**Meteorological Standards**

**M-1 Base Hurricane Storm Set\***

*(\*Significant Revision)*

***A. The Base Hurricane Storm Set is the National Hurricane Center HURDAT2 as of April 11, 2017 (or later), incorporating the period 1900-2016. Annual frequencies used in both hurricane model calibration and hurricane model validation shall be based upon the Base Hurricane Storm Set. Complete additional season increments based on updates to HURDAT2 approved by the Tropical Prediction Center/National Hurricane Center are acceptable modifications to these data. Peer reviewed atmospheric science literature may be used to justify modifications to the Base Hurricane Storm Set.***

1. ***Any trends, weighting, or partitioning shall be justified and consistent with current scientific and technical literature. Calibration and validation shall encompass the complete Base Hurricane Storm Set as well as any partitions.***

Purpose: The Base Hurricane Storm Set covers the period 1900-2016. The primary use of this Base Hurricane Storm Set is in both calibration and validation of modeled versus historical hurricanes impacting Florida. Failure to update modeled landfall statistics based on changes in the Base Hurricane Storm Set through the 2016 hurricane season is not acceptable.

The National Hurricane Center periodically updates the online version of HURDAT2 incorporating the latest approved reanalysis updates, including the latest hurricane season, and other modifications to historical storms. Since the online database is the source for HURDAT2, a freeze date has been specified for the HURDAT2 version to be used.

Variations between modeling organization hurricane characteristics and the HURDAT2 fields are expected; however, any variations in the track or intensity data from HURDAT2 must be justified as described in the standard.

Relevant Forms: G-2, Meteorological Standards Expert Certification

M-1, Annual Occurrence Rates

A-2A, Base Hurricane Storm Set Statewide Hurricane Losses (2012 FHCF Exposure Data)

A-2B, Base Hurricane Storm Set Statewide Hurricane Losses (2017 FHCF Exposure Data)

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

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

**Disclosures**

1. Specify the Base Hurricane Storm Set release date and the time period used to develop and implement landfall and by-passing hurricane frequencies into the hurricane model.
2. If the modeling organization has made any modifications to the Base Hurricane Storm Set related to landfall frequency and characteristics, provide justification for such modifications.
3. If the hurricane model incorporates short-term, long-term, or other systematic modification of the historical data leading to differences between modeled climatology and that in the Base Hurricane Storm Set, describe how this is incorporated.
4. Provide a completed Form M-1, Annual Occurrence Rates. Provide a link to the location of the form [insert hyperlink here].

**Audit**

1. The modeling organization Base Hurricane Storm Set will be reviewed.
2. A flowchart illustrating how changes in the HURDAT2 database are used in the calculation of landfall distribution will be reviewed.
3. Changes to the modeling organization Base Hurricane Storm Set from the previously-accepted hurricane model 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, long-term, or other systematic variations in annual hurricane frequencies incorporated in the hurricane model will be reviewed.
5. Modeled probabilities will be compared with observed hurricane frequency using methods documented in current scientific and technical 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 HURDAT2 database. In the case of partitioning, modeled probabilities from the partition and its complement will be reviewed and compared with the complete HURDAT2 database.

**M-2 Hurricane Parameters and Characteristics**

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

Purpose: Scientifically sound information is to be used for determining hurricane parameters and characteristics. The stochastic storm set is to include only hurricanes that have realistic hurricane characteristics. Any differences in the treatment of hurricane parameters between historical and stochastic storms must be justified.

Relevant Forms: G-2, Meteorological Standards Expert Certification

S-3, Distributions of Stochastic Hurricane Parameters

**Disclosures**

1. Identify the hurricane parameters (e.g., central pressure, radius of maximum winds) that are used in the hurricane model.
2. Describe the dependencies among variables in the windfield component and how they are represented in the hurricane model, including the mathematical dependence of modeled windfield as a function of distance and direction from the center position.
3. Identify whether hurricane parameters are modeled as random variables, functions, or fixed values for the stochastic storm set. Provide rationale for the choice of parameter representations.
4. Describe if and how any hurricane parameters are treated differently in the historical and stochastic storm sets and provide rationale.
5. State whether the hurricane model simulates surface winds directly or requires conversion between some other reference level or layer and the surface. Describe the source(s) of conversion factors and the rationale for their use. Describe the process for converting the modeled vortex winds to surface winds including the treatment of the inherent uncertainties in the conversion factor with respect to location of the site compared to the radius of maximum winds over time. Justify the variation in the surface winds conversion factor as a function of hurricane intensity and distance from the hurricane center.
6. Describe how the windspeeds generated in the windfield model are converted from sustained to gust and identify the averaging time.

