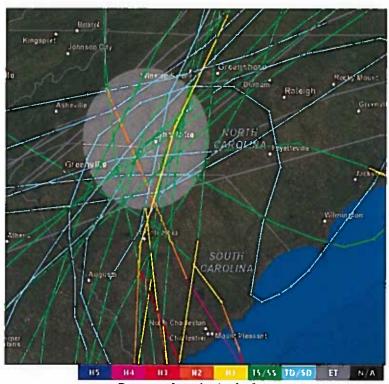
# **Evaluation of Hurricane Catastrophe Models Used in South Carolina**



Prepared exclusively for:

South Carolina Department of Insurance Division of Actuarial and Market Services Columbia, South Carolina

Prepared by:

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## **Proprietary Information and Trade Secret Material**

This report is presented to the South Carolina Department of Insurance (SCDOI) in accordance with the Department's RFP for review of computer simulation models that are designed to produce hurricane insurance loss costs for insuring properties in South Carolina (SC).

Hurricane Catastrophe Modeling Companies (modelers) invest substantial resources in the development of their hurricane catastrophe models, modeling methodologies and databases. This document contains proprietary and confidential information and trade secret material and is intended for the exclusive use of SCDOI.

A panel of experts formed by SCDOI has prepared this report using information provided by these modeling companies:

- AIR Worldwide Corporation (AIR)
- Applied Research Associates (ARA)
- EQECAT
- Risk Management Solution (RMS)

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## **Executive Summary**

This report is presented to the South Carolina Department of Insurance (SCDOI) in accordance with the Department's Request for Proposal (RFP) for review of computer simulation models that are designed to produce hurricane insurance loss costs for insuring properties in South Carolina (S.C.).

A panel of three experts (with extensive experience reviewing hurricane loss models) reviewed the models submitted to the SCDOI. Each expert is a member of the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM, or Florida Commission), and has participated in at least ten years of hurricane model reviews for the State of Florida.

Former South Carolina Insurance Department Chief Actuary Martin M. Simons MAAA, ACAS, FCA provides property and casualty insurance actuarial consulting services throughout the United States and Canada. Dr. Jenni L. Evans, Professor of Meteorology at The Pennsylvania State University, and Dr. Masoud Zadeh, Owner of Risk and Reliability Engineering, both have extensive experience in reviewing hurricane models.

As the experience with Hurricane Hugo demonstrated, past insurance claims data is inadequate to produce insurance rates to cover catastrophes such as hurricanes. The insurance industry uses the results from computer models to produce the hurricane insurance loss costs (and thereby hurricane insurance rates) that are incorporated in their rate filings. The models are designed to produce many years of modeled hurricanes, based on the information available from the National Hurricane Center and the science we know about hurricanes.

Once the hurricanes are produced, the models analyze the effects of the hurricane winds and other hazards on properties of varying types of construction. These effects are expressed in terms of monetary losses at each property, which include losses to damage to buildings, appurtenant structures and contents and losses due to additional living expenses (time element coverage) due to these hazards and damage to infrastructure.

Finally, the loss estimates produced by the model must be adjusted to account for insurance contracts such as policy limits, deductibles, and coverage types and any local legal requirements to arrive at insurance loss estimates.

Due to the complexity of hurricane models, along with the their impact in the



production of hurricanes insurance rates, the legislature of the State of Florida created the FCHLPM, an independent Commission charged with determining that the hurricane models produce "accurate" and "reliable" loss costs from which the state's hurricane insurance rates can be produced. To optimize the effectiveness of this review, information that is similar whether the model is run in Florida or in South Carolina is based on the work of the FCHLPM. South Carolina law permits the Department to consider models approved by other states as a part of its evaluation. In addition to consideration of this shared information, this report is built on information that is specifically relative to South Carolina.

This report does not express any opinion on the rate review process and should not be interpreted as such. It is provided as a guide to the South Carolina Department of Insurance and sets forth recommendations which, if implemented, may enhance the Department's rate review process for future insurance filings. The recommendations are prospective in nature and should be considered going forward.

