NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE ZETA

(AL282020)

24–29 October 2020

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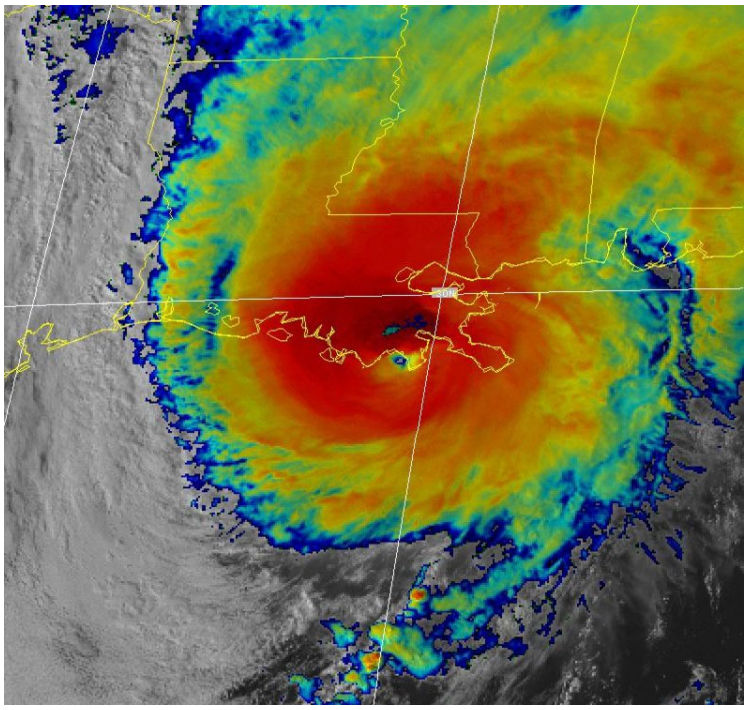

GOES-EAST VISIBLE/INFRARED "SANDWICH" IMAGE OF ZETA NEAR LANDFALL AT 2109 UTC 28 OCTOBER 2020

Zeta was a late-season hurricane that made landfall on the Yucatan Peninsula as a category 1 (on the Saffir-Simpson Hurricane Wind Scale) hurricane. After weakening to a tropical storm, Zeta rapidly intensified into a category 3 hurricane just before landfall in southeastern Louisiana. Zeta's fast forward motion brought strong winds well inland into areas of the southeastern United States. The hurricane caused 5 direct fatalities and about $4.4 billion in damage in the United States.

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Hurricane Zeta

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SYNOPTIC HISTORY

The genesis of Zeta was complex. A large area of unsettled weather developed over the southwestern Caribbean Sea by 19 October due to the combination of a tropical wave and a mid-level trough. On the next day, low-level southwesterly flow was observed north of Panama, and deep convection increased north of that country, causing the formation of a weak surface trough. By this time the original tropical wave had moved near the Yucatan Peninsula with an accompanying broad area of low pressure noted on satellite imagery. Although high vertical wind shear prevented additional development of the Yucatan disturbance, southerly flow from that system caused the precursor trough of the tropical cyclone over the southwestern Caribbean Sea to drift northward, and by 22 October Zeta's precursor system was located about 100 n mi southwest of Jamaica. This disturbance had gradually been improving in organization as upper-level ridging built over the western Caribbean and moist southwesterly flow in the low- to mid-levels increased, aided by the positive phase of the Madden-Julian Oscillation (Fig. 1) moving through the area. The system drifted west-northwestward to a location about 100 n mi south of Grand Cayman on 23 October, with a broad area of low pressure, disorganized convection and a poorly defined circulation noted. After deep convection increased overnight, satellite data indicate that a well-defined low formed by 1200 UTC 24 October, marking the genesis of a tropical depression about 60 n mi southwest of Grand Cayman. The "best track" chart of the tropical cyclone's path is given in Fig. 2, with the wind and pressure histories shown in Figs. 3 and 4, respectively. The best track positions and intensities are listed in Table 1[1].

The depression initially drifted west-southwestward as high pressure built over the Gulf of Mexico, and the depression gradually strengthened to a tropical storm 12 h after genesis as intense central convection developed, even while the low- and mid-level circulation centers were not in alignment. Zeta moved slowly and erratically to the west or west-northwest on 25 October while steadily strengthening in a low-shear and very warm water environment. Aircraft reconnaissance found that Zeta became a hurricane early on 26 October about 200 n mi southeast of Cozumel, Mexico. The hurricane moved much faster toward the west-northwest beginning on that day as deep-layer high pressure strengthened to the north, and Zeta made landfall near Ciudad Chemuyil, Mexico around 0355 UTC 27 October with an estimated intensity of 75 kt and a minimum central pressure of 977 mb. Zeta weakened over the Yucatan Peninsula and then emerged over the southern Gulf of Mexico as a 55-kt tropical storm later that morning.

[1] A digital record of the complete best track, including wind radii, can be found on line at ftp://ftp.nhc.noaa.gov/atcf. Data for the current year's storms are located in the *btk* directory, while previous years' data are located in the *archive* directory.

The synoptic pattern was changing rapidly ahead of Zeta as a deep-layer cutoff low over the southwestern United States moved eastward. This low caused the ridge over the Gulf of Mexico to erode from the west, and the tropical cyclone moved northwestward on 27 October across the southern Gulf of Mexico. Zeta maintained its strength that day while it recovered from land interaction, but began to re-intensify the next day in a conducive environment of low shear and warm SSTs—an uncommon combination for so late in the year in the southern Gulf of Mexico. Zeta became a hurricane again early on 28 October while it turned northward and moved faster over the south-central Gulf of Mexico. The cutoff low reached west Texas that day, and the fast flow between the low and the retreating ridge located near Florida caused Zeta to accelerate north-northeastward. This pattern also likely provided a favorable divergent upper-level environment for strengthening, and Zeta rapidly intensified while it moved quickly (with a forward speed of 20–25 kt) toward the Louisiana coast. Radar and reconnaissance data indicate that Zeta made landfall near Cocodrie, Louisiana at around 2100 UTC 28 October with an intensity of 100 kt and a minimum central pressure of 970 mb.

The hurricane's eye moved directly over New Orleans a couple of hours after landfall, with the center crossing into southern Mississippi that night and moving across southwestern Alabama early the next day, bringing strong winds well inland. Zeta weakened to a tropical storm just south of Tuscaloosa, Alabama early on 29 October and then raced northeastward across northern Georgia and the southern Appalachian Mountains. The storm transitioned into a post-tropical cyclone over central Virginia by 1800 UTC that day, and continued moving rapidly northeastward. Zeta became entwined with a frontal zone early on 30 October and then dissipated over the western Atlantic Ocean a couple of hundred miles east of Atlantic City, New Jersey.

METEOROLOGICAL STATISTICS

Observations in Zeta (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and Satellite Analysis Branch (SAB), and objective Advanced Dvorak Technique (ADT) estimates and Satellite Consensus (SATCON) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropsonde observations from six flights of the 53rd Weather Reconnaissance Squadron of the U.S. Air Force Reserve Command and eleven flights of the NOAA Aircraft Operations Center (AOC) WP-3D and G-IV aircraft. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Global Precipitation Mission (GPM), the European Space Agency's Advanced Scatterometer (ASCAT), and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Zeta, along with WSR-88D radar data from coastal NWS Weather Forecast Offices (WFOs).

Ship reports of winds of tropical storm force associated with Zeta are given in Table 2, and selected surface observations from land stations and data buoys are given in Table 3.

Winds and Pressure

Zeta's first peak intensity of 75 kt at landfall on the Yucatan Peninsula at 0355 UTC 27 October is based on a combination of NOAA Hurricane Hunter aircraft data that were available until about 4 hours before landfall and subsequent lower surface pressures observed at landfall. The plane measured credible SFMR winds of 66–71 kt during its last mission, along with a central pressure of about 980–983 mb at 0000 UTC (two drops in the last half hour of the flight measured 984–983 mb, but with varying surface winds of 8 kt to 32 kt). A WeatherFlow station at Xel-Ha Park measured 978 mb along with 11 kt of wind at 0356 UTC, suggesting a 977 mb pressure at landfall. With the drop in central pressure in the few hours after the plane departed, it is very likely further strengthening occurred, and the landfall intensity is set to 75 kt, which is still below the Knaff-Zehr-Courtney pressure-wind relationship (79 kt) for this system. A sustained wind of 64 kt was also measured at Playa del Carmen, about 20 n mi northeast of the landfall location.

The Louisiana landfall intensity is estimated at 100 kt. Peak 700-mb flight-level winds of 119 kt were measured at 1843 UTC 28 October, a couple of hours before landfall. Subsequently, the aircraft sampling of Zeta's eastern quadrant was incomplete leading up to landfall because of the fast-moving and rapidly intensifying nature of the hurricane, and the northeastern eyewall was onshore by the time the aircraft returned to the area (Fig. 5). However, the highest winds were observed on the Slidell, Louisiana, WSR-88D radar (KLIX). Radial velocity data from KLIX showed 10-bin (~0.25 km per bin) average radar velocities of 125 kt at 2031 and 2033 UTC, indicating a large area of strong winds, with peak 4-bin velocities of 127 kt for 4 volume scans centered around 2030 UTC at heights between 9,500 and 10,000 ft. These data would normally correspond to an intensity of around 110 kt using the typical dropsonde-based wind reductions from a height of around 700 mb/10,000 ft. However, the available data suggest that these typical flight-level to surface wind reductions were not realized in the later stages of Zeta, possibly since the eye was broken in the southeastern quadrant. A dropsonde at 1840 UTC measured a 110 kt average wind in the lowest 150 meters in the northeastern quadrant, which corresponds to an intensity of 90–95 kt. This dropsonde was near the area where 700-mb flight-level winds were 119 kt, and the resulting ratio of the surface wind estimate from the dropsonde to the flight-level winds was roughly 80%. Using this reduction factor for the radar-derived winds (125–127 kt, which were near 700 mb) results in an intensity estimate of 100 kt at landfall. It is also worth noting that prior to landfall the pressure fell 3 mb after the aircraft data around 1840 UTC that supported an intensity of 95 kt. While a 5-kt change is typical for post-analysis best track intensity changes, this increase in Zeta's peak intensity crosses the threshold from Category 2 to Category 3. However, these Category 3 sustained winds were likely experienced over only a very small area at and near the coast near the landfall location, and this change in the estimated landfall intensity is of little practical significance in terms of the impacts associated with the storm there. It is also important to emphasize that NHC's intensity analysis uncertainty is about +/- 10%, and the atypical structure of Zeta's inner core at and prior to landfall also contributed to the uncertainty in this case.

The strongest wind report received from a near-standard height was from the public in Golden Meadow, Louisiana at 2139 UTC - a sustained wind of 82 kt and a gust to 96 kt (instrument height 6 m). There were few strong wind reports at the immediate coast in southeastern Louisiana since the area that experienced Zeta's peak winds (near and west of Port Fourchon in the East

Timbalier National Wildlife Refuge) is relatively unpopulated. The first tropical-storm-force winds were recorded along the Louisiana coast around 1800 UTC 28 October.

In Mississippi, the strongest sustained wind report received was from Gulfport where a WeatherFlow station measured a sustained wind of 74 kt and a gust to 88 kt at 0057 UTC 29 October, and it is estimated that category 2 were experienced in some locations west of there. While no sustained hurricane-force winds were measured in Alabama, they are estimated to have occurred north of coastal Mobile County in unpopulated areas. The peak sustained wind report in Alabama was at Buccaneer Yacht Club in Mobile, where a WeatherFlow instrument measured sustained winds of 53 kt at 0147 UTC 29 October. The peak gust in Alabama, 79 kt, was measured at Mobile Regional Airport near that same time.

Farther east, there were multiple sustained tropical-storm-force wind reports across the Florida Panhandle, with the highest sustained wind of 41 kt measured by a WeatherFlow instrument at Santa Rosa Sound at 0157 UTC 29 October. Sustained tropical-storm-force winds were also noted in portions of northern Georgia, northwestern South Carolina and western North Carolina while Zeta was still tropical, in mountainous areas and lower elevation areas to the south and southeast of the Appalachians.

The minimum pressure at landfall in Louisiana is estimated to be 970 mb based on a dropsonde at 2042 UTC 28 October, which measured 971 mb and 11 kt of surface wind. There were no other surface pressure reports available in or near the eye along the coast at landfall.

Zeta is the latest landfalling major hurricane on record for the continental United States, with the old record being the Tampa Bay Hurricane of 25 October 1921.

Storm Surge[2]

Zeta produced storm surge inundation of 6 to 10 ft above ground level (AGL) along the Mississippi coast (particularly in the back bays) and along the Alabama coast west of Mobile Bay. In the Back Bay of Biloxi, a United States Geological Survey (USGS) stream gauge at Old Fort Bayou in Ocean Springs measured a peak water level of 9.5 ft above Mean Higher High Water (MHHW), and a second gauge farther to the west in Biloxi recorded 7.2 ft MHHW. A storm surge hindcast produced by the NHC Storm Surge Unit (not shown) indicates that slightly higher water levels (up to 10 ft AGL) occurred in the back bay between these two locations in the St. Martin area. Elsewhere along the Mississippi coast, the National Ocean Service (NOS) tide gauge at the Bay Waveland Yacht Club recorded a maximum water level of 8.2 ft MHHW, and the NOS gauge at the Pascagoula NOAA Lab measured a peak water level of 7.1 ft MHHW. Farther to the east, the NOS gauge at the Bayou La Batre Bridge in Alabama measured a maximum water

[2] Several terms are used to describe water levels due to a storm. **Storm surge** is defined as the abnormal rise of water generated by a storm, over and above the predicted astronomical tide, and is expressed in terms of height above normal tide levels. Because storm surge represents the deviation from normal water levels, it is not referenced to a vertical datum. **Storm tide** is defined as the water level due to the combination of storm surge and the astronomical tide, and is expressed in terms of height above a vertical datum, i.e. the North American Vertical Datum of 1988 (NAVD88). **Inundation** is the total water level that occurs on normally dry ground as a result of the storm tide, and is expressed in terms of height above ground level. At the coast, normally dry land is roughly defined as areas higher than the normal high tide line, or Mean Higher High Water (MHHW).

level of 6.9 ft MHHW. The National Weather Service Forecast Office in Mobile found several high water marks of 4 to 8 ft AGL in the Coden, Alabama, area, but the character of these debris lines and their exposure suggests that the marks likely included the effects of wave action on top of the surge. Table 2 and Figure 6 provide observations from various tide stations and water level sensors along much of the U.S. Gulf coast.

Zeta also produced storm surge inundation of 6 to 10 ft AGL in the unprotected wetland areas of Plaquemines Parish, Louisiana, to the west of the West Bank Mississippi River Levee. The highest observation in the area was 7.0 ft MHHW at a USGS gauge in Barataria Bay to the north of Grand Isle. However, the storm surge hindcast indicates that higher water levels likely occurred to the east of that location, with Zeta's winds piling water up against the west side of the levee. The observations and hindcast suggest that inundation of 6 to 10 ft AGL occurred west of the levee between Port Sulphur and Empire. Just to the south of there, a sensor deployed at Joshua's Marina in Buras by a storm chase team measured a storm surge of about 5.2 ft above normal tide levels. Storm surge inundation of 3 to 6 ft AGL occurred elsewhere along the coast of southeastern Louisiana from Terrebonne Bay to the Mississippi border, including the south and west shores of Lake Pontchartrain. The highest water level observations in these areas were 5.8 ft MHHW from a U.S. Army Corps of Engineers (USACE) gauge at Lake Pontchartrain-West End and 4.8 ft MHHW from an NOS gauge at New Canal Station on Lake Pontchartrain. Inundation of 1 to 3 ft AGL occurred along the remainder of the Louisiana coast west of Terrebonne Bay.

