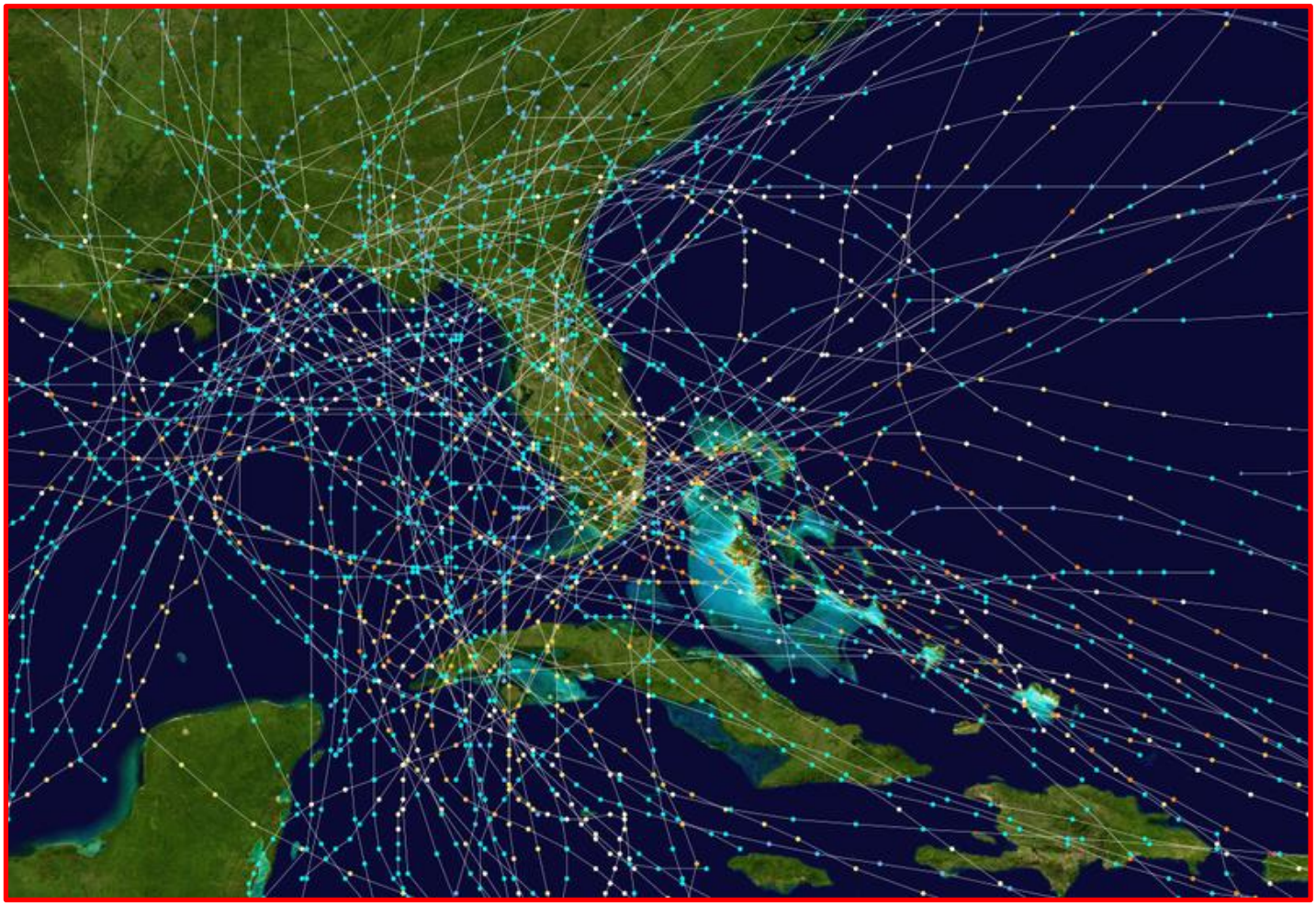
Florida Commission on Hurricane Loss Projection Methodology

Professional Team Report
2013 Standards



AIR Worldwide Corporation

On-Site Review
March 2-4, 2015

Review of Reported Type II Differences
May 11, 2015

On March 2-4, 2015, the Professional Team visited on-site at AIR Worldwide Corporation (AIR) in Boston, Massachusetts. The following individuals participated in the review:

AIR

Brandie Andrews, CCM, Assistant Vice President
Laxmi Balcha, ACA, CL, CCM, Director, Software Development
Tanya Bedore, Principal Technical Writer, Software Development
Warren Chanzit, CCM, Risk Analyst
Arthur (Tim) Doggett, Ph.D., Assistant Vice President, Senior Principal Scientist, Atmospheric Science Research and Modeling
Baldvin Einarsson, Ph.D., Core QA Associate
Tomas Girnius, Ph.D., Principal Scientist, Research and Modeling
Jay Guin, Ph.D., Executive Vice President
Anthony Hanson, Senior Principal Analyst
Cheryl Hayes, Assistant Vice President, Exposures Group, Research and Modeling
Jonathan Holden, Vice President
Mark Hope, CCM, Scientist
Suilou Huang, Ph.D., Research Scientist, Research and Modeling
Cagdas Kafali, Ph.D., Assistant Vice President, Senior Principal Engineer Research and Modeling
Todd Keller, Analyst, Research and Modeling
Jonathan Kinghorn, Corporate Communications Writer, Marketing
Sylvie Lorsolo, Ph.D., Atmospheric Scientist
Anush Mani-Subramanian, Product Consultant
Ram Nagulpally, Assistant Vice President, Quality Assurance
Gayatri Natarajan, Senior Product Manager
Robert Newbold, CCM, Senior Vice President
Sudhir Potharaju, Vice President & Director, Software Development
Andrew Rahedi, Senior Core QA Associate
Karthik Ramanathan, Ph.D., Engineer
Adam Reichert, Ph.D., Scientist, Research and Modeling
John Rowe, Vice President, Research and Modeling
Christy Shang, CCM, Risk Consultant
Andrew Shatz, CCM, Analyst, Data Management Group, Research and Modeling
Benjamin Spaulding, Ph.D., Manager, Data Management Group, Research and Modeling
Scott Stransky, Manager, Principal Scientist, Research and Modeling
Susan Tolwinski-Ward, Ph.D., Scientist, Research and Modeling
Heidi Wang, FCAS, CCM, Senior Manager Business Development
Yingqun Wang, Team Lead, Software Development
Katie Ward, CCM, Risk Consultant
David Wilson, Senior Product Manager

Professional Team

Jenni Evans, Ph.D., Meteorologist
Paul Fishwick, Ph.D., Computer Scientist
Tim Hall, Ph.D., Meteorologist, observer
Mark Johnson, Ph.D., Statistician, Team Leader
Marty Simons, ACAS, Actuary
Masoud Zadeh, Ph.D., P.E., Structural Engineer
Donna Sirmons, Staff

The review began with introductions and an overview of the audit process. AIR provided an explanation of the deductible error issue discovered in Touchstone 1.5.3 that was reported to the Commission in January, 2015. The Professional Team discussed AIR's Quality Assurance testing prior to the release of Touchstone 1.5.3 and enhancements made to the testing procedures to help detect this type of error in future software releases. The Professional Team reviewed a comparison of workflow charts for applying deductibles in Touchstone 1.5.2 and Touchstone 1.5.3, and corrected flowcharts were prepared and reviewed on-site. The computer code and SourceSafe revision history were reviewed to verify the corrections. Additional comments were added to the computer code.

The audit then proceeded with AIR providing a general overview of the model updates including updating the historical and stochastic storm catalogs, the ZIP Code and industry exposure databases, the land use land cover data, the methodology for calculating the average physical properties for a ZIP Code, and vulnerability function updates for mobile homes, implementation of square footage of a residential structure, and adjustments for no attached wall structures, structural aging and building technology changes, and year built unknown. The largest model change increases result from the update to the vulnerability functions, with mobile homes as the main driver.

AIR discussed Touchstone software flexibility that allows clients to adjust analysis settings for ground up losses. AIR demonstrated how the AIR view of losses is reported in the model output along with any modified analyses. The Professional Team discussed the crucial information contained in the analysis log which accompanies the Project Information and Assumptions Form (PIAF). AIR presented another software update providing an analysis options template for use with Florida rate filing analyses. The response to Standard G-1, Disclosure 5 will be revised to include the second software update.

The Professional Team recommends AIR present the following information to the Commission during the Trade Secret session of the meeting to review the model for acceptability:

1. New square footage modifiers and updates to mobile home vulnerability functions
2. Method for completion of Form A-6
3. Method for completion of Form V-3
4. Method for excluding storm surge losses from the modeled losses.

The Professional Team reviewed the following corrections to be included in the revised submission to be provided to the Commission no later than 10 days prior to the meeting to review the model for acceptability. Page numbers correspond to the November 2014 submission.

1. Page 40, G-1 Disclosure 5 – revised to include use of claims data for updating the vulnerability functions
2. Page 41, G-1 Disclosure 5 – revised to include software update for loss analysis templates
3. Page 29, G-1 Disclosure 4 – updated Grimmond reference to include reference journal
4. Page 95, M-4.D – revised to clarify the effects of the vertical variation of winds is handled in the vulnerability functions
5. Pages 136-141, S-5 Disclosure 1 – revised to correct losses in Tables 11-15
6. Page 147, V-1 Disclosure 1 – revised a) to clarify use of claims data for updating the vulnerability functions
7. Page 148, V-1 Disclosure 1 – revised e) to clarify year built categories
8. Page 159, V-1 Disclosure 7 – revised to clarify number of vulnerability functions
9. Page 190, V-3 Disclosure 3 – revised to clarify differences between Table 18 and Table 50

10. Page 240, C-3 – revised Table 55 to include sources for potential model updates
11. Pages 323-327, Form S-4 – revised to correct losses in Tables 44-45
12. Pages 329-332, Form S-4 – revised to correct Figures 74-81
13. Page 333, Form S-5 – revised to include second previously accepted submission losses
14. Pages 340-341, Form V-1 – revised to correct damage ratios and to correct Figure 82
15. Page 342, Form V-2 – revised to clarify the process for completing the form
16. Page 350, Form V-2 – revised to correct Appurtenant Structures heading in modification factors column in Table 50

Addendum Following Review of AIR Reported Type II Differences

AIR

Brandie Andrews, CCM, Assistant Vice President
Arthur (Tim) Doggett, Ph.D., Assistant Vice President, Senior Principal Scientist, Atmospheric Science Research and Modeling
Robert Newbold, CCM, Senior Vice President

Professional Team

Paul Fishwick, Ph.D., Computer Scientist
Mark Johnson, Ph.D., Statistician, Team Leader
Marty Simons, ACAS, Actuary
Donna Sirmons, Staff

On May 11, 2015, a subset of the Professional Team had a WebEx meeting with AIR Worldwide to review the issues with implementation of demand surge factors in AIR Atlantic Tropical Cyclone Model v15.0.0 implemented in Touchstone v2.1.0 as reported to the Commission on April 20, 2015. This situation is somewhat unique (is not explicitly addressed in the Report of Activities of November 1, 2013) in that changes are being made to the model that has not yet been approved by the Commission, but has been reviewed by the Professional Team who verified all the standards during the on-site review.