Each model used in South Carolina for rate filings should simulate the hurricane risk most appropriate to South Carolina. To evaluate the models based on this requirement, the panel of experts produced a series of evaluation questions designed to examine whether the best scientific meteorological, structural engineering and actuarial knowledge and information available are implemented in the models appropriately for South Carolina (Appendix B). Along with the initial evaluation questions, three Forms were developed to be completed by each modeler. These Forms are designed to address how each hurricane model addresses hurricane hazard, vulnerability of properties to hurricane hazards, and insurance contractual requirements specific to South Carolina. These evaluation questions and Forms were sent to all the participating modeling organizations (modelers) which develop, maintain, and update or that have an interest in developing, maintaining, and updating hurricane models for use in South Carolina: AIR Worldwide (AIR), Applied Research Associates (ARA), EQECAT, and Risk Management Solutions (RMS).

Upon receipt and review of the responses to the initial evaluation questions from each modeler, the panel of experts produced a series of follow up questions specific to each modeler based on analysis of the modeler responses. The follow-up questions and responses to them are also contained in this report. Appendices C, D, E, and F contain the follow up questions and the responses from AIR, ARA, EQECAT and RMS, respectively. The responses from the modelers (Appendices C through F) contain proprietary and confidential information and trade secret



material. Moreover, excerpts from modelers' responses have been given or paraphrased throughout of the main part of this report. Therefore, it is important to note that this document as whole contains proprietary and confidential information and trade secret material and is intended for the exclusive use of SCDOI. Section 38-75-1140 requires the Director to maintain the confidentiality of information that is considered proprietary or a trade secret.

The reviews of the panel of experts summarized here have determined that some revisions may be required in the way certain of the hurricane models produce loss costs for South Carolina so that they are in accordance with the statutory requirements that rates not be excessive, inadequate or unfairly discriminatory. Perhaps more important, this report provides a tool for future regulation of property insurance policies that include hurricane coverage. This report does not express any opinion on the materiality of the revisions.

In accordance with Standards established by the FCHLPM, each model must produce an "output report." The output report provides a wealth of information regarding assumptions adjustments and inputs that have been used to produce the model output. Consistent with the Florida Commission, we suggest that to be deemed acceptable, a model must provide detailed information to the regulator regarding the output report, and how to determine whether the modeler or the filing insurer has made any adjustments or assumptions outside of the workings of the model. The output report is a vehicle of record for the modeler, their clients and the regulator; it contains all relevant data needed to document the assumptions and adjustments underlying the modeled loss costs presented in a rate filing, and also provides information in several areas where the regulator might be concerned in the future.



## 1. Introduction

## 1.1 Background

This report is presented to the South Carolina Department of Insurance (SCDOI) in accordance with the Department's RFP for review of computer simulation models that are designed to produce hurricane insurance loss costs for insuring properties in South Carolina.

There is a great deal of information that may be gleaned from the responses of the modelers, both to the initial questions and more importantly to the follow up questions. We have highlighted aspects of each modeler's responses in the following sections and followed those with a summary section. In this section, we describe the approach used and provide guidance on how to use this document.

## 1.2 Project Team

The authors of this report are each members of the Professional Team of the Florida Commission on Hurricane Loss Projection Methodology (hereafter referred to as FCHLPM, or simply Florida Commission, and to be described later in this report) and are well versed in the sciences and skills required for such a review. A short bio for each of the members of the panel of experts is given below. The more expanded curricula vitae for the members are given in Appendix A.

Martin M. Simons MAAA, ACAS, FCA provides property and casualty insurance actuarial consulting services to regulators, legislators, state agencies, and consumers throughout the United States and Canada. He is currently a member of the General Committee of the Actuarial Standards as well as the Extreme Events Committee of the American Academy of Actuaries. Since 1997, he has been the lead actuary on the Professional Team of the Florida Commission on Hurricane Loss Projection Methodology. He was the senior member of the Advisory Committee to the Hawaii Hurricane Relief Fund from its creation, to involvement in approving the industry filing to take back the hurricane risk. From 1985 to 1997, he was the Deputy Director and Chief Actuary for the South Carolina Department of Insurance.