In Alabama, storm surge inundation of 3 to 6 ft AGL occurred along the coast of Mobile Bay. The highest water level observations within the bay were 5.9 ft MHHW at the NOS gauge at the West Fowl River Bridge and 5.3 ft MHHW at Coast Guard Sector Mobile. On the east side of the bay, the NOS gauge at Weeks Bay recorded 4.2 ft MHHW. The National Weather Service surveyed debris lines as high as 7 ft AGL in the Daphne and Spanish Fort areas, but the character and exposure of these marks indicates that these heights included the effects of waves on top of the surge. Inundation heights were lower along the open coast, with the NOS gauge at Dauphin Island registering 2.4 ft MHHW.

Storm surge inundation was 1 to 2 ft AGL along the coast of the Florida Panhandle. The highest water level observations were 2.1 ft and 2.0 ft MHHW from the NOS gauges at Pensacola and Panama City Beach, respectively.

Rainfall and Flooding

Zeta is estimated to have produced up to 10 inches (255 mm) of rain in the Yucatan Peninsula (Fig. 7), with a peak measured total of 9.57 inches (243 mm) at Cozumel. While there were reports of flooded streets in the Mexican state of Quintana Roo, there were no significant damage reports in Mexico from the flooding.

In the United States, a general area of 4–6 inches of rain was observed from near Zeta's landfall location in southeastern Louisiana through southeastern Mississippi and western Alabama, with peak totals up to about 8 inches (Fig. 8). Peak observed rainfall totals by state included 7.35 inches in Pearl River, Louisiana, 6.87 inches near Leaksville, Mississippi, and

4.26 inches near Woodville, Alabama. It should be emphasized, however, that the fast forward speed of Zeta limited the rainfall and flooding impacts in those areas (see the state-by-state summaries in the Casualty and Damage Statistics below). Note that there was also an area of heavy rain in Arkansas (up to about 8 inches) that was not solely associated with Zeta, but was due to a combination of moisture from Zeta and the non-tropical cut-off low.

The first significant freshwater flooding reports were in northern Georgia, well northeast of the landfall area, where a narrow strip of 4–6 inches of rainfall occurred from there northward along the southern and eastern edge of the Appalachian Mountains through western North Carolina and southern Virginia. The peak rainfall total for Zeta actually occurred in western North Carolina just east of Cedar Mountain of 8.80 inches, with one other report over 8 inches (Blantyre, 8.41 inches). The peak rainfall total in Georgia was 6.43 inches near Suches, and the highest total in Virginia was 4.28 inches near Altavista.

An enormous number of rainfall reports were received from Zeta in both its tropical and extratropical stages. While there are too many reports (~9,000) to include here, the full rainfall spreadsheet is included at: https://www.nhc.noaa.gov/data/tcr/supplemental/zeta_rain.xlsx.

The precursor disturbance of Zeta led to heavy rain and flooding in Jamaica, although no rainfall totals are available.

Tornadoes

There was only one tornado reported while Zeta was a tropical cyclone, in Noxubee County, Mississippi. It was rated EF1 (on the Enhanced Fujita Scale) with a path length of 5 miles. The damage estimated from the tornado was about $30,000 from roof damage to two homes, two sheds and two downed power poles.

CASUALTY AND DAMAGE STATISTICS

Zeta was responsible for five direct fatalities[3], all in the United States. One man drowned due to storm surge near a marina in Biloxi, Mississippi. The other four deaths were due to trees falling on homes or mobile homes: three in Georgia (2 in Gwinnett County, 1 in Cherokee County) and one in Alabama (Clarke County). Two additional indirect deaths were reported: an electrocution from a power line in New Orleans and a motorcycle accident in Harrison County, Mississippi caused by low-hanging power lines. At least 75 injuries were reported in Louisiana, Mississippi, Alabama and Georgia, with over 70 of those occurring in southern Mississippi.

[3] Deaths occurring as a direct result of the forces of the tropical cyclone are referred to as “direct” deaths. These would include those persons who drowned in storm surge, rough seas, rip currents, and freshwater floods. Direct deaths also include casualties resulting from lightning and wind-related events (e.g., collapsing structures). Deaths occurring from such factors as heart attacks, house fires, electrocutions from downed power lines, vehicle accidents on wet roads, etc., are considered “indirect” deaths.

The NOAA National Centers for Environmental Information (NCEI) estimates that Zeta caused $4.4 billion (USD) in damage in the United States. The state-by-state breakdowns are in the U.S. sections below.

Outside of the United States, two deaths occurred in Jamaica from the precursors of Zeta as heavy rain caused a mudslide that destroyed a home in Shooter's Hill on 23 October. Note that these deaths are not considered direct because the system was not yet a tropical cyclone. The Jamaican government reported up to $15 million (USD) of damage to homes and infrastructure on the island from the precursor disturbances.

Mexico

The damage reported across Mexico was generally light. There were flooded roads and extensive tree branch damage in eastern Quintana Roo and Yucatan states, but no deaths or serious injuries were reported.

Louisiana

Hurricane-force winds caused widespread damage across southeastern Louisiana near and east of the track of Zeta's center. Significant wind damage was noted in many parishes south of Lake Pontchartrain, including Orleans, Jefferson, St. Bernard, Plaquemines, Terrebonne and Lafourche Parishes. Hundreds of homes in those parishes suffered significant wind damage, with numerous reports of lost or severely damaged roofs, and about 100 homes were destroyed, including a large metal commercial building. Local officials estimated that thousands of additional homes had minor damage. Numerous trucks, trailers and boats were flipped over by strong winds along Louisiana Highway 46 (where they were parked to avoid the storm surge). Trees, along with hundreds of power lines and power poles, were also downed or snapped from Zeta, including some falling on homes (Fig. 9) and over 500 tree emergencies (trees down on a road or a building) were reported. Storm surge breached the levee in Grand Isle in a few places and flooded Louisiana Highway 1, cutting off access from Port Fourchon to Grand Isle. Several homes and businesses in Leeville and Golden Meadow were flooded, and storm surge overtopped a local levee in the Myrtle Grove area. The surge also flooded other coastal roads, including Louisiana Highway 56, and the bottom levels of the Lumcon building in Terrebonne were flooded.

Elsewhere across the state, there was notable damage to trees, power lines and power poles near as far as about 60 n mi to the left of the track of Zeta's center, with widespread power outages. These areas included the parishes of St. Charles, St. Tammany, St. James and St. John the Baptist. More than 3,000 people were housed in shelters across the state, and overall about one-half million customers lost power at some point during the hurricane. The NCEI estimates that about $1.25 billion of damage was caused in the state due to Zeta.

Mississippi

The worst damage from Zeta in the state was in the coastal counties of Hancock, Harrison and Jackson, which were affected by sustained hurricane-force winds. Many snapped trees, downed power lines and power poles were reported across those counties, and up to 10,000 homes were damaged from the wind or flying debris. The most extreme damage appears to be in Harrison County, one person died from the storm surge and numerous homes suffered

moderate-to-major damage. Similar damage was also reported at several homes in Jackson County. The storm surge flooding caused hundreds of roads to become impassable in the Bay St. Louis area, and portions of U.S. Highway 90 were underwater in Harrison County.

Farther north, Stone, George, Perry, Greene and Wayne Counties all reported significant-to-widespread tree and power line damage. Several hundred homes were damaged in those counties, primarily due to the wind and/or trees. A couple of hundred homes had severe damage and a few dozen were destroyed, with falling trees again the primary cause.

Generally minor damage was reported in other areas of southern Mississippi. About 40 roads were blocked from falling trees in Forrest County, and a tree fell onto a home near Rawl Springs which temporarily trapped the occupants. Scattered trees and power lines were blown down across Lamar County, with any significant damage occurring south of U.S. Highway 98, and one tree fell through a house just south of Purvis. Minor tree damage was reported across Pearl River, Walthall, Pike, Marion, Jones, Clarke and Lauderdale Counties, with the most significant in Pearl River County. Over 200,000 customers lost power during Zeta across the state, and about $635 million of damage was estimated by NCEI.

Alabama

Zeta's large wind field to the east of the center also produced damage in areas of southern Alabama, with the worst damage in Baldwin and Mobile Counties. Widespread downed trees, power lines and power poles were reported, and numerous homes suffered roof damage and structural damage from falling trees. A notable storm surge occurred on the west end of Dauphin Island, in Bayou La Batre and Coden, and the northwest portion of Mobile Bay. The U.S. Highway 90 Causeway was completely flooded and a portion of Water Street was submerged in Downtown Mobile. The storm surge also resulted in damage to some restaurants and businesses along the eastern portion of the U.S. Highway 90 Causeway in Baldwin County. Several piers were destroyed on the eastern shore of Mobile Bay and the seawall at the Fairhope Pier was damaged, along with a few docked sailboats. Significant surge extended south to Point Clear where the surge went across County Road 1, and a few parks along the eastern shore of the bay were damaged.

Significant wind damage was reported farther north, near and southeast of where the center of Zeta tracked. The counties of Washington, Choctaw, Clarke, Wilcox and Monroe all sustained numerous-to-widespread tree and power line damage, and one person died from a falling tree in Clarke County. Numerous homes, estimated in the hundreds, were reported damaged in those counties, with the bulk of the damage due to falling trees.

Other wind damage was noted across portions of southern, central and even northeastern Alabama. Many reports were received of trees, power lines and power poles downed, along with widespread power outages, some blocked roads and roof damage. Two injuries were noted in Tallapoosa County from the falling trees, with structural damage observed in Butler, Crenshaw, Lee, Clay, Chilton, Jefferson, Chambers, Talladega and Perry Counties. Over 400,000 customers lost power at some point during Zeta, and NCEI estimates that about $840 million of damage was done in the state due to Zeta.

Florida

The effects of Zeta were primarily felt in the northwestern part of the state. About 10,000 customers lost power from gusty winds, and downed trees were noted. These trees resulted in a vehicle accident in Holmes County and five closed roads in Walton County. Strong rip currents and some beach erosion were reported in Bay County, along with a few signs down. No significant damage or injuries were recorded.

Georgia

Strong winds from Zeta affected much of Georgia, but were most concentrated in the northern portion of the state. Similar to other regions, strong gusty winds brought down trees and power lines, causing widespread outages and damage to some structures. Atlanta was most severely hit in the early morning hours of 29 October with tropical-storm-force wind gusts, causing downed trees, blocked roads and downed traffic signals over a large portion of the metropolitan area. Falling trees were responsible for 3 deaths (2 in Gwinnett County, 1 in Cherokee County), and at least four families had to be rescued in the Atlanta area due to trees falling on their homes or cars. DeKalb County reported more than 50 trees down on roadways. There was also some inland flooding reported in northern Georgia in Union County due to the Nottely River overtopping its banks, with flooding also reported in Rabun County along several lakes and the Tallulah River. About 1 million customers lost power at some point during Zeta, mostly in northern Georgia. The NCEI estimates that Zeta caused $1.1 billion in damage in Georgia and was one of the top 5 costliest tropical cyclones on record there.

South Carolina and North Carolina

Western North Carolina and northwestern South Carolina saw widespread trees and power lines down, causing significant power outages especially in areas like Burke County, NC, along with the most serious flooding reported anywhere in Zeta. A flash flood caused a mudslide in Caldwell County, NC, along with some flooding of the upper Catawba River. Additional flooding was reported in southern Buncombe County, NC. Some trees and powerlines were reported downed in the Greenville, SC, area with sustained tropical-storm-force winds recorded at the nearby airport, and some homes were damaged. Iredell County, NC, also reported widespread downed trees, with over 200 of them falling on power lines, with other trees falling on a couple of dozen homes. Mecklenburg County, NC, reported 100 trees down across the county, along with one tree falling on a structure. Several dozen downed trees were recorded over McDowell County, NC, knocking down power lines, and 3 vehicles and 1 home were reported damaged. In addition, flash flooding was reported in that county with water from Jack's Creek rising over a bridge and the nearby Bat Cave Road. Three water rescues were made in Surry County, NC, due to extensive flooding, especially near Elkin and Ararat, and several roads and bridges were washed out in those areas. Other significant effects were noted in Pickens County, SC, with about 400 downed trees, and many of these were on roadways or homes, with 15 homes requiring first responder support. Over 100 reports of wind damage were received in Rockingham County, NC, mostly from trees blown over. Homes were also reported damaged in Rowan and Union Counties, NC. Over 400,000 customers lost power in North Carolina from Zeta, along with about 150,000 in South Carolina. About $550 million in damage was estimated in North and South Carolina from Zeta by NCEI.

Virginia

A mix of water and wind damage reports were received from the state, mostly in the south-central portion of the state. These reports were generally of flooding and falling trees causing some blocked roads and minor structural damage to residences (mostly from the falling trees). Pittsylvania County noted up to 100 trees knocked down and numerous downed power lines with damage to one vehicle due to a light pole collapse. The City of Martinsville and Henry County also reported damage to cars from falling trees and power lines. Around 60,000 customers were without power at some point during the storm, but damage was less than $25 million across the state.

FORECAST AND WARNING CRITIQUE

Genesis

Zeta's formation was not well forecast at first (Table 4). The precursor disturbance was first mentioned in the NHC Tropical Weather Outlook (TWO) and given a low (<40%) 5-day chance of formation 228 h before Zeta became a tropical depression. The probabilities stayed in the low category and were introduced into the 2-day section for about a day (114–96 h prior to genesis), then all probabilities were removed from the TWO 90 h before genesis. In hindsight, the genesis was more complex than initially expected and did not happen along a precursor wave (see Synoptic History section), but instead from a disturbance generated behind the wave (so the overall system took longer to form than expected). The system was re-inserted into the TWO 66 h before genesis, and 5-day genesis probabilities were increased to the medium (40–60%) category 30 h before formation and to the high (>60%) category about 18 h before formation. The disturbance was first given a low chance of 2-day formation 48 h before it became a tropical depression, a medium chance 24 h and a high chance 18 h before formation. While many models showed the genesis of a tropical cyclone, almost all of them showed it forming too soon and not necessarily due to the correct evolution, leading to a challenging genesis forecast.

Track

A verification of NHC official track forecasts for Zeta is given in Table 5a. Official forecast track errors were lower than the mean official errors for the previous 5-yr period at all forecast times through 48 h, above the mean official forecast errors at 60–72 h, and well below the mean at 96 h (albeit for a small sample). Overall, this was a skillful set of forecasts considering the high climatology and persistence (OCD5) errors, roughly 50–75% greater than their respective 5-year means at all forecast times, which generally indicate that Zeta's overall track was harder to forecast than that of a typical Atlantic tropical cyclone (possibly due to the unusual track for late October).

A homogeneous comparison of the official track errors with selected guidance models is given in Table 5b and Fig. 10.[4] On the whole, none of the models had lower errors than the NHC official forecasts. A large portion of the guidance had a notable northeastward bias, especially for the landfall in Mexico (Fig. 11a). Across the Gulf Coast, the models largely had an eastward bias at first, but about 24 h after genesis the biases were much smaller (though still to the east), and the track guidance also came into better agreement (Fig. 11b). Fig. 12 shows a comparison of all of the model/forecast runs before Louisiana landfall from the NHC official forecast (OFCL), HFIP Corrected Consensus aid (HCCA), the GFS model and the U.K. Met global model (EGRI). The NHC track forecasts were very accurate and consistently showed a track close to the eventual Louisiana landfall location. The Hurricane Multi-Scale Ocean-Coupled Non-Hydrostatic Model (HMNI) and EGRI had poor forecasts for Zeta (the former having a high northeast bias, while the latter was too slow/left), while the Canadian model (CMCI) and HCCA had relatively good forecasts for the hurricane.