1. Describe the historical data used as the basis for the hurricane model’s hurricane tracks. Discuss the appropriateness of the hurricane model stochastic hurricane tracks with reference to the historical hurricane data.
2. If the historical data are partitioned or modified, describe how the hurricane parameters are affected.
3. Describe how the coastline is segmented (or partitioned) in determining the parameters for hurricane frequency used in the hurricane model. Provide the hurricane frequency distribution by intensity for each segment.

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

**Audit**

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

2. Graphical depictions of hurricane parameters as used in the hurricane model will be reviewed. Descriptions and justification of the following will be reviewed:

1. The dataset basis for the fitted distributions, the methods used, and any smoothing techniques employed,
2. The modeled dependencies among correlated parameters in the windfield component and how they are represented, and
3. The asymmetric structure of hurricanes.

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 current scientific and technical 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 Hurricane 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. Description of and justification for the value(s) of the far-field pressure used in the hurricane model will be reviewed.

**M-3 Hurricane Probability Distributions**

1. ***Modeled probability distributions of hurricane parameters and characteristics shall be consistent with historical hurricanes in the Atlantic basin.***
2. ***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).***
3. ***Hurricane models shall use maximum one-minute sustained 10-meter windspeed when defining hurricane landfall intensity. This applies both to the Base Hurricane Storm Set used to develop landfall frequency distributions as a function of coastal location and to the modeled winds in each hurricane which causes damage. The associated maximum one-minute sustained 10-meter windspeed shall be within the range of windspeeds (in statute miles per hour) categorized by the Saffir-Simpson Hurricane Wind Scale.***

**Saffir-Simpson Hurricane Wind Scale:**

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

Purpose: The modeled probability distributions of hurricane parameters and characteristics are to be consistent with those documented in current scientific and technical literature. Consistent means that spatial distributions of modeled hurricane probabilities accurately depict those of vulnerable coastlines in Florida and neighboring states.

The probability of occurrence of hurricanes is to reasonably reflect the historical record with respect to intensities and geographical locations. Extension beyond Florida’s boundaries demonstrates continuity of methodology.

Relevant Forms: G-2, Meteorological Standards Expert Certification

M-1, Annual Occurrence Rates

A-2A, Base Hurricane Storm Set Statewide Hurricane Losses (2012 FHCF Exposure Data)

A-2B, Base Hurricane Storm Set Statewide Hurricane Losses (2017 FHCF Exposure Data)

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

S-3, Distributions of Stochastic Hurricane Parameters

**Disclosures**

1. Provide a complete list of the assumptions used in creating the hurricane characteristics databases.
2. Provide a brief rationale for the probability distributions used for all hurricane parameters and characteristics.

**Audit**

1. Demonstration of the quality of fit extending beyond the Florida border will be reviewed by showing results for appropriate coastal segments in Alabama, Georgia, and Mississippi.
2. The method and supporting material for selecting stochastic storm tracks will be reviewed.
3. The method and supporting material for selecting storm track strike intervals will be reviewed. If strike locations are on a discrete set, the landfall points for major metropolitan areas in Florida will be reviewed.
4. Any modeling-organization-specific research performed to develop the functions used for simulating hurricane model variables and to develop databases will be reviewed.
5. Form S-3, Distributions of Stochastic Hurricane Parameters, will be reviewed.

**M-4 Hurricane Windfield Structure**

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

***B. The land use and land cover (LULC) database shall be consistent with National Land Cover Database (NLCD) 2011 or later. Use of alternate datasets 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 hurricane model windfield shall account for the effects of the vertical variation of winds if not accounted for in the vulnerability functions.***

Purpose: The windfield model is to be implemented consistently with a contemporary land use and land cover distribution and with the vertical distribution of the hurricane boundary layer winds where applicable. The resulting surface windfield is required to be representative of historical storms in Florida and neighboring states.

