Recommended Edits to the 12-22-14 Draft Statistical Flood Standards

Flood Standards Development Committee Meeting

April 22, 2015

SF-1, Flood Modeled Results and Goodness-of-Fit

Standard

AIR: **Technical**

Problem Statement: On the wind side, the Commission provides the list of historical hurricanes that, at minimum, should be included in the historical storm set. This forms the basis for the "historical results" referenced in this standard, as modelers create a small catalog of historical hurricanes and run the model on this catalog to produce historical results. There is no HURDAT equivalent on the flood side. In building the model AIR has used historical river flow data, but this river flow information is continuous and does not come with a label for a specific flood event.

The basis for much of the statistical testing done on the wind side is the modeled (i.e. stochastic) results and the historical (i.e. based on the historical storm set) results. It becomes important for the Commission to define a set of historical events in the base historical storm set before the standards can require reporting on "historical results." Unless the Commission is prepared to do this, we suggest distinguishing between historical modeled results and historical data observations and requiring statistical testing on the latter.

Amendatory Language:

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

Purpose

Professional Team: **Editorial**

Amendatory Language:

Many aspects of flood model development and implementation involve fitting a probability distribution to historical data for use in generating stochastic floods. Such fitted models shall be checked to ensure that the distributions are reasonable. The chi-square goodness-of-fit test may not be ~~a~~ sufficiently rigorous ~~methodology~~ for demonstrating the reasonableness of models of historical data.

This standard explicitly requires the modeling organization to have the results of data fitting with probability distributions available for the flood model assessments. Also, this standard requires the production of graphical and numerical statistical summaries by the modeling organization in advance of an audit (which could have the desirable effect in a self-audit of identifying potential problem areas).

Relevant Forms:	GF-3,	Statistical Flood Standards Expert Certification
	MHF-1,	~~Annual Flood Occurrence Rates~~ Historical Event Flood Extent and Depth Validation Maps
	AF-6,	Output Ranges
	SF-1,	Distributions of Stochastic Flood Parameters (Coastal, Inland)
	SF-~~1~~2,	Probability and Frequency of Florida Flood Events per Year
	SF-~~2~~3,	Examples of Flood Loss Exceedance Estimates
	~~SF-3,~~	~~Distributions of Stochastic Flood Parameters (Coastal, Fluvial, Pluvial)~~
	SF-4,	Flood Validation Comparisons
	SF-5,	Average Annual Zero Deductible Statewide Flood Loss Costs – Historical versus Modeled

Disclosures

Professional Team: **Technical/Editorial**

Amendatory Language:

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

~~1.~~

~~1.~~2. Describe the nature and results of the tests performed to validate the flood extent and depths~~footprints~~ generated.

~~2.~~3. Provide the date of loss of the insurance company data available for validation and verification of the flood model.

~~3.~~4. Provide an assessment of uncertainty in flood loss costs for output ranges using confidence intervals or other accepted scientific characterizations of uncertainty.

~~4.~~5. Justify any differences between the historical and modeled results using currently accepted scientific and statistical methods in the appropriate disciplines.

~~5.~~6. Provide graphical comparisons of modeled and historical data and goodness-of-fit tests. Examples to include are flood frequencies, ~~footprints~~flood extent and depths, and physical damage.

~~6.~~7. Provide a completed Form SF-~~1~~2, Probability and Frequency of Florida Flood Events per Year. Provide a link to the location of the form [insert hyperlink here].

~~7.~~8. Provide a completed Form SF-~~2~~3, Examples of Flood Loss Exceedance Estimates. Provide a link to the location of the form [insert hyperlink here].

Audit

Professional Team: **Technical/Editorial**

Amendatory Language:

1. Forms SF-1, Distributions of Stochastic Flood Parameters (Coastal, Inland), ~~Forms~~ SF-~~1~~ 2, ~~(~~Probability and Frequency of Florida Flood Events per Year~~)~~, and SF-~~2~~ 3, ~~(~~Examples of Flood Loss Exceedance Estimates~~), and SF-3 (Distributions of Stochastic Flood Parameters – Coastal, Fluvial, Pluvial)~~ 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 flood ~~footprints~~extent and depths, damage estimates, annual flood loss, and flood loss costs will be reviewed.

