Edits to the Draft Meteorological Hydrological Flood Standards

Flood Standards Development Committee Meeting

February 19, 2015

MHF-1, Flood Event Data Sources

Standard

Professional Team: **Technical/Editorial**

B. The model shall incorporate relevant data sources in order to account for ~~the confluence of~~ meteorological and hydrological events and circumstances occurring either inside or outside of Florida that result in or contribute to flooding in Florida.

C. ~~Annual frequencies used in both f~~Flood model calibration and ~~flood model~~ validation shall be conducted using historical data consistent with peer reviewed ~~data sources,~~or publically developed data sources~~, or both types representing an unadjusted long-term record~~.

D. Calibration and validation shall encompass relevant flood event data sources required to model flood, which shall include, but not be limited to, coastal ~~flooding associated with storm surge, fluvial flooding,~~ and ~~pluvial~~ inland flooding, as well as any partitions or subsets.

Purpose

Professional Team: **Technical/Editorial**

As a minimum, the flood model shall include coastal, riverine, lacustrine, and surface water flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~.

Coastal flooding includes storm surge from high wind events and can occur along Atlantic and Gulf of Mexico shorelines, as well as in or near bays, estuaries, sounds, and other tidally connected water bodies. Storm surge can also occur on large lakes (e.g., Lake Okeechobee).

Riverine flooding includes flooding associated with defined channels and adjacent floodplains.

Lacustrine flooding includes flooding associated with lakes, ponds, and adjacent floodplains.

Surface water flooding includes flooding on land without defined channels, and is often called stormwater, drainage, urban flooding, or ponding.

Since riverine, lacustrine, and surface water flooding result from precipitation and runoff (not storm surge), they will be grouped together and referred to as inland flooding. Modeling of inland flooding may require one or more “sub-models” or “component models.”

Utilized ~~D~~data sources associated with each type of flooding will be ~~utilized~~documented, and the stochastic flood event data sources shall be scientifically defensible. If other flood sub-perils are included, they ~~should~~ shall be identified.

Disclosures

Professional Team: **Technical/Editorial**

1. Identify relevant data sources, the release dates, and the time periods used to develop and implement flood frequencies for coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~ into the flood model.

2. ~~If the modeling organization has made any modifications to original data sources related to flood frequencies and characteristics for any aspect of coastal flooding associated with storm surge, fluvial flooding, and pluvial flooding, provide justification for each such modification.~~Where the flood model incorporates modification, partitioning, or adjustment of the historical data leading to differences between modeled climatology and historical data, justify each modification and describe how it is incorporated. (moved and edited from Disclosure 4)

3. State whether the model includes flooding other than coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~. State whether the other flooding types are independent of the minimum required sub-perils of coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~.

~~4. Where the flood model incorporates short term or long term modification of the historical data leading to differences between modeled climatology and that in the original data, describe how this is incorporated.~~

~~5.~~4. Provide a completed Form MHF-1, Annual Flood Occurrence Rates for ~~storm surge, fluvial flooding, and pluvial~~coastal and inland flooding ~~by region or for specified locations~~, which includes data for various probabilities of exceedances (corresponding to 5, 25, 50, 100, 200, 500, and 1,000 year return periods). Provide a separate form for coastal and inland flooding subdivided for each specific location chosen. Provide a link to the location of the form [insert hyperlink here].

Audit

Professional Team: **Technical/Editorial**

2. ~~Reasoning and j~~Justification ~~underlying~~ for any ~~short-term and long-term variations in coastal flooding associated with storm surge, fluvial flooding, and pluvial flooding frequencies incorporated in the flood model will be reviewed~~modification, partitioning, or adjustment to historical data and the impact on flood model parameters and characteristics will be reviewed.

3. Modeled probabilities will be compared with the observed spatial distribution of flood frequencies across Florida using methods documented in currently accepted scientific literature. The goodness-of-fit of modeled to historical statewide and regional coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~ flood frequencies as provided in Form MHF-1 (Annual Flood Occurrence Rates by County) will be reviewed.

