	Valid Location Coverage Value	Minimum Value	Maximum Value	Average Value
Building	9,738	446,325,000.00	5,000.00	100,000.00	45,833.33
Contents	4,869	202,875,000.00	25,000.00	50,000.00	41,666.67
BI	4,869	81,150,000.00	10,000.00	20,000.00	16,666.67
Total	**19,476**	**730,350,000.00**			

Valid Location Coverage Limits

Loss Type	Location Coverage Count	Valid Location Coverage Limit	Minimum Limit	Maximum Limit	Average Limit
Total	**0**	**0**			

Geocoded Values and Limits

Geocoded	Location Count	Location Coverage Value	Location Coverage Limit
Yes	4,869	730,350,000.00	0.00
Total	**4,869**	**730,350,000.00**	**0.00**

Form A-1 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

Risk Modeler v2.27.0
1 of 8

Figure 120: Risk Modeler post import summary (page 2 of 8)

Site

Site Limits

Valid	Location Count	Site Limit
Yes	4,869	0.00
Total	**4,869**	**0.00**

Valid Site Limits

Minimum Site Limit	Maximum Site Limit	Average Site Limit
-	-	-

Account and Policy

Account

Valid	Account Count	Location Coverage Value
Yes	4,869	730,350,000.00
Total	**4,869**	**730,350,000.00**

Policy Coverage Limits

Valid	Policy Coverage Count	Policy Coverage Limits
Total	**0**	**0**

Valid Policy Coverage Limits

Loss Type	Valid Policy Coverage Limit	Minimum Limit	Maximum Limit	Average Limit
Total	**0**			

Policy Limits

Valid	Blanket Limits Count	Blanket Limits
Total	**0**	**0**

Valid Policy Limits

Minimum Blanket Limit	Maximum Blanket Limit	Average Blanket Limit
-	-	-

Policy Dates

0	0
Expired Policies	Active Policies

Form A-1 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

Risk Modeler v2.27.0
2 of 8

Figure 121: Risk Modeler post import summary (page 3 of 8)

Line of Business

Policy Limits

Line of Business	Valid Location Coverage Value
Total	0

Form A-1 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

Risk Modeler v2.27.0
3 of 8

Figure 122: Risk Modeler post import summary (page 4 of 8)

Construction Class

Schema	Class		Valid Location Coverage Value
RMS	MASONRY		292,140,000.00
RMS	Manufactured/Mobile Home with Tie-Downs		146,070,000.00
RMS	WOOD		292,140,000.00
		Total	**730,350,000.00**

Occupancy Class

Schema	Class		Valid Location Coverage Value
ATC	Permanent Dwelling (single family housing)		730,350,000.00
		Total	**730,350,000.00**

Form A-1 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

Risk Modeler v2.27.0
4 of 8

Figure 123: Risk Modeler post import summary (page 5 of 8)

Geocoding Resolution

Resolution	Location Count	Location Coverage Value
Postal Code	4,869	730,350,000.00
Total	4,869	730,350,000.00

Form A-1 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

Risk Modeler v2.27.0
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Figure 124: Risk Modeler post import summary (page 6 of 8)

Area

Country	State	Valid Location Coverage Value
US	FL	730,350,000.00
	Total	**730,350,000.00**

Country	CRESTA	Valid Location Coverage Value
US		730,350,000.00
	Total	**730,350,000.00**

Form A-1 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

Risk Modeler v2.27.0
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Figure 125: Risk Modeler post import summary (page 7 of 8)

Peril Details (Windstorm)

DISTCOAST	Valid Location Coverage Value
>= 0.0 and < 0.2	38,700,000.00
>= 0.2 and < 0.5	35,550,000.00
>= 0.5 and < 1.0	46,800,000.00
>= 1.0 and < 2.5	113,400,000.00
>= 2.5 and < 5.0	85,950,000.00
>= 5.0 and < 10.0	88,650,000.00
>= 10.0 and < 25.0	121,950,000.00
>= 25.0 and < 100.0	199,350,000.00
Total	**730,350,000.00**

Aggregate US Windstorm Exposures for Coastal Counties by Geocoding Resolution

Tier 1

State	Geocoding Resolution	# of Locations	Location Cov Values
FL	Postal Code	3,462	519,300,000.00
	Total	**3,462**	**519,300,000.00**
All Tier 1 counties	Postal Code	3,462	519,300,000.00
	Total	**3,462**	**519,300,000.00**

Tier 2

State	Geocoding Resolution	# of Locations	Location Cov Values
FL	Postal Code	1,239	185,850,000.00
	Total	**1,239**	**185,850,000.00**
All Tier 2 counties	Postal Code	1,239	185,850,000.00
	Total	**1,239**	**185,850,000.00**

Total for Tier 1 and Tier 2 counties **705,150,000.00**

Aggregate US Windstorm Exposures for Coastal Counties by Unknown Building Characteristics

Total for Tier 1 and Tier 2 counties **0**

Form A-1 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

Risk Modeler v2.27.0
7 of 8

Figure 126: Risk Modeler post import summary (page 8 of 8)

Reinsurance

	Policies	Locations
Facultative	0	0
Surplus Share Treaty	0	0

Form A-1 - Wednesday April 26, 2023
Note: All exposure amounts are shown in their original currency. No currency conversion is performed while aggregating exposure for this report.

Risk Modeler v2.27.0
8 of 8

Table 51: Example of client output table showing application of annual deductible factors

North Atlantic Hurricane Models 23.0 (Build 2250)

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 52: Acronym definitions

Acronym	Definition
AAL	Average annual loss
ACM	Association for Computing Machinery
AEP	Aggregate exceedance probability
AIA	American Institute of Architects
ALE	Additional living expenses
AOP	All other perils
Amax	Angle to maximum winds
ARA	Applied Research Associates,
ASCE	American Society of Civil Engineers
ASOS	Automated Surface Observing System
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
C-MAN	Coastal Marine Automated Network
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

Acronym	Definition
GIS	Geographic information systems
GPS	Global positioning system
HAZUS	Federal Emergency Management Agency Hazards United States
HCI	Human-Computer Interaction
HOA	Condo association
hPa	Hectopascal – unit of pressure
HPC	High performance computing
HTTPS	Hypertext Transfer Protocol Secure
HUD	U.S. Housing and Urban Development
HURDAT	HURricane DATabase
HWind	Moody's 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
mb	Millibars
m/s	Meter per second
MAAA	Member American Academy of Actuaries
MBA	Master of business administration
MCA	Master of computer application
MDA	MacDonald, Dettwiler and Associates
MDR	Mean damage ratio
MFD	Multi-family dwelling
MH	Mobile/Manufactured Home
mi	Mile
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
NCARB	National Council of Architectural Registration Boards
NCDC	National Climatic Data Center
NDBC	National Data Buoy 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

Acronym	Definition
pdf	Probability density function
PhD	Doctor of philosophy
PLA	Post-event loss amplification
PLC	Public Limited Company
PV	Photovoltaic
QA	Quality assurance
RAM	Random access memory
RES	Residential
RL	RiskLink
RM	Reinforced masonry
Rmax	Radius to maximum winds
RMS	Risk Management Solutions, Inc.
ROA	Report of activities
RPL	Return period loss
SBC	Standard building code
SFBC	Standard Florida building code
SMO	Server management objects
SP	Software patch
sq ft	Square foot
SQL	[brand name of relational database management system]
SWR	Secondary water resistance
TB	Terabyte
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
UX	User experience
Vmax	Maximum wind
VPC	Virtual private cloud
VRG	Variable resolution grid
XML	Extensible markup language