Jenni L. Evans Ph.D. (Applied Mathematics) is a Professor of Meteorology and Interim Director of the Earth and Environmental Systems Institute at The



Pennsylvania State University. She is a Fellow of the American Meteorological Society and, among many other roles, has previously served as a councilor for that Society. Having joined the team in 2003, she has been the lead meteorologist on the Professional Team of the Florida Commission on Hurricane Loss Projection Methodology since 2004. She has also served as advisor to hurricane model evaluation inquiries for the states of Massachusetts and Maryland. She has over forty peer-reviewed journal articles on various aspects of tropical cyclones and has presented over 100 invited talks and conference papers on her research. She is presently the Chair of the World Meteorological Society (WMO, a branch of the United Nations) International Workshop on Tropical Cyclones, a quadrennial workshop designed to bring together researchers and forecasters from all across the globe.

Masoud M. Zadeh, Ph.D., provides engineering risk consulting services in the areas of natural and manmade hazard risk assessment and management to insurance and reinsurance industry, insurance regulators, nuclear industry, commercial and local, state, and Federal government sectors. He has developed, applied, reviewed and/or audited catastrophe risk models for natural hazards, such as hurricanes, tornadoes, high winds, and earthquakes. From 1997, he has been on the HAZUS Wind Committee overseeing the development of HAZUS-MH hurricane module for Federal Emergency Management Agency (FEMA). Since 2005, he has been the lead structural engineer on the Professional Team of the Florida Commission on Hurricane Loss Projection Methodology (FCHLPM). Before then, he led a team of engineers, scientists, and actuaries to submit a commercial hurricane catastrophe risk model to FCHLPM and to successfully obtain the model acceptance by FCHLPM three years in a row. He is an independent consulting engineer. Dr. Zadeh is a licensed Professional Engineer.

## 1.3 Project Approach

Hurricane catastrophe models are almost universally used by primary insurers and reinsurers, rating agencies and regulators, for ratemaking, risk analysis, catastrophic exposure and capacity management, reinsurance and catastrophe bond pricing, financial strength analyses, hazard mitigation analyses and other applications relating to the effects of hurricanes on properties.

It is virtually unanimously agreed by members of the actuarial profession that historical insurance claim data alone is an inadequate tool for estimating future property insurance loss costs from hurricanes, and that reliance solely on such



traditional methods to estimate expected hurricane loss costs based on historical losses is actuarially unsound.

As the community experience with Hurricanes Hugo, Iniki, and Andrew demonstrated, such information is inadequate to deal with the stochastic aspects of catastrophes such as hurricanes. Because of the low frequency and high severity of hurricane claims, an extremely long period of time (many thousands of years) would be necessary for insurance claim data to be credible for producing hurricane loss costs. The actuarial credibility of the insurance claim data for producing hurricane loss costs is close to zero. That is, one can place no confidence in hurricane insurance loss costs derived from insurance company claims data alone. The Insurance Department should refrain from accepting historical claim data alone for hurricanes as a basis for indicating rates that are not excessive, inadequate or unfairly discriminatory.

In order to provide a regulatory review of filings that use stochastic models to derive hurricane loss costs at a level that is cost effective for South Carolina, the regulator may use the reviews performed by the FCHLPM as a basis for the South Carolina review. The Florida Legislature established the Florida Commission in 1995 to review the way hurricane insurance loss costs are produced for Florida properties. The mission of the Florida Commission is defined as (Page 11 of Report of Activities, Ref.1):

"The mission of the Florida Commission on Hurricane Loss Projection Methodology is to assess the efficacy of various methodologies which have the potential for improving the accuracy of projecting insured Florida losses resulting from hurricanes and to adopt findings regarding the accuracy and reliability of these methodologies for use in residential rate filings."

The basis of the work of the Florida Commission are the terms "accurate" and "reliable" which are defined in said reference (Page 39 of Report of Activities, Ref. 1):

"In the context of computer simulation modeling, "accurate" means that the models meet the standards that have been developed to assure scientifically acceptable loss cost projections and probable maximum loss levels. However, "accurate" cannot necessarily mean that a model



conform to known facts since that contradicts the nature of the modeling process. "Reliable" is defined for computer simulation models as meaning that the model will consistently produce statistically similar results upon repeated use without inherent or known bias."