Intensity

A verification of NHC official intensity forecasts for Zeta is given in Table 6a. Official forecast intensity errors were higher or much higher than the mean official errors for the previous 5-yr period at all forecast times except 60 h. This pattern matches the OCD5 errors that were generally higher than their respective 5-yr means, suggesting that Zeta's intensity was more difficult to forecast than for a typical Atlantic tropical cyclone, likely due to land interaction and the rapid intensification (RI) episode in the Gulf of Mexico.

A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 6b and Figure 13. NHC's official intensity forecasts were generally not as good as some of the guidance in the short-term, but beat most of the guidance at 48 h and beyond. The GFS, ECMWF and LGEM models did not do well for Zeta's intensity forecast. Overall the HCCA and HWRF models were the best performers for Zeta, although the long-range performance of all models was fairly poor.

Two periods were especially difficult for the model suite – one near the Yucatan Peninsula (not enough strengthening before landfall) and the second in the Gulf of Mexico (Fig. 14a) due to the bulk of the guidance missing Mexico. In fact, the intensity trends near Yucatan were not correctly predicted by almost all guidance (presumably due to the poor track forecast), showing steady strengthening through the central Gulf of Mexico then weakening over the northern Gulf of Mexico. The RI episode in the Gulf of Mexico before landfall was not forecast by any of the guidance (Fig. 14b) even as it was starting, although the HWRF model did provide useful guidance that the intensification could be significant.

Storm Surge

For the coasts of Mississippi and southeastern Louisiana, the initial peak storm surge inundation forecast issued at 2100 UTC 26 October was 4 to 6 ft above normally dry ground

[4] The Florida State Superensemble (FSSE) did not have enough forecasts to meet NHC's homogeneity requirement and thus were not included in the track / intensity model verification.

somewhere between Port Fourchon, Louisiana, and Dauphin Island, Alabama. For the Mississippi coast, the forecast was raised to 5 to 8 ft AGL at 1500 UTC 27 October and ultimately settled on 7 to 11 ft AGL at 2100 UTC 28 October (in the hours before the worst surge affected that area). For the peak surge along the Louisiana coast, the forecast was raised to 5 to 7 ft AGL at 0900 UTC 28 October and then ultimately to 6 to 9 ft AGL at 2100 UTC 28 October, about the time Zeta was making landfall near Cocodrie, Louisiana.

Watches and Warnings

Coastal wind watches and warnings associated with Zeta are given in Table 7. For the United States, a Hurricane Watch was issued about 45 h before the sustained tropical-storm-force winds reached the coast, and a Hurricane Warning was issued about 33 h before the sustained tropical-storm-force winds reached land. These values are close to the desired lead-times of 48 h for watches and 36 h for warnings. Note that other than a small eastward extension of the Tropical Storm Warning area, the watches and warnings were consistent from first issuance until landfall.

Storm surge watches and warnings associated with Zeta are given in Table 8 and indicated in Fig. 15. A Storm Surge Watch was first issued for the northern Gulf coast from Intracoastal City, Louisiana, to Navarre, Florida, including Lake Pontchartrain, Lake Borgne, Vermilion Bay, Mobile Bay, and Pensacola Bay at 2100 UTC 26 October. The entire watch area was upgraded to a Storm Surge Warning at 0900 UTC 27 October. The watch and warning were issued approximately 45 h and 33 h, respectively, before the onset of sustained tropical-storm-force winds around 1800 UTC 28 October on the Louisiana coast.

NHC uses storm surge inundation of 3 ft or greater above normally dry ground as a first-cut threshold for issuing storm surge watches and warnings. As shown in Fig. 14, nearly all tide and stream gauges that measured at least 3 ft above MHHW fell within the Storm Surge Warning area. A few gauges on the south side of Lake Pontchartrain outside of the Hurricane and Storm Damage Risk Reduction System (HSDRRS) recorded water levels higher than 3 ft MHHW; however, a storm surge warning was intentionally not issued for that area because it would have triggered emergency alerts within the adjacent greater New Orleans area within the HSDRRS. No observations of inundation of 3 ft or greater above normally dry ground were received from the eastern end of the warning area (western Florida Panhandle) or the western end (around Vermilion Bay).

IMPACT-BASED DECISION SUPPORT SERVICES (IDSS) AND PUBLIC COMMUNICATION

The NHC began communication with emergency managers on 26 October as Zeta was in the northwestern Caribbean through its landfall in Louisiana on 28 October. This communication included briefings and Federal video-teleconferences with FEMA Headquarters and FEMA Regions 4 and 6, along with the Gulf States. These decision support briefings were coordinated through the FEMA Hurricane Liaison Team, embedded at the NHC. In addition, the NHC director

maintained direct communications with senior state emergency management officials to discuss the evolving threat to the Gulf coast. The Tropical Analysis and Forecast Branch of NHC provided five live briefings on Zeta to the U.S. Coast Guard District 8 in New Orleans between 25 and 28 October in support of USCG's life-saving mission. In addition to NHC's IDSS described above, there was a large-scale collaborative IDSS effort across the NWS, including WFOs, RFCs, and National Centers, in response to the multiple life-threatening hazards produced by Zeta along the Gulf Coast and in the southeastern United States.

NHC opened a media pool on 27–28 October to network broadcast and cable news/weather outlets and local TV stations along the northern Gulf Coast and inland from Lake Charles, Louisiana, to Panama City, Florida. During the 2-day pool operation, 43 broadcasts were generated for generic distribution, network, cable and local affiliates and Skype interviews. Audio recordings of the top-of-the-hour generic pool broadcasts were made available on the NHC website.

On social media, the @NHC_Atlantic Twitter account had 23 million Twitter impressions beginning when Zeta's precursor disturbance was highlighted in the Tropical Weather Outlook on 21 October. NHC provided 8 Facebook Live broadcasts via its Facebook page with 300,000 views during the 2-day period. Postings of the latest NHC advisories were made onto the NHC Facebook page at a minimum of once every three hours. The post reach during this event was 2.5 million, and the post engagement was 1.2 million.

ACKNOWLEDGMENTS

Data in Table 3 were compiled from Post Tropical Cyclone Reports issued by NWS Weather Forecast Offices (WFOs) in Jackson, Mississippi; Birmingham, Alabama; Peachtree City, Georgia; Blacksburg, Virginia; Tallahassee, Florida; Mobile, Alabama; and New Orleans and Lake Charles, Louisiana, as well as Public Information Statements issued by inland WFOs. Data and reports from the Weather Prediction Center (WPC), National Data Buoy Center, NOS Center for Operational Oceanographic Products and Services, U.S. Geological Survey, and U.S. Army Corps of Engineers were also used in the creation of this report. Laura Alaka and William Booth from the NHC Storm Surge Unit provided storm surge data and a storm surge hindcast for the analysis, Senior Hurricane Specialist John Cangialosi created the best track map (Fig. 2), Hurricane Specialist Philippe Papin created the radar figures (Fig. 5a-c), David Roth from WPC created the rainfall map and Roger Edwards from the Storm Prediction Center provided the final tornado count.

Table 1. Best track for Hurricane Zeta, 24–29 October 2020.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
24 / 1200	18.4	82.6	1007	25	tropical depression
24 / 1800	18.2	83.0	1006	30	"
25 / 0000	18.0	83.2	1005	35	tropical storm
25 / 0600	17.7	83.5	1004	40	"
25 / 1200	17.8	83.6	1003	45	"
25 / 1800	18.0	83.7	1000	50	"
26 / 0000	18.2	83.8	996	55	"
26 / 0600	18.5	84.1	993	65	hurricane
26 / 1200	18.9	84.8	990	65	"
26 / 1800	19.4	85.7	984	70	"
27 / 0000	19.9	86.6	980	70	"
27 / 0355	20.4	87.4	977	75	"
27 / 0600	20.6	87.9	981	65	"
27 / 1200	21.3	89.0	985	60	tropical storm
27 / 1800	22.2	90.0	988	55	"
28 / 0000	23.2	90.8	990	55	"
28 / 0600	24.4	91.5	984	65	hurricane
28 / 1200	26.0	91.7	978	80	"
28 / 1800	28.0	91.1	973	95	"
28 / 2100	29.2	90.6	970	100	"
29 / 0000	30.2	89.9	973	85	"
29 / 0600	32.8	87.5	986	60	tropical storm
29 / 1200	35.3	83.6	990	45	"
29 / 1800	37.8	78.2	992	45	extratropical
30 / 0000	39.5	71.7	993	45	"
30 / 0600					dissipated
28 / 2100	29.2	90.6	970	100	maximum winds, minimum pressure and landfall near Cocodrie, Louisiana
27 / 0355	20.4	87.4	977	75	landfall near Ciudad Chemuyil, Mexico

Table 2. Selected ship reports with winds of at least 34 kt for Hurricane Zeta, 24-29 October 2020.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
28 / 0400	MAOR7	24.0	88.4	140 / 42	1009.3
28 / 0900	MAOR7	24.0	89.7	170 / 36	1006.2
28 / 1100	MAOR7	23.9	90.2	180 / 36	1005.6
28 / 1700	9HA401	27.9	91.5	320 / 40	988.1
29 / 1800	WDI317	32.5	77.8	220 / 45	1006.8

Table 3. Selected surface observations for Hurricane Zeta, 24–29 October 2020.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
MEXICO									
Weatherflow									
Cancun (XCCN) (21.06N 86.78W)	27/0228	1000.7	27/0220	56 (1 min, 11 m)	64				
Cozumel (XCOZ) (20.53N 86.94W)	27/0244	992.0	27/0329	48 (1 min, 11 m)	68				
Playa del Carmen (XPDC) (20.58N 87.12W)	27/0311	991.2	27/0253	64 (1 min, 11 m)	76				
Puerto Morelos (XPRM) (20.83N 86.89W)	27/0249	995.2	27/0651	57 (1 min, 10 m)	65				
Tulum-Xel-Ha Park (XTUL) (20.32N 87.36)	27/0356	978.1	27/0432	38 (1 min, 10 m)	48				
Public/Other									
Akumal (iCyclone) (20.40N 87.32W)	27/0357	979.2							
Playa del Carmen (iCyclone) (20.62N 87.09W)	27/0350	996.0							
UNITED STATES									
Buoys									
42012 (NOAA) (30.06N 87.55W)	29/0020	1004.3	29/0341	43 (1 min, 4 m)	52				
42056 (NOAA) (19.82N 84.95W)	26/1150	1002.6	26/1741	52 (1 min, 4 m)	60				
Gulf of Mexico Offshore Oil Platforms									
Main Pass 289C (KVKY) (29.25N 88.44W)			29/0215	55 (2 min, 115m)	64				
Mississippi Canyon (MDJ) (28.64N 89.79W)			28/1815	45 (90 m)	53				
LOUISIANA									
International Civil Aviation Organization (ICAO) Sites									
Belle Chasse NAS (KNBG) (29.82N 90.03W)	28/2255	973.2	28/2335	46 (2 min, 10 m)	76				1.59
Boothville/Venice (KLNQ) (29.35N 89.44W)	28/2235	995.6[l]	28/2215	40[l] (2 min, 10 m)	59[l]				
Houma (KHUM) (29.56N 90.66W)	28/1850	1003.7[l]	28/1850	32[l] (2 min, 10 m)	42[l]				
New Orleans International (KMSY) (29.98N 90.25W)	28/2310	978.3	28/2335	41 (2 min, 10 m)	62				2.93
New Orleans Lakefront (KNEW) (30.04N 90.03W)	28/2320	973.6							
Reserve (KAPS) (30.09N 90.58W)	28/2315	991.2	28/2315	35 (2 min, 10 m)	46				1.94
Slidell (KASD) (30.35N 89.82W)	29/0025	977.0	28/2353	36 (2 min, 10 m)	59				4.06
Coastal-Marine Automated Network (C-MAN) Sites									

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
SW Pass (BURL1) (28.91N 89.43W)			28/2200	55 (2 min, 38 m)	65				
National Ocean Service (NOS) Sites									
Frenier Landing (FREL1) (30.11N 90.42W)	28/2336	983.7	28/2336	40 (1 min, 10 m)	53				
Grand Isle (GISL1) (29.27N 89.96W)			28/2154	39 (2 min, 7 m)	61	3.24		3.0	
New Canal (NWCL1) (30.03N 90.11W)	28/2324	974.5	28/2254	59 (2 min, 10 m)	85	4.77	5.15	4.8	
North of Eugene Island (EINL1) (29.37N 91.38W)	28/2130	993.6	28/2130	34 (4 m)	42	2.22		1.2	
Pilot's Station East/SW Pass (PSTL1) (28.93N 89.41W)	28/2212	996.2	28/2218	54 (2 min, 20 m)	67	2.90		2.5	
PIlottown (PILL1) (29.18N 89.26W)	28/2230	997.8	28/2300	46 (2 min, 10 m)	59				
Shell Beach (SHBL1) (29.87N 89.67W)	28/2330	980.2	28/2342	70 (2 min, 16 m)	88	3.66	4.11	3.4	
West Bank 1 (BYGL1) (29.79N 90.42W)	28/2230	977.3	28/2206	32 (2 min, 31 m)	47				
Port Fourchon (PTFL1) (29.11N 90.20W)						3.10		3.0	
Freshwater Canal Locks (FRWL1) (29.55N 92.31W)			29/1600	19 (20 m)	26	2.77	3.44	2.6	
Pilot's Station East (PSTL1) (28.93N 89.41W)	28/2100	996.2	28/2218	54 (24 m)	67	2.90		2.5	
Calcasieu Pass (CAPL1) (29.77N 93.34W)	28/1930	1002.8	29/0612	27 (12 m)	33	1.91	2.14	1.7	
Pilottown (PILL1) (29.18N 89.26W)	28/2218	997.8	28/2300	46 (12 m)	59	1.99		1.6	
Lake Charles (LCLL1) (30.22N 93.22W)	28/2048	1004.2				1.75	2.23	1.5	
Bulk Terminal (BKTL1) (30.19N 93.30W)						1.83	2.00	1.3	
LAWMA, Amerada Pass (AMRL1) (29.45N 91.34W)	28/2136	994.3	29/0948	23 (11 m)	33	2.12	1.86	1.2	
Berwick, Atchafalaya River (TESL1) (29.67N 91.24W)			28/2130	28 (13 m)	37	0.86	2.05	0.0	
United States Geological Survey (USGS) Stream Gauges									
Barataria Bay N of Grand Isle (NGIL1) (29.42N 89.95W)							7.81	7.0	
Pearl River Navigation Canal Lock & Dam #1 (PRUL1) (30.46N 89.78W)									7.35
Caillou Bay SW of Cocodrie (CCOL1) (29.08N 90.87W)							5.22	4.3	