~~6. If the historical flood data are partitioned or modified, describe how the various flood parameters and characteristics are affected.~~

MHF-2, Flood Parameters (Inputs)~~and Characteristics~~

Standard

Professional Team: **Technical/Editorial**

A. The flood model shall be developed with consideration given to flood parameters ~~and characteristics~~ that are scientifically appropriate for modeling coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~. The modeling organization shall justify the use of all flood parameters ~~and characteristics~~ based on information currently available in scientific literature.

C. The land use and land cover (LULC) database shall be consistent with National Land Cover Database (NLCD) 2006 or later. Use of alternate datasets shall be justified. (moved from MHF-4.C)

Purpose:

Professional Team: **Technical/Editorial**

This standard requires that the modeling organization use only scientifically sound information for determining coastal and inland flooding ~~associated with storm surge, fluvial flooding and pluvial flooding~~ parameters ~~and characteristics. The stochastic flood event data sources shall be scientifically defensible. Any differences in the treatment of flood parameters between historical and stochastic floods shall be justified.~~

~~A f~~Flood parameter~~s is an~~are input~~s~~ to the flood model~~. Flood parameters~~ and are needed by the model to define or determine the nature, severity, and physical characteristics ~~items such as precipitation~~ associated with ~~a flood event, or items to define the nature of the fluvial and pluvial areas (e.g., catchments, river networks~~coastal and inland flooding.

Flood parameters for all flood types include topographic and LULC information and linear features such as levees, road embankments, causeways, and bridges.

Coastal flood parameters include tides, storm surge forcing by wind and barometric effects, associated wave conditions, and flood-related erosion.

Inland flood parameters include hydrologic soil group information and hydraulic structure and conveyance-system data (e.g., bridges, culverts, channels).

This standard requires that the flood model be implemented consistently with contemporary soil categories and LULC distributions. Note: The NLCD products referenced above are created by the Multi-Resolution Land Characteristics (MRLC) Consortium, a partnership of federal agencies led by the U.S. Geological Survey (USGS) and are updated every five years.

Any differences in the treatment of flood parameters between historical and stochastic floods shall be justified.

~~Flood characteristics are outputs of the flood model. An example of a flood characteristic is the modeled depth of flood water at a particular location.~~

~~Distributional properties associated with flood parameters shall be scientifically determined and recognized in the flood model.~~

Disclosures:

Professional Team: **Technical/Editorial**

1. For coastal and inland flood model components, ~~Identify~~ identify and justify the various flood parameters ~~and characteristics which are~~ used in ~~each of~~ the flood model ~~components: coastal flooding associated with storm surge, fluvial flooding, and pluvial flooding~~.

2. For coastal and inland flood model components, ~~Describe~~ describe the dependencies among model variables and specify any assumed mathematical dependencies among these variables ~~for each of the following components of the flood model:~~
   ~~a. Coastal flooding associated with storm surge,~~
   ~~b. fluvial flooding, and~~
   ~~c. pluvial flooding.~~

3. For coastal and inland flood model components, ~~Describe~~ describe the dependencies which exist among and between each ~~the following~~ component~~s of the flood model:~~
   ~~a. Coastal flooding associated with storm surge,~~
   ~~b. fluvial flooding, and~~
   ~~c. pluvial flooding.~~

5. Describe how any flood parameters are treated differently in the historical and stochastic flood event sets (e.g., ~~a~~ varying versus fixed ~~value in one event set and not the other~~).

~~6. For coastal flooding associated with storm surge, state whether the flood model simulates surface winds directly. If the storm surge component relies on conversion of winds between some other reference level or layer and the surface, describe the process used including the treatment of the inherent uncertainties in the conversion factor.~~

~~7.~~6. For coastal flood~~ing associated with storm surge~~ analyses, describe how the coastline is segmented (or partitioned) in determining the parameters for coastal flood frequency used in the flood model.

~~8.~~7. For ~~fluvial~~ inland flood analyses associated with riverine and lacustrine flooding, describe how the ~~fluvial area is~~rivers, lakes, and associated floodplains are segmented (or partitioned) in determining the parameters for flood frequency used in the flood model.

~~9.~~8. For ~~pluvial~~ inland flood analyses associated with surface water flooding, describe how the ~~pluvial~~ affected area is segmented (or partitioned) in determining the parameters for flood frequency used in the flood model.

~~10.~~9. Describe how any flood parameters change or ~~evolution~~ evolve during an individual flood life cycle (e.g., ~~of~~ the functional representation of Manning's roughness of trees varying with flood ~~parameters during an individual flood life cycle~~depth).