The Professional Team began with a review of the purpose and procedure for the webinar. AIR provided a summary of the enhancements made in the model between Touchstone v2.1 and Touchstone v3.0, the reasons for the changes since the November 1, 2014 submission, and the impact on Florida loss costs and probable maximum losses.

A synopsis of the subsequent audit discussion is given below.

The timeline for the AIR model and software releases generally and the development cycle for Touchstone v3.0 were discussed. The differences that were detected by AIR were discovered as part of their regular Quality Assurance process and their interactions with clients.

The AIR Demand Surge Functions were reviewed, and it was determined that no changes were made to these functions. The demand surge factors are applied to individual storms so that any change in storm losses in another state (e.g., Louisiana with a levee failure) could lead to adjustments in the losses in Florida associated with this event.

The changes to the numerical values in Forms A-1, A-4B and A-8 from their values at the on-site visit were reviewed in detail. The differences were very slight and consistent with the enhancements made to the model. Some initially apparent anomalies were determined to be artifacts of the rounding used in completing the forms.

The changes due to the 150 stochastic storms affecting New Orleans levees were reviewed in detail. Also, the Virginia elevation change was reviewed. These reviews indicated that the small changes to the aforementioned forms were reasonable.

Based on the material provided by AIR for review, the WebEx audit of May 11, 2015, and the deliberations of the Professional Team following the call, the Professional Team concludes that all standards previously verified remain verified for the AIR Atlantic Tropical Cyclone Model v15.0.1 as Implemented in Touchstone v3.0.0.

Report on Deficiencies

The Professional Team reviewed the following deficiencies cited by the Commission at the December 16, 2014 meeting. The deficiencies were eliminated by the established time frame, and the modifications have been verified.

1. A general description of any trade secret information that will be presented to the Professional Team is not included; non-responsive to Acceptability Process II.A.3 requirement (page 46) in the *Report of Activities* as it is the modeling organization's responsibility to identify in the submission the anticipated trade secret items that will be shown to the Professional Team during the on-site review.

2. Standard G-1, Disclosure 4 (pages 27-39)
   Response is incomplete as NOAA Technical Memorandum NWS NHC-6 provided in response to Standard M-1, Disclosure 1 (page 82) and Standard M-2, Disclosure 7 (page 88) is not included in the List of References.

3. Standard G-1, Disclosure 5.A (page 40)
   Response is incomplete as gridded intensity, mentioned in item b, has not been defined in the submission.

4. Standard G-1, Disclosure 5.A (page 40)
   Response is incomplete as the change in vulnerability function year-built categories is not included.

5. Standard G-2, Disclosure 9 (page 68)
   Response is non-responsive to the standard requirement that the individual signing Form G-6 (page 291) shall have an advanced degree in computer/information science. Anjelo Jeyarajan has an MBA which does not qualify as an advanced degree relating to computer/information science.

6. Standard M-3, Disclosure 1 (page 94)
   Response is incomplete as no attribution is given in Table 7 for the databases used for surface terrain characteristics and Rmax EBT, RADAR data. Rmax EBT has not been defined in the submission.

Report on Issues

The Professional Team discussed the following issues identified by the Commission at the December 16, 2014 meeting. The modeler is to address these issues with the Commission during the meeting to review the model for acceptability.

1. How Florida Building Code enforcement of reinforced and unreinforced masonry is handled in the model. What is the default condition in the model post 2002? If the data is available, does the model take this into account, and if so, how?

2. How screen enclosures for both attached and unattached are handled in the model.

Professional Team Pre-Visit Letter

The Professional Team's pre-visit letter questions are provided in the report under the corresponding standards.

Pre-Visit Letter

The purpose of the pre-visit letter is to outline specific issues unique to the modeler's submission, and to identify lines of inquiry to be followed during the on-site review to allow adequate preparation by the modeler. Aside from due diligence with respect to the full submission, various questions that the Professional Team is certain to ask the modeler during the on-site review are provided in this letter. This letter does not preclude the Professional Team from asking for additional information during the on-site review that is not given below or discussed during an upcoming conference call that will be held if requested by the modeler. One goal of the potential conference call is to address modeler questions related to this letter or other matters pertaining to the on-site review. The overall intent is to expedite the on-site review and to avoid last minute preparations that could just as easily have been handled earlier.

Some of this material may have been shown or may have been available on a previous visit by the Professional Team. The Professional Team will also be considering material in response to deficiencies and issues designated by the Florida Commission on Hurricane Loss Projection Methodology (Commission).

The goal of the Professional Team on-site review is to provide the Commission with a clear and thorough report of the model, subject to non-disclosure restrictions on proprietary information. All modifications, adjustments, assumptions, or other criteria that were included in producing the information requested by the Commission in the submission should be disclosed and will be reviewed.

It is important that all material prepared for presentation during the on-site review be presented using a medium that is readable by all members of the Professional Team simultaneously. The Professional Team will review selected computer code in conjunction with the reviews performed for each section. Computer code should be readily available in a format that will allow simultaneous visualization by the entire Professional Team. Access to critical articles or materials referenced in the submission or during the on-site review should be available on-site for the Professional Team. The Professional Team should be provided access to internet connections through the Professional Team members' laptops for reference work that may be required while on-site.

The on-site schedule is tentatively planned to proceed in the following sequence: (1) presentation by the modeler of new or extensively updated material related to the model; (2) section by section review commencing within each section with pre-visit letter responses; (3) responses to new or significantly changed standards in the 2013 Report of Activities, and (4) responses to the audit items for each standard in the Report of Activities.

Be prepared to have available for the Professional Team's consideration, all insurance company claims data received or newly processed since the previous submission. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

Provide an explanation for each loss cost change of more than 5% from the loss costs produced in the previous submission using the 2007 Florida Hurricane Catastrophe Fund (FHCF) exposure data to the corresponding loss costs produced in the current submission using the 2007 FHCF exposure data.

When the Professional Team arrives on-site, provide five (5) printed copies of all figures with scales for the X and Y axes labeled that are not so labeled in the submission. Label the figures with the same figure number as given in the submission. Also, provide five (5) printed copies of Form V-3 and the electronic file used to complete Form V-3 on a removable drive medium. This material will be used during the on-site review and will be returned when the on-site review is complete. Additionally, provide five (5) printed copies of Form A-6 (all 8 worksheets) and the electronic file(s) used to complete Form A-6 and Form A-7. The electronic files will be examined only on-site and will be deleted from the Professional Team member's laptop at the conclusion of the review.

Be prepared to provide for the Professional Team's review all engineering data (post event surveys, tests, etc.) received since the previous review by the Professional Team. Be prepared to describe any processes used to amend or validate the model that incorporates this data.

If any changes have been made in any part of the model or the modeling process from the descriptions provided in the original 2013 submission, provide the Professional Team with a complete and detailed description of those changes, the reasons for the changes (e.g., an error was discovered), and all revised Forms where any output of the form changed.

For your information, the Professional Team will arrive in business casual attire.

The pre-visit comments are grouped by standards sections.

GENERAL STANDARDS – Mark Johnson, Leader

G-1 Scope of the Computer Model and Its Implementation*

*(*Significant Revision)*

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

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

Audit

1. The main intent of the audit is to determine the capabilities of the model and to assess its implementation for purposes of Florida projected insured loss costs and probable maximum loss levels. Copies of all representative or primary technical papers that describe the underlying model theory shall be made available.

2. The process defined in Standard G-1.B will be: (1) reviewed for its inclusion of all stages of the modeling process, and (2) traced using the Computer Standards for one or more items listed in the response to Disclosure 5.

3. All software and data (1) located within the model, (2) used to validate the model, (3) used to project model loss costs and probable maximum loss levels, and (4) used to create forms required by the *Report of Activities*:
    a. Shall fall within the scope of the Computer Standards,
    b. Shall be located in centralized, model-level file areas, and
    c. Shall be reviewable interactively (viewed simultaneously by all Professional Team members in conjunction with the review of each standard).

4. Modeling organization specific publications cited must be available in hard or soft copy or via a web link.

5. Maps, databases, or data files relevant to the modeling organization's submission will be reviewed.

6. Provide the following information related to changes in the model from the initial submission this year to each subsequent revision.

    A. Model changes:
        1. A summary description of changes that affect, or believe to affect, the personal or commercial residential loss costs or probable maximum loss levels,
        2. A list of all other changes, and
        3. The rationale for each change.

B. Percentage difference in average annual zero deductible statewide loss costs based on the 2007 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named *"hlpm2007c.exe"* for:
   1. All changes combined, and
   2. Each individual model component and subcomponent change.

C. For any modifications to Form A-4A (Output Ranges, 2007 FHCF Exposure Data) since the initial submission, additional versions of Form A-5 (Percentage Change in Output Ranges, 2007 FHCF Exposure Data):
   1. With the initial submission as the baseline for computing the percentage changes, and
   2. With any intermediate revisions as the baseline for computing the percentage changes.

D. Color-coded maps by county reflecting the percentage difference in average annual zero deductible statewide loss costs based on the 2007 Florida Hurricane Catastrophe Fund's aggregate personal and commercial residential exposure data found in the file named *"hlpm2007c.exe"* for each model component change:
   1. Between the previously accepted submission and the revised submission,
   2. Between the initial submission and the revised submission, and
   3. Between any intermediate revisions and the revised submission.

