

21-HURRICANE DATA PROVISIONS (HDP)

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2021 AND SUCCEEDING CROP YEARS

These provisions document the procedures for determining the counties where a loss is triggered for *Hurricane Insurance Protection – Wind Index* (HIP-WI). Counties triggered are determined by the Saffir-Simpson Hurricane wind scale using data provided from the National Hurricane Center operated by the National Oceanic and Atmospheric Administration (NOAA). Trigger counties are defined as counties that intersect the hurricane corridor as defined under these provisions.

1. Data

The data used for HIP-WI is the International Best Track Archive for Climate Stewardship (IBTrACS) dataset from the National Climatic Data Center within the National Hurricane Center operated by NOAA and hosted on their website. The table below shows the variables used to develop the wind extents and determine the trigger counties.

Variable	Column Name	Units
Season	SEASON	Year
Name	NAME	N/A
Time	ISO_TIME	UTC (YYYY-MM-DD HH:MM:SS)
Latitude	USA_LAT	Degrees North
Longitude	USA_LON	Degrees East
Maximum Sustained Winds	USA_WIND	Knots
Hurricane Category	USA_SSHS	N/A
Wind Extents Northeast	USA_R64_NE	Nautical Miles
Wind Extents Southeast	USA_R64_SE	Nautical Miles
Wind Extents Southwest	USA_R64_SW	Nautical Miles
Wind Extents Northwest	USA_R64_NW	Nautical Miles

IBTrACS generally records new values for these variables in three-hour intervals. If additional data points exist, RMA will use the three-hour interval data only. If data is missing, RMA will coordinate with NOAA to fill in the missing data. IBTrACS data can be found at the following link:

<https://www.ncei.noaa.gov/data/international-best-track-archive-for-climate-stewardship-ibtracs/v04r00/access/csv/>

2. Loss Triggers

The most recent county boundary shapefile from the US Census Bureau is used to determine if the hurricane corridor intersects the county (or equivalent) boundary.

(<https://www.census.gov/cgi-bin/geo/shapefiles/index.php>). Adjacent counties are determined

21-HURRICANE DATA PROVISIONS (HDP)

using the county adjacency file from the US Census Bureau (https://www2.census.gov/geo/docs/reference/county_adjacency.txt).

NOAA publishes IBTrACS datasets approximately two weeks following the occurrence of a hurricane landfall. Once published, RMA will obtain the IBTrACS dataset and determine the trigger counties. If NOAA publishes an updated final IBTrACS dataset prior to the start of the following hurricane season, which begins June 1st of the following year, RMA will process the updated data to determine if a loss is triggered for any additional counties but will not remove any previously triggered counties.

3. Storm Center Points

The latitudes and longitudes are projected in a continental USA Albers Equal-Area projection to determine the storm center points when the hurricane strength is greater than or equal to a Category 1 hurricane ($USA_SSHs \geq 1$). In addition, RMA will calculate a storm center point between the last tropical storm center point and the first hurricane center point (i.e. when a tropical storm strengthens to a hurricane) and another storm center point between the last hurricane center point and the first tropical storm center point (i.e., when a hurricane weakens to a tropical storm). A tropical storm point, by itself, does not constitute a storm center point for the determination of payment.

4. Wind Extents

The maximum of the $USA_R64(NE, SE, SW, NW)$ values are used as the radius of a circle around each storm center point. These are referred to as the hurricane buffers.

$$\text{Hurricane Buffer} = \text{Max}(USA_R64_NE, USA_R64_SE, USA_R64_SW, USA_R64_NW)$$

Example

Suppose the maximum distance of the hurricane wind extent from the storm center point is 35 nautical miles (nm) for northeast quadrant, 25 nm for the southeast quadrant, 10 nm for the southwest quadrant, and 30 nm for the northwest quadrant. In this case, the maximum distance of the hurricane wind extent from the storm center is 35 nm (northwest quadrant). The hurricane buffer is then a 35 M radius circle around the storm center point.

5. Estimated Storm Center Point and Buffer

A hurricane ceases to exist at some point between where the last hurricane point is measured and when the first tropical storm point is measured. The maximum sustained winds (USA_WIND) value is used to calculate where the estimated center point and wind extents are measured.

The estimated center point and buffer are calculated based on the last hurricane center point (USA_LAT and USA_LON) and maximum sustained wind speeds (USA_WIND_{hurr}) and the first

21-HURRICANE DATA PROVISIONS (HDP)

tropical storm center point (USA_LAT and USA_LON) and maximum sustain wind speeds (USA_WIND_{ts}).