~~11.~~10. Describe any assumptions or calculations used in the model relating to antecedent conditions ~~in the flood extent and depth area~~(e.g., groundwater levels, lake levels, river discharges, tides, waves, etc.).

11. For coastal modeling, describe any assumptions or calculations for wave radiation stresses and their impact on storm surge stillwater elevations.

12. Describe any assumptions or calculations used in the model relating to future conditions (e.g., sea level rise, changes in precipitation patterns, changes in storm frequency or severity).

13. Provide the source, ~~and~~ resolution, and accuracy of the topography and bathymetry ~~and coastal topography used in the storm surge calculation at the risk location level~~ throughout the flood model domain.

~~12.~~14. Describe any assumptions or calculations used in the model relating to flood-induced erosion or topographic changes.

~~13.~~15. As applicable, describe the ~~method or~~ methods used to account for soil infiltration rates and saturation in the flood model. Provide citations to published papers, if any, used to develop and support the soil infiltration rate methodology.

16. ~~As applicable, d~~Describe the ~~method or~~ methods used to account for ~~soil saturation~~land-use conditions and future changes in land-use, if any, in the flood model. Provide citations to published papers, if any, used to develop and support the ~~soil saturation~~land-use evaluation methodology.

17. Provide the collection and publication dates of the soil and LULC data used in the flood model, and justify their applicability and timeliness for Florida.

18. Describe the methodology used to convert LULC information into a spatial distribution of hydrological parameters, including roughness coefficients, throughout the model domain.

~~14.~~19. For each parameter used in the model, provide the horizontal and vertical projection and datum references, if applicable. If any horizontal or vertical datum conversions are required, provide conversion factors and describe the conversion methodology utilized.

Audit

Professional Team: **Technical/Editorial**

2. Prepare graphical depictions of flood parameters as used in the flood model. Describe and justify:
   a. The data set basis for any fitted distributions, the methods used, and any smoothing techniques employed,
   b. The modeled dependencies among correlated parameters in the flood model and how they are represented,
   c. The ~~fitting methods used and any smoothing techniques employed~~dependencies between the coastal and inland flooding analyses.

~~3. For coastal flooding associated with storm surge, the treatment of the inherent uncertainty in the factor used to convert from a reference windfield to a geographic distribution of surface winds and the impact of the resulting winds upon the storm surge will be reviewed and compared with currently accepted scientific literature. Treatment of conversion factor uncertainty at a fixed time and location will be reviewed.~~

~~4~~3. Scientific literature cited in Standard GF-1 (Scope of the Computer Flood Model and Its Implementation) may be reviewed to determine applicability.

~~5. All external data sources that affect the model generated windfields associated with coastal flooding due to storm surge will be identified, and their appropriateness will be reviewed.~~

~~6. For coastal flooding associated with storm surge, describe how the relevant characteristics are calculated in the flood model.~~

~~7. For fluvial flooding, describe how the relevant characteristics are calculated in the flood model.~~

~~8. For pluvial flooding, describe how the relevant characteristics are calculated in the flood model.~~

~~9. For coastal flooding associated with storm surge, provide the frequency distribution of the flood extent and depth associated with each coastal segment.~~

~~10. For fluvial flooding, provide the frequency distribution of the flood extent and depth associated with each fluvial area segment.~~

~~11. For pluvial flooding, provide the frequency distribution of the flood extent and depth associated with each pluvial area segment.~~

~~12.~~ 4. Describe ~~how~~ the initial conditions for each flood event and how the flood event is initialized in an individual event calculation.

~~13. Provide a comparison of the flood extent and depth calculated in the model with historical flood events for five locations, each location from a different county.~~

~~14. Provide a comparison of the water depth calculated in the model for the same five locations and compare with the NOAA *Maximum of MEOW* for each location. The modeling organization should use the most reasonable vintage of the *MEOW* data for this exercise.~~

~~Provide a comparison to five NOAA validation case studies. (possible substitute to Audit 14 above using SLOSH data)~~

~~15.~~ 5. Provide any modeling organization specific research performed to develop the soil infiltration rates used in the flood model. Identify the databases used. This material will be reviewed in the context of the cited scientific literature.