Pre-Visit Letter

1. G-1, Disclosure 5.A, page 40: Explain in detail the gridded intensity approach to obtaining average physical properties in item b.

2. G-1, Disclosure 5.C, page 44: Explain the situation with the adjacent Franklin and Wakulla Counties in Figure 5.

3. G-1, Disclosure 5.C, page 45: Explain the situation with the adjacent Glades and Charlotte Counties in Figure 6.

Verified: YES

Professional Team Comments:

Discussed the methodology for a user entering address information and geocodes or only ZIP Code address information. Discussed the changes for calculating the average physical properties for a ZIP Code and the improvements in stability.

Discussed the changes in loss costs in Franklin and Wakulla Counties being driven by the hazard updates in the model. Reviewed in detail the changes to each ZIP Code in Franklin and Wakulla Counties due to the updated average physical properties methodology, land use land cover changes, and ZIP Code centroid movements.

Discussed the changes in loss costs in Glades and Charlotte Counties.

Noted instances where meteorology and vulnerability components were isolated in compliance with Standard G-4.

G-2 Qualifications of Modeling Organization Personnel and Consultants

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

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

Audit

1. The professional vitae of modeling organization personnel and consultants responsible for the current model and information on their predecessors if different than current personnel will be reviewed. Background information on individuals providing testimonial letters in the submission shall be provided.

2. Forms G-1 (General Standards Expert Certification), G-2 (Meteorological Standards Expert Certification), G-3 (Statistical Standards Expert Certification), G-4 (Vulnerability Standards Expert Certification), G-5 (Actuarial Standards Expert Certification), G-6 (Computer Standards Expert Certification), and all independent peer reviews of the model under consideration will be reviewed. Signatories on the individual forms will be required to provide a description of their review process.

3. Discuss any incidents where modeling organization personnel or consultants have been found to have failed to abide by the standards of professional conduct adopted by their profession.

Pre-Visit Letter

4. G-2, Disclosure 2.B, pages 63-64: Provide resumes of new personnel.

Verified: YES

Professional Team Comments:

Reviewed resumes of new personnel:

- James Bachand, B.S. Computer Science, Wentworth Institute of Technology, Boston, MA; A.S. Computer Information Systems, Holyoke Community College, Holyoke, MA
- Laxmi Balcha, M.S. Software Engineering, Brandeis University, Waltham, MA; B.S. Electronics & Communications Engineering, Osmania University, Hyderabad, India

- Warren Chanzit, B.S. Chemical Engineering, Northwestern University, Evanston, IL
- Johnny Cheng, B.S. Computer Information Systems, New England Institute of Technology, Warwick, RI
- Phaninath Dheram, M.Phil. Computer Science, Jawaharlal Nehru University, New Delhi, India; M.S. Physics, University of Hyderabad, Hyderabad, India
- Baldvin Einarsson, Ph.D. Mathematics, University of Iceland, Reykjavik, Iceland; B.S. Mathematics, University of Iceland
- Mark Hope, Ph.D. candidate, Civil Engineering, University of Notre Dame, Notre Dame, IN; B.S. Environmental Engineering, Marquette University, Milwaukee, WI
- Suilou Huang, Ph.D. Oceanography, University of Rhode Island, Kingston, RI; M.S. Statistics, University of Rhode Island; M.S. Oceanography, University of Rhode Island; M.S. Physical Chemistry, Sun-Yatsen University, Guangzhou, China; B.S. Chemistry, Sun Yat-Sen University
- Aditya Jinna, M.S. Computer Engineering, Wayne State University, Detroit, MI; B.E. Electronic and Instrumentation Engineering, Osmania University, Hyderabad, India
- Sylvie Lorsolo, Ph.D. Geosciences (Atmospheric Science), Texas Tech University, Lubbock, TX; M.S. Environmental Sciences, Toulon University, Toulon, France; M.S. Applied Physics, Toulon University; B.S. Physics, Toulon University
- Manoj Medarametla, M.S. Software Systems, Birla Institute of Technology & Science, Pilani, India; B.E. Information Technology, Osmania University, Hyderabad, India
- Ram Nagulpally, M.S. Mechanical Engineering, University of Arizona, Tucson, AZ; B.E. Mechanical Engineering, Osmania University, Hyderabad, India
- Andrew Rahedi, M.A. (Computational and Statistical) Physics, Wesleyan University, Middletown, CT; B.S. Physics, Bates College, Lewiston, ME
- Karthik Ramanathan, Ph.D. Civil and Environmental Engineering, Georgia Tech, Atlanta, GA; M.S. Civil and Environmental Engineering, Georgia Tech; M.S. Civil and Environmental Engineering, University of Pittsburgh, Pittsburgh, PA; B.S. Civil and Environmental Engineering, Osmania University, Hyderabad, India
- Adam Reichert, Ph.D. Computer Science, University of Illinois, Urbana-Champaign, IL; B.S. Physics, Stanford University, Palo Alto, CA
- Andrew Shatz, M.A. Geographic Information Sciences, Clark University Graduate School of Geography, Worcester, MA; B.A. Geography and Music Composition, Clark University
- Ben Spaulding, Ph.D. Geography, University of Connecticut, Storrs, CT; M.A. Geography, University of Connecticut; B.A. Geography, Keene State College, Keene, NH
- Anush Mani Subramanian, MBA Finance and Operations, Great Lakes Institute of Management, Tamil Nadu, India; B.E. Computer Science, Anna University, Chennai, India
- Pasupulati Swarna Latha, MCA Computer Applications, Osmania University, Hyderabad, India
- Susan Tolwinski-Ward, Ph.D. Applied Mathematics, Ph.D. Minor Atmospheric Sciences, University of Arizona, Tucson, AZ; M.S. Applied Mathematics, University of Arizona; B.S. Physics, Brown University, Providence, RI

- Yingqun Wang, M.S. Computer Science, California State University, San Bernadino, CA
- Katie Ward, B.S. Environmental Science, Geology, Northeastern University, Boston, MA
- David Wilson, MBA, Wallace E. Carroll Graduate School of Management, Boston College, Boston, MA; B.S. Mathematics, State University of New York at Albany, Albany, NY
- Alex Wong, B.S. candidate Computer Science, Northeastern University, Boston, MA
- Yili Yao, M.S. Computer Science, State University of New York, Stony Brook, NY; B.A. Computer Science, Clark University, Worcester, MA

Discussed that there were no departures of personnel attributable to violations of professional standards.

G-3 Risk Location*

*(*Significant Revision)*

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

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

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

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

E. Geocoding methodology shall be consistent and justifiable.

Audit

1. Provide geographic displays for all ZIP Codes.
2. Provide geographic comparisons of previous to current locations of ZIP Code centroids.
3. Provide the third party vendor, if applicable, and a complete description of the process used to validate ZIP Code information.
4. The treatment of ZIP Code centroids over water or other uninhabitable terrain will be reviewed.
5. Examples of geocoding for complete and incomplete street addresses will be reviewed.
6. Examples of latitude-longitude to ZIP Code conversions will be reviewed.
7. Model ZIP Code-based databases will be reviewed.

Pre-Visit Letter

5. G-3.C, page 69: Provide maps of previous and current ZIP Code centroid locations (as has been done in previous reviews).
6. G-3.D, page 69: Explain how the model ZIP Code dependent databases are updated when the ZIP Code database is updated.

7. G-3, Disclosure 3, page 71: Explain the methodology and process for conversion from latitude and longitude to street address or ZIP Code.

8. G-3, Disclosure 3, page 76: Explain Table 6.

9. G-3, Disclosure 4, page 76: Explain how various databases are linked to a given user provided latitude and longitude and how they are used and updated.

Verified: YES

Professional Team Comments:

Discussed the ZIP Code database update as of June 2014.

Discussed no change in the methodology for updating and validating ZIP Code centroids.

Reviewed geographic displays of ZIP Codes and comparisons of new centroid locations to previous locations for the entire state.

Reviewed in detail the ten Florida ZIP Codes that experienced the largest centroid movements.

Discussed the third party vendor used for verification of the population-weighted ZIP Code centroids.

Reviewed the process for ensuring the accuracy of ZIP Code centroids. Reviewed the ZIP Code dependencies flowchart.

Discussed the process for updating the model ZIP Code dependent files and databases when the ZIP Code database is updated.

Reviewed the geocoding methodology which is dependent on the address detail provided by the model user. Reviewed ZIP All, AIRAddress Server, and AIRGeography flowcharts.

Reviewed the methodology and process for converting latitude and longitude locations to street level address or ZIP Code and for geocoding street address information entered by the model user.

Discussed Table 6, Touchstone Geocode Match Levels for User Supplied Geocodes, where the geocode match level is either supplied by the model user or none where the model user does not provide the geocode.

Reviewed table and examples of geocoding for complete and incomplete street addresses.

G-4 Independence of Model Components

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

Audit

1. Demonstrate that the model components adequately portray hurricane phenomena and effects (damage, loss costs, and probable maximum loss levels). Attention will be paid to an assessment of (1) the theoretical soundness of each component and (2) the basis of their integration. For example, a model would not meet this standard if an artificial calibration adjustment had been made to improve the match of historical and model results for a specific hurricane.

2. Describe all changes in the model since the previous submission that might impact the independence of the model components.

Verified: YES

Professional Team Comments:

There was no evidence to suggest that one component of the model was deliberately adjusted to compensate for another component.

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 Certification that the submission has been personally reviewed and is editorially correct.

Audit

1. Demonstrate that the person or persons who have reviewed the submission has had experience in reviewing technical documentation and such person or persons is familiar with the submission requirements as set forth in the Commission's *Report of Activities as of November 1, 2013*.

2. Describe all changes to the submission document since the previously accepted submission that might impact the final document submission.

3. Demonstrate that the submission has been reviewed for grammatical correctness, typographical accuracy, completeness, and inclusion of extraneous data or materials.

4. Demonstrate that the submission has been reviewed by the signatories on Forms G-1 through G-6 (Standards Expert Certification forms) for accuracy and completeness.