A line is drawn between the two center points, and the bearing and distance (Distance_{full}) is used to calculate the estimated center point. The same bearing is used, but the distance is calculated using the following formula:

$$\text{Distance} = \text{Distance}_{full} * \frac{USA_WIND_{hurr} - 64}{USA_WIND_{hurr} - USA_WIND_{ts}}$$

The estimated buffer is calculated using the last hurricane buffer (HurricaneBuffer_{last}) and the following formula:

$$\text{Buffer} = \text{Max}\left(\frac{\text{HurricaneBuffer}_{last}}{2}, \text{HurricaneBuffer}_{last} * \left(1 - \frac{USA_WIND_{hurr} - 64}{USA_WIND_{hurr} - USA_WIND_{ts}}\right)\right)$$

In cases where a hurricane forms close to land, the same process is employed using the last tropical storm point and the first hurricane point.

Example:

Given the table below:

SEASON	NAME	ISO_TIME	USA_LAT	USA_LON	USA_SSHS	USA_WIND	USA_R64_ NE	USA_R64_ SE	USA_R64_ SW	USA_R64_ NW
2020	HURRICANE	9/29/20 0:00	21.3000	-74.0000	0	60				
2020	HURRICANE	9/29/20 3:00	21.6999	-74.5877	1	65	15			
2020	HURRICANE	9/29/20 6:00	22.1000	-75.1000	1	70	25	15		20
2020	HURRICANE	9/29/20 9:00	22.5072	-75.5228	1	75	30	15	15	20
2020	HURRICANE	9/29/20 12:00	22.9000	-75.9000	1	80	35	25	10	30
2020	HURRICANE	9/29/20 15:00	23.2574	-76.3003	1	90	35	20	11	30
2020	HURRICANE	9/29/20 18:00	23.6000	-76.7000	1	80	30	20	11	25
2020	HURRICANE	9/29/20 21:00	23.9649	-77.1001	1	75	20	15		20
2020	HURRICANE	9/30/20 0:00	24.3000	-77.5000	1	70	10			
2020	HURRICANE	9/30/20 3:00	24.5650	-77.9152	0	60				

The last hurricane storm point occurs on September 30th at 0:00 and the first tropical storm point occurs on September 30th at 3:00 hours. The maximum sustained wind speeds are 70knots and 60 knots, respectively. Figure 1 below shows the estimated center point and buffer.

21-HURRICANE DATA PROVISIONS (HDP)