~~16.~~ 6. Provide any modeling organization specific research performed to develop soil saturation in the food model. Identify the databases used. This material will be reviewed in the context of the cited scientific literature.

MHF-3, Wind and Pressure Field Structures for Storm Surge

Standard

Professional Team: **Technical**

A. Representations of the spatial and temporal structures of wind and pressure fields shall be employed to drive storm surge models.

B. The wind and pressure fields shall be based on contemporary scientific literature or developed using scientifically defensible methods.

C. Wind and pressure fields for coastal flood modeling shall be employed for at least two classes of storms: tropical cyclones and extra-tropical cyclones.

D. Wind and pressure fields that drive coastal flood models shall be modeled for a time period that extends from before the storm's passage over the continental shelf waters of Florida and neighboring states to the time the storm no longer affects flooding in Florida.

E. The features of modeled wind and pressure fields shall be consistent with those of historical storms affecting Florida.

Purpose

Professional Team: **Technical**

Storm surge is frequently the dominant component of flooding due to cyclonic storms, and wind is the dominant feature of cyclonic storms that drives surge. The representation of the windfield and related pressure field is, therefore, crucial to surge modeling. This standard ensures that the wind and pressure fields used to drive surge as part of flood models are scientifically sound and have been evaluated by comparison to historical storms affecting Florida. Modelers have leeway in their methods of representing wind and pressure fields, and different storm classes may well require different approaches.

Relevant Forms: GF-2A, Meteorological/Hydrological Flood Standards Meteorologist Expert Certification
GF-2B, Meteorological/Hydrological Flood Standards Hydrologist Expert Certification
AF-2, Flood Event Data Sources Statewide Losses

Disclosures

Professional Team: **Technical**

1. Describe the nature of the wind and pressure field representation (e.g., parametric or resampled reanalysis of historical storms).

2. Provide the historical data used to estimate parameters and to develop stochastic storm sets from reanalysis. Identify weights applied to the historic data.

3. If parametric gradient wind and pressure fields are employed, state and justify the choice of the parametric forms and the parameter values.

4. Provide a rotational (*y*-axis) versus radial (*x*-axis) plot of the average or default wind and pressure profiles for parametric, symmetric fields or a latitude-longitude map of typical reanalysis-based wind and pressure fields.

5. If parametric gradient wind and pressure fields are employed, describe how these winds are translated to surface winds (e.g., numerically via planetary boundary layer models or parametrically via empirical surface wind reduction factors and inflow angles). Discuss the associated uncertainties.

6. If parametric gradient wind and pressure fields are employed, describe how storm translation is accounted for when computing surface winds.

7. State if and describe how high-frequency windspeeds typically reported by meteorological agencies (e.g., 1-minute average peak) are converted to the longer averages more appropriate for driving storm surge models (e.g., 10- to 30-minute average peak).

8. Describe the derivation of surface water wind stress from surface windspeed. If a sea-surface drag coefficient is employed, describe how it is related to the surface windspeed. Provide a comparison of the sea-surface drag coefficient to coefficients from the scientific literature.

9. If windfields are employed as part of inland (non-surge) flood modeling, describe the nature of the windfield and the data used for validation.

Audit

Professional Team: **Technical**

1. All external data sources that affect the model generated wind and pressure fields associated with storm surge will be identified and their appropriateness reviewed, as will any weights applied to the data sources.

2. Calibration and evaluation of wind and pressure fields will be reviewed. Provide accepted scientific comparisons of simulated wind and pressure fields to historical storms.

3. Discuss the sensitivity of final flood results to the nature of the wind and pressure field representations.

4. Describe the over-land evolution of simulated wind and pressure fields and what impact, if any, they have on flooding.

5. The treatment of the inherent uncertainty in the factor used to convert from a reference windfield to a geographic distribution of surface winds and the impact of the resulting winds upon the storm surge will be reviewed and compared with currently accepted scientific literature. Treatment of conversion factor uncertainty at a fixed time and location will be reviewed.

MHF-4, Flood ~~Extent and Depth~~Characteristics (Outputs)

Standard

Professional Team: **Technical/Editorial**

C. ~~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.~~Inland flooding and its interaction with storm surge shall be represented.