5. The modification history for submission documentation will be reviewed.

6. A flowchart defining the process for form creation will be reviewed.

7. Form G-7 (Editorial Certification) will be reviewed.

Verified: YES

Professional Team Comments:

Editorial items noted by the Professional Team were satisfactorily addressed during the audit. The Professional Team has reviewed the submission per Audit item 3, but cannot guarantee that all editorial difficulties have been identified. The modeler is responsible for eliminating such errors.

Meteorological Standards – Jenni Evans, Leader

M-1 Base Hurricane Storm Set*

*(*Significant Revision)*

A. Annual frequencies used in both model calibration and model validation shall be based upon the National Hurricane Center HURDAT2 starting at 1900 as of August 15, 2013 (or later). Complete additional season increments based on updates to HURDAT2 approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these storm sets. Peer reviewed atmospheric science literature can be used to justify modifications to the Base Hurricane Storm Set.

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

Audit

1. The modeling organization's Base Hurricane Storm Set will be reviewed.

2. Provide a flowchart illustrating how changes in the HURDAT2 database are used in the calculation of landfall distribution.

3. Changes to the modeling organization Base Hurricane Storm Set from the previously accepted submission will be reviewed. Any modification by the modeling organization to the information contained in HURDAT2 will be reviewed.

4. Reasoning and justification underlying any short-term and long-term variations in annual hurricane frequencies incorporated in the model will be reviewed.

5. Modeled probabilities will be compared with observed hurricane frequency using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical statewide and regional hurricane frequencies as provided in Form M-1 (Annual Occurrence Rates) will be reviewed.

6. Form M-1 (Annual Occurrence Rates) will be reviewed for consistency with Form S-1 (Probability and Frequency of Florida Landfalling Hurricanes per Year).

7. Comparisons of modeled probabilities and characteristics from the complete historical record will be reviewed. Modeled probabilities from any subset, trend, or fitted function will be reviewed, compared, and justified against the complete historical record. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete historical record.

Pre-Visit Letter

10. Form M-1.E, pages 297-298: Describe how changes in HURDAT2 due to the re-analyses and additions of new hurricane seasons are incorporated into the Base Hurricane Storm Set. Individual cases may be reviewed.

Verified: YES

Professional Team Comments:

Discussed the new historical catalog based on HURDAT2 as of August 15, 2013, including the reanalysis through 1945 and the addition of two years of no landfalls. Discussed the list of storms added and modified.

Reviewed updates in the historical catalog for NoName04 (1901), LaborDay03 (1935) and NoName04 (1935).

Discussed supplemental landfall information used for storms where the information was not explicitly provided in HURDAT2. Discussed the need for a timeseries of minimum central pressure for windfield calculation.

Reviewed flowchart on the change in processing storms from HURDAT2 compared to HURDAT.

Reviewed flowchart on implementation of changes in HURDAT2 database used in the calculation of stochastic landfall distribution.

Discussed the overall impact on the stochastic catalog with a decreased frequency of Florida landfalls.

Reviewed goodness-of-fit tests on landfall frequencies by Florida regions.

Discussed no short term variations used.

Determined that Forms M-1 and S-1 are consistent.

M-2 Hurricane Parameters and Characteristics

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

Audit

1. All hurricane parameters used in the model will be reviewed.

2. Prepare graphical depictions of hurricane parameters as used in the model. Describe and justify:
   a. The data set basis for the fitted distributions,
   b. The modeled dependencies among correlated parameters in the windfield component and how they are represented,
   c. The asymmetric nature of hurricanes,
   d. The fitting methods used and any smoothing techniques employed.

3. The treatment of the inherent uncertainty in the conversion factor used to convert the modeled vortex winds to surface winds will be reviewed and compared with currently accepted scientific literature. Treatment of conversion factor uncertainty at a fixed time and location within the windfield for a given hurricane intensity will be reviewed.

4. Scientific literature cited in Standard G-1 (Scope of the Computer Model and Its Implementation) may be reviewed to determine applicability.

5. All external data sources that affect model generated windfields will be identified and their appropriateness will be reviewed.

6. Describe and justify the value(s) of the far-field pressure used in the model.

Pre-Visit Letter

11. M-2, Disclosure 3, page 85: Discuss the impact of the truncation of Rmax on the resultant distribution for Vmax.

Verified: YES

Professional Team Comments:

Discussed the truncation of Rmax using limits dependent on central pressure that are consistent with the range of historically observed Rmax.

Reviewed the gradient wind reduction factor derived from storm observations. Reviewed graphical depictions of the gradient wind reduction factor distribution with radius.

Discussed that parameter distributions are still based on databases of earlier vintage than HURDAT2.

Reviewed goodness-of-fit tests for modeled versus actual forward speed.

Discussed spatial distribution of the far-field pressure. Discussed no changes in the far-field pressure methodology used in the model.

M-3 Hurricane Probabilities*

*(*Significant Revision)*

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

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).

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

Saffir-Simpson Hurricane Scale:

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

Audit

1. Demonstrate that the quality of fit extends beyond the Florida border by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.

2. Describe and support the method of selecting stochastic storm tracks.

3. Describe and support the method of selecting storm track strike intervals. If strike locations are on a discrete set, show the landfall points for major metropolitan areas in Florida.

4. Provide any modeling organization specific research performed to develop the functions used for simulating model variables or to develop databases.

5. Form S-3 (Distributions of Stochastic Hurricane Parameters) will be reviewed for the probability distributions and data sources.

Verified: YES

Professional Team Comments:

Discussed no change in the methodology used to generate stochastic storm tracks. Discussed frequency adjustments made to the stochastic catalog to account for the 2011 and 2012 hurricane seasons and to adjust for the latest HURDAT2 reanalyses.

Discussed modeling organization specific research that has been published.

M-4 Hurricane Windfield Structure*

*(*Significant Revision)*

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

B. The land use and land cover database shall be consistent with National Land Cover Database (NLCD) 2006 or later. Use of alternate data sets shall be justified.

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.

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

Audit

1. Provide any modeling organization-specific research performed to develop the windfield functions used in the model. Identify the databases used.

2. Provide any modeling organization-specific research performed to derive the roughness distributions for Florida and adjacent states.

3. The spatial distribution of surface roughness used in the model will be reviewed.

4. Provide the previous and current hurricane parameters used in calculating the loss costs for the LaborDay03 (1935) and NoName09 (1945) landfalls, and justify the choices used. Provide the resulting spatial distribution of winds. These will be reviewed with Form A-2 (Base Hurricane Storm Set Statewide Losses).

5. For windfields not previously reviewed, provide detailed comparisons of the model windfield with Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005).

6. For windfield and pressure distributions not previously reviewed, present time-based contour animations (capable of being paused) to demonstrate scientifically reasonable windfield characteristics.

7. The effects of vertical variation of winds as used in the model where applicable will be reviewed.

8. Form M-2 (Maps of Maximum Winds) will be reviewed.

Pre-Visit Letter

12. M-4.B, page 95: Demonstrate how the LULC database used by the model "is consistent with" the NLCD 2011 LULC.

13. M-4.C, page 95: Discuss how the different references listed here are used in the development of the roughness database used in the model.

14. M-4, Disclosure 1, page 96: Specify the equations from Willoughby et al. 2006.

15. M-4, Disclosure 10, page 102: The method for updating the historical windfield footprints will be examined. Updates to Hurricane NoName09 from 1945 (AL091945) will be compared with the same hurricane as presented in the previous submission.

16. Form M-2, pages 299-304: Discuss the relative variation of the windspeed minima versus maxima between the three temporal sampling periods.

17. Form M-2, pages 303-304: Discuss the implementation of roughness and how it is consistent with a decrease of 10 mph between open and actual terrain (actual stronger).

Verified: YES

Professional Team Comments:

Discussed the update of the land use land cover database to the USGS National Land Cover Database (NLCD) 2011 which was published in 2014.

Discussed that the update to the NLCD 2011 data had changes to certain categories that required surface roughness adjustment. There were large classes of water in South Florida misclassified as offshore wetlands. Reviewed satellite imagery and high resolution elevation data used to correct the classification.

Discussed the new method for calculating friction factor at a location based upon an average. Discussed how this is applied in calculation of winds by ZIP Code.

Discussed the different references and their applicability in the development of the roughness database. Reviewed roughness tables from the literature and how the data is applied in the model databases.

Reviewed the equations from Willoughby et al. (2006) used in the development of the windspeed radial profile. Discussed use of dual exponential profile.

Discussed no changes were made to the windfield model. All changes in the windfield are related to storm parameter changes in HURDAT2 or the updated LULC and friction factor calculation.

Reviewed graphical comparisons of the change in storm track for NoName09-1945.

Discussed changes in NoName09-1945 relate to the re-analysis of the storm track and central pressure being drawn from the updated HURDAT2 data rather than from supplemental information (such as NOAA reports or earlier journal articles).

Reviewed geographic comparison of the new NLCD 2011 data to the previous NLCD 2001 data. Reviewed change in LULC distribution due to development at the inland boundary of greater Miami.

Discussed the change in windspeed minima versus maxima in Form M-2 for the historical database related to the use of Hurricane Andrew (1992) based on HURDAT2.

Reviewed the spatial distribution of surface roughness used in the model.

Discussed the implementation of roughness and the expectations for windspeeds in open terrain versus actual terrain.

Discussed databases and research included for development of the windfield functions.

Reviewed comparison of previous and current hurricane parameters used in calculating loss costs for the LaborDay03 (1935) and NoName09 (1945) landfalls. Reviewed maps of the spatial distribution of winds with storm tracks plotted for both storms. Discussed transition of roughness from over water to over-land.

Reviewed Form M-2 and discussed relative magnitudes and locations of wind extrema.

Reviewed modeled windfield maps for Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005). Modeled windfield maps included comparison to H*WIND and Extended Best Track wind radii.

Discussed the availability of reanalysis metadata for verifying the spatial distribution of winds.

Reviewed contour animations for the windfield and pressure distributions of Hurricane Frances (2004).

Discussed how the effects in the variation of vertical winds on commercial residential high-rise buildings is being handled by the vulnerability functions.