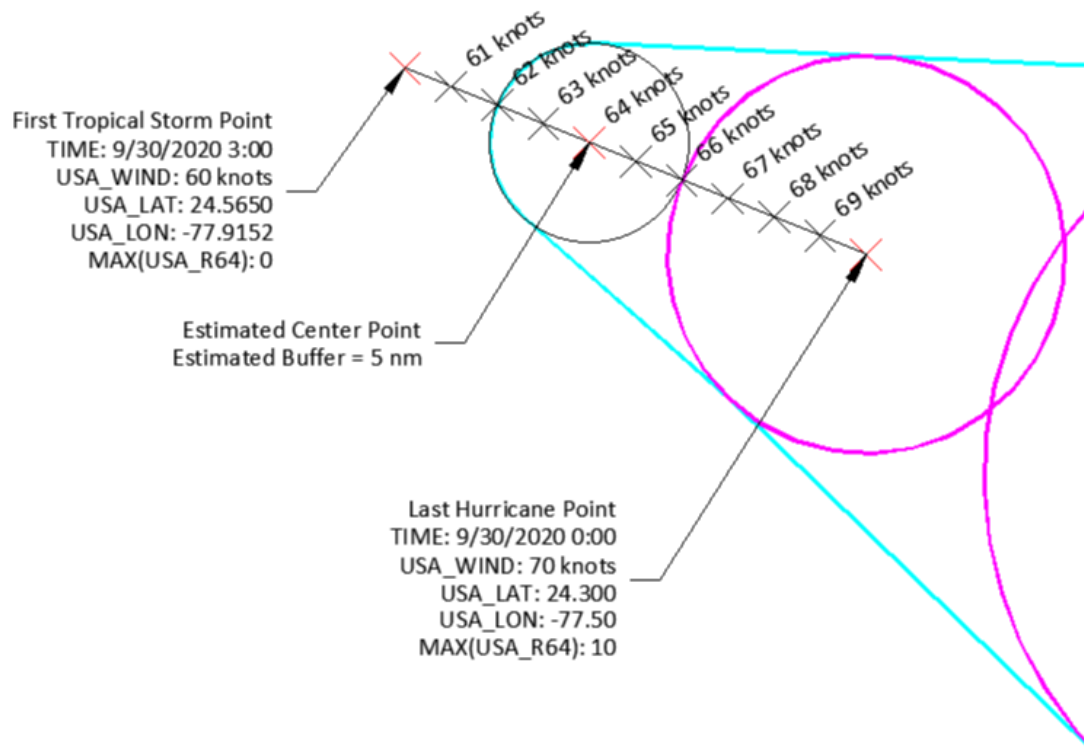


Figure 1 – Estimated Center Point and Buffer

6. Hurricane Corridor

When the storm center points and corresponding hurricane buffers are plotted, the result is a series of (often overlapping) circles. Line segments are then drawn between each pair of hurricane buffers that are tangent to both hurricane buffers to develop the hurricane corridor. The hurricane corridor is comprised of the tangent lines and arcs of the hurricane buffers or in some cases only the tangent lines are used if they intersect prior to the buffer. Figure 2 below shows the final hurricane corridor.

21-HURRICANE DATA PROVISIONS (HDP)

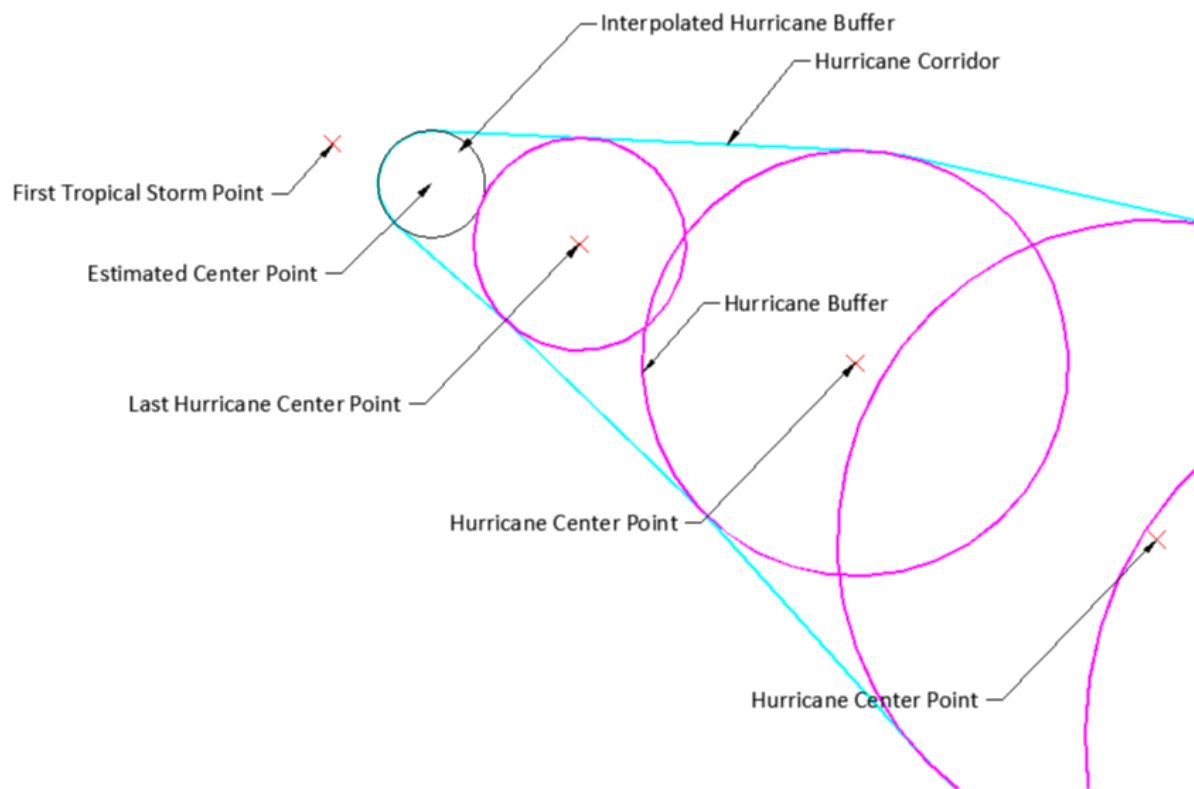


Figure 2 – Hurricane Corridor

The hurricane corridor is then projected on the continental USA Albers Equal-Area projection. Any county that intersects the hurricane corridor is determined to be a trigger county. Any counties adjacent to a trigger county (according to the US Census County Adjacency File) are also determined to be trigger counties. The trigger counties and date (ISO_TIM) will be published in the actuarial documents. Payments will be issued in accordance with the HIP-WI endorsement.