Purpose

Professional Team: **Technical/Editorial**

This standard requires that the modeling organization use only scientifically sound information for determining inland and coastal flooding characteristics. Flood characteristics are outputs of the flood model. Example flood characteristics include modeled time history of flood depths, flow velocities, flow discharge, water surface elevations, wave conditions (in coastal flooding), and the maximum horizontal extent of flooding for a particular storm or return period event. ~~be implemented consistently with a contemporary land use and land cover distribution (including soil type).~~

The resulting surface flood extent, ~~and~~ depth, and other characteristics shall be representative of historical floods in Florida.

~~Note: The NLCD products are created by the Multi-Resolution Land Characteristics (MRLC) Consortium, a partnership of Federal agencies led by the U.S. Geological Survey (USGS) and are updated every five years.~~

Comparison of the flood ~~extent and depth~~characteristics produced by the stochastic flood events and historical flood ~~extent and depth~~events shall be documented, and variations between them shall be justified.

Disclosures

Professional Team: **Technical/Editorial**

1. Provide visual descriptions (sufficient to illustrate various regions in Florida) illustrating the flood ~~extent and depth~~characteristics for coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~.

2. For coastal flooding ~~associated with storm surge~~, describe how the model accounts for ~~erosion,~~ wave ~~action, velocity and other relevant flood characteristics in the calculation of flood damage~~generation and decay, wave breaking, wave run-up, and other wave effects.

~~2.~~3. For inland and coastal modeling, describe how the model accounts for flow velocity and other relevant flood characteristics in the calculation of flood damage.

~~3.~~4. Identify all hydrological variables that affect the flood extent, ~~and~~ depth, and other flood characteristics.

~~4.~~5. ~~Provide the collection and publication dates of the land use and land cover data and soil type data used in the flood model and justify their timeliness for Florida~~Describe the effect of any assumptions or calculations relating to antecedent conditions, as referenced in MHF-2, Disclosure 10, on the flood characteristics.

~~5.~~6. Describe ~~the methodology used to convert land use and land cover information into a spatial distribution of hydrological roughness coefficients in Florida as related to the flood extent and depth~~and provide visual depictions of how the characteristics of each flood model component are utilized in or interface with the other components, if applicable.

~~6.~~7. Demonstrate the consistency of the model-generated flood extent and depth with observed floods affecting Florida. Describe and justify the appropriateness of the databases used in the flood extent and depth validations.

~~7.~~8. ~~Describe how the model's flood extent and depth is consistent with the inherent differences in flood extent and depth for such diverse floods as Hurricane Dennis (2005) for coastal, South Florida flooding (2000), Tropical Storm Debby (2012) for North Florida, Hurricane Irene (1999), March 1993 storm on the Gulf Coast, May 2009 on the Space Coast, Hurricane Ivan (2004), and Hurricane Opal (1995)~~Provide comparisons of the model calculated and historical flood extents and depths for a minimum of XXX events. The minimum number will be divided into tropical, extra-tropical, and sub-tropical events as stipulated in Table MHF-1. The comparisons must demonstrate that the events selected are of sufficient variety, and each model component (storm surge, riverine/lacustrine flooding, and surface water flooding) is sufficiently robust, to capture important flood parameters, replicate historical flood characteristics, and accommodate the varied geographic, geologic, hydraulic, and LULC conditions in Florida.

9. For each of the coastal storm events in Disclosure 8, provide a comparison of the model calculated flood extents and water surface elevations with either the NOAA Maximum Envelope of Water (MEOW) or NOAA validation case studies using Sea, Lake, and Overland Surges from Hurricanes (SLOSH) data, if applicable. The modeling organization should use the most reasonable vintage of the MEOW data for this exercise.

~~8.~~10. Describe any variations in the treatment of the flood model flood extent and depth for stochastic versus historical floods and justify this variation.

~~9.~~11. Provide the level of resolution of the grid or areas modeled for the flood extent and depth and how the hydrological characteristics associated with the grid or areas are determined.

~~10.~~12. Provide a completed Form MHF-2, Maps of Flood Extent and Depth by Return Period. Explain any differences between modeled flood extent and depth and historical flood extent and depth. Provide a link to the location of the form [insert hyperlink here].