SF-2, Sensitivity Analysis for Flood Model Output

Purpose

Professional Team: **Editorial**

Amendatory Language:

Sensitivity analysis goes beyond mere quantification of the magnitude of the output (e.g., flood ~~footprint~~extent and depth, flood loss cost, etc.) by identifying and quantifying the input variables that impact the magnitude of the output when the input variables are varied simultaneously. The simultaneous variation of all input variables enables the modeling organization to detect interactions and to properly account for correlations among the input variables. Neither of these goals can be achieved by using one-factor-at-a-time variation, hence such an approach to sensitivity analysis does not lead to an understanding of how the input variables jointly affect the flood model output. The simultaneous variation of the input variables is an important diagnostic tool and provides needed assurance of the robustness and viability of the flood model output.

Disclosures:

Professional Team: **Technical/Editorial**

Amendatory Language:

1. Identify the most sensitive aspect of the flood model and the basis for making this determination. Identify other input variables that impact the magnitude of the output when the input variables are varied simultaneously. Describe ~~Provide a full discussion of~~ the degree to which these sensitivities affect output results and illustrate with an example.

Audit

Professional Team: **Editorial**

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

SF-3, Uncertainty Analysis for Flood Model Output

Purpose

Professional Team: **Editorial**

Amendatory Language:

Modeling organizations have traditionally quantified the magnitude of the uncertainty in the output (e.g., flood ~~footprint~~extent and depths, flood loss cost, etc.) through a variance calculation or by use of confidence intervals. While these statistics provide useful information, uncertainty analysis goes beyond a mere quantification of these statistics by quantifying the expected percentage reduction in the variance of the output that is attributable to each of the input variables. Identification of those variables that contribute to the uncertainty is the first step that can lead to a reduction in the uncertainty in the output. It is important to note that the key input variables identified in an uncertainty analysis are not necessarily the same as those in a sensitivity analysis nor are they necessarily in the same relative order. As with sensitivity analysis, uncertainty analysis is an important diagnostic tool and provides needed assurance of the robustness and viability of the flood model output.

SF-4, Flood Model Loss Cost Estimates

Standard

AIR: **Technical**

Problem Statement: We see a problem with measuring the error in loss costs coming from sampling process at the 10 x 10 meter resolution. Why has the Commission selected 10 x 10 meter for the standard? As a starting point the same convergence standards should be applied to the flood model as are applied to the wind model. The use of the flood model for ratemaking can be managed with the convergence limitations in mind, not the other way around.

Explanation: This edit will lessen the required convergence standard to be on par with what is required for the wind model.

Amendatory Language:

> At ~~a~~ the ~~ten meter by ten meter~~county level of resolution, the contribution to the error in flood loss cost estimates attributable to the sampling process shall be negligible for each of the modeled components (coastal flooding associated with storm surge, fluvial flooding, and pluvial flooding). However, the number of simulations to achieve negligible loss cost estimates may differ for each modeled component.

Professional Team: **Technical/Editorial**

Amendatory Language:

> At a ten meter by ten meter level of resolution, the contribution to the error in flood loss cost estimates attributable to the sampling process shall be negligible for each of the modeled components (i.e., for each of coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~). However, the number of simulations to achieve negligible loss cost estimates may differ for ~~each modeled~~the coastal and inland flooding components.

Disclosure

Professional Team: **Technical**

Amendatory Language:

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

SF-5, Replication of Known Flood Losses

Standard

AIR: **Technical**

Problem Statement: Given the fact that the government insures flood risk and the data is protected by privacy laws, we should remove the requirement about more than one company and multiple years of loss data. To produce true comparisons of modeled and historical losses, detailed exposures at the time of the event are needed, as well as a thorough understanding of the policy conditions and loss settlement. None of these are currently available. As the private flood market evolves over time, we can improve the standards, but we should start simple with what we have.