Loss costs represent the portion of the insurance rate that is applicable to claim payments, but not insurer expenses, reinsurance costs or profits. There are many aspects of hurricane modeling that are similar relative to producing Florida loss costs or South Carolina loss costs, so we were able to use the model reviewing background instituted by the Florida Commission to perform an analysis of hurricane insurance loss costs produced by catastrophe models for South Carolina at very low cost. In order to obtain the information needed to analyze whether a model produces results that are accurate and reliable for loss cost estimates in South Carolina, we went directly to each modeler. The modeler made available proprietary information that they did not wish to be available to the general public or their competitors. For this reason, the panel of experts agreed to keep the information marked "confidential" out of the public realm. We sincerely advise that the confidentiality of this document remain.

At the request of the panel of experts, the South Carolina Insurance Department requested certain information from the modelers. Included were inquiries relating to the meteorological, structural engineering, and actuarial aspects of the model. The inquiries may be found as Appendix B of this report.

The panel of experts reviewed the responses to each of our initial inquiries by each of the modelers. A set of "follow up" questions was developed for each modeler based on reviews of the initial submissions by the panel of experts. The focus of all inquiries was to determine how each model operates in developing loss costs appropriate to South Carolina.

At the request of the panel of experts, the "follow up" questions were submitted to the modelers by the South Carolina Department of Insurance. Some of the information in the "follow up" questions also includes confidential information. The follow up questions and confidential responses to them from the modelers may be found as Appendices C, D, E and F of this report for AIR, ARA, EQECAT, and RMS, respectively. One of the modelers requested a one-month extension, which caused a significant delay in the completion of this report.

This report is written as a result of the process described above. The panel of



experts has provided its findings and recommendations relative to regulating hurricane rates, and therefore the models used to create those rates in South Carolina (Section 6). The information throughout this report is meant to provide a transparent view of the process to those who are responsible for regulating hurricane insurance loss costs.



## 1.4 Project Limitations

In estimating the future effects of hurricanes in South Carolina, reasonable procedures and standard actuarial, meteorological, and engineering techniques and methodologies have been applied in reviewing those models that produce hurricane insurance loss costs in South Carolina.

This was a very limited review of the hurricane models. It did not include review of models at modelers' sites and interview with modelers' personnel. The review did not include completion of many Forms that generally are required for models submitted to Florida Commission for review. Moreover, the statistical and software development aspects of the models were not extensively reviewed. The implied assumption here is that these aspects of the models should not change from state to state and that these aspects have been reviewed extensively in Florida. Certain databases of the models that are state-dependent were not reviewed in this limited scope evaluation of hurricane models. These databases include, but are not limited to; ZIP Codes used in South Carolina, population weighted centroids of ZIP Codes, surface roughness and associated roughness factors, building stock distribution in South Carolina, and elevation databases for modeling topography effects, if used in a model.

The review also was limited in planned scope and resources allocated for the review. The panel of experts, however, easily went beyond the scope and resources allocated to complete its review and this report. This report, however, shall be reviewed and used, given the above limitations.

Projected hurricane effects are, by their very nature, subject to limitations of estimation as hurricane insurance costs are affected by projections of events and conditions that have not yet occurred. While it is widely agreed that catastrophe models provide the best estimates of potential hurricane costs, because of the limitation of the data available and the uncertainty of the statistical elements associated with the model components, there is no guarantee that loss costs produced by catastrophe models will prove to be adequate or not excessive.

## 1.5 Report Structure

Following this Introduction (Section 1), evaluations of the individual hurricane models for South Carolina for AIR Worldwide Corporation (AIR; Section 2), Applied Research Associates (ARA; Section 3), EQECAT (Section 4), and Risk Management Solution (RMS; Section 5) are provided. The results of these



evaluations are summarized and recommendations are presented in Section 6. Resumes of the panel of experts are given in Appendix A. The first set of evaluation questions and request for information sent to all modelers are given in Appendix B. The responses of AIR, ARA, Eqecat and RMS to all inquiries from the SCDOI are included in Appendices C-F.

