22-HDP

(Released June 2021)

HURRICANE DATA PROVISIONS (HDP)

2022 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). The county loss trigger is determined using data provided from the National Hurricane Center operated by the National Oceanic and Atmospheric Administration (NOAA) and the US Census Bureau, which may be modified in the Special Provisions of Insurance.

1. Data

The data used for determining the county loss trigger 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 the website below (or a successor 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/products/international-best-track-archive, or successor website.

2. County Data

The county boundary shapefile from the US Census Bureau at https://www.census.gov/cgi-bin/geo/shapefiles/index.php, or successor website, is used to determine if the hurricane

corridor intersects the county boundary. Adjacent counties are determined using the county adjacency file from the US Census Bureau at https://www2.census.gov/geo/docs/reference/county_adjacency.txt, or successor website.

The most recent shapefile and county adjacency file available at the contract change date will be used to determine trigger counties. Census county boundaries and adjacent counties may be modified by Special Provisions of Insurance.

3. Storm Center Points

IBTrACS uses World Geodetic System 1984 longitude and latitude coordinates which locate the center of the storm in 3-hour intervals. When wind speeds reach or exceed 64 knots (USA_WIND >= 64), the storm center point is a hurricane center point. In addition, RMA will calculate a hurricane 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 hurricane 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 hurricane center point for determining a county loss trigger.

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.

Hurricane Buffer = $Max(USA\_R64\_NE, USA\_R64\_SE, USA\_R64\_SW, USA\_R64\_NW)$

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 nm radius circle around the storm center point.

5. Estimated Hurricane 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 hurricane center point and wind extents are measured.

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

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

Distance = $Distance_{full} * \frac{USA\_WIND_{hurr} - 64}{USA\_WIND_{hurr} - USA\_WIND_{ts}}$

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

Buffer = $Max(\frac{HurricaneBuffer_{last}}{2}, HurricaneBuffer_{last} * (1 - \frac{USA\_WIND_{hurr} - 64}{USA\_WIND_{hurr} - USA\_WIND_{ts}}))$

The same process is used during the formation of a hurricane, 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 70 knots and 60 knots, respectively. Figure 1 below shows the estimated center point and buffer.