Amendatory Language:

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

Purpose

Professional Team: **Editorial**

Amendatory Language:

> Each flood model shall reasonably replicate past known events for flood frequency and severity. The Meteorological/Hydrological Flood Standards assess the flood model's flood event frequency projections and flood ~~footprints~~extent and depths. This standard applies to severity or the combined effects of flood ~~footprint~~extent and depths, flood vulnerability functions, and insurance flood loss limitations. To the extent possible, each of the three functions of flood ~~footprint~~extent and depths, flood vulnerability, and flood insurance ~~shall~~ are required to be separately tested and verified.
>
> Given a past flood event and a book of insured properties at the time of the flood event, the flood model ~~shall be able~~is required to provide expected flood losses.

Disclosures

Professional Team: **Technical**

Amendatory Language:

1. Describe the nature and results of the analyses performed to validate the flood loss projections generated for personal residential losses. Include analyses for ~~the latest five years~~ the events indicated in Disclosure 1 of MHF-4.

Audit

Professional Team: **Editorial**

Amendatory Language:

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

SF-6, Comparison of Projected Flood Loss Costs

Disclosures

Professional Team: **Editorial**

Amendatory Language:

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

Audit

Professional Team: **Editorial**

Amendatory Language:

1. Justify the following:
   a. Meteorological/Hydrological parameters,
   b. The departures, if any, from the flood ~~footprint~~extent and depths, flood vulnerability functions, or flood insurance functions applied to the actual flood events for the purposes of this test and those used in the flood model under consideration,
   c. Exposure assumptions.

Form SF-~~3~~1: Distributions of Stochastic Flood Parameters (Coastal, ~~Fluvial, Pluvial~~Inland)

Professional Team: **Editorial**

Amendatory Language:

Provide the probability distribution functional form used for each stochastic flood parameter in the flood model (one each for coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~). Provide a summary of the justification for each functional form selected for each general classification. Specify the relevant classification (coastal or inland) for each distribution.

Stochastic Flood Parameter (Function or Variable)/ (Coastal or Inland)	Functional Form of Distribution	Data Source	Year Range Used	Justification for Functional Form

Form SF-~~1~~2: Probability and Frequency of Florida Flood Events Per Year

Professional Team: **Technical**

Amendatory Language:

Complete the table below showing the probability and ~~modeled~~ frequency of Florida flood events per year. Modeled ~~probability~~ probabilities shall be rounded to four decimal places. The basis for the historical probabilities and frequencies are to be disclosed and should include the flooding events associated with hurricanes as given in Form AF-2. ~~The historical probabilities and frequencies below have been derived from the Flood Event Data Sources for the xxx year period [add dates] (as given in Form AF-2, Flood Event Data Sources Statewide Losses).~~ Exclusion of flood events that caused zero modeled Florida flood damage or additional Florida flood events included in the modeling organization flood data sources as identified in their response to Standard MHF-1 (Flood Event Data Sources) should be used to adjust the historical flood probabilities and frequencies provided here.

If the data are partitioned or modified, provide the historical flood probabilities and frequencies for the applicable partition (and its complement) or modification as well as the modeled flood probabilities and frequencies in additional copies of Form SF-~~1~~ 2 (Probability and Frequency of Florida Flood Events per Year).

Flood Model Results
Probability and Frequency of Florida Flood Events per Year

Number of Flood Events Per Year	Historical Probabilities*	Modeled Probabilities	Historical Frequencies*	Modeled Frequencies
0				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10 or more				

*Historical Probabilities and Historical Frequencies to be provided by the Commission.

Form SF-~~2~~3: Examples of Flood Loss Exceedance Estimates

Professional Team: **Technical**

Amendatory Language:

[Coastal, Inland, Combined, or Combined Only]

Provide projections of the aggregate personal residential insured flood losses for various probability levels using the notional risk data set specified in Form AF-1 (Zero Deductible Personal Residential Flood Loss Costs) and using the Florida Hurricane Catastrophe Fund's aggregate personal residential exposure data found within the file named "*hlpm2012c.exe.*" Provide the total average annual flood loss for the loss exceedance distribution. If the modeling methodology does not allow the flood model to produce a viable answer, please state so and why.