M-5 Landfall and Over-Land Weakening Methodologies*

*(*Significant Revision)*

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

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

Audit

1. Describe the variation in over-land decay rates used in the model.

2. Comparisons of the model's weakening rates to weakening rates for historical Florida hurricanes will be reviewed.

3. The detailed transition of winds from over-water to over-land (i.e., landfall, boundary layer) will be reviewed. The region within 5 miles of the coast will be emphasized. Provide color-coded snapshot maps of roughness length and spatial distribution of over-land and over-water windspeeds for Hurricane Jeanne (2004), Hurricane Dennis (2005), and Hurricane Andrew (1992) at the closest time after landfall.

Pre-Visit Letter

18. M-5, Disclosure 2, page 107: Discuss the filling rate model with reference to Figure 15 and how the over-land filling of storms such as Hurricane Katrina (2005), Hurricane Irene (1999), Hurricane Charley (2004), and Hurricane Frances (2004) is captured by the filling model.

Verified: YES

Professional Team Comments:

Discussed the filling rate model as a function of landfall intensity, landfall location and time over-land, with the time evolution of central pressure illustrated in Figure 15. Discussed that 1-hourly track points are derived from HURDAT2 for historical events over-land.

Discussed model component allowing for over-land intensification and its implementation in the stochastic model. Discussed that this is unchanged from the previous submission. Reviewed model code for over-land intensification in conjunction with Standards C-3 and C-4.

Reviewed color-coded snapshot maps of windspeed and roughness length for Hurricane Andrew (1992), Hurricane Jeanne (2004), and Hurricane Dennis (2005). Reviewed

windspeed and roughness length maps at high resolution for onshore and offshore flow at landfall.

M-6 Logical Relationships of Hurricane Characteristics

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

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

Audit

1. Form M-3 (Radius of Maximum Winds and Radii of Standard Wind Thresholds) and the modeling organization's sensitivity analyses provide the information used in auditing this standard.

2. Justify the relationship between central pressure and radius of maximum winds.

3. Justify the variation of the asymmetry with the translation speed.

Pre-Visit Letter

19. M-6, Disclosure 3, page 110 and Form M-1, Table 36, page 295: Discuss the modeled distribution of hurricane size. Consideration should be given to the role of size in the climatology of by-passing hurricanes.

Verified: YES

Professional Team Comments:

Reviewed plots of Rmax comparing simulated storms to historical storms.

Discussed no change in model treatment of windfield asymmetry.

Reviewed variation of historical windspeed radii (73 mph and 40 mph). Discussed bounds on modeled and observed wind radii.

STATISTICAL STANDARDS – Mark Johnson, Leader

S-1 Modeled Results and Goodness-of-Fit

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

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

Audit

1. Forms S-1 (Probability and Frequency of Florida Landfalling Hurricanes per Year), S-2A (Examples of Loss Exceedance Estimates, 2007 FHCF Exposure Data), S-2B (Examples of Loss Exceedance Estimates, 2012 FHCF Exposure Data), and S-3 (Distributions of Stochastic Hurricane Parameters) will be reviewed. Provide justification for the distributions selected including, for example, citations to published literature or analyses of specific historical data.

2. The modeling organization's characterization of uncertainty for windspeed, damage estimates, annual loss, and loss costs will be reviewed.

Pre-Visit Letter

20. S-1, Disclosure 2, pages 115-118: Explain the update to the validation tests from the previous submission as well as Figures 17 and 18.

21. S-1, Disclosure 3, page 118: Describe the use of data from Hurricane Ike (2008), Hurricane Irene (2011), and Hurricane Sandy (2012).

22. S-1, Disclosure 6, pages 119-120: Review the updated landfall frequency distribution fit. Explain how the underlying data has changed (e.g., historical 7 landfalls in Figure 19).

23. S-1, Disclosure 6, page 122: Explain the change in categories in the updated central pressure frequency plot.

24. S-1, Disclosure 6, page 123: Provide the back-up material for the updated Figure 22.

Verified: YES

Professional Team Comments:

Reviewed windfield footprints for Hurricane Andrew (1992). Discussed no change in the modeled windfield except due to changes to specific hurricane parameters.

Discussed new claims data included from (1) Hurricane Ike (2008) used for validating changes to the mobile home vulnerability functions, and (2) from Hurricane Irene (2011) and Hurricane Sandy (2012) for validating square footage vulnerability changes. Discussed the applicability of these new hurricanes to Florida.

Reviewed the updated landfall frequency distribution fits. Reviewed graphical comparisons of historical and modeled landfall frequency by 50-mile and 100-mile coastal segments.

Reviewed goodness-of-fit test results on landfall frequency.

Discussed use of Hurricane Andrew (1992), Hurricane Erin (1995), and Hurricane Opal (1995) data as the basis for Figure 22.

Discussed the reason for avoiding the presentation of an estimated probability of exceedance for the top event in Forms S-2A and S-2B.

S-2 Sensitivity Analysis for Model Output

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

Audit

1. The modeling organization's sensitivity analysis will be reviewed in detail. Statistical techniques used to perform sensitivity analysis shall be explicitly stated. The results of the sensitivity analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.

2. Form S-6 (Hypothetical Events for Sensitivity and Uncertainty Analysis) will be reviewed, if applicable.

Verified: YES

Professional Team Comments:

Verified no changes in model methodology from the previous submission and that no new sensitivity tests were required.

S-3 Uncertainty Analysis for Model Output

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

Audit

1. The modeling organization's uncertainty analysis will be reviewed in detail. Statistical techniques used to perform uncertainty analysis shall be explicitly stated. The results of the uncertainty analysis displayed in graphical format (e.g., contour plots with temporal animation) will be reviewed.

2. Form S-6 (Hypothetical Events for Sensitivity and Uncertainty Analysis) will be reviewed, if applicable.

Verified: YES

Professional Team Comments:

Verified no changes in model methodology from the previous submission and that no new uncertainty tests were required.

S-4 County Level Aggregation

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

Audit

1. Provide a graph assessing the accuracy associated with a low impact area such as Nassau County. We would expect that if the contribution error in an area such as Nassau County is small, the error in the other areas would be small as well. Assess where appropriate, the contribution of simulation uncertainty via confidence intervals.

Pre-Visit Letter

25. S-4, page 133: Provide the convergence graphs and other material to support the verification of this standard.

Verified: YES

Professional Team Comments:

Reviewed convergence test results comparing 50,000 years to 100,000 years of simulation for Nassau, Lee, Putnam, Levy, Franklin, Hillsborough, and Okaloosa Counties.

Discussed use of 50,000 simulated years and the basis for this number being adequate.

Reference reviewed:

Thompson, K.M., Burmaster, D.E., and Crouch, A.C. (1992): Monte Carlo Techniques for Quantitative Uncertainty Analysis in Public Health Risk Assessments. *Risk Analysis*, Vol. 12, No. 1, pp. 53-63.

S-5 Replication of Known Hurricane Losses

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

Audit

1. The following information for each insurer and hurricane will be reviewed:
    a. The validity of the model assessed by comparing expected losses produced by the model to actual observed losses incurred by insurers at both the state and county level,
    b. The version of the model used to calculate modeled losses for each hurricane provided,
    c. A general description of the data and its source,
    d. A disclosure of any material mismatch of exposure and loss data problems, or other material consideration,
    e. The date of the exposures used for modeling and the date of the hurricane,
    f. An explanation of differences in the actual and modeled hurricane parameters,
    g. A listing of the departures, if any, in the windfield applied to a particular hurricane for the purpose of validation and the windfield used in the model under consideration,
    h. The type of property used in each hurricane to address:
        (1) Personal versus commercial
        (2) Residential structures
        (3) Mobile homes
        (4) Commercial residential
        (5) Condominiums
        (6) Structures only
        (7) Contents only,
    i. The inclusion of demand surge, storm surge, loss adjustment expenses, or law and ordinance coverage in the actual losses or the modeled losses.

2. The following documentation will be reviewed:
    a. Publicly available documentation referenced in the submission,
    b. The data sources excluded from validation and the reasons for excluding the data from review by the Commission (if any),
    c. An analysis that identifies and explains anomalies observed in the validation data,
    d. User input sheets for each insurer and hurricane detailing specific assumptions made with regard to exposed property.

3. The confidence intervals used to gauge the comparison between historical and modeled losses will be reviewed.

4. Form S-4 (Validation Comparisons) will be reviewed.

5. The results of one hurricane event for more than one insurance company and the results from one insurance company for more than one hurricane event will be reviewed to the extent data are available.

Pre-Visit Letter

26. S-5, Disclosure 1, pages 134-141: There are a number of substantial changes in actual losses and modeled losses from the previous submission (e.g., Table 11 Hurricane Charley (2004) modeled loss, Table 12 Hurricane Katrina (2005), Table 13 Mobile Homes). Explain the updates.

Verified: YES

Professional Team Comments:

Reviewed revised Tables 11-15, Tables 44-45 and Figures 74-81 provided on-site. Discussed actual losses within the event footprint were reported in the initial submission (November 2014) whereas the revised tables include the overall actual losses.

Reviewed the confidence intervals comparing historical and modeled losses.

S-6 Comparison of Projected Hurricane Loss Costs

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

Audit

1. Form S-5 (Average Annual Zero Deductible Statewide Loss Costs – Historical versus Modeled) will be reviewed for consistency with Standard G-1 (Scope of the Computer Model and Its Implementation), Disclosure 5.

2. Justify the following:
    a. Meteorological parameters,
    b. The effect of by-passing hurricanes,
    c. The effect of actual hurricanes that had two landfalls impacting Florida,
    d. The departures, if any, from the windfield, vulnerability functions, or insurance functions applied to the actual hurricanes for the purposes of this test and those used in the model under consideration,
    e. Exposure assumptions.

Verified: YES

Professional Team Comments:

Reviewed color-coded map displaying the effect of by-passing hurricanes.

Reviewed color-coded map displaying the effect of hurricanes making two landfalls in Florida.

VULNERABILITY STANDARDS – Masoud Zadeh, Leader

V-1 Derivation of Vulnerability Functions*

*(*Significant Revision)*

A. Development of the building vulnerability functions shall be based on at least one of the following: (1) historical data, (2) tests, (3) rational structural analysis, and (4) site inspections. Any development of the building vulnerability functions based on rational structural analysis, site inspections, and tests shall be supported by historical data.

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

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

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

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

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

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

Audit

1. Modifications to the building vulnerability component in the model since the previously accepted model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications and their impacts on the building vulnerability component. Comparisons with the previously accepted model will be reviewed.