Audit

Professional Team: **Technical/Editorial**

2. Provide any modeling organization specific research performed to derive the ~~topography, land use and land cover and soil type distributions, including any associated~~ hydrological characteristics associated with the topography, soil type, and LULC distributions for the flood extent and depth ~~area~~.

3. Provide the current flood parameters used in calculating the flood loss costs for ~~three~~ XXX historical flood events~~ which include coastal flooding associated with storm surge, fluvial flooding, and pluvial flooding, and justify the choices used~~. Calculations shall be based on flood model results for coastal and inland flooding due to tropical, extra-tropical, and sub-tropical storm events. Selection of historical events not specified in Table MHF-1 shall be justified. Specification of flood parameters used in the models shall be justified for all storm events. Provide the resulting temporal and spatial distributions of ~~the surface hydrology~~any flood characteristics contributing to flood damage. These will be reviewed with Form AF-2 (Flood Event Data Sources Statewide Losses). [consider for deletion if Form AF-2 is not going to specify a list]

4. If applicable, present time-based contour animations (capable of being paused) to demonstrate scientifically reasonable temporal evolution of flood ~~extent and depth~~ characteristics. (Trade Secret item to be provided during the closed meeting portion of the Commission meeting to review the flood model for acceptability.)

5. Form MHF-2 (Maps of Flood Extent and Depth by Return Period) will be reviewed.

~~4.~~6. Describe how the relevant characteristics are calculated in the flood model for coastal and inland flooding. The methods by which each flood model component utilizes the characteristics of or interfaces with other model components, if applicable, will be reviewed.

~~5.~~7. Provide the flood elevation frequency distributions associated with each segment for coastal and inland flooding.

~~6.~~8. The comparison of the calculated characteristics with historical flood events will be reviewed. The selected locations and corresponding storm events will be reviewed to verify sufficient representation of the variety of geographic areas and tropical, extra-tropical, and sub-tropical storm events that result in flooding in Florida. While it is expected that the location/storm event combinations selected for coastal and inland flooding will differ; if a combination is applicable to multiple of the conditions, a discussion of the appropriateness shall be submitted and reviewed.

~~6.~~9. The comparison of the flood extents and water surface elevations calculated in the model with the NOAA Maximum of MEOW or NOAA validation studies using SLOSH data for each location will be reviewed, if applicable. The vintage of the MEOW data used for this exercise will be reviewed.

MHF-5, Flood Probabilities and Severities

Standard

Professional Team: **Editorial**

A. Modeled probability distributions of flood parameters and characteristics shall be consistent with historical floods for Florida resulting from coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~.

Purpose

Professional Team: **Editorial**

This standard requires that the modeled probability distributions of flood parameters and characteristics be consistent with those documented in official meteorological and hydrological databases. Consistent means that spatial distributions of modeled flood probabilities accurately depict coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~ in Florida. This standard addresses consideration of flooding events in neighboring states (e.g., Georgia) which could impact Florida (e.g., Chattahoochee River floods from massive rains in North Georgia).

~~This standard also notes the necessity to recognize the impacts from flooding driven by wind related events.~~

Audit

Professional Team: **Editorial**

2. Describe and support the method of generating stochastic coastal and inland ~~flooding associated with storm surge, fluvial, and pluvial~~ flood events.

3. Describe and support the method of determining flood extent and depth for coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~.

5. Form SF-3 (Distributions of Stochastic Flood Parameters – Coastal~~, Fluvial, Pluvial~~ and Inland) will be reviewed for the probability distributions and data sources.

6. Comparisons of modeled flood probabilities and characteristics for coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~ against the available historical record will be reviewed. Modeled probabilities from any subset, trend, or fitted function will be reviewed, compared, and justified against this 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.

~~7. Comparisons of coastal flood extremes will be reviewed and compared with the historically-determined Maximum Envelope of Water (*MEOW*) database at a county level or finer.~~

MHF-6, Modeling of Flood Mitigation and Prevention Measures and Their Failures

Purpose

Professional Team: **Technical**

Flood mitigation and prevention measures include permanent features (e.g., levees, floodwalls, seawalls, flap gates), as well as activities that are temporary or ongoing or require human intervention to be activated (e.g., tide gates, temporary flood barriers, water level reduction behind dams prior to storm events, emergency pumping, dune construction, beach nourishment). This standard ensures that flood mitigation and prevention measures are accounted for and updated on a periodic basis. It also ensures that any treatment of the potential failure of flood mitigation or prevention measures properly reflects the scientific and engineering basis.