Part A

Return Period (years)	Probability of Exceedance	Estimated Flood Loss Notional Risk Data Set	Estimated Personal Residential Flood Loss
Top Event	N/A		
10,000	0.01%		
5,000	0.02%		
2,000	0.05%		
1,000	0.10%		
500	0.20%		
250	0.40%		
100	1.00%		
50	2.00%		
20	5.00%		
10	10.00%		
5	20.00%		

Part B

Mean (Total Average Annual Flood Loss)		
Median		
Standard Deviation		
Interquartile Range		
Sample Size		

Form SF-4: Flood Validation Comparisons

Professional Team: **Editorial**

Amendatory Language:

A. Provide five flood validation comparisons of actual personal residential exposures and flood loss to modeled exposures and flood loss. Provide these~~These~~ comparisons ~~must be provided~~ by line of insurance, construction type, policy coverage, county or other level of similar detail in addition to total flood losses. Include flood loss as a percent of total exposure. Total exposure represents the total amount of insured values (all coverages combined) in the area affected by the flood. This would include exposures for policies that did not have a flood loss. If this is not available, use exposures for only those policies that had a flood loss. Specify which was used. Also, specify the name of the flood event compared.

B. Provide a scatter plot of modeled vs. historical flood losses for each of the required flood validation comparisons. (Plot the historical flood losses on the *x*-axis and the modeled flood losses on the *y*-axis.)

Rather than using directly a specific published flood ~~footprint~~extent and depths, the water height, the duration of the flood event (time needed for flood waters to recede), water flows including wave action, rate of water flow along banks and structures, and the weight, pressure and energy generated by moving water and its volume underlying the modeled flood loss cost calculations must be produced by the flood model being evaluated and should be the same flood parameters as used in completing Form AF-2 (Flood Event Data Sources Statewide Losses).

Example Formats for Personal Residential Flood Loss:

Flood Event Description (location, date and duration of event) = _____

_____

Exposure = Total exposure or flood loss only (please specify) _____

Type = Coastal, Inland, or Combination Coastal/Inland = _____

Construction	Company Actual Flood Loss / Exposure	Modeled Flood Loss / Exposure	Difference
Wood Frame			
Masonry			
Other (specify)			
Total			

Flood Event Description (location, date and duration of event) = _____

_____

Exposure = Total exposure or flood loss only (please specify) _____

Type = Coastal, Inland, or Combination Coastal/Inland = _____

Coverage	Company Actual Flood Loss / Exposure	Modeled Flood Loss / Exposure	Difference
A			
B			
C			
D			
Total			

Form SF-5: Average Annual Zero Deductible Statewide Flood Loss Costs – Historical verus Modeled

Professional Team: **Technical**

Amendatory Language:

A. Provide the average annual zero deductible statewide personal residential flood loss costs produced using the list of floods in the flood data sources as defined in Standard MHF-~~1~~ 4 (Flood ~~Event Data Sources~~Characteristics) based on the Florida Hurricane Catastrophe Fund's aggregate personal residential exposure data found within the file named "*hlpm2012c.exe.*"

Average Annual Zero Deductible Statewide Personal Residential Flood Loss Costs

Time Period –	Historical Floods	Produced by Flood Model
Current Submission		

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

C. Provide ~~the~~ a 95% confidence interval on the difference~~s~~ between the means of the historical and modeled personal residential flood losses and identify its basis~~.~~

D. If the data are partitioned or modified, provide the average annual zero deductible statewide personal residential flood loss costs for the applicable partition (and its complement) or modification, as well as the modeled average annual zero deductible statewide personal residential flood loss costs in additional copies of Form SF-5 (Average Annual Zero Deductible Statewide Flood Loss Costs – Historical versus Modeled).