## 1.6 Using this Report

Each model reviewed here must satisfy a fundamental set of criteria for each of the three component modules: meteorology, vulnerability and actuarial. These criteria are captured in the review process implemented by the Florida Commission for use in Florida, and adapted in this review for South Carolina. Important considerations that must be satisfied for each model are summarized here to guide the reader as they review the remainder of this report.

#### Important Considerations in the Evaluation of the Meteorology Module

The Meteorology module of the model develops a picture of hurricane-related hazard based upon historical hurricane data. The historical hurricane data accepted by the Florida Commission for determining historical storm data for Florida is the HURDAT2 database (Refs. 2 and 3), which is created and maintained by the National Hurricane Center (NHC) of the National Weather Service (NWS). Any differences between the features of the historical hurricanes (intensity, track, frequency/return period, size) that are recorded in HURDAT and the features of the historical storms as used by the modeler must be justified.

To ensure that the Meteorology module is based on realistic hurricanes, the modelers produced maps of the historical hurricanes they used and then four maps of hurricanes calculated in their model. These maps should not look the same, but certain features of the maps should be similar: the hurricane tracks should have the same kinds of patterns and the distribution of hurricanes impacting South Carolina should be similar. For example, if most storms were moving due west from Bermuda, the model would not be considered realistic. The four samples of modeled storms can have very different numbers of storms, but they should not all have many more, or many fewer, hurricanes than observed in the historical record.

The Meteorology module produces a *spatial* distribution of hurricane wind risk that includes information on the intensity of the hurricane (maximum winds), its size (area of damaging winds) and its track (which gives the speed and direction of



storm motion). A faster moving hurricane will have very different wind speeds to the right (faster) compared to the left (slower) if you are looking towards the direction it is moving; this asymmetry will be proportionately less in a slower moving hurricane. Topography can cause the winds to vary locally (for example, to speed up through valleys), however this will only be important if the hurricane still has damaging winds when it travels over hilly areas. The damaging winds calculated in the Meteorology module also reflect a *geographic* distribution of hurricane wind risk that incorporates information relative to the distance of the insured property from hurricane track and the current land use and land cover. Since many hurricanes affecting South Carolina cross the coast (make "landfall") in other states, the treatment of hurricane weakening over land is important.

From the time a storm crosses the coast, the hurricane winds generally decrease as that storm moves further inland. This weakening of the hurricane will be modified by the properties of the land itself (referred to as "land use and land cover"). For example, the winds for a hurricane moving over a lake will remain faster than the winds for a hurricane moving over a forest or densely populated area, however, a rough surface can make winds gustier. The net effect is likely to be slower winds in general, but with the occasional very strong gust, as was experienced at relatively distant inland locations with Hurricane Hugo in 1989.

Another impact on the winds is topography: winds can be stronger than expected along narrow valleys or over hilltops, and weaker than expected in sheltered locations. The impacts of topography would be experienced in the far west of the state where storms are typically weaker and near the damaging wind threshold, so any effects should be small. Thus, this effect is of only secondary importance in evaluating the models.

An acceptable Meteorology module must capture all of these aspects in the simulation of each of the stochastic storms (those hurricanes created by the model).

## Important Considerations in the Evaluation of the Vulnerability Module

The vulnerability module of a hurricane catastrophe model should address the vulnerability of insured properties to various hurricane hazards. Because of differing building standards and construction types, the vulnerability module is one of the areas of a hurricane model that can vary from state to state or even among regions within a given state. The vulnerability module typically addresses the following aspects of hurricane risk:



- Separation of property vulnerabilities and losses into vulnerability of buildings, appurtenant structures, and contents and additional living expenses (ALE) or time element (TE) loss. These categories of property vulnerability and losses are generally consistent across states.
- Building classification. A set of primary characteristics of a building that
  influences its vulnerability to hurricane hazards is used to classify building
  stock into various classes. Buildings in each class generally perform
  similarly in a given hurricane environment. For any state, such
  classification must be able to appropriately model the majority of building
  characteristics, including:
- The construction practices in any given locality or state.
- Applicable building codes and enforcement.
- Secondary characteristics within a general building class that might influence the performance of buildings in that class.
- Mitigation features are those aspects of building that are added to a building at the initial time of construction or after the construction of the building to reduce potential losses from hurricanes.