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
American Bay near Pointe-a-la-Hache (PLHL1) (29.57N 89.70W)							5.70[I]	4.3[I]	
Crooked Bayou near Delacroix (GRPL1) (29.71N 89.72W)							5.47	4.1	
Hackberry Bay NW of Grand Isle (HACL1) (29.40N 90.04W)							4.80[I]	4.0[I]	
Little Lake near Cutoff (CTFL1) (29.52N 90.18W)							4.62	3.9	
Black Bay near Pointe-a-la-Hache (PSIL1) (29.63N 89.56W)							4.68[I]	3.3[I]	
Barataria Pass at Grand Isle (EGIL1) (29.27N 89.95W)							3.74	2.9	
Caminada Pass NW of Grand Isle (CPGL1) (29.23N 90.05W)							3.58	2.8	
Caillou Lake SW of Dulac (DCLL1) (29.25N 90.92W)							3.33	2.3	
Mississippi Sound near Grand Pass (GRPL1) (30.12N 89.25W)							2.39	1.2	
Lake Pontchartrain – West End (WEGL1) (30.02N 90.12W)							6.30	5.8	
Rigolets near Lake Pontchartrain (RIGL1) (30.16N 89.74W)							5.32	4.3	
Lake Pontchartrain at Lakefront Airport (PLAL1) (30.04N 90.02W)							4.21[I]	3.6[I]	
Bayou Dupre Flood Gate (BDML1) (29.94N 89.84W)							4.35	3.1	
Chef Manteur Pass near Lake Borgne (CMPL1) (30.07N 89.80W)							4.04	2.9	
Lake Pontchartrain at Mandeville (LPML1) (30.37N 90.09W)							3.34	2.7	
Pass Manchac Pontchatoula (PMPL1) (30.28N 90.40W)							2.84	1.8	
Bayou Bienvenue Flood Gate (30.00N 89.92W)							2.65	1.5	
Timmer/Simpson/Theiss Surginator Sensors									
Buras – Joshua's Marina (29.35N 89.54W)						5.2[E]			

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Venice – Venice Marina (29.24N 89.36W)						2.8[E]			
Venice – Cypress Cove Marina (29.25N 89.36W)						1.8[E]			
Hydrometeorological Automated Data System (HADS) Sites (NWS)									
Barataria Bay Pass (EGIL1) (29.27N 89.95W)			28/2200	64					
Barataria Bay near Grand Isle (NGIL1) (29.42N 89.95W)			28/2200	60					
Bay Dosgris (E of Galiano) (DOSL1) (29.47N 90.10W)			28/2200	68					
Caillou Lake near Dulac 15 SW (DCLL1) (29.25N 90.92W)			28/2130	46					
Calliou Bay near Cocodrie 18 SW (CCOL1) (29.08N 90.87W)			28/2000	49					
Mississippi Sound at Grand Pas (GRPL1) (30.12N 89.25W)			28/2300	45					
NE Bay Gardene Near Pt a La Hache 11E (BGNL1) (29.59N 89.61W)			28/2230	63					
New Orleans (NORL1) (29.93N 90.14W)									4.70
Seabrook Closure (SBCL1) (30.03N 90.04W)			29/0000	33					
Weatherflow									
Bayou Bienvenue (XBYU) (30.00N 89.90W)	28/2312	971.1	28/2252	76 (5 min, 27 m)	97				
Dulac (XDUL) (29.35N 90.73W)	28/2136	980.6	28/2146	55 (1 min, 10 m)	68				
Mandeville (XMVL) (30.36N 90.09W)	29/0012	980.1	29/0035	42 (1 min, 10 m)	51				
Midlake (XPTN) (30.20N 90.12W)	28/2335	976.8	28/2351	56 (1 min, 12 m)	64				
New Orleans Lakefront (XLKF) (30.04N 90.02W)	28/2334	972.6	28/2358	58 (1 min, 10 m)	67				
Waggaman (XJEF) (29.94N 90.23W)	28/2234	973.6	28/2235	48 (1 min, 10 m)	65				
Offshore Oil Platforms									
Louisiana Offshore Oil Port (LOPL1) (28.89N 90.02W)	28/2133	993.1[I]	28/1958	35[I] (2 min, 58 m)	60[I]				
South Marsh Island 268A (KSCF) (29.12N 91.87W)			28/1910	46 (25 m)	52				

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
West Delta 27A (KDLP) (29.12N 89.55W)			28/2135	51 (2 min, 35 m)	73				
Remote Automated Weather Stations (RAWS)									
Big Branch NWR (BBNL1) (30.32N 89.94W)			29/0047		43				4.74
Sela Portable (TS947) (30.11N 89.86W)			28/2134	23 (2 m)	57				
Citizen Weather Observer Program (CWOP)									
Belle Chasse (CW3916) (29.84N 90.00W)	28/2217	987.1[I]	28/2215	32[I]	54[I]				
Belle Chasse (EW3364) (29.86N 89.99W)	28/2218	986.5[I]	28/2218	31[I]	52[I]				
Bourg (FW6044) (29.56N 90.60W)	28/2150	978.3	28/2210	30[I]	50[I]				
Gretna (EW8473) (29.91N 90.05W)	28/2330	976.6	28/2231	23[I]	44[I]				
Houma (EW3858) (29.56N 90.64W)	28/2128	987.1							4.84
Kenner (FW1110) (30.03N 90.22W)	28/2315	979.3	28/2301	27	50				3.39
Lacombe (FW1251) (30.32N 89.97W)	29/0030	981.0							4.17
Laplace (AU112) (30.06N 90.45W)	28/2335	985.8							2.48
Mandeville (FW1704) (30.42N 90.07W)	29/0016	985.4							4.01
New Orleans (CW4185) (29.95N 90.20W)	28/2246	978.0[I]	28/2246	25[I]	54[I]				2.83
New Orleans (EW6362) (29.97N 90.09W)	28/2325	975.3	28/2250	30	58				
New Orleans (FW1622) (29.94N 90.07W)	28/2308	977.0	28/2238	24	43				3.85
Raceland (D1103) (29.70N 90.57W)	28/2202	982.7	28/2202	29	47				2.91
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Lacombe 1.4N (LA-ST-8) (30.32N 89.93W)									4.95
Public/Other									
Barataria (29.73N 90.12W)	28/2159	977.0[I]	28/2159	49[I]					
Bourg (29.54N 90.59W)	28/2154	995.6	28/2144	33 (17 m)	55				
Braithwaite (29.87N 89.95W)	28/2304	976.3	28/2304	47 (11 m)	59				
Estelle (29.84N 90.12W)	28/2215	981.7[I]	28/2354	32[I] (6 m)	48[I]				
Golden Meadow (29.16N 90.18W)	28/2134	983.1	28/2139	82 (6 m)	96				
Golden Meadow (29.39N 90.27W)			28/2129	72	91				
Grand Isle (29.23N 90.00W)			28/2033	47	76				
Gretna (29.93N 90.06W)	28/2300	974.3[I]	28/2230	36[I] (2 m)	55[I]				

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Jefferson (29.95N 90.14W)	28/2314	974.3	28/2349	47[l] (5 m)	55				
New Orleans 1 WSW (29.96N 90.10W)			28/2259		82				
Slidell (30.22N 89.82W)	28/2330	980.4[l]	28/2330	49[l] (7 m)	70[l]				
St. Rose (29.96N 90.32W)	28/2244	979.7	28/2319	44 (9 m)	54				
Westwego (29.91N 90.14W)	28/2300	975.6	28/2230	35 (3 m)	56				
MISSISSIPPI									
International Civil Aviation Organization (ICAO) Sites									
Biloxi (KBIX) (30.43N 88.92W)	29/0100	989.5	29/0126	56 (2 min, 10 m)	78				2.67
Gulfport (KGPT) (30.40N 89.07W)	29/0055	985.8	29/0049	55 (2 min, 10 m)	83				1.97
Hattiesburg (KHBG) (31.27N 89.26W)	29/0227	984.8	29/0227	28 (2 min, 10 m)	50				3.67
Hattiesburg (KPIB) (31.47N 89.33W)	29/0225	988.8	29/0225	31 (2 min, 10 m)	40				2.26
Meridian (KMEI) (32.34N 88.75W)	29/0358	992.1	29/0417	28 (2 min, 10 m)	39				3.51
Meridian (KNMM) (32.55N 88.56W)	29/0422	993.9	29/0512	23 (2 min, 10 m)	34				4.15
Pascagoula (KPQL) (30.46N 88.53W)	29/0135	996.3	29/0040	39 (2 min, 10 m)	53				2.03
National Ocean Service (NOS) Sites									
Petit Bois Island, Port of Pascagoula (PTBM6) (30.21N 88.50W)	29/0048	997.9	29/0048	49 (10 min, 5 m)	68				
Bay Waveland Yacht Club (WYCM6) (30.33N 89.33W)	29/0036	980.7	29/0018	70 (2 min, 10 m)	90	8.74	9.23	8.2	
Pascagoula NOAA Lab (PNLM6) (30.37N 88.56W)						7.41	7.95	7.1	
USGS Stream Gauges									
Old Fort Bayou at Ocean Springs (OPFM6) (30.42N 88.82W)							10.88	9.5	
Back Bay of Biloxi (BBBM6) (30.42N 88.98W)							8.57	7.2	
East Pearl River near Claiborne (EPCM6) (30.19N 89.53W)							8.57	7.2	
Pascagoula River at Pascagoula (PRPM6) (30.37N 88.56W)							7.97	6.7	
West Pascagoula River at Gautier (WPGM6) (30.38N 88.61W)							7.97	6.6	
Hydrometeorological Automated Data System (HADS) Sites (NWS)									

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Chickasawhay River at Leaksville (LEKM6) (31.15N 88.56W)									6.87
Chickasawhay River at Enterprise (ENSM6) (32.18N 88.82W)									4.61
Weatherflow									
Biloxi (XBIL) (30.44N 88.98W)	29/0156	985.0	29/0101	52 (1 min, 15 m)	73				
Gulfport (XGPT) (30.36N 89.11W)	29/0042	985.9	29/0057	74 (1 min, 10 m)	88				
Ship Island (XSHI) (30.23N 88.98W)	29/0044	990.3	29/0052	67 (1 min, 12 m)	75				
Remote Automated Weather Stations (RAWS)									
Black Creek (BLCM6) (30.85N 89.03W)									4.23
Camp Keller (CKWM6) (30.52N 88.98W)			29/0050	29 (6 m)	65				2.31
Grand Bay (GRBM6) (30.44N 88.43W)			29/0125	28 (6 m)	45				2.66
Hancock (NNHM6) (30.45N 89.45W)			29/0109		39 (6 m)				3.57
Lauderdale (RLDM6) (32.37N 88.46W)									4.74
Leakesville (LKKM6) (31.14N 88.60W)			29/0314		58 (6 m)				
MS Sandhill (SHCM6) (30.45N 88.66W)			29/0151	22 (6 m)	56				1.88
Ragland Hills (FRGM6) (31.20N 89.18W)			29/0227	21 (6 m)	35				4.11
Wausau (LAUM6) (31.53N 88.89W)			29/0409		40 (6 m)				4.01
Citizen Weather Observer Program (CWOP)									
Carriere (AU216) (30.64N 89.70W)	29/0040	980.4							4.70
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Carriere 5.4 E (MS-PR-13) (30.62N 89.56W)									4.59
Picayune 5.6 ENE (MS-PR-4) (30.55N 89.59W)									4.85
Public/Other									
Bay St. Louis (iCyclone) (30.32N 89.34W)	29/0034	979.6							
Hattiesburg Forrest County EMA (31.25N 89.34W)			29/0225		49				
Lake Bogue Homa (KMSLAURE22) (31.70N 89.02W)			29/0352	30	44				
Macedonia 3 SSW (KMSPETAL10) (31.34N 89.20W)			29/0234	38	52				

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Moss Point (30.49N 88.47W)	28/2315	997.6[I]	29/0159	38[I] (12 m)	50[I]				
Ocean Springs (30.36N 88.73W)	29/0104	991.5	29/0104	29 (7 m)	44				
Saucier (30.63N 88.97W)			29/0134	31 (35 m)	52				
Three Rivers (30.60N 88.47W)			29/0134	31[I] (26 m)	50[I]				
Wool Market (30.50N 88.96W)	29/0059	988.1[I]	29/0106	36[I] (27 m)	52[I]				
ALABAMA									
International Civil Aviation Organization (ICAO) Sites									
Alabaster (KEET) (33.18N 86.78W)	29/0640	990.9							
Alexander City (KALX) (32.91N 85.96W)	29/0655	997.3	29/0755	30 (2 min, 10 m)	54				1.24
Anniston (KANB) (33.60N 85.85W)	29/0745	991.9	29/0841	34 (2 min, 10 m)	47				1.31
Auburn Univ Airport (KAUO) (32.62N 85.44W)	29/0635	1002.4	29/0740	30 (2 min, 10 m)	55				
Evergreen (KGZH) (31.42N 87.04W)	29/0400	999.0	29/0349	37 (2 min, 10 m)	61				1.14
Fairhope (KCQF) (30.46N 87.88W)	29/0135	1001.7	29/0255	37 (2 min, 10 m)	50				
Florala Municipal (K0J4) (31.04N 86.31W)	29/0402	1005.8	29/0658	29 (2 min, 10 m)	47				
Greenville (KPRN) (31.85N 86.61W)	29/0452	994.2	29/0658	29 (2 min, 10 m)	56				
Maxwell AFB (KMXF) (32.39N 86.37W)	29/0556	996.6	29/0553	35 (2 min, 10 m)	51				1.06
Mobile (KBFM) (30.64N 88.07W)	29/0130	999.0	29/0105	43[I] (2 min, 10 m)	64[I]				1.12
Mobile (KMOB) (30.68N 88.25W)	29/0205	997.3	29/0210	48 (2 min, 10 m)	79				1.71
Montgomery (KMGM) (32.30N 86.40W)	29/0553	996.5	29/0645	36[I] (2 min, 10 m)	53[I]				
Pell City (KPLR) (33.56N 86.25W)	29/0715	991.1	29/0815	27 (2 min, 10 m)	44				
Selma (KSEM) (32.34N 86.99W)			29/0511	34 (2 min, 10 m)	53				
Sylacauga (KSCD) (33.17N 86.30W)	29/0655	992.3	29/0735	36[I] (2 min, 10 m)	54[I]				
Talladega (KASN) (33.57N 86.05W)	29/0755	993.2	29/0835	33 (2 min, 10 m)	36[I]				1.45
Troy (KTOI) (31.86N 86.01W)	29/0616	1002.7	29/0621	27 (2 min, 10 m)	45				
Coastal-Marine Automated Network (C-MAN) Sites									
Dauphin Island (DPIA1) (30.25N 88.07W)	29/0100	1000.8	29/0100	49 (14 m)	62				
Middle Bay Light, AL (MBLA1) (30.44N 88.01W)	29/0039	998.6	29/0230	53 (14 m)	58				
National Ocean Service (NOS) Sites									

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Fort Morgan (FMOA1) (30.23N 88.02W)	29/0136	1000.9	29/0054	58 (36 m)	68				
Coast Guard Sector Mobile (MCGA1) (30.65N 88.06W)	29/0130	999.4	29/0148	39 (7 m)	55	6.16	6.49	5.3	
Bayou La Batre Bridge (BLBA1) (30.41N 88.25W)						7.21	7.82	6.9	
West Fowl River Bridge (WFRA1) (30.38N 88.16W)						6.45	6.82	5.9	
Mobile State Docks (OBLA1) (30.71N 88.04W)	29/0242	1000.2				5.64	6.32	5.2	
Chickasaw Creek (CIKA1) (30.78N 88.07W)						5.20	5.79	4.5	
Dog River Bridge (BYSA1) (30.57N 88.09W)						5.05		4.4	
Weeks Bay, Mobile Bay (WBYA1) (30.42N 87.83W)						4.53		4.2	
East Fowl River Bridge (EFRA1) (30.44N 88.11W)						4.16	4.50	3.7	
Dauphin Island (DILA1) (30.25N 88.08W)						2.76	3.11	2.4	
National Weather Service High Water Marks									
Coden								4 - 8 (waves)	
Daphne								5 - 7 (waves)	
Spanish Fort								2 - 7 (waves)	
Bayou La Batre								3 - 4 (waves)	
Dauphin Island								1 - 3 (waves)	
Hydrometeorological Automated Data System (HADS) Sites (NWS)									
Clanton (CLXA1) (32.85N 86.61W)			29/0650	33 (3 m)	49				1.69
Russellville 4 SSE (RUXA1) (34.45N 87.71W)									3.78
Woodville 2 W (WDVA1) (34.62N 86.30W)									4.26
Selma (SLXA1) (32.34N 86.98W)			29/0540	37 (3 m)	54				2.10
Talladega (TLXA1) (33.57N 86.06W)			29/0855	34	49				2.31
Thomasville 2S (TOXA1) (31.93N 87.74W)			29/0445	38 (3 m)	52				3.75
Weatherflow									
Buccaneer Yacht Club (XBUC) (30.58N 88.07W)	29/0123	998.5	29/0147	53 (1 min, 10 m)	62				