2. Historical data shall be available in the original form with explanations for any changes made and descriptions of how missing or incorrect data were handled. For historical data used to develop building vulnerability functions, demonstrate the goodness-of-fit of the data. Complete reports detailing loading conditions and damage suffered are required for any test data used. Complete

rational structural analyses shall be presented so that a variety of different building types and construction characteristics may be selected for review. Tests and original site inspection reports shall be available for review.

3. Copies of any papers, reports, and studies used in the development of the building vulnerability functions shall be available for review. Copies of all public record documents used may be requested for review.

4. Multiple samples of building vulnerability functions for commercial residential building structures, personal residential building structures, mobile homes, and appurtenant structures shall be available. The magnitude of logical changes among these items for a given windspeed shall be explained and validation materials shall be available.

5. Justify the construction types and characteristics used.

6. Provide validation of the mean building vulnerability functions and associated uncertainties.

7. Document and justify all modifications to the building vulnerability functions due to building codes and their enforcement. If age of building is used as a surrogate for building code and code enforcement, provide complete supporting information for the number of age groups used as well as the year(s) of construction that separates particular group(s).

8. Provide validation material for the disclosed minimum windspeed. Provide the computer code showing the inclusion of the minimum windspeed at which damage occurs.

9. The effects on building vulnerability from local and regional construction characteristics and building codes will be reviewed.

10. Describe how the claim practices of insurance companies are accounted for when claims data for those insurance companies are used to develop or to verify building vulnerability functions. Examples include the level of damage the insurer considers a loss to be a total loss, claim practices of insurers with respect to concurrent causation, or the impact of public adjusting.

11. Provide the percentage of damage at or above which the model assumes a total loss.

12. Form V-1 (One Hypothetical Event) will be reviewed.

Pre-Visit Letter

27. V-1.D, page 145: Provide support for the statement, “For residential, single family homes, the vulnerability functions do not vary by height/stories.”

28. V-1.D, pages 145-146: Explain the new year-built categories of 2002-2008 and post 2008 versus the previous submission year-built categories of 2002-2004 and post 2004.

29. V-1.D, page 146: Explain how the Wind-borne Debris Region and High-Velocity Hurricane Zone, as specified in the 2001 Florida Building Code, are relevant to later codes such as the current Florida Building Code.

30. V-1, Disclosure 3, pages 151-156: Discuss Figures 31-35 and how they compare with the corresponding figures in the previous submission.

31. V-1, Disclosure 7, page 159: Explain how the number of stories, regions within the state of Florida, and year of construction are addressed by the model.

32. V-1, Disclosure 8, page 162: Explain how building code adoption and enforcement are considered in the model.

33. V-1, Disclosure 11, page 163: Explain the assumptions, data, methods, and process used to develop vulnerability functions for partial unknown characteristics. Explain the response and how year built is a primary characteristic versus the response to Disclosure 7 which lists this as a secondary characteristic.

34. V-1, Disclosure 14, page 166: Discuss Figure 36 and how it compares with the corresponding figure in the previous submission.

35. V-1, Disclosures 14 & 15, pages 164-172: Provide numerical mean damage ratios for both the actual and simulated data by appropriate windspeed bands for Figures 36-39.

36. V-1, Disclosure 18, page 173: Explain how secondary characteristics are used to address missile impact and water infiltration.

37. Form V-1, pages 338-341: Explain the process for completing Form V-1 and compare the results with the previous submission.

Verified: YES

Professional Team Comments:

Discussed the new square footage modifiers and updates to mobile home vulnerability functions based on new research and claims data. Discussed the loss validation claims data.

Discussed new client data handling procedures and quality assurance procedures for handling client data modifications. Reviewed the 2014 Client Data Processing Workflow and compared the workflow process to the previous 2012 Client Data Processing Workflow.

Discussed the exposures, input parameters, and standardized scaling factors affecting revised Tables 11-15, 44, and 45 in the submission.

Reviewed table of personal residential actual versus modeled losses for nine storms and nine companies.

Reviewed table of commercial residential actual versus modeled losses for six storms and two companies.

Discussed the differences in Table 11 and Table 12 for Hurricane Ivan (2005) losses among the November 2014 submission, the previous submission, and the current submission.

Reviewed in detail the updates to the square footage modifiers. Discussed the effects of square footage on the wind vulnerability and the company loss data used for validation.

Reviewed graphical comparison of percent Total Risk Value (TRV) binned by square footage.

Reviewed average mean damage ratio by square footage within various wind ranges.

Reviewed graphical comparisons of average to good building conditions by square footage and roof covering and roof geometry by square footage showing the correlation between secondary features and size of home.

Discussed the impact of square footage on wind vulnerability.

Discussed experiments using computational fluid dynamics on basic structural shapes varied in square footage and complexity and the results published in:

> Butler, K., Relative Variations in Roof Pressure Loads of High Value, Large Square Footage Homes, 12th Americas Conference on Wind Engineering, Seattle, Washington, June 16-20, 2013.

Discussed implementation of the square footage factors that reduce vulnerability and phases out with increased windspeed.

Reviewed in detail the updates to the manufactured (mobile) home damage functions.

The Professional Team recommends the new square footage modifiers and updates to the manufactured (mobile) home damage functions be presented to the Commission during the trade secret session.

Discussed the updated implementation of year-built categories Pre-1995, 1995-2008 (varies year by year), and Post-2008. Reviewed comparison of previous and updated year built aging factors.

Discussed the reasons for not updating the building vulnerability functions for the current Florida Building Code. The Professional Team recommends implementation of more recent vintage Florida Building Codes in the model.

Discussed basis and validation for single family structure vulnerability functions not varying by height or story.

Discussed how number of stories, regions, and year of construction are addressed in the model. The Professional Team recommends research to evaluate the importance of number of stories for damage to low rise personal residential properties.

Reviewed mean damage ratios for actual and simulated data by windspeed bands.

Reviewed Figures 31-35 and discussed changes from the previous submission.

Discussed the use of secondary characteristics to address missile impact and water intrusion.

Discussed the process for completing Form V-1 and the low results provided in Part B. Form V-1 was recalculated and revised.

Discussed that damage function modification by square footage does not lead to double counting of other secondary modifiers.

V-2 Derivation of Contents and Time Element Vulnerability Functions*

*(*Significant Revision)*

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

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

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

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

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

Audit

1. Modifications to the contents and time element vulnerability component in the model since the previously accepted model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications and their impact on the contents and time element vulnerability component. Comparisons with the previously accepted model will be reviewed.

2. To the extent that historical data are used to develop mathematical depictions of contents vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models.

3. Justify changes from the previously accepted submission in the relativities between vulnerability functions for building and the corresponding vulnerability functions for contents.

4. Documentation and justification of the following will be reviewed:
   a. The method of derivation and data on which the time element vulnerability functions are based;
   b. Validation data specifically applicable to time element coverages;
   c. Assumptions regarding the coding of time element losses by insurers;
   d. The effects of demand surge on time element for the 2004 and 2005 hurricane seasons;
   e. Assumptions regarding the variability of time element losses by size of property;
   f. Statewide application of time element coverage assumptions;
   g. Assumptions regarding time element coverage for mobile homes, tenants, and condo unit

owners exposure;

h. The methods used to incorporate the estimated time required to repair or replace the property;

i. The methodology and available validation for determining the extent of infrastructure damage and its effect on time element costs.

5. Justify changes from the previously accepted submission in the relativities between vulnerability functions for building and the corresponding vulnerability functions for time element.

6. To the extent that historical data are used to develop mathematical depictions of time element vulnerability functions, demonstrate the goodness-of-fit of the data to fitted models.

Pre-Visit Letter

38. V-2, Disclosure 4, page 179: Explain in detail the response and provide the number of unique contents vulnerability functions.

Verified: YES

Professional Team Comments:

Reviewed plot of the building mean damage ratio and contents mean damage ratio.

Discussed the basis for contents and time element vulnerability functions.

V-3 Mitigation Measures*

*(*Significant Revision)*

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

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

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

Audit

1. Modifications to mitigation measures in the model since the previously accepted model will be reviewed in detail, including the rationale for the modifications, the scope of the modifications, the process, the resulting modifications, and their impacts on the vulnerability component. Comparisons with the previously accepted model will be reviewed.

2. Form V-2 (Mitigation Measures – Range of Changes in Damage) and Form V-3 (Mitigation Measures – Mean Damage Ratios and Loss Costs, Trade Secret item) provide the information used in auditing this standard.

3. Individual mitigation measures as well as their effect on damage due to use of multiple mitigation measures will be reviewed. Any variation in the change over the range of windspeeds for individual and multiple mitigation measures will be reviewed.

4. Mitigation measures used by the model that are not listed as required in this standard will be disclosed and shown to be theoretically sound and reasonable.

Pre-Visit Letter

39. V-3.A, pages 188-189: Discuss the Florida Building Code 2001 selection.

40. V-3, Disclosure 1, page 190: Explain the inconsistency in this response with the changes observed in Table 50 mitigation measures (page 345) compared with the corresponding Table 26 in the previous submission.

41. Form V-2, pages 342-350: Compare the results in Form V-2 with the previous submission.

Verified: YES

Professional Team Comments:

Discussed the process for completing Forms V-2 and V-3.

Reviewed Trade Secret Form V-3 in detail.

Discussed the continued use of the 2001 Florida Building Code. The Professional Team recommends implementation of more recent vintage Florida Building Codes in the model.

Discussed the differences in the current Form V-2 to the previous Form V-2 due to methods used to complete the form. Response to paragraph B was revised and will be included in the revised submission.

Discussed the values given in Form V-2, Table 50 for sliding glass doors and reinforced sliding glass doors.

ACTUARIAL STANDARDS – Marty Simons, Leader

A-1 Modeling Input Data

A. When used in the modeling process or for verification purposes, adjustments, edits, inclusions, or deletions to insurance company input data used by the modeling organization shall be based upon accepted actuarial, underwriting, and statistical procedures.

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

Audit

1. Quality assurance procedures shall include methods to assure accuracy of insurance data. Compliance with this standard will be readily demonstrated through documented rules and procedures.

2. All model inputs and assumptions will be reviewed to determine that the model output report appropriately discloses all modifications, adjustments, assumptions, and defaults used to produce the loss costs.