The vulnerability module of each hurricane model is reviewed to determine if South Carolina specific issues are appropriately addressed. The most important aspects for review and evaluation of vulnerability modules are building code variations and their adaptation and enforcement in South Carolina, variation of building vulnerability across the state, and variation of building design wind speeds.

#### Important Considerations in the Evaluation of the Actuarial Module

The vulnerability section described above determines the damages to buildings in South Carolina from hurricanes. Those damage calculations must be converted into actuarial, insurance or financial results, inclusive of the effects of deductibles and policy limits.

The actuarial functions must be appropriately accounted for in accordance with the Actuarial Standards of Practice, and the results of the Actuarial Module are the hurricane insurance loss costs (i.e., the claims portion of the hurricane rate or premium) for various areas of the State. To be in accordance with the statutory requirements that rates "shall not be excessive, inadequate or unfairly



discriminatory, the differences in the hurricane insurance loss costs in the state should be based upon the exposure to hurricane losses and the damage to properties as determined in the meteorology and vulnerability modules.

Once again, the hurricane insurance loss costs produced by these hurricane models include only the claims portion of the hurricane insurance rate or premium. As with all loss costs, expenses, including loss adjustment expenses must be added to these loss costs as well as a determination of the appropriate profit and contingency factor to produce final hurricane insurance rates in accordance with the statutes.

### 1.7 Preliminary Findings and Recommendations

#### A. Findings and Conclusions

The report provided a means for the South Carolina Insurance Department to determine whether there were selections or adjustments made by either the filing insurer or the modeler to the input or output of the model; things that may have an impact on the loss costs but were outside of the actual operation of the model. There may be valid reasons for such adjustments, such as corrections to account for properties that are in ZIP-Codes that are invalid at the time the model is run in support of a filing. Regardless, there is extensive historical information available (hurricanes, building characteristics, building codes, insurance conditions) and necessary for identifying important assumptions and provisions inherent in any rate filing.

Information relative to changes and/or adjustments to the input or output data is extremely useful. Based on some of the responses we received, we do not believe that filings submitted by individual insurers in South Carolina always included such information. The regulator should be aware of any adjustments to the input or output data, and it should be up to the modelers to provide detailed descriptions of what the regulator might look for to determine whether the model output has been "adjusted." For example, the report described that only long term models (those that use the entire historical set of storms from the year 1900) should be used to derive hurricane insurance loss costs (and eventually hurricane rates). However, some insurers may use terms such as medium range, short range, and warm water models to describe their models. These models do not fit with the



definition of long term models and models described in this way should not be used for rate filings in South Carolina. The report also points out that tropical storms or tropical depressions should not be used in the modeler's stochastic storm set (the storms generated in the model) or historical event set.

The report also provides the Department with the means to determine whether items that are outside of our review, such as storm surge losses, are included in the loss costs provided in support of a rate filing.

The report provides information related to how to address different building codes in South Carolina so that those buildings that are built in accordance with various State and geographical building codes are given the credits in their hurricane insurance loss costs that are warranted.

Correct consideration of both the historical hurricane events and the distributions of building codes across the state would result in substantial and systematic variations of insurance rates across South Carolina. If a filing lacked this variability, the rate filer or the modeler concerned should be asked to justify their results.

In summary, it is recommended that the Department consider the following:

- a. Requiring the output report as a part of the rate filing if the filing is based on a hurricane or catastrophe model
- b. Not accept hurricane models described as "medium range", "short range" or "warm water" because they may not be long term models.
- c. Disallowing the use of tropical storm data in the modeler's stochastic storm set; and
- d. Ensuring that the model used includes both hurricane events and building code distribution.

#### B. Future Reviews of Hurricane Models

In lieu of a complete review, the report provides a process for when modelers wish to present the regulator with a new version of a model. When that occurs, it is



recommended that the regulator demand documentation of any differences between the old and the new version of the model and the effects on South Carolina loss costs resulting from each individual change in the model.