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Gulf Shores (XGLF) (30.36N 87.65W)			29/0210	39 (1 min, 10 m)	50				
Remote Automated Weather Stations (RAWS)									
Grove Hill (TT309) (31.69N 87.76W)			29/0426	36	70				2.73
Citizen Weather Observer Program (CWOP)									
Calvert (EW0390) (31.15N 88.00W)	29/0259	993.2	29/0314	31	59				1.82
Childersburg (EW5369) (33.27N 86.36W)	29/0652	991.5	29/0722		47				
Gulf Shores (DW2229) (30.25N 87.72W)	29/0153	1002.7	29/0353	28	50				
Madison (EW2748) (34.70N 86.76W)	29/0830	995.3							3.97
Madison (FW2925) (34.72N 86.78W)									3.99
Margaret (DW5411) (33.47N 86.34W)	29/0728	991.2	29/0738	30	44				1.03
Mobile (FW6880) (30.66N 88.14W)	29/0230	1000.3	29/0200	22	50				1.91
Ohatchee (FW1272) (33.81N 85.98W)	29/0656	994.9	29/0615	25	46				
Orange Beach (FW3872) (30.28N 87.58W)	29/0146	1003.0	29/0216	33	54				
University of South Alabama Chili Mesonet									
Loxley (30.64N 87.70W)				37[l]	50[l]				
Dauphin Island Sea Lab Mesonet									
Meaher Park (MHPA1) (30.67N 87.94W)	29/0230	998.3[l]	29/0300	42[l] (9 m)					
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Thomasville 5.2 SSW (AL-CK-10) (31.84N 87.77W)									3.35
Public/Other									
Downtown Mobile 1W (MBCFS) (30.69N 88.05W)			29/0125		53				
Pinto Island 1 NE (30.68N 88.02W)			29/0144		61				
Robertsdale 3 ENE (30.57N 87.67W)			29/0143		59				
FLORIDA									
International Civil Aviation Organization (ICAO) Sites									
Crestview (KCEW) (30.79N 86.52W)	29/0353	1006.4	29/0410	26 (2 min, 10 m)	46				
Duke Field (KEGI) (30.65N 86.52W)	29/0417	1006.1	29/0417	32 (2 min, 10 m)	42				
Hurlburt Field (KHRT) (30.42N 86.68W)	29/0356	1006.4	29/0331	31 (2 min, 10 m)	46				

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Milton (KNDZ) (30.70N 87.02W)	29/0356	1002.0	29/0156	33 (2 min, 10 m)	50				
Milton (KNSE) (30.72N 87.02W)	29/0404	1003.0	29/0256	34 (2 min, 10 m)	49				
Pensacola (KPNS) (30.47N 87.20W)	29/0325	1004.9	29/0250	39 (2 min, 10 m)	49				
Pensacola NAS (KNPA) (30.35N 87.32W)	29/0256	1004.7	29/0156	37 (2 min, 10 m)	51				
National Ocean Service (NOS) Sites									
Panama City Beach (PCBF1) (30.21N 85.88W)	29/0800	1008.5	29/0436	32 (17 m)	38	2.63	2.85	2.0	
Pensacola (PCLF1) (30.40N 87.21W)	29/0224	1004.6	29/0430	34 (10 m)	44	2.49	3.04	2.1	
Apalachicola (APCF1) (29.73N 84.98W)	29/1930	1009.3	29/0436	22 (9 m)	26	2.12	2.63	1.8	
Panama City (PACF1) (30.15N 85.67W)			29/0912	28 (10 m)	34	2.29	2.41	1.6	
Cedar Key (CKYF1) (29.13N 83.03W)	29/2054	1009.1	29/2230	26 (12 m)	30	2.10	3.03	1.5	
USGS Stream Gauges									
Spring Creek (SBIF1) (30.07N 84.33W)							3.35	1.7	
Suwannee River (SUWF1) (29.34N 83.09W)							3.00	1.5	
Aucilla River at Nutall Rise (NUTF1) (30.11N 83.98W)							3.29	1.4	
Spring Creek (SBIF1) (30.07N 84.33W)							3.35	1.7	
Northwest Florida Water Management District Gauges									
White City (SEWF1) (29.88N 85.22W)								1.7	
Suwannee River Water Management District Gauges									
Steinhatchee (STIF1) (29.67N 83.38W)								1.9	
Weatherflow									
Ft. Walton Beach (XFWB) (30.40N 86.56W)	29/0338	1005.7	29/0358	38 (1 min, 7 m)	47				
Gulf Breeze (XGBZ) (30.36N 87.16W)	29/0226	1003.3	29/0434	33 (1 min, 15 m)	42				
Okaloosa Island Fishing Pier (XOFP) (30.39N 86.59W)			29/0335	37 (5 min, 14 m)	47				
Santa Rosa Sound (DB127) (30.38N 87.01W)	29/0225	1002.8	29/0157	41 (1 min, 7 m)	51				
WeatherSTEM									
Berrydale (1088W) (30.91N 87.03W)	29/0350	1003.4	29/0210	28	50				1.40
Century (1208W) (30.97N 87.41W)	29/0340	999.0	29/0240	42	53				1.33

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Ft. Walton Beach (0241W) (30.45N 86.62W)	29/0620	1006.8	29/0350	32	36				
Gonzalez 2 SSW (1206W) (30.58N 87.30W)	29/0200	1001.7	29/0150	29	45				
Gulf Breeze (0327W) (30.36N 87.17W)	29/0230	1006.1	29/0000	35	44				
Navarre Beach (0401W) (30.38N 86.86W)	29/0310	1006.1	29/0350	39	47				
Pace (0904W) (30.61N 87.15W)	29/0240	1004.4	29/0430	36	53				0.94
Pace (1213W) (30.70N 87.18W)	29/0420	1004.4	29/0420	38	46				
Pensacola (0402W) (30.50N 87.25W)	29/0310	1001.7	29/0330	34	52				
Pensacola (1199W) (30.43N 87.22W)	29/0250	1005.1	29/0540	31	43				
Pensacola (1201W) (30.48N 87.21W)	29/0300	1004.1	29/0120	30	43				
Pensacola (1203W) (30.49N 87.30W)	29/0300	1003.7	29/0210	41	46				
Citizen Weather Observer Program (CWOP)									
Niceville (CW7473) (30.49N 86.46W)	29/0645	1007.5	29/0401	31	45				
Perdido Key (FW7996) (30.33N 87.37W)	29/0126	1005.8	29/0126	33					
Valparaiso (DW6507) (30.50N 86.49W)	29/0416	1007.1	29/0301	29	49				
University of South Alabama Chili Mesonet									
Jay (30.95N 87.17W)				41[l]	50[l]				
Public/Other									
Ed Walline Beach (EDWA) (30.35N 86.23W)			29/0730	39	43				
GEORGIA									
International Civil Aviation Organization (ICAO) Sites									
Atlanta (KATL) (33.66N 84.42W)	29/0918	999.3	29/0918	28 (2 min, 10 m)	45				0.89
Atlanta (KPDK) (33.88N 84.30W)	29/0902	997.6	29/0953	27 (2 min, 10 m)	41				0.98
Blairsville (KDZJ) (34.85N 84.00W)	29/1015	997.3	29/1135	28 (2 min, 10 m)	42				3.26
Canton (KCNI) (34.31N 84.42W)	29/0915	996.3	29/1055	27 (2 min, 10 m)	46				
Carrollton (KCTJ) (33.63N 85.15W)	29/0755	998.3	29/0735	28 (2 min, 10 m)	43				
Cartersville (KVPC) (34.14N 84.85W)	29/0853	994.8	29/0853	24 (2 min, 10 m)	42				1.07
Columbus (KCSG) (32.53N 84.93W)	29/0745	1003.0	30/0710	26 (2 min, 10 m)	49				
Fulton County Brown Field (KFTY) (33.78N 84.52W)	29/0853	997.7	29/0842	25 (2 min, 10 m)	44				0.82

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Gainesville (KGVL) (34.27N 83.83W)	29/0953	998.0[I]	29/0953		40				1.36
Jasper (KJZP) (34.45N 84.46W)	29/0915	996.3	29/0915	35 (2 min, 10 m)	45				
Jefferson (KJCA) (34.18N 83.56W)	29/0955	1000.0	29/0955	29 (2 min, 10 m)	42				1.10
Kennesaw (KRYY) (34.01N 84.60W)	29/0850	996.6	29/0850		39				
Marietta (KMGE) (33.92N 84.52W)	29/0856	996.3	29/0856	28 (2 min, 10 m)	42				0.83
Monroe (KD73) (33.78N 83.69W)	29/0930	1001.7	29/1010	28 (2 min, 10 m)	41				
Pine Mountain (KPIM) (32.84N 84.88W)	29/0735	1002.7	29/0855	26 (2 min, 10 m)	39				
Rome (KRMG) (34.35N 85.16W)	29/0911	991.9	29/0911	23[I] (2 min, 10 m)	44				1.92
Hydrometeorological Automated Data System (HADS) Sites (NWS)									
Epworth 5SW (EPWG1) (34.90N 84.44W)									3.34
Owltown / Choestoe (CHOG1) (34.80N 83.90W)									6.31
Pine Mountain 4 NE (BURG1) (34.97N 83.12W)									3.81
Suches 4 NW (SCHG1) (34.72N 84.07W)									6.43
Sugar Hill (CMMG1) (34.16N 84.08W)	29/0915		29/0915	32					0.93
Tate City (TUSG1) (34.95N 83.62W)									3.79
WeatherSTEM									
Athens (0756W) (33.94N 83.38W)	29/1000	999.7	29/1030	21	46				
Cumming (0637W) (34.22N 84.11W)	29/0910	996.3	29/1020	31	39				1.56
Cumming (1076W) (34.22N 84.12W)	29/0930	993.2	29/0930	30	43				1.77
Druid Hills (0536W) (33.80N 84.32W)			29/0900	36	47				0.92
1.0 E Oakwood (34.23N 83.87W)			29/0910		42				
0.9 W Rest Haven (34.13N 83.99W)			29/0930		42				
Remote Automated Weather Stations (RAWS)									
Brasstown (BRSG1) (34.81N 83.71W)			29/1206		36				4.38
Chattooga (CHGG1) (34.64N 83.52W)			29/1106		49				2.24
Nimblewill (CPMG1) (34.61N 84.13W)									3.88
Suches (TCCG1) (34.77N 84.07W)			29/1205		36				3.98

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Tallulah (TULG1) (34.91N 83.33W)									3.74
Citizen Weather Observer Program (CWOP)									
Ellijay (EW5151) (34.55N 84.27W)									3.27
Georgia Automated Environmental Monitoring Network (AEMN)									
Floyd-NW GA Research & Ed Center (34.34N 85.12W)	29/0800	991.6	29/0900	22	42				
Gaines-Lake Lanier (34.35N 83.79W)	29/0900	998.6	29/0945	20	46				
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Blairsville 5.3 ESE (GA-UN-9) (34.84N 83.87W)									5.14
Dillard 4 NE (GA-RB-1) (34.99N 83.30W)									6.42
Hiawassee 5 SSE (GA-TW-1) (34.89N 83.71W)									5.30
Rabun Gap 2 SW (GA-RB-4) (34.94N 83.42W)									5.61
Tiger 2 NW (GA-RB-13) (34.87N 83.46W)									5.19
Public/Other									
Rome (34.35N 85.17W)			29/1000		48				1.92
Canton Cherokee (34.32N 84.42W)			29/0915		46				
Dallas (33.83N 84.74W)			29/1002		39				
Lawrenceville (33.98N 83.97W)			29/1006		39				
Smyrna (33.87N 84.50W)			29/0933		39				
Peachtree City (33.35N 84.57W)			29/0741		38				
TENNESSEE									
International Civil Aviation Organization (ICAO) Sites									
Cleveland (KRZR) (35.21N 84.79W)	29/1015	993.9							1.84
Knoxville (KTYS) (35.81N 83.99W)	29/1103	995.6	29/1640	24 (2 min, 10 m)	30				1.49
Madisonville (KMNV) (35.55N 84.38W)	29/1035	995.3							
Sevierville (KGKT) (35.86N 83.53W)	29/1135	994.9	29/1635	19 (2 min, 10 m)	25				1.25
Remote Automated Weather Stations (RAWS)									
Ocoee (BOCT1) (35.16N 84.59W)			29/1105		39				1.90

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Citizen Weather Observer Program (CWOP)									
Chattanooga (CW5013) (35.00N 85.13W)	29/0930	994.9							
Public/Other									
Wears Valley 3 ESE (35.70N 83.61W)			29/1000		48				
SOUTH CAROLINA									
International Civil Aviation Organization (ICAO) Sites									
Anderson (KAND) (34.50N 82.71W)	29/1056	999.2	29/1056	30 (2 min, 10 m)	51				
Clemson (KCEU) (34.67N 82.88W)	29/1054	997.9							
Fairfield County / Winnsboro (KFDW)			29/1355		34				
Greenville (KGMU) (34.85N 82.35W)	29/1105	999.7[I]	29/1105	24[I] (2 min, 10 m)	37[I]				
Greenville /Spartanburg (KGSP) (34.89N 82.22W)	29/1153	998.6	29/1237	34 (2 min, 10 m)	47				
Lancaster (KLKR) (34.73N 80.85W)			29/1355		38				
Liberty / Pickens (KLQK) (34.81N 82.70W)	29/1115	998.7	29/1135	27[I] (2 min, 10 m)	45[I]				
McEntire JNBG (KMMT)			29/1433		35				
Seneca (KCEU) (34.67N 82.88W)	29/1054	998.0[I]	29/1054	17[I] (2 min, 10 m)	38[I]				
Shaw AFB (KSSC)			29/1442		35				
WeatherSTEM									
Clemson University (0477W) (34.68N 82.84W)	29/1100		29/1140	29	39				
Greenville (1184W) (34.94N 82.41W)	29/1210		29/1110	37	72				
Newberry			29/1210		37				
Remote Automated Weather Stations (RAWS)									
Carolina Sandhills			29/1414		35				
Citizen Weather Observer Program (CWOP)									
Chestnut Springs (D1971) (35.16N 82.46W)	29/1130		29/1115	31	62				
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Salem 2 NE (SC-OC-92) (34.91N 82.95W)									5.64
Salem 1 SW (SC-OC-78) (34.88N 82.99W)									5.62
NORTH CAROLINA									
International Civil Aviation Organization (ICAO) Sites									