Verified: YES

Professional Team Comments:

Verified that the model losses do not take into account flood or storm surge other than through indirect effects.

Discussed the QA procedures for testing data through the pre-processing steps and validating the model output.

Discussed the analysis options that may be selected for generating loss costs and the variables a model user may select. Reviewed the analysis log documenting the user-selected analysis options.

Discussed the process for requesting, reviewing, processing and maintaining client claims data. Reviewed sample letter to clients requesting claims data.

A-2 Event Definition

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

B. Time element loss costs shall reflect losses due to infrastructure damage caused by a hurricane.

Audit

1. The model will be reviewed to determine that the definition of an event in the model is consistent with this standard.

2. The model will be reviewed to determine that by-passing storms and their effects are considered in a manner that is consistent with this standard.

3. The model will be reviewed to determine whether (if so, how) the model takes into account flood or hurricane storm surge.

Verified: YES

Professional Team Comments:

Discussed no change in the definition of an event or the handling of by-passing storms in the model.

A-3 Coverages*

*(*Significant Revision)*

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

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

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

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

Audit

1. The methods used to produce building, appurtenant structure, contents and time element loss costs and probable maximum loss levels will be reviewed.

Verified: YES

Professional Team Comments:

Discussed the methodology for building coverage ground-up losses and deductible application.

Reviewed examples of annual aggregate occurrence losses for a given stochastic year.

A-4 Modeled Loss Cost and Probable Maximum Loss Considerations

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

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

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

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

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

F. The methods, data, and assumptions used in the estimation of demand surge shall be actuarially sound.

Audit

1. Describe how the model handles expenses, risk load, investment income, premium reserves, taxes, assessments, profit margin, economic inflation, and any criteria other than direct property insurance claim payments.

2. The method of inclusion of secondary uncertainty in the probable maximum loss levels will be examined.

3. Provide the data and methods used to incorporate individual aspects of demand surge on personal and commercial residential coverages, inclusive of the effects from building material costs, labor costs, contents costs, repair time, etc.

4. Provide a detailed description of how the model accounts for hurricane storm surge losses.

5. All referenced literature will be reviewed to determine applicability.

Pre-Visit Letter

42. A-4.C, page 214: Describe the process used to ensure that storm surge losses are excluded from the model's loss cost outputs.

Verified: YES

Professional Team Comments:

Discussed the process for excluding storm surge losses from the model loss output.

The Professional Team recommends the modeler present their methodology for excluding storm surge losses from the modeled losses to the Commission during the Trade Secret session.

Discussed that modeled loss costs do not include expenses, risk load, investment income, premium reserves, taxes, assessments, or profit margin, and the model does not make a prospective provision for economic inflation.

Discussed no change in methodology for producing probable maximum loss estimates.

Discussed no change in methodology for demand surge calculations.

A-5 Policy Conditions

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

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

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

Audit

1. Describe the process used to determine the accuracy of the insurance-to-value criteria in data used to develop or validate the model results.

2. To the extent that historical data are used to develop mathematical depictions of deductibles and policy limits, demonstrate the goodness-of-fit of the data to fitted models.

3. To the extent that historical data are used to validate the model results, the treatment of the effects of deductibles, policy limits, and coinsurance in the data will be reviewed.

4. Justify changes from the previously accepted submission in the relativities among corresponding deductible amounts for the same coverage.

Verified: YES

Professional Team Comments:

Verified no change in the process for calculating and applying deductibles and policy limits from the previous submission.

A-6 Loss Output*

*(*Significant Revision)*

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

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

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

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

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

F. Loss costs cannot increase as the quality of building codes and enforcement increases, all other factors held constant.

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

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

I. Output ranges shall be logical for the type of risk being modeled and deviations supported.

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

1. masonry construction versus frame construction,

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

3. inland counties versus coastal counties, and

4. northern counties versus southern counties.

A-6 Loss Output (Continued)

K. For loss cost and probable maximum loss level estimates derived from or validated with historical insured hurricane losses, the assumptions in the derivations concerning (1) construction characteristics, (2) policy provisions, (3) coinsurance, (4) contractual provisions, and (5) relevant underwriting practices underlying those losses, as well as any actuarial modifications, shall be appropriate based on the type of risk being modeled.

Audit

1. Provide the data and methods used for probable maximum loss levels for Form A-8 (Probable Maximum Loss for Florida). Describe the hurricane associated with the Top Event.

2. All referenced literature will be reviewed to determine applicability.

3. Graphical representations of loss costs by ZIP Code and county will be reviewed.

4. Color-coded maps depicting the effects of land friction on loss costs by ZIP Code will be reviewed.

5. The procedures used by the modeling organization to verify the individual loss cost relationships will be reviewed. Forms A-1 (Zero Deductible Personal Residential Loss Costs by ZIP Code), A-2 (Base Hurricane Storm Set Statewide Losses), A-3A (2004 Hurricane Season Losses, 2007 FHCF Exposure Data), A-3B (2004 Hurricane Season Losses, 2012 FHCF Exposure Data), A-6 (Logical Relationship to Risk, Trade Secret item), and A-7 (Percentage Change in Logical Relationship to Risk) will be used to assess coverage relationships.

6. Demonstrate that loss cost relationships among deductible, construction type, policy form, coverage, building code/enforcement, building strength, condo unit floor, number of stories, territory, and region are consistent and reasonable.

7. The total personal and commercial residential insured losses provided in Forms A-2 (Base Hurricane Storm Set Statewide Losses), A-3A (2004 Hurricane Season Losses, 2007 FHCF Exposure Data), and A-3B (2004 Hurricane Season Losses, 2012 FHCF Exposure Data) will be reviewed individually for total personal residential and total commercial residential insured losses.

8. Forms A-4A (Output Ranges, 2007 FHCF Exposure Data), A-4B (Output Ranges, 2012 FHCF Exposure Data), and A-5 (Percentage Change in Output Ranges, 2007 FHCF Exposure Data) will be reviewed, including geographical representations of the data when applicable.

9. Justify all changes in loss costs from the previously accepted submission.

10. Forms A-4A (Output Ranges, 2007 FHCF Exposure Data) and A-4B (Output Ranges, 2012 FHCF Exposure Data) will be reviewed to ensure appropriate differentials among deductibles, coverage, and construction types.

11. Anomalies in the output range data will be reviewed and shall be justified.

Pre-Visit Letter

43. Form A-4B, page 487: Describe how the file hlpm2012c.txt was processed for use in completing Form A-4B.

44. Form A-5.B, page 524: Explain the changes for Mobile Homes.

45. Form A-7.A, page 539: Explain the percentage changes for inland frame and masonry owners.

Verified: YES

Professional Team Comments:

Reviewed the procedures and SQL script for processing the aggregate FHCF 2012 exposure data in completing Form A-4B.

Discussed Form A-1 Franklin County losses for all three structure types.

Discussed the ZIP Codes remapped in the current Form A-1 as compared to the previous Form A-1.

Discussed the changes in Form A-2 losses for NoName04-1901, LaborDay03-1935, and NoName04-1935 due to HURDAT2 reanalysis.

Discussed the changes in 2004 event losses in Form A-3 for ZIP Codes 32561, 32563, 32976, and 33956.

Discussed the changes in Form A-5 for mobile homes.

Discussed the percentage changes for inland frame and masonry owners in Form A-7.

Reviewed event descriptions and storm tracks for the events that produced the maximum annual aggregate loss.

Reviewed the event description and storm track for the top event that produced the maximum event loss on the occurrence EP curve.

Reviewed the results in Trade Secret Form A-6 in detail.

Reviewed geographical maps of the percentage changes in Form A-5.

Discussed reasons for several anomalies in the output range data. Discussed the use of an SQL script to identify anomalies.

COMPUTER STANDARDS – Paul Fishwick, Leader

C-1 Documentation

A. Model functionality and technical descriptions shall be documented formally in an archival format separate from the use of letters, slides, and unformatted text files.

B. The modeling organization shall maintain a primary document repository, containing or referencing a complete set of documentation specifying the model structure, detailed software description, and functionality. Development of the documentation shall be indicative of accepted software engineering practices.

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

D. The modeling organization shall maintain (1) a table of all changes in the model from the previously accepted submission to the initial submission this year and (2) a table of all substantive changes since this year's initial submission.

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

Audit

1. The primary document repository, in either electronic or physical form, and its maintenance process will be reviewed. The repository shall contain or reference full documentation of the software.

2. All documentation shall be easily accessible from a central location.

3. Complete user documentation, including all recent updates, will be reviewed.

4. Modeling organization personnel, or their designated proxies, responsible for each aspect of the software (i.e., user interface, quality assurance, engineering, actuarial, verification) shall be present when the Computer Standards are being audited. Internal users of the software will be interviewed.

5. Provide verification that documentation is created separately from and is maintained consistently with the source code.

6. The tables specified in C-1.D that contain the items listed in Standard G-1(Scope of the Computer Model and Its Implementation), Disclosure 5 will be reviewed. The tables shall contain the item number in the first column. The remaining five columns shall contain specific document or file references for affected components or data relating to the following Computer Standards: C-2 (Requirements), C-3 (Model Architecture and Component Design), C-4 (Implementation), C-5 (Verification), and C-6 (Model Maintenance and Revision).

7. Trace the model changes specified in Standard G-1 (Scope of the Computer Model and Its Implementation), Disclosure 5 through all Computer Standards.

Pre-Visit Letter

46. C-1.B, page 233: Relate the primary binder table of contents with the response to Standard G-1, Disclosure 5 by demonstrating individual table item compliance with Computer Standards C-1 through C-7.

Verified: YES

Professional Team Comments:

Reviewed the primary document binder and associated sub-documents relating to Standards C-1 through C-7 as required by audit items 1 through 6.

Traced model changes from Standard G-1, Disclosure 5 through the Computer Standards as required in Standard C-1, Audit Item 7.

Reviewed the Computer Standards audit procedure and time schedule developed by the modeler. This procedure was used by the new signatory for the Computer Science standards.