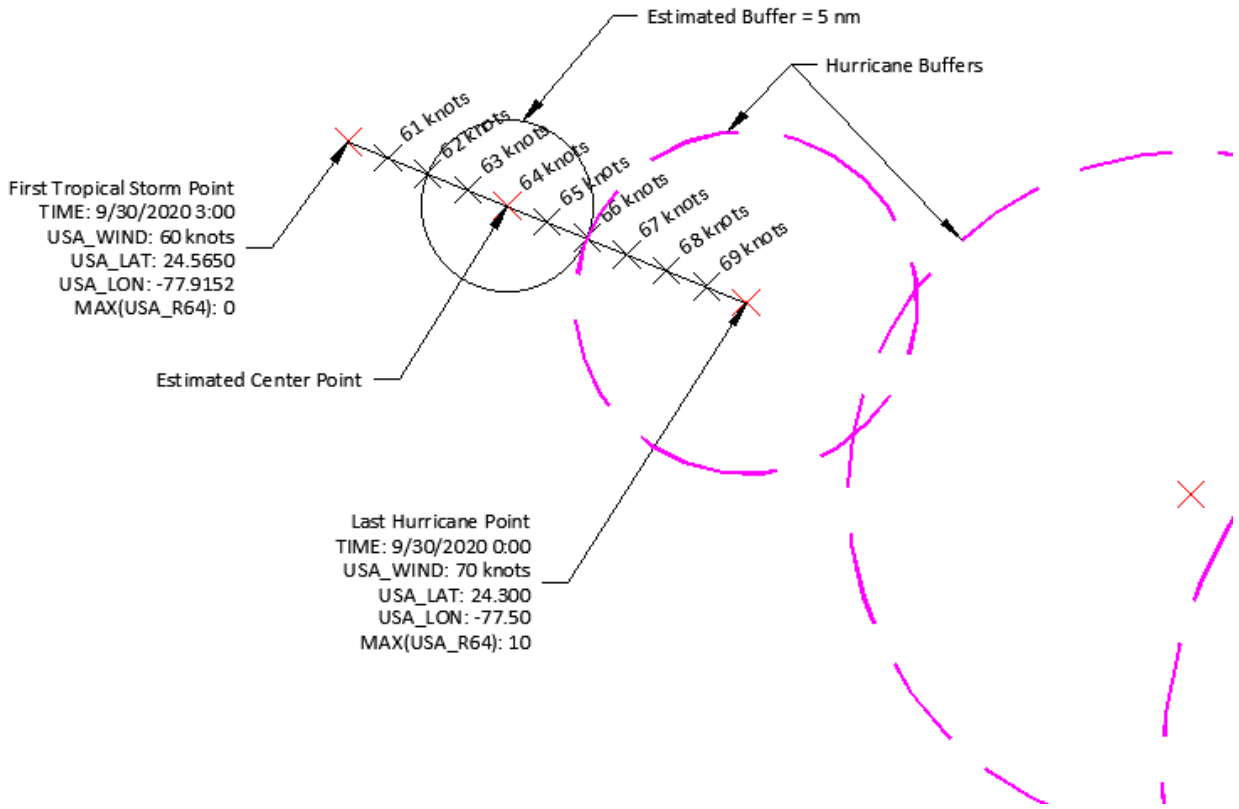

Figure 1 – Estimated Center Point and Buffer

6. Hurricane Corridor

When the storm center points and corresponding hurricane buffers are plotted, the result is a series of (often overlapping) circles. A convex hull is calculated for each pair of adjacent buffers which results in a series of ovals. Figure 2 below shows the convex hulls for the adjacent buffers.

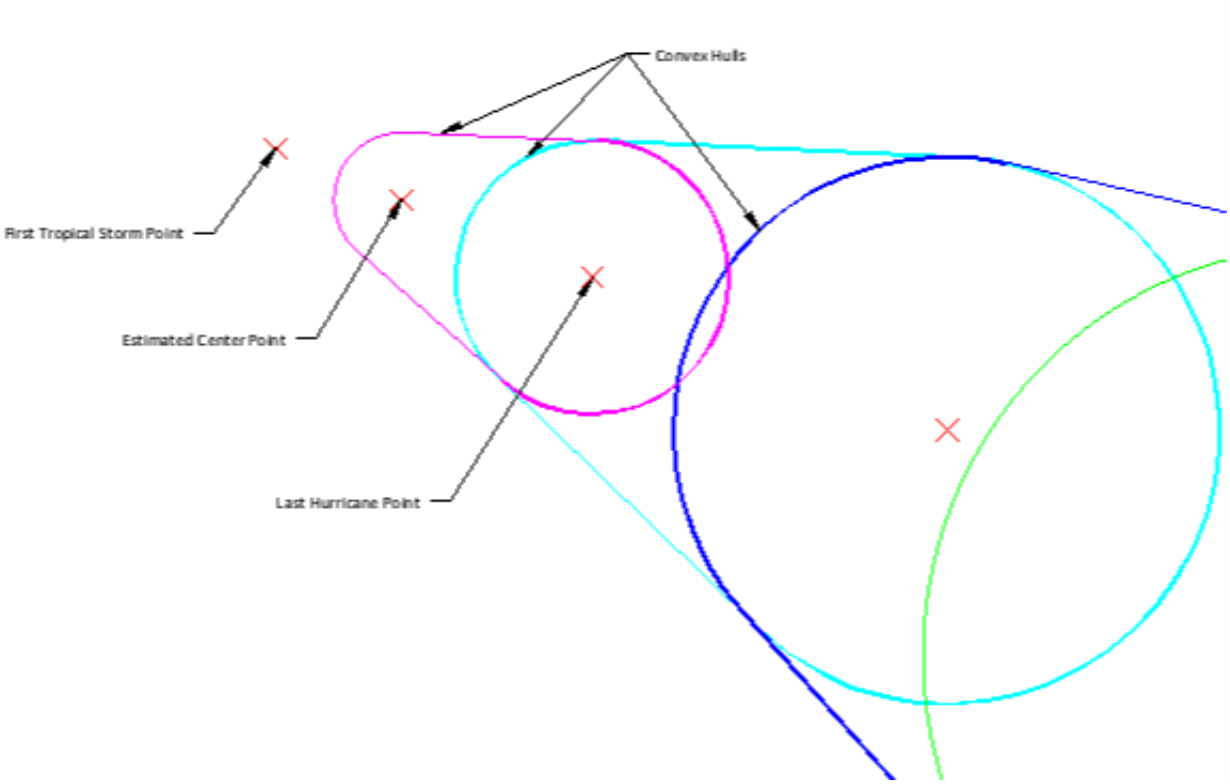

Figure 2 – Convex Hulls

7. Determining County Loss Triggers

Once the convex hulls are calculated, county loss triggers are determined. The convex hulls and the county shapefile are mapped in the same coordinate reference system. Any county shape that intersects the convex hulls meets the county loss trigger. Any county that is adjacent (according to the US Census Bureau county adjacency file) to a county that is intersected by the convex hulls will also meet the county loss trigger.

The county loss trigger and date will be published in the actuarial documents. Payments will be issued in accordance with the HIP-WI endorsement. NOAA publishes IBTrACS datasets approximately two weeks following the occurrence of a hurricane landfall. Once published, RMA will obtain the IBTrACS dataset and determine whether a county is triggered. If NOAA publishes an updated final IBTrACS dataset following the hurricane season, RMA will process the updated data to determine if any additional counties are triggered. Counties previously identified as being triggered, will remain triggered.

RMA will use the R programming language to implement these provisions. Sample computer code to determine triggered counties can be found at:

https://rma.usda.gov/Topics/Hurricane-Insurance-Protection-Wind-Index.