Disclosures

Professional Team: **Technical/Editorial**

1. If applicable, describe the methodology to account for flood mitigation and prevention measures in the flood model and indicate if these measures can be set (either to on or ~~to~~ off) in the flood model.

2. Describe how temporary/ongoing flood mitigation and prevention measures and measures requiring human intervention are incorporated into the flood model. Consider how much time is required to construct, install or activate such measures, as compared with warning time that may be available before a flood event. Consider the likelihood of construction/installation/ activation based on reports in the literature for past storm events.

~~2.~~3. List the flood mitigation and prevention measures ~~used~~ incorporated in the flood model and the sources of all data employed.

~~3.~~4. If applicable, illustrate the distributions of flood extent, ~~and~~ depth, and other characteristics ~~distributions~~ showing the impact of flood mitigation and prevention measures versus no flood mitigation and prevention measures.

~~7~~8. State whether the flood model incorporates ~~nature discharge of flood waters~~natural or intentional discharge of flood waters by governmental or other human actions for flood mitigation purposes. If so, describe how this is handled in the flood model.

MHF-7, Logical Relationships of Flood Characteristics

Standard

Professional Team: **Technical/Editorial**

B. The interaction of ~~coastal flooding associated with~~ storm surge and inland flooding shall increase the flood extent and depth area, all other factors held constant.

D. The larger the ~~area of the~~ over~~-~~ water ~~windfield~~storm, as measured by the area enclosed by windspeed or pressure contours, the greater the ~~coastal flood~~storm surge extent and depth area, all other factors held constant.

E. ~~The coastal flooding associated with s~~Storm surge shall increase with a shallow and gently sloping shoreline, all other factors held constant.

G. Coastal wave heights and periods shall increase with windspeed, subject to depth, fetch, or duration limits, all other factors held constant.

~~G.~~H. The ~~fluvial~~ inland flood extent and depth associated with riverine and lacustrine flooding shall increase with increasing discharge in the river.

Disclosures

Professional Team: **Technical/Editorial**

1. Provide a sample ~~hydro~~graph of water surface elevation and discharge ~~(rate of flow~~ versus time~~)~~ associated with inland flooding for ~~an area in~~ each region ~~of the~~in Florida: Panhandle, Gulf Coast, North Florida, Central Florida, and South Florida. Discuss how the flood characteristics result in logical relationships.

2. Provide sample plots and tabulations of storm surge elevations and associated wave conditions at open coast and bay/estuarine locations around the Florida coastline. The number of examples shall be sufficient to demonstrate model applicability to a variety of geographic, oceanographic, hydraulic, and meteorological conditions.

Form MHF-1: Annual Flood Occurrence Rates by County

Professional Team: **Technical/Editorial**

A. Provide annual flood occurrence rates for ~~storm surge, fluvial, and pluvial~~coastal and inland flooding ~~by region or for specified locations,~~ which includes data for ~~various~~ the probabilities of exceedance ~~(~~corresponding to 5, 25, 50, 100, 200, 500, and 1,000 year return periods~~)~~. A separate form shall be provided for coastal and inland flooding and shall be subdivided for each specific location chosen. Annual flood occurrence rates shall be rounded to four decimal places.

Form MHF-2: Maps of Flood Profiles by Return Period

Professional Team: **Editorial**

Historical Florida Floods

A. Identify six recent historical Florida floods that illustrate coastal and inland flooding ~~associated with storm surge, fluvial flooding, and pluvial flooding~~.

B. Provide exhibits for the selected historical flood events illustrating modeled return periods for different river or coastal segments.

   Plot the locations and numerical measures of the maximum flood level relative to the local datum for ~~storm surge, fluvial areas, or pluvial~~coastal and inland areas on each contour map for the six historical events.

Modeled Florida Floods

C. Demonstrate the consistency of the spatial distribution of model-generated flood extent and depth with observed flood extent and depth for ~~storm surge, fluvial, and pluvial~~coastal and inland floods affecting Florida. Contour colors will be the same as those used for the maps provided in response to B above.