Reviewed the explanation from the modeler of the Type I error (reference page 57 of the Report of Activities as of November 1, 2013) for the previous version of Touchstone Version 1.5.3. This explanation was found in a letter, dated January 21, 2015, from AIR Worldwide to Dr. Lorilee Medders, Chair, Florida Commission on Hurricane Loss Projection Methodology. The modeler explained the issue and how this issue did not affect Touchstone Version 2.1.0 currently under review.

Reviewed the two tables required by Standard C-1.D for the model version under review (AIR Hurricane Model: AIR Atlantic Tropical Cyclone Model V15.0.0 as Implemented in Touchstone V2.1.0).

C-2 Requirements

The modeling organization shall maintain a complete set of requirements for each software component as well as for each database or data file accessed by a component. Requirements shall be updated whenever changes are made to the model.

Audit

1. Provide confirmation that a complete set of requirements for each software component, as well as for each database or data file accessed by a component, has been maintained and documented.

Pre-Visit Letter

47. C-2, page 236: Provide requirements documentation that specifically relates to each model change identified in Standard G-1, Disclosure 5.

50. Appendix 8, page 627: Provide an example of the "demonstration of Touchstone illustrated" for Standard C-2 cited by Angelo Jeyarajan.

Verified: YES

Professional Team Comments:

Reviewed the requirements, specified in tabular form, for all items in Standard G-1, Disclosure 5 from the modeler's submission.

Reviewed the slides and discussed the demonstration given to Angelo Jeyarajan during his review of the model under the Computer Standards.

Reviewed the Audit Schedule followed by Yingqun Wang when conducting her review of the model under the Computer Standards.

C-3 Model Architecture and Component Design*

*(*Significant Revision)*

The modeling organization shall maintain and document (1) detailed control and data flow diagrams and interface specifications for each software component, (2) schema definitions for each database and data file, and (3) diagrams illustrating model-related flow of information and its processing by modeling organization personnel or team. Documentation shall be to the level of components that make significant contributions to the model output.

Audit

1. The following will be reviewed:
    a. Detailed control and data flow diagrams, completely and sufficiently labeled for each component,
    b. Interface specifications for all components in the model,
    c. Documentation for schemas for all data files, along with field type definitions,
    d. Each network diagram including components, sub-component diagrams, arcs, and labels, and
    e. Diagrams illustrating model-related information flow among modeling organization personnel or team (e.g., using Unified Modeling Language (UML), Business Process Model and Notation (BPMN), or equivalent technique including a modeling organization internal standard).

2. A model component custodian, or designated proxy, shall be available for the review of each component.

Verified: YES

Professional Team Comments:

Reviewed two flowcharts (found in Attachment C to the January 21, 2015, letter described in the Professional Team comments under Standard C-1) illustrating the process related to the issue explained in the letter. Informed the modeler that one of the two flowcharts employed a non-standard notation in a decision block. Verified the correction of the flowchart on-site.

Reviewed three flowcharts defining workflows for the development of the ZIP Code Databases: ZIPALL, AIRAddress Server, and AIRGeography.

Reviewed the geocoding flowchart.

Reviewed the 2014 Client Data Processing Workflow.

Reviewed a series of flowcharts for removing and adding hurricane events.

Discussed with the modeler that the use of dashed arcs in a flowchart was unclear. Verified that the modeler corrected the flowchart semantics by eliminating the dashed arcs to indicate parallel activity within the control flow.

Reviewed flowchart in implementation of HURDAT2 database for the stochastic landfall distribution.

Reviewed three workflow diagrams: 1) Research Modeling Development, 2) Model 21 Porting and Implementation, and 3) Touchstone Development.

Reviewed the Flow of Information Workflows.

Reviewed the code for the implementation of over-land intensification (see Standard M-5).

C-4 Implementation

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

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

C. All components shall be traceable, through explicit component identification in the flow diagrams, down to the code level.

D. The modeling organization shall maintain a table of all software components affecting loss costs, 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.

E. Each component shall be sufficiently and consistently commented so that a software engineer unfamiliar with the code shall be able to comprehend the component logic at a reasonable level of abstraction.

F. The modeling organization shall maintain the following documentation for all components or data modified by items identified in Standard G-1 (Scope of the Computer Model and Its Implementation), Disclosure 5:

1. A list of all equations and formulas used in documentation of the model with definitions of all terms and variables.

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

Audit

1. The interfaces and the coupling assumptions will be reviewed.

2. Provide the documented coding guidelines and confirm that these guidelines are uniformly implemented.

3. The procedure used in creating, deriving, or procuring and verifying databases or data files accessed by components will be reviewed.

4. The traceability among components at all levels of representation will be reviewed.

5. The following information shall be available and will be reviewed for each component, either in a header comment block, source control database, or the documentation:
    a. Component name,
    b. Date created,

c. Dates modified and by whom,
d. Purpose or function of the component,
e. Input and output parameter definitions.

6. The table of all software components as specified in C-4.D will be reviewed.

7. Model components and the method of mapping to elements in the computer program will be reviewed.

8. Comments within components will be examined for sufficiency, consistency, and explanatory quality.

Verified: YES

Professional Team Comments:

Reviewed C++ implementation of the sum of means versus convolution methods in computing loss.

Reviewed the modeler's documented process for coding guidelines, defined by the programming languages used for implementation.

Discussed with the modeler the methods for disseminating the coding guidelines to the modeling groups. These methods include the use of code reviews with stakeholders and subject matter experts.

Informed the modeler that the section of C++ code used in computing loss had insufficient commenting. Verified that the modeler included additional comments to improve readability.

Verified that there were two software enhancements made by the modeler in the primary Touchstone interface, relating to template-based user control over running the software. One of the enhancements was not in the November 2014 submission under Standard G-1, Disclosure 5. Verified that these enhancements were added on-site and will be included in the revised submission.

Reviewed the two software enhancement implementations in terms of the user interaction and interface.

Reviewed the software metrics table required by Standard C-4, D.

Verified that any model options selected made would be identified as-such in the output form referenced in Standard A-1.B.

Reviewed the implementation of the overland intensification process, as related to Standard M-5.

Reviewed the M21 Equations/Formulas, Variable Mapping and Crosschecking document.

Reviewed the MATLAB implementation for the mathematical representation producing a vulnerability factor for square footage.

Reviewed the correspondence between the mathematical surface defined by equations and the MATLAB source code implementation.

C-5 Verification*

*(*Significant Revision)*

A. General

For each component, the modeling organization shall maintain procedures for verification, such as code inspections, reviews, calculation crosschecks, and walkthroughs, sufficient to demonstrate code correctness. Verification procedures shall include tests performed by modeling organization personnel other than the original component developers.

B. Component Testing

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

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

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

4. Aggregation tests shall be performed and documented to ensure the correctness of all model components. Sufficient testing shall be performed to ensure that all components have been executed at least once.

C. Data Testing

1. The modeling organization shall use testing software to assist in documenting and analyzing all databases and data files accessed by components.

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

Audit

1. The components will be reviewed for containment of sufficient logical assertions, exception-handling mechanisms, and flag-triggered output statements to test the correct values for key variables that might be subject to modification.

2. The testing software used by the modeling organization will be reviewed.

3. The component (unit, regression, aggregation) and data test processes and documentation will be reviewed including compliance with independence of the verification procedures.

4. Fully time-stamped, documented cross-checking procedures and results for verifying equations, including tester identification, will be reviewed. Examples include mathematical calculations versus source code implementation, or the use of multiple implementations using different languages.

5. Flowcharts defining the processes used for manual and automatic verification will be reviewed.

6. The response to Disclosure 1 will be reviewed.

7. Verification approaches used for externally acquired data, software, and models will be reviewed.

Pre-Visit Letter

48. C-5, page 259: Provide complete and thorough verification procedures and output from the model changes identified in Standard G-1, Disclosure 5.

51. Appendix 8, page 630: Provide an example of the "cross-checking procedures and results" review process for Standard C-5 as cited by Angelo Jeyarajan.

Verified: YES

Professional Team Comments:

Verified that the Quality Assurance testing was added to mitigate finding errors similar to the error listed by the modeler in their January 21, 2015, letter to the Commission. The error was discovered as a result of running a full range of tests when a major model version (Touchstone 2.0) was created. The modeler has updated their testing procedure so that all future tests will be run even for minor releases of the model.

Verified enhanced documentation for the process used by the modeler to ensure correspondence among different types of media (e.g., design documents versus design code). Reference G-1.B.

Reviewed testing and verification procedures used by the modeler.

Discussed the use of two broad categories of quality assurance: 1) within the modeling group, and 2) within the software engineering group.

Reviewed the testing performed for two of the vulnerability-related model updates: 1) square footage, and 2) mobile homes.

Reviewed the quality assurance procedure to test actual versus modeled losses using the 2012 and 2014 databases. This procedure was a result of an enhanced workflow procedure.

C-6 Model Maintenance and Revision*

*(*Significant Revision)*

A. The modeling organization shall maintain a clearly written policy for model revision, including verification and validation of revised components, databases, and data files.

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

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

D. The modeling organization shall maintain a list of all model versions since the initial submission for this year. Each model description shall have a unique version identification, and a list of additions, deletions, and changes that define that version.

Audit

1. All policies and procedures used to maintain the code, data, and documentation will be reviewed. For each component in the system decomposition, provide the installation date under configuration control, the current version identification, and the date of the most recent change(s).

2. The policy for model revision will be reviewed.

3. The tracking software will be reviewed and checked for the ability to track date and time.

4. The list of all model revisions as specified in C-6.D will be reviewed.

Pre-Visit Letter

49. C-6.D, page 274: Provide the model version history over the past 5 years, leading up to the version identified in the submission.

Verified: YES

Professional Team Comments:

Verified that there are two software tools used by the modeler for software maintenance.

Reviewed the policy for model revision.

Reviewed the Version Change Management Workflows document.

Reviewed the model version history over the past 5 years culminating in the most recent version.

C-7 Security

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

Audit

1. The written policy for all procedures and methods used to ensure the security of code, data, and documentation will be reviewed. Specify all security procedures.

2. Documented security procedures for access, client model use, anti-virus software installation, and off-site procedures in the event of a catastrophe will be reviewed.

Verified: YES

Professional Team Comments:

Reviewed the electronic security policy.

Verified that there were no security issues or breaches related to the model since the previous accepted model version.

Verified that the policy for security has not changed since the previous accepted model version.