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Alamance (KBUY) (36.05N 79.48W)	29/1454	998.0	29/1705	24 (2 min, 10 m)	44				
Albemarle (KVUJ) (35.42N 80.15W)	30/0435	1001.4	29/1415	31 (2 min, 10 m)	45				
Asheville (KAVL) (35.43N 82.54W)	20/1202	995.9	29/1254	20 (2 min, 10 m)	34				2.76
Charlotte (KCLT) (35.22N 80.95W)	30/0152	999.4	29/1325	31 (2 min, 10 m)	50				
Concord Regional (KJQF) (35.39N 80.70W)			29/1450		40				
Franklin (K1A5) (35.22N 83.41W)	29/1115	999.0							
Greensboro (KGSO) (36.10N 79.95W)	29/1427	996.9	29/1411	33 (2 min, 10 m)	44				0.71
Hickory (KHKY) (35.74N 81.38W)	29/1240	993.6	29/1342	24 (2 min, 10 m)	48				
Mt Airy (KMWK) (36.46N 80.55W)	29/1435	997.6	29/1555	14[l] (2 min, 10 m)	23[l]				4.08[l]
Pope AFB (KPOB) (35.17N 79.02W)			29/1553		45				
Raleigh-Durham (KRDU) (35.90N 78.78W)			29/1607		45				
Reidsville (KSIF) (36.44N 79.84W)	29/1455	995.6	29/1455	23 (2 min, 10 m)	40				
Rocky Mount-Wilson (KRWI) (35.85N 77.90W)			29/1649		45				
WeatherSTEM									
Greensboro (0783W) (36.06N 79.89W)	29/1430	998.0	29/1640	25	47				
NC State Stadium (0789W) (35.80N 78.72W)	29/2250	996.6	29/1710	26	49				
Winston-Salem State Univ (0585W) (36.08N 80.22W)	29/1400	992.9	29/1550	42	54				
Remote Automated Weather Stations (RAWS)									
Blantyre (BLAN7) (35.30N 82.62W)									8.41
Hendersonville - Guion Farm (GUIN7) (35.21N 82.59W)			29/1210		56				4.79
Mt. Island Lake (MTIN7) (35.38N 80.99W)			29/1410	18 (6 m	49				
Citizen Weather Observer Program (CWOP)									
Advance (EW7058) (35.99N 80.44W)	29/1353	996.6	29/1423	31	44				
Banner Elk (EW9464) (36.20N 81.85W)	29/1301	995.3	29/1131	28	47				
Banner Elk (FW8439) (36.20N 81.83W)	29/1250	999.7	29/1456	24	50				1.92
Belmont (DW5686) (35.25N 81.03W)	29/1306	1000.3	29/1256	25	51				
Blowing Rock (EW3885) (36.17N 81.63W)	29/1345	995.3	29/1545	25	47				2.48

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Cashiers (EW5101) (35.08N 83.15W)	29/1045		29/0931	54	89				
Connelly Springs (FW7455) (35.65N 81.50W)	29/1231	996.6	29/1231	25	46				
Connelly Springs (FW7456) (35.58N 81.56W)	29/1231	998.0	29/1231	22	49				
Conway (KK4ARX) (E0790) (36.43N 77.23W)	29/1930	997.0	29/1730	44	63				
Morganton (FW7442) (35.66N 81.65W)	29/1231	996.3	29/1231	23	45				1.41
Morganton (FW7457) (35.64N 81.78W)	29/1216	997.0	29/1401	21	45				
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Black Mountain (NC-BC-76) (35.59N 82.31W)									6.84
Brevard 6 S (NC-TR-24) (35.14N 82.73W)									5.06
Brevard 10 S (NC-TR-32) (35.09N 82.77W)									5.58
Cedar Mountain 2 E (NC-TR-27) (35.15N 82.61W)									8.80
East Flat Rock (NC-HN-12) (35.29N 82.41W)									5.17
Hendersonville 6 SW (NC-HN-25) (35.24N 82.50W)									6.86
Hendersonville 2.4 SSE (NC-HN-32) (35.29N 82.44W)									5.04
Lenoir 5 WNW (NC-CD-28) (35.94N 81.61W)									5.02
Public/Other									
Brooks Crossroads 2 NNE (36.15N 80.77W)			29/1330		54				
Clingmans Dome (35.56N 83.5W)			29/1200		50				
Fairview 1 S (35.51N 82.4W)			29/1202	50	68				
Linville 3 NE			29/1400		58				
Beech Mountain			29/1210		43				
VIRGINIA									
International Civil Aviation Organization (ICAO) Sites									
Blackstone (KBKT) (37.08N 77.95W)	29/1755	994.9	29/1715	25	38				

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundation (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Danville (KDAN) (36.57N 79.33W)	29/1453	995.3	29/1650	21 (2 min, 10 m)	40				
Fredericksburg (KRMN) (38.40N 77.46W)									3.82
Norfolk (KORF) (36.90N 76.19W)	29/2010	995.9	29/1835	32 (2 min, 10 m)	41				
Rustburg (K0V4) (37.14N 79.02W)	29/1715	994.6	29/1755	25 (2 min, 10 m)	35				
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Altavista 6 NNE (VA-CM-14) (37.19N 79.24W)									4.28

[a] Date/time is for sustained wind when both sustained and gust are listed.
[b] Except as noted, sustained wind averaging periods for C-MAN and land-based reports are 2 min; buoy averaging periods are 8 min.
[c] Storm surge is water height above normal astronomical tide level.
[d] Storm tide is water height above the North American Vertical Datum of 1988 (NAVD88).
[e] Estimated inundation is the maximum height of water above ground. For NOS tide gauges and USGS water level sensors, the height of the water above Mean Higher High Water (MHHW) is used as a proxy for inundation
[E] Estimated
[I] Incomplete data

Table 4. Number of hours in advance of formation associated with the first NHC Tropical Weather Outlook forecast in the indicated likelihood category. Note that the timings for the "Low" category do not include forecasts of a 0% chance of genesis.

	Hours Before Genesis	
	48-Hour Outlook	**120-Hour Outlook**
Low (<40%)	114 / 48 (2nd entry)	228 / 66 (2nd entry)
Medium (40%-60%)	24	30
High (>60%)	18	18

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Zeta, 24–29 October 2020. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	**19.5**	**25.0**	**39.8**	**63.1**	85.8	101.8	**75.1**	
OCD5	70.1	171.5	280.2	368.4	452.0	527.6	610.5	
Forecasts	18	16	14	12	10	8	4	
OFCL (2015-19)	24.1	36.9	49.6	65.1	80.7	96.3	133.2	
OCD5 (2015-19)	44.7	96.1	156.3	217.4	273.9	330.3	431.5	

Table 5b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Zeta, 24–29 October 2020. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here is smaller than that shown in Table 5a due to the homogeneity requirement.

Model ID	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	20.5	25.4	40.0	64.0	87.2	108.3	75.1	
OCD5	61.0	173.1	280.3	366.2	447.1	518.6	610.5	
GFSI	23.3	37.2	48.2	**62.9**	98.7	143.5	229.1	
EMXI	21.7	35.4	64.1	92.5	115.9	133.8	112.0	
EGRI	25.3	37.8	70.8	105.7	134.1	120.8	392.6	
CMCI	29.8	50.8	79.7	100.1	88.7	**101.4**	98.3	
NVGI	37.4	73.9	109.5	148.3	211.4	219.3	246.0	
HWFI	24.7	34.7	41.3	66.5	103.8	140.9	115.4	
HMNI	23.9	37.7	55.4	86.2	146.3	256.8	338.6	
CTCI	23.2	38.6	60.8	93.2	128.3	195.7	158.1	
HCCA	**20.1**	26.4	40.1	65.4	95.1	113.1	**57.7**	
AEMI	26.1	35.8	40.9	**53.7**	**83.9**	116.7	82.0	
GFEX	20.5	28.9	43.4	66.1	92.5	116.6	83.2	
TVCA	20.9	27.2	42.0	69.1	101.4	120.0	**58.0**	
TVCX	21.0	27.1	43.0	68.4	98.7	113.1	**47.3**	
TVDG	21.0	27.2	42.7	68.9	98.6	108.5	**57.8**	
TABD	30.8	44.3	66.6	89.7	120.9	184.6	255.8	
TABM	30.4	39.1	40.9	**56.6**	90.5	134.0	203.3	
TABS	37.8	70.7	92.5	127.7	170.8	210.1	227.1	
Forecasts	15	15	13	11	9	7	4	

Table 6a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Zeta, 24–29 October 2020. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	7.5	11.6	12.1	12.1	**11.5**	16.2	32.5	
OCD5	8.7	14.2	16.4	19.2	12.3	14.1	29.5	
Forecasts	18	16	14	12	10	8	4	
OFCL (2015-19)	5.2	7.7	9.4	10.7	11.9	13.0	14.4	
OCD5 (2015-19)	6.8	10.8	14.1	17.0	18.8	20.6	22.5	

Table 6b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Zeta, 24–29 October 2020. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here is smaller than that shown in Table 6a due to the homogeneity requirement.

Model ID	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	8.1	12.0	12.7	12.3	11.1	13.6	36.7	
OCD5	9.4	14.9	16.8	19.4	12.4	13.6	38.7	
HWFI	9.1	**10.7**	**8.0**	**11.6**	12.1	18.3	**29.7**	
HMNI	**7.6**	**11.7**	13.9	16.7	14.7	19.7	38.0	
CTCI	**7.3**	13.2	17.8	19.3	15.2	20.4	46.7	
DSHP	8.6	**10.0**	**11.8**	14.5	12.6	**13.4**	**35.3**	
LGEM	9.7	12.1	14.7	15.3	12.4	15.4	40.3	
IVCN	**7.9**	**9.9**	**11.3**	14.5	11.4	14.3	37.7	
IVDR	**7.9**	**10.0**	**11.5**	14.6	11.3	14.4	39.3	
HCCA	**7.4**	**9.9**	**9.9**	**11.4**	11.4	14.9	**34.7**	
GFSI	9.9	13.5	18.2	19.1	15.4	22.6	54.3	
EMXI	13.0	18.1	17.6	17.9	22.0	26.1	42.3	
Forecasts	16	15	13	11	9	7	3	

Table 7. Tropical cyclone wind watch and warning summary for Hurricane Zeta, 24–29 October 2020.

Date/Time (UTC)	Action	Location
24 / 2100	Tropical Storm Watch issued	Pinar del Rio, Cuba
25 / 0300	Tropical Storm Watch changed to Tropical Storm Warning	Pinar del Rio
25 / 0300	Tropical Storm Watch issued	Tulum to Rio Lagartos, Mexico
25 / 1200	Tropical Storm Watch changed to Hurricane Watch	Tulum to Rio Lagartos
25 / 1500	Tropical Storm Warning issued	Tulum to Rio Lagartos
25 / 2100	Tropical Storm Warning changed to Hurricane Warning	Tulum to Rio Lagartos
25 / 2100	Hurricane Watch discontinued	All
26 / 0900	Tropical Storm Warning issued	Dzilam to Progreso
26 / 0900	Tropical Storm Warning issued	Punta Allen to Tulum
26 / 0900	Hurricane Warning modified to	Tulum to Dzilam
26 / 2100	Tropical Storm Watch issued	AL/MS Border to Okaloosa/Walton CL
26 / 2100	Tropical Storm Watch issued	Intracoastal City to Morgan City
26 / 2100	Tropical Storm Warning discontinued	Pinar del Rio
26 / 2100	Hurricane Watch issued	Morgan City to AL/MS Border
26 / 2100	Hurricane Watch issued	Lake Pontchartrain
26 / 2100	Hurricane Watch issued	Lake Maurepas
27 / 0000	Tropical Storm Warning discontinued	All
27 / 0000	Hurricane Warning discontinued	Tulum to Dzilam
27 / 0000	Hurricane Warning issued	Progreso to Punta Allen
27 / 0900	Tropical Storm Watch changed to Tropical Storm Warning	AL/MS Border to Okaloosa/Walton CL

Date/Time (UTC)	Action	Location
27 / 0900	Hurricane Watch changed to Hurricane Warning	Morgan City to AL/MS Border
27 / 0900	Hurricane Watch changed to Hurricane Warning	Lake Pontchartrain
27 / 0900	Hurricane Watch changed to Hurricane Warning	Lake Maurepas
27 / 0900	Hurricane Warning changed to Tropical Storm Warning	Progreso to Punta Allen
27 / 1800	Tropical Storm Warning discontinued	Progreso to Punta Allen
28 / 0900	Tropical Storm Warning modified to	AL/MS Border to Walton/Bay CL
28 / 1500	Tropical Storm Watch discontinued	All
29 / 0300	Hurricane Warning modified to	Pearl River to AL/MS Border
29 / 0300	Hurricane Warning discontinued	Lake Pontchartrain
29 / 0300	Hurricane Warning discontinued	Lake Maurepas
29 / 0600	Hurricane Warning discontinued	All
29 / 0900	Tropical Storm Warning modified to	Navarre to Walton/Bay CL
29 / 1200	Tropical Storm Warning discontinued	All

Table 8. Storm surge watch and warning summary for Hurricane Zeta, 24–29 October 2020.

Date/Time (UTC)	Action	Location
26 / 2100	Storm Surge Watch issued	Intracoastal City LA to Navarre FL
26 / 2100	Storm Surge Watch issued	Lake Pontchartrain, Lake Borgne, Vermilion Bay, Mobile Bay, and Pensacola Bay
27 / 0900	Storm Surge Warning issued	Intracoastal City LA to Navarre FL
27 / 0900	Storm Surge Warning issued	Lake Pontchartrain, Lake Borgne, Vermilion Bay, Mobile Bay, and Pensacola Bay
27 / 2100	Storm Surge Warning discontinued	Intracoastal City to the Mouth of the Atchafalaya River LA
27 / 2100	Storm Surge Warning discontinued	Vermilion Bay
29 / 0300	Storm Surge Warning discontinued	Mouth of the Atchafalaya River LA to the Mouth of the Pearl River
29 / 0300	Storm Surge Warning discontinued	Lake Pontchartrain and Lake Borgne
29 / 0600	Storm Surge Warning discontinued	Mouth of the Pearl River to the Mississippi/Alabama border
29 / 0600	Storm Surge Warning discontinued	Alabama/Florida border to Navarre FL
29 / 0600	Storm Surge Warning discontinued	Pensacola Bay
29 / 0900	Storm Surge Warning discontinued	All