Relevant Forms: G-2, Meteorological Standards Expert Certification

M-2, Maps of Maximum Winds

A-2A, Base Hurricane Storm Set Statewide Hurricane Losses (2012 FHCF Exposure Data)

A-2B, Base Hurricane Storm Set Statewide Hurricane Losses (2017 FHCF Exposure Data)

**Disclosures**

1. Provide a rotational windspeed (*y*-axis) versus radius (*x*-axis) plot of the average or default symmetric wind profile used in the hurricane model and justify the choice of this wind profile. If the windfield represents a modification from the previous submission, plot the old and new profiles on the same figure using consistent inputs. Describe variations between the old and new profiles with references to historical storms.
2. Describe how the vertical variation of winds is accounted for in the hurricane model where applicable. Document and justify any difference in the methodology for treating historical and stochastic storm sets.
3. Describe the relevance of the formulation of gust factor(s) used in the hurricane model.
4. Identify all non-meteorological variables (e.g., surface roughness, topography) that affect windspeed estimation.
5. Provide the collection and publication dates of the land use and land cover data used in the hurricane model and justify their timeliness for Florida.
6. Describe the methodology used to convert land use and land cover information into a spatial distribution of roughness coefficients in Florida and neighboring states.
7. Demonstrate the consistency of the spatial distribution of model-generated winds with observed windfields for hurricanes affecting Florida. Describe and justify the appropriateness of the databases used in the windfield validations.
8. Describe how the hurricane model’s windfield is consistent with the inherent differences in windfields for such diverse hurricanes as Hurricane King (1950), Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005).
9. Describe any variations in the treatment of the hurricane model windfield for stochastic versus historical storms and justify this variation.
10. Provide a completed Form M-2, Maps of Maximum Winds. Explain the differences between the spatial distributions of maximum winds for open terrain and actual terrain for historical storms. Provide a link to the location of the form [insert hyperlink here].

**Audit**

1. Any modeling-organization-specific research performed to develop the windfield functions used in the hurricane model will be reviewed. The databases used will be reviewed.
2. Any modeling-organization-specific research performed to derive the roughness distributions for Florida and neighboring states will be reviewed.
3. The spatial distribution of surface roughness used in the hurricane model will be reviewed.
4. The previous and current hurricane parameters used in calculating the hurricane loss costs for the LaborDay03 (1935) and NoName09 (1945) landfalls will be reviewed. Justification for the choices used will be reviewed. The resulting spatial distribution of winds will be reviewed with Form A-2A, Base Hurricane Storm Set Statewide Hurricane Losses (2012 FHCF Exposure Data) and Form A-2B, Base Hurricane Storm Set Statewide Hurricane Losses (2017 FHCF Exposure Data).

1. For windfields not previously reviewed, detailed comparisons of the hurricane model windfield with Hurricane King (1950), Hurricane Charley (2004), Hurricane Jeanne (2004), and Hurricane Wilma (2005) will be reviewed.
2. For windfield and pressure distributions not previously reviewed, time-based contour animations (capable of being paused) demonstrating scientifically-reasonable windfield characteristics will be reviewed.
3. Representation of vertical variation of winds in the hurricane model, where applicable, will be reviewed.
4. Form M-2, Maps of Maximum Winds, will be reviewed.

**M-5 Landfall and Over-Land Weakening Methodologies**

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

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

Purpose: Evaluation of intensity at landfall, weakening of hurricanes over-land, and the transition of winds from ocean to land are to be consistent with up-to-date depictions of appropriate surface characteristics.

Relevant Form: G-2, Meteorological Standards Expert Certification

**Disclosures**

1. Describe and justify the functional form of hurricane decay rates used by the hurricane model.

2. Provide a graphical representation of the modeled decay rates for Florida hurricanes over time compared to wind observations.

3. Describe the transition from over-water to over-land boundary layer simulated in the hurricane model.

4. Describe any changes in hurricane parameters, other than intensity, resulting from the transition from over-water to over-land.

5. Describe the representation in the hurricane model of passage over non-continental U.S. land masses on hurricanes affecting Florida.

6. Describe any differences in the treatment of decay rates in the hurricane model for stochastic hurricanes compared to historical hurricanes affecting Florida.

**Audit**

1. The variation in over-land decay rates used in the hurricane model will be reviewed.
2. Comparisons of the hurricane 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. 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 will be reviewed.