#### C. Guidelines

It is fundamentally true that model results produced for rate filings are as good as:

- how the model is used,
- the quality and accuracy of the model inputs,
- the choice of control variables and optional parameters (e.g., building code, hurricane climatology, policy conditions) used to run the model,
- whether default values for certain input variables are used or their values are selected and set by users,
- how the results are interpreted, and
- how model outputs (loss costs and probable maximum loss levels) are used to arrive at rates that are submitted to SCDOI for review and approval.

Intimate knowledge and expertise concerning how hurricane models should be developed and used is of utmost value to the review and evaluation of hurricane rate filings. Therefore, the panel of experts extended its evaluation of hurricane models used in South Carolina to provide guidelines and recommendations for the review of hurricane rate filings, when hurricane catastrophe model(s) output are used.

The report provides a set of guidelines and recommendations to the Department. These recommendations are not exhaustive, and are not meant to be a replacement for the current processes and procedures in place at SCDOI for review and approval of hurricane rate filings; rather, the recommendations are intended to provide additional insights into how the hurricane catastrophe model should be properly used and how its outputs can be utilized in rate filings. Assuming that appropriate model(s) are used for loss computations, there are three broad areas the report recommends for the Department to consider, when reviewing hurricane rate filings:



- What are the values used for inputs and options into the model(s) that
  affect the outputs (loss costs and probable maximum loss levels)? The
  variables typically include risk characteristics such as policy
  information, risk location, primary and secondary characteristics for
  different construction classes, mitigation features, and unknown vs.
  known parameters;
- What control variables are used? These might include, but are not limited to, whether short-term, mid-term, and long-term views of the hurricane frequencies are used; inclusion or exclusion of demand surge; inclusion or exclusion of losses due to storm surge, waves, and flooding; whether or not users have provided their own vulnerability functions or modified the "standard" vulnerability functions in the approved model; damage or loss level(s) (in terms of percentage of total loss) determining what is regarded as a "total loss"; replacement value vs. insurance limit, and whether or not deductibles are a percentage of limit, or replacement value; whether or not losses due to tropical storms which never become hurricanes are included in the analysis; whether or not default values preferred or suggested by modeling companies are used or the values are selected or set by users; and any other factors that might impact loss costs.
- How the output results from the model(s) were interpreted and used to arrive at rates.

The panel of experts has developed the following an example list of typical questions that the SCDOI might consider asking for additional information in a rate filing:

- 1. Are the rates based on model(s) which have been reviewed and accepted by the Florida Commission (FCHLPM), but with appropriate modifications for hurricane frequencies and characteristics and vulnerability models (building codes, etc.) appropriate for South Carolina? The rate filer should describe the characteristics of the version being used for loss costs. This description should clearly document any differences in the model inputs, options or control variables between the versions approved by the FCHLPM and the model being used in the rate filing in South Carolina.
- 2. Each model has various input parameters that are set or selected from available options by the user of the model. The user may be the modeling



company personnel, insurance company personnel, insurance brokers, reinsurers, or any other applicable third party. Even working within reasonable constraints, different users may set or select different values for these input parameters. Different inputs will quite possibly result in different model outputs, e.g., loss costs, for the same property. It is recommended that the SCDOI request from insurers submitting a rate filing ALL of the model inputs set by the user, along with the reason and justification for each selection. If the model options chosen deviate from those prescribed in model versions approved by the FCHLPM, and that difference is not due to state-specific constraints (e.g., building code), this could warrant additional scrutiny by the SCDOI.

- 3. SCDOI should request a description of the methodology and its basis for converting between the model output (loss costs) and the premiums (rates).
- 4. Although models may have the capability to provide different loss costs based on different characteristics of each insured property, the properties may be lumped together and averaged into a class of properties. However, some of these characteristics may demonstrate distinct behavior with sharply different loss costs; these characteristics should not be lumped together. One example is year of construction, which might be a proxy for the building code in place at the time of construction of a property. For example, a property built in 1970 should not have the same premium as one built in 2012, assuming everything else is the same (e.g., primary characteristics, roof shape, roof cover, opening reinforcement, location, etc.).

The analysis of a property insurance rate filing that includes hurricane coverage is greatly improved through the appropriate use of the tools and suggestions provided in the report from the panel of experts.