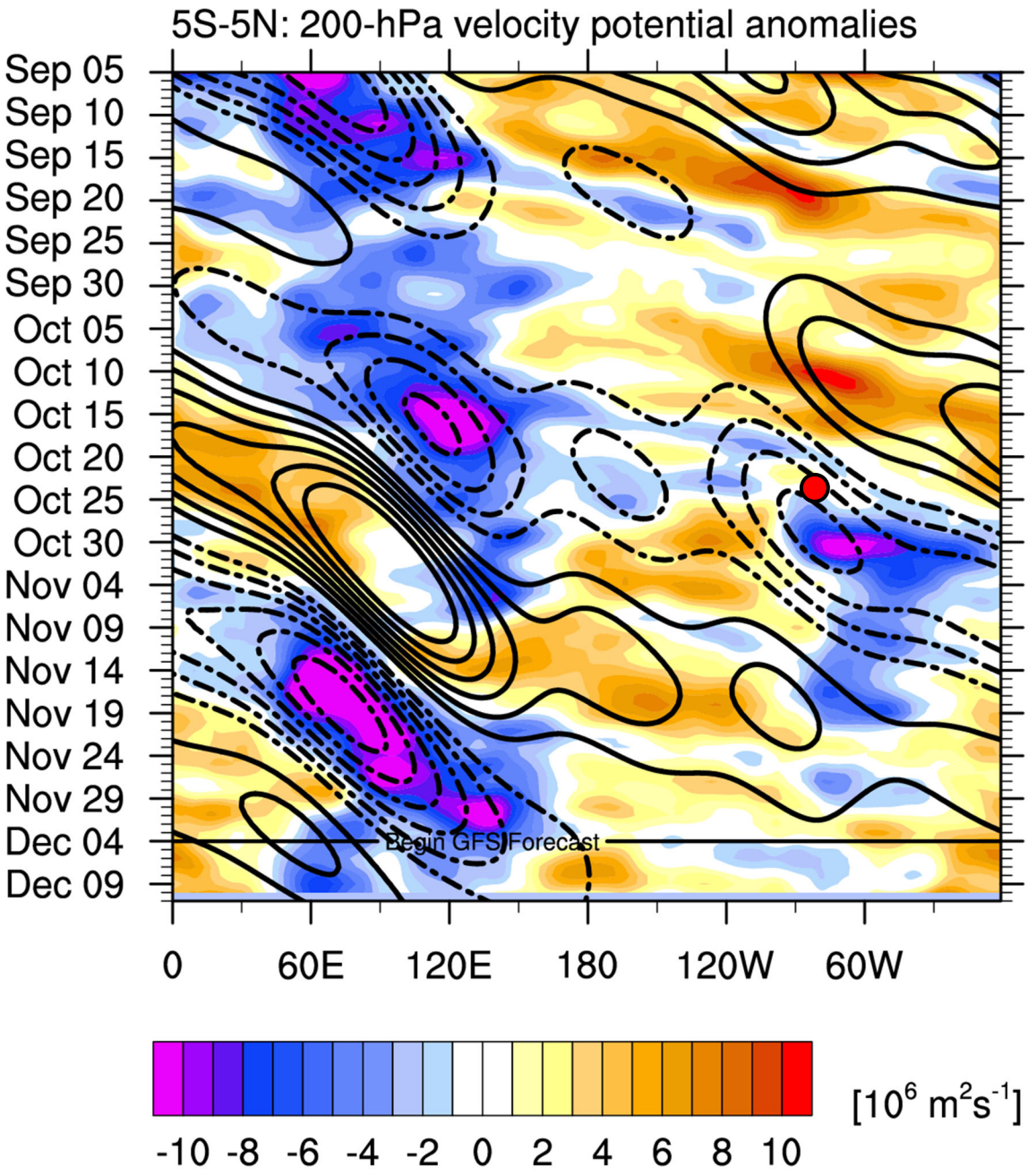

Figure 1. Velocity potential anomalies at 200 mb (VP200) from 5°N-5°S. The shading shows unfiltered VP200 anomalies (negative values [in blue] represent mass divergence). Black contours show MJO-filtered VP200 anomalies; dashed lines represent the upper-level divergent (convectively active) phase of the MJO. The contour interval begins at 1 standard deviation and is in 0.5 standard deviation increments thereafter. The red dot is the genesis location of Zeta. Figure courtesy of Michael Ventrice (DRW Trading).

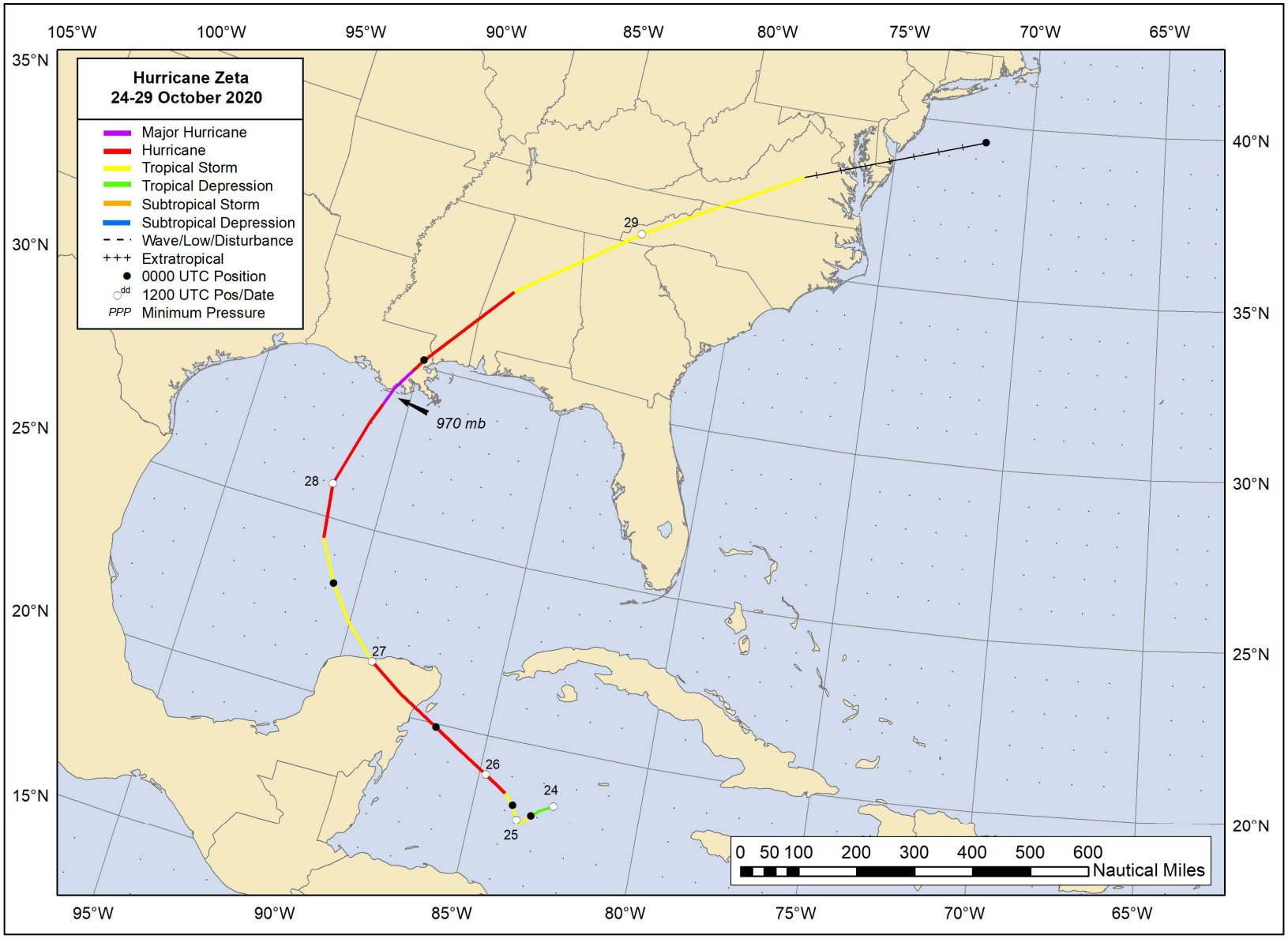

Figure 2. Best track positions for Hurricane Zeta, 24–29 October 2020.

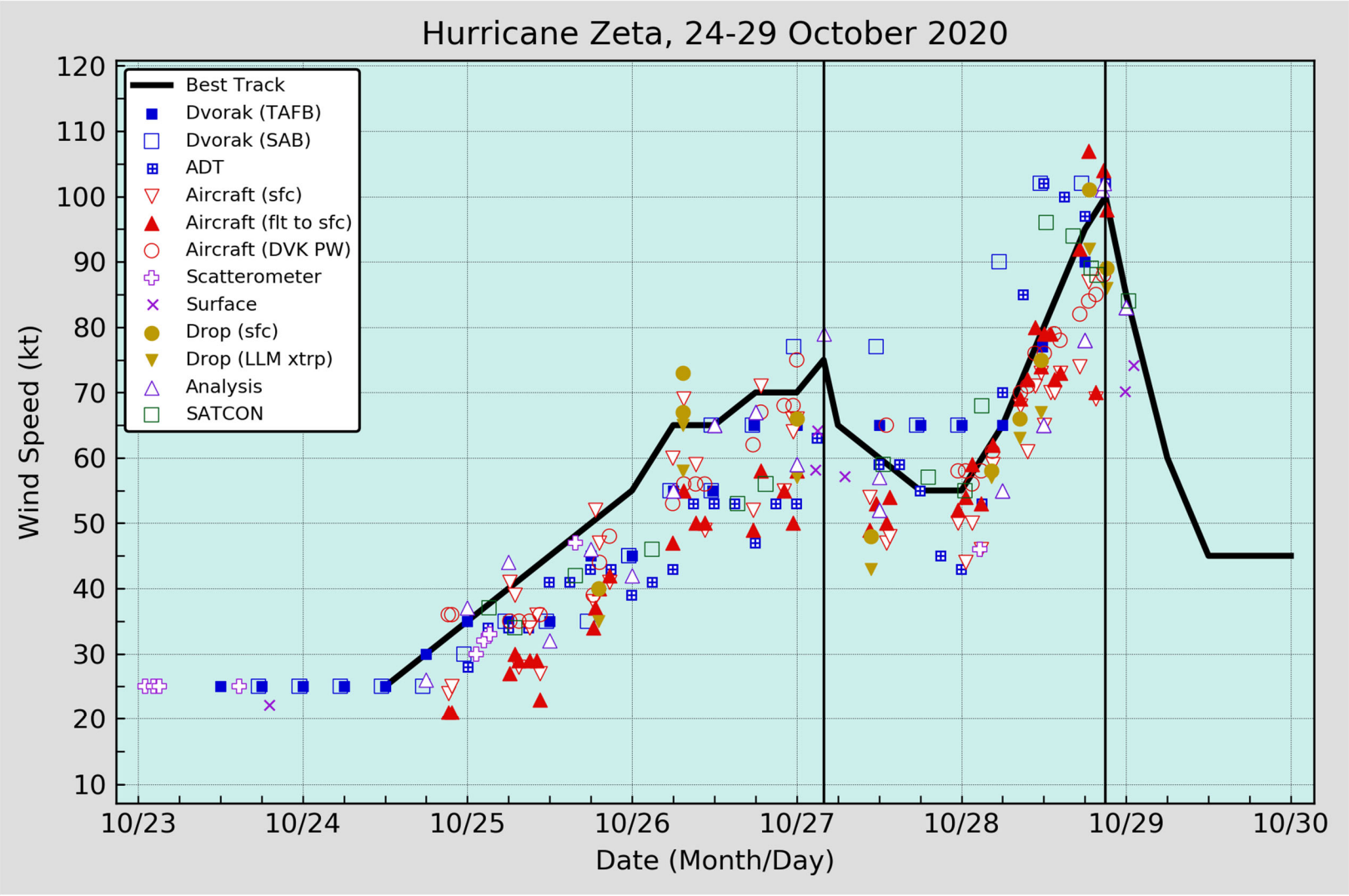

Figure 3. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Zeta, 24-29 October 2020. Aircraft observations have been adjusted for elevation using 90%, 80%, 75% and 80% adjustment factors for observations from 700 mb, 850 mb, 925 mb, and 1500 ft, respectively. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

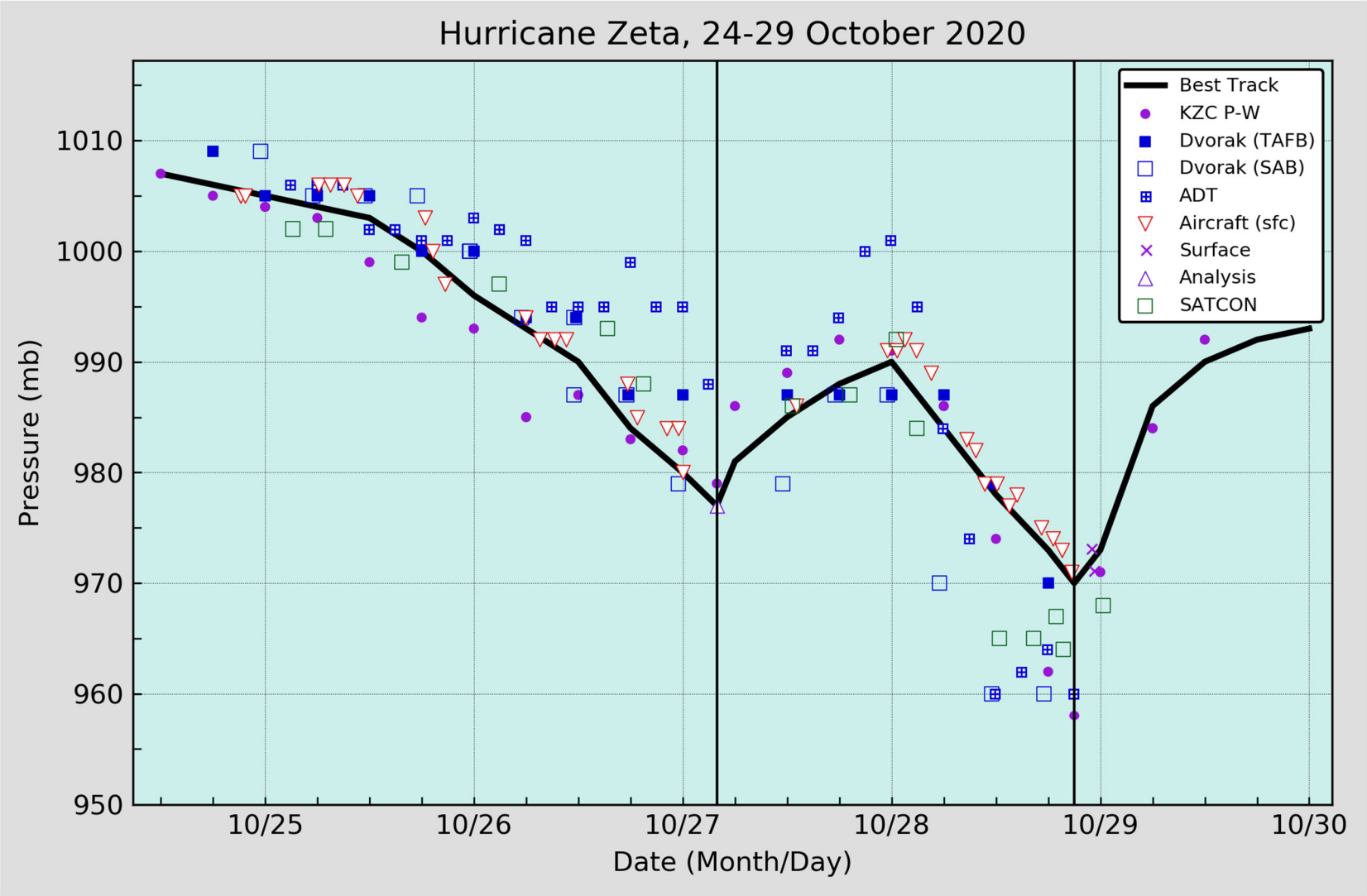

Figure 4. Selected pressure observations and best track minimum central pressure curve for Hurricane Zeta, 24–29 October 2020. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