**M-6 Logical Relationships of Hurricane Characteristics**

1. ***The magnitude of asymmetry shall increase as the translation speed increases, all other factors held constant.***
2. ***The mean windspeed shall decrease with increasing surface roughness (friction), all other factors held constant.***

Purpose: Logical relationships demonstrate physical consistency of the hurricane model windfield.

Relevant Forms: G-2, Meteorological Standards Expert Certification

M-3, Radius of Maximum Winds and Radii of Standard Wind

Thresholds

**Disclosures**

* 1. Describe how the asymmetric structure of hurricanes is represented in the model.

2. Provide a completed Form M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds. Provide a link to the location of the form [insert hyperlink here].

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

**Audit**

1. Form M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds, and the modeling organization’s sensitivity analyses will be reviewed.
2. Justification for the relationship between central pressure and radius of maximum winds will be reviewed. The relationships among intensity, Rmax, and their changes will be reviewed.
3. Justification for the variation of the asymmetry with the translation speed will be reviewed.
4. Methods (including any software) used in verifying these logical relationships will be reviewed.

**Form M-1: Annual Occurrence Rates**

Purpose: This form illustrates the differences among statewide and regional frequencies of landfalling and by-passing Florida hurricanes for historical and modeled hurricanes. The historical events are derived from the Base Hurricane Storm Set with possible adjustments by the modeling organization as specified in Standard M-1, Base Hurricane Storm Set.

1. Provide a table of annual occurrence rates for landfall from the dataset defined by marine exposure that the hurricane model generates by hurricane category (defined by maximum windspeed at landfall in the Saffir-Simpson Hurricane Wind Scale) for the entire state of Florida and additional regions as defined in *Figure 3*.List the annual occurrence rate per hurricane category. Annual occurrence rates shall be rounded to four decimal places in the printed form.

The historical frequencies below have been derived from the Base Hurricane Storm Set as defined in Standard M-1, Base Hurricane Storm Set. If the modeling organization Base Hurricane Storm Set differs from that defined in Standard M-1 (for example, using a different historical period), the historical rates in the table shall be edited to reflect this difference (see below). Hurricane intensity for by-passing hurricanes is the intensity at maximum windspeed, not the windspeed on Florida.

Question from RMS:

Further clarification is requested on Form M-1: Are four decimal points required for both printed and electronic copies of this form?

1. Describe hurricane model variations from the historical frequencies.
2. Provide vertical bar graphs depicting distributions of hurricane frequencies by category by region of Florida (*Figure 3*), for the neighboring states of Alabama/Mississippi and Georgia, and for by-passing hurricanes. For the neighboring states, statistics based on the closest coastal segment to the state boundaries used in the hurricane model are adequate.
3. If the data are partitioned or modified, provide the historical annual occurrence rates for the applicable partition (and its complement) or modification as well as the modeled annual occurrence rates in additional copies of Form M-1, Annual Occurrence Rates.
4. List all hurricanes added, removed, or modified from the previously-accepted hurricane model version of the Base Hurricane Storm Set.
5. Provide this form in Excel format. The file name shall include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include Form M-1, Annual Occurrence Rates, in a submission appendix.

Note: Except where specified, Number of Hurricanes does not include By-Passing Hurricanes. Each time a hurricane goes from water to land (once per region) it is counted as a landfall in that region. However, each hurricane is counted only once in the Entire State totals. Hurricanes recorded for neighboring states need not have reported damaging winds in Florida.

Form M-1, Annual Occurrence Rates, Form A-2A, Base Hurricane Storm Set Statewide Hurricane Losses (2012 FHCF Exposure Data), Form A-2B, Base Hurricane Storm Set Statewide Hurricane Losses (2017 FHCF Exposure Data), and Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, are based on the 117 year period 1900-2016 (consistent with Standard M-1, Base Hurricane Storm Set). It is intended that the storm set underlying Forms M-1, Annual Occurrence Rates, A-2A, Base Hurricane Storm Set Statewide Hurricane Losses (2012 FHCF Exposure Data), Form A-2B, Base Hurricane Storm Set Statewide Hurricane Losses (2017 FHCF Exposure Data), and S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, will be the same.

As specified in Standard M-1, Base Hurricane Storm Set, the modeling organization may exclude hurricanes that caused zero modeled damage, or include additional complete hurricane seasons, or may modify data for historical storms based on evidence in current scientific and technical literature. This may result in the modeling organization including additional landfalls in Florida and neighboring states to those listed in Form A-2A, Base Hurricane Storm Set Statewide Hurricane Losses (2012 FHCF Exposure Data), and Form A-2B, Base Hurricane Storm Set Statewide Hurricane Losses (2017 FHCF Exposure Data), for Florida or counted in Form M-1, Annual Occurrence Rates, in the case of neighboring states. In this situation, the historical numbers in Form M-1, Annual Occurrence Rates, should be updated to agree with the modeling organization Base Hurricane Storm Set.

Any additional *Florida* hurricanes should be included in Form A-2A, Base Hurricane Storm Set Statewide Hurricane Losses (2012 FHCF Exposure Data) and Form A-2B, Base Hurricane Storm Set Statewide Hurricane Losses (2017 FHCF Exposure Data), as instructed there, and the historical landfall counts in Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year, should be updated.

In some circumstances, the modeling organization windfield reconstruction of a historical storm may indicate that it is a by-passing hurricane (the modeling organization windfield results in damaging winds somewhere in the state). In this situation, the historical numbers in Form M-1, Annual Occurrence Rates, should be updated to agree with the modeling organization Base Hurricane Storm Set, but no changes are required for Form A-2A, Base Hurricane Storm Set Statewide Hurricane Losses (2012 FHCF Exposure Data), Form A-2B, Base Hurricane Storm Set Statewide Hurricane Losses (2017 FHCF Exposure Data), or Form S-1, Probability and Frequency of Florida Landfalling Hurricanes per Year.

**Annual Occurrence Rates**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Entire State** | | | | **Region A – NW Florida** | | | |
| **Historical** | | **Modeled** | | **Historical** | | **Modeled** | |
| **Category** | **Number** | **Rate** | **Number** | **Rate** | **Number** | **Rate** | **Number** | **Rate** |
| 1 | 22 | 0.19 |  |  | 13 | 0.11 |  |  |
| 2 | 18 | 0.16 |  |  | 7 | 0.06 |  |  |
| 3 | 15 | 0.13 |  |  | 7 | 0.06 |  |  |
| 4 | 10 | 0.09 |  |  | 0 | 0.00 |  |  |
| 5 | 2 | 0.02 |  |  | 0 | 0.00 |  |  |
|  | | | | | | | | |
|  | **Region B – SW Florida** | | | | **Region C – SE Florida** | | | |
| **Historical** | | **Modeled** | | **Historical** | | **Modeled** | |
| **Category** | **Number** | **Rate** | **Number** | **Rate** | **Number** | **Rate** | **Number** | **Rate** |
| 1 | 7 | 0.06 |  |  | 7 | 0.06 |  |  |
| 2 | 4 | 0.03 |  |  | 6 | 0.05 |  |  |
| 3 | 6 | 0.05 |  |  | 5 | 0.04 |  |  |
| 4 | 4 | 0.03 |  |  | 6 | 0.05 |  |  |
| 5 | 0 | 0.00 |  |  | 2 | 0.02 |  |  |
|  | | | | | | | | |
|  | **Region D – NE Florida** | | | | **Florida By-Passing Hurricanes** | | | |
| **Historical** | | **Modeled** | | **Historical** | | **Modeled** | |
| **Category** | **Number** | **Rate** | **Number** | **Rate** | **Number** | **Rate** | **Number** | **Rate** |
| 1 | 1 | 0.01 |  |  | 3 | 0.03 |  |  |
| 2 | 2 | 0.02 |  |  | 2 | 0.02 |  |  |
| 3 | 0 | 0.00 |  |  | 4 | 0.03 |  |  |
| 4 | 0 | 0.00 |  |  | 0 | 0.00 |  |  |
| 5 | 0 | 0.00 |  |  | 0 | 0.00 |  |  |
|  | | | | | | | | |
|  | **Region E – Georgia** | | | | **Region F – Alabama/Mississippi** | | | |
| **Historical** | | **Modeled** | | **Historical** | | **Modeled** | |
| **Category** | **Number** | **Rate** | **Number** | **Rate** | **Number** | **Rate** | **Number** | **Rate** |
| 1 | 0 | 0.00 |  |  | 6 | 0.05 |  |  |
| 2 | 2 | 0.02 |  |  | 4 | 0.03 |  |  |
| 3 | 0 | 0.00 |  |  | 5 | 0.04 |  |  |
| 4 | 0 | 0.00 |  |  | 0 | 0.00 |  |  |
| 5 | 0 | 0.00 |  |  | 1 | 0.01 |  |  |