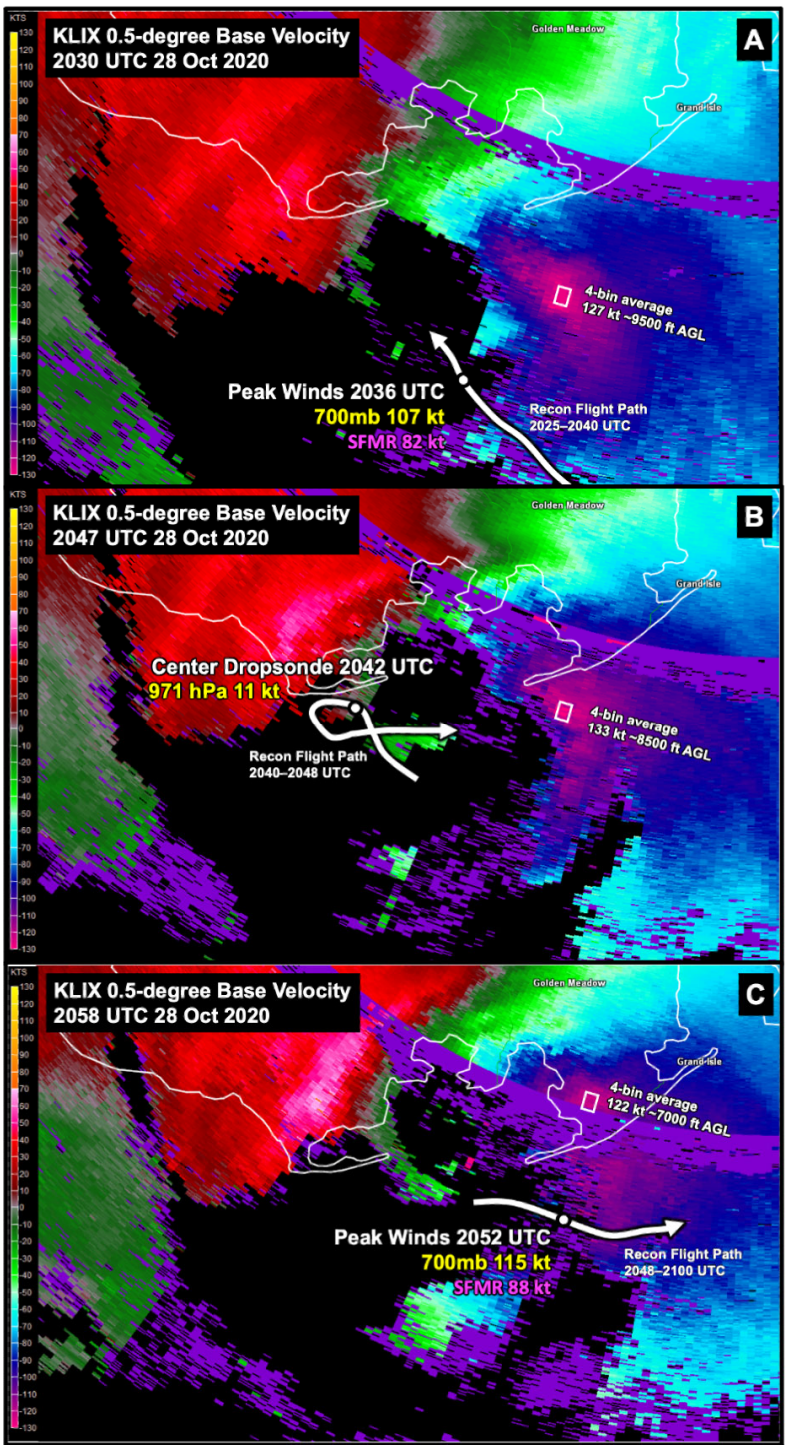

Figure 5. Snapshots of Slidell, Louisiana WSR-88D (KLIX) radial velocity data at (a) 2030 UTC (b) 2047 UTC, and (c) 2058 UTC on 28 October 2020 as Zeta made landfall. Annotated in each panel is the flight path of the hurricane hunter aircraft (white arrows and text), peak 700 mb and SFMR winds on flight legs in (a) and (c) in yellow and purple text, respectively, eye dropsonde pressure and wind in (b) in yellow text, and the northeast eyewall 4-bin sample average from the radial velocity data (white box with denoted text). Note that the hurricane hunter flight path did not cross the region of peak winds observed in the radar velocity data.

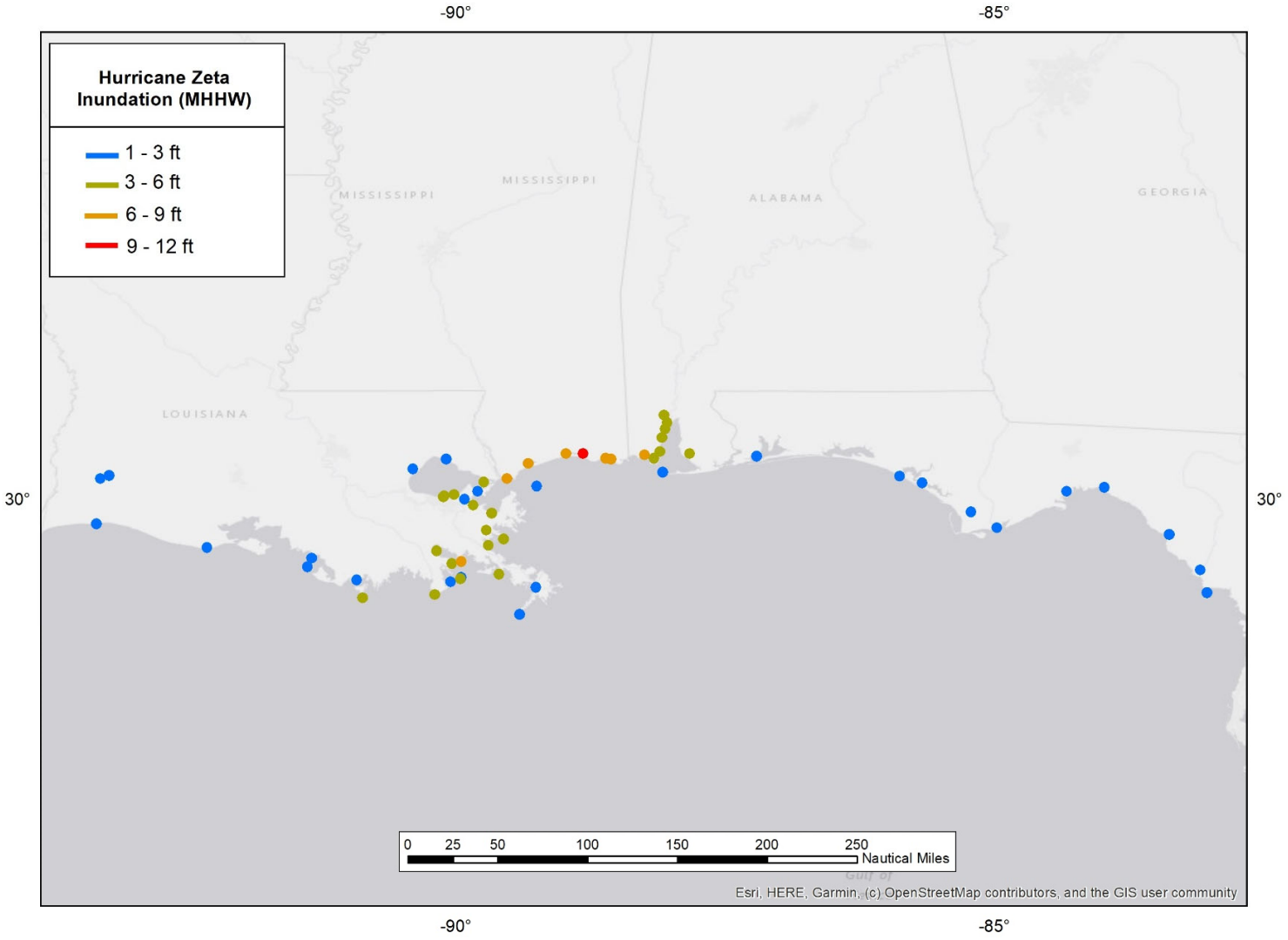

Figure 6. Maximum water levels measured from tide and stream gauges from Hurricane Zeta. Water levels are referenced as feet above Mean Higher High Water (MHHW), which is used as a proxy for inundation (above ground level) on normally dry ground along the immediate coastline.

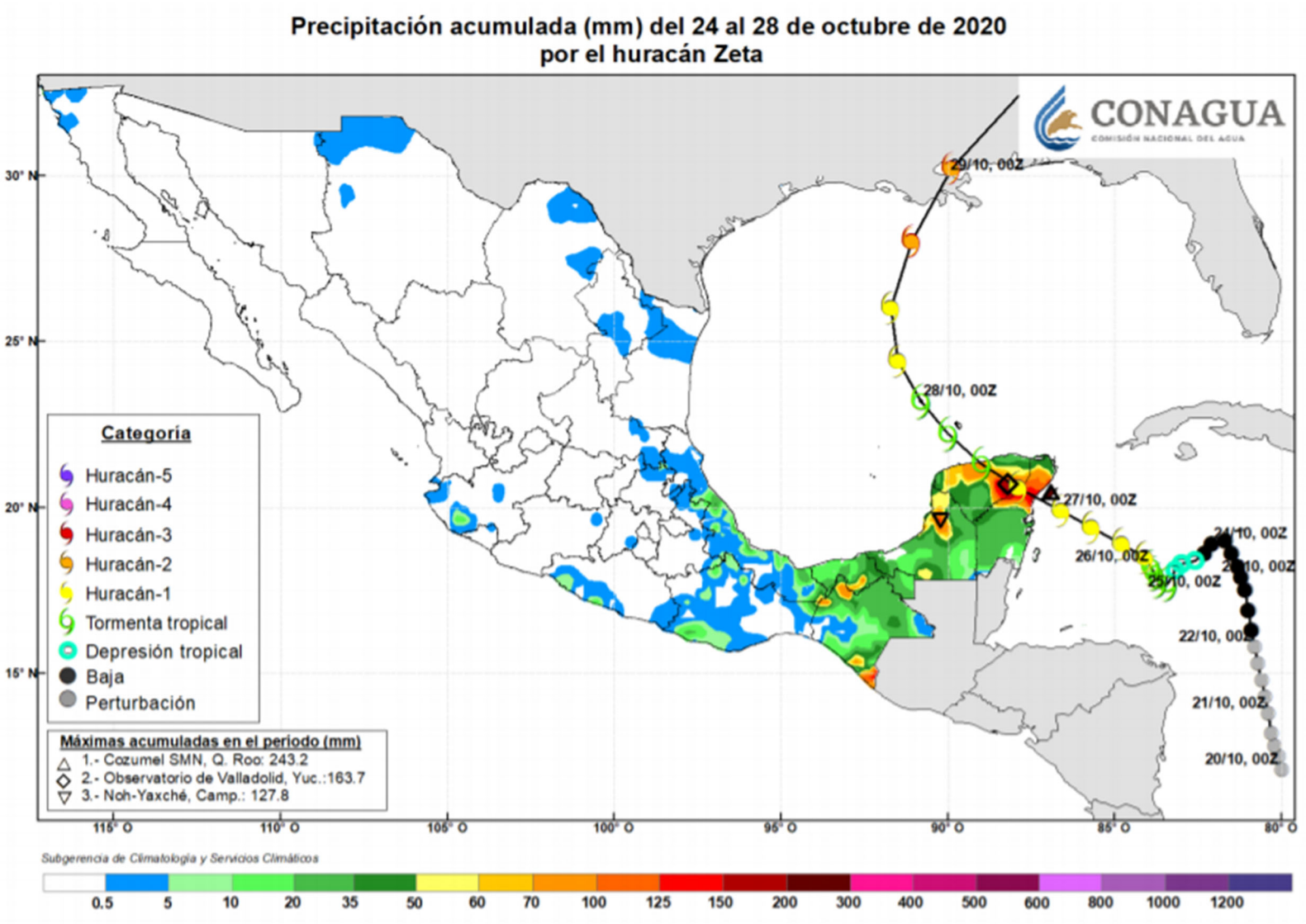

Figure 7. Rainfall accumulation (mm) over Mexico generally in association with Zeta from 24–28 October 2020. Figure courtesy CONAGUA.

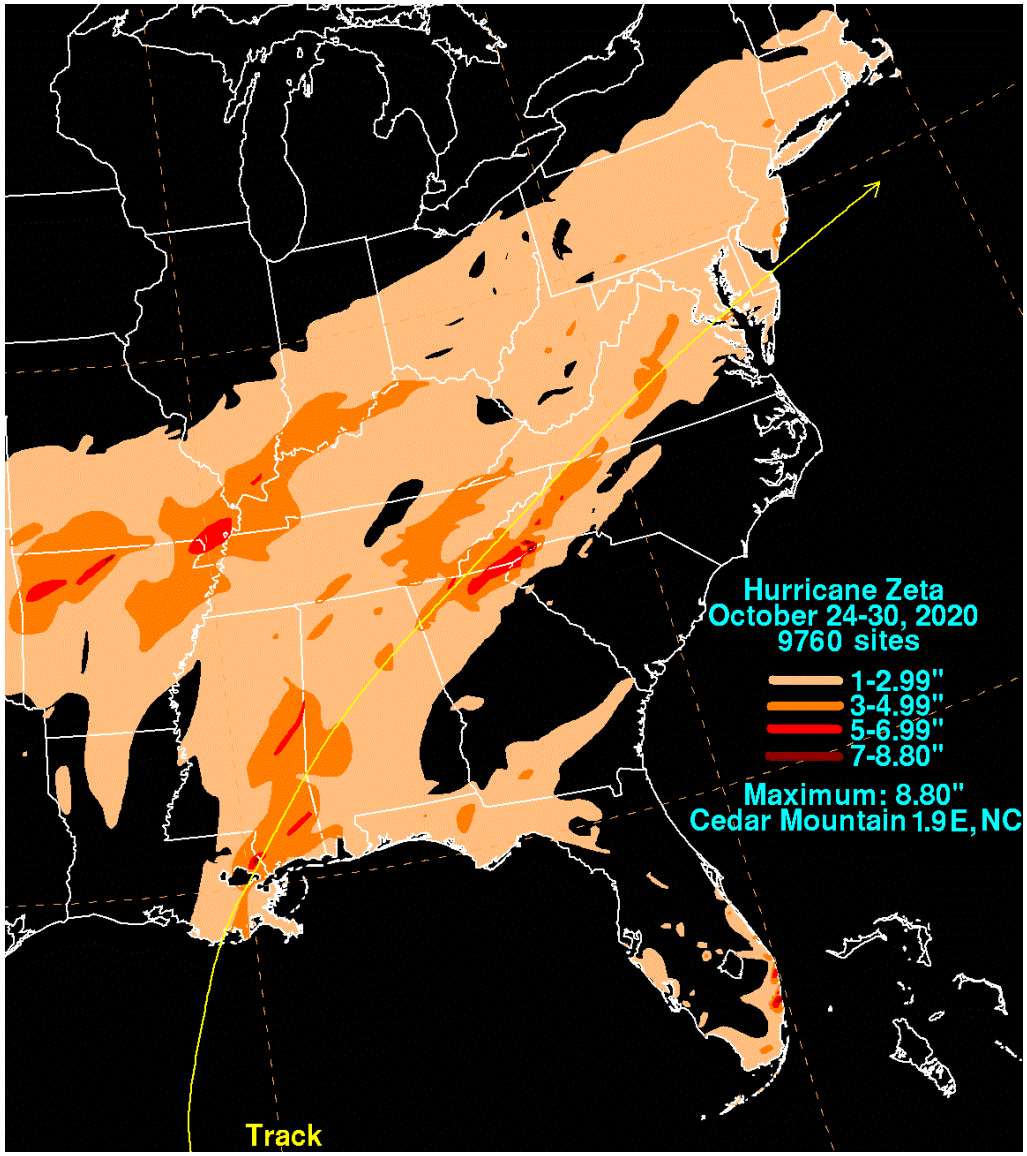

Figure 8. Rainfall accumulations (inches) from Hurricane Zeta. Image courtesy of David Roth at the NOAA Weather Prediction Center.

Figure 9. A tree downed by Zeta on a home in Metairie, Louisiana (Twitter via Scott Walker, Jefferson Parish Councilman)