***Figure 3***

State of Florida and Neighboring States

**By Region**



**F**

**(Alabama/**

**Mississippi)**

**E**

**(Georgia))**

**Form M-2: Maps of Maximum Winds**

Purpose: This form illustrates the ability of the hurricane model to simulate regional variations in historical windspeeds from hurricanes and the differences between the spatial distributions of maximum winds for open terrain and actual terrain.

A. Provide color-coded contour plots on maps with ZIP Code boundaries of the maximum winds for the modeled version of the Base Hurricane Storm Set for land use set for open terrain and for land use set for actual terrain. Plot the position and values of the maximum windspeeds on each contour map.

B. Provide color-coded contour plots on maps with ZIP Code boundaries of the maximum winds for a 100-year and a 250-year return period from the stochastic storm set for land use set for open terrain and for land use set for actual terrain. Plot the position and values of the maximum windspeeds on each contour map.

Actual terrain is the roughness distribution used in the standard version of the hurricane model as defined by the modeling organization. Open terrain uses the same roughness length of 0.03 meters at all land points.

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

The same color scheme and increments shall be used for all maps.

Use the following eight isotach values and interval color-coding:

* 1. Minimum damaging Blue
  2. 50 mph Medium Blue
  3. 65 mph Light Blue
  4. 80 mph White
  5. 95 mph Light Red
  6. 110 mph Medium Red
  7. 125 mph Red
  8. 140 mph Magenta

Contouring in addition to these isotach values may be included.

C. Include Form M-2, Maps of Maximum Winds, in a submission appendix.

**Form M-3: Radius of Maximum Winds and**

Radii of Standard Wind Thresholds

Purpose: This form illustrates the physical consistency of the hurricane model’s windfield.

1. For the central pressures in the table below, provide the first quartile (1Q), median (2Q), and third quartile (3Q) values for (1) the radius of maximum winds (Rmax) used by the hurricane model to create the stochastic storm set, and the first quartile (1Q), median (2Q), and third quartile (3Q) values for the outer radii of (2) Category 3 winds (>110 mph), (3) Category 1 winds (>73 mph), and (4) gale force winds (>40 mph).
2. Describe the procedure used to complete this form.

C. Identify other variables that influence Rmax.

D. Specify any truncations applied to Rmax distributions in the hurricane model, and if and how these truncations vary with other variables.

E. Provide a box plot and histogram of Central Pressure (*x*-axis) versus Rmax (*y*-axis) to demonstrate relative populations and continuity of sampled hurricanes in the stochastic storm set.

F. Provide this form in Excel using the format given in the file named *“2017FormM3.xlsx.”* The file name shall include the abbreviated name of the modeling organization, the hurricane standards year, and the form name. Also include Form M-3, Radius of Maximum Winds and Radii of Standard Wind Thresholds, in a submission appendix.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Central Pressure (mb)** | **Rmax  (mi)** | | | **Outer Radii (>110 mph) (mi)** | | | **Outer Radii (>73 mph) (mi)** | | | **Outer Radii (>40 mph) (mi)** | | |
| **1Q** | **2Q** | **3Q** | **1Q** | **2Q** | **3Q** | **1Q** | **2Q** | **3Q** | **1Q** | **2Q** | **3Q** |
| 990 |  |  |  |  |  |  |  |  |  |  |  |  |
| 980 |  |  |  |  |  |  |  |  |  |  |  |  |
| 970 |  |  |  |  |  |  |  |  |  |  |  |  |
| 960 |  |  |  |  |  |  |  |  |  |  |  |  |
| 950 |  |  |  |  |  |  |  |  |  |  |  |  |
| 940 |  |  |  |  |  |  |  |  |  |  |  |  |
| 930 |  |  |  |  |  |  |  |  |  |  |  |  |
| 920 |  |  |  |  |  |  |  |  |  |  |  |  |
| 910 |  |  |  |  |  |  |  |  |  |  |  |  |
| 900 |  |  |  |  |  |  |  |  |  |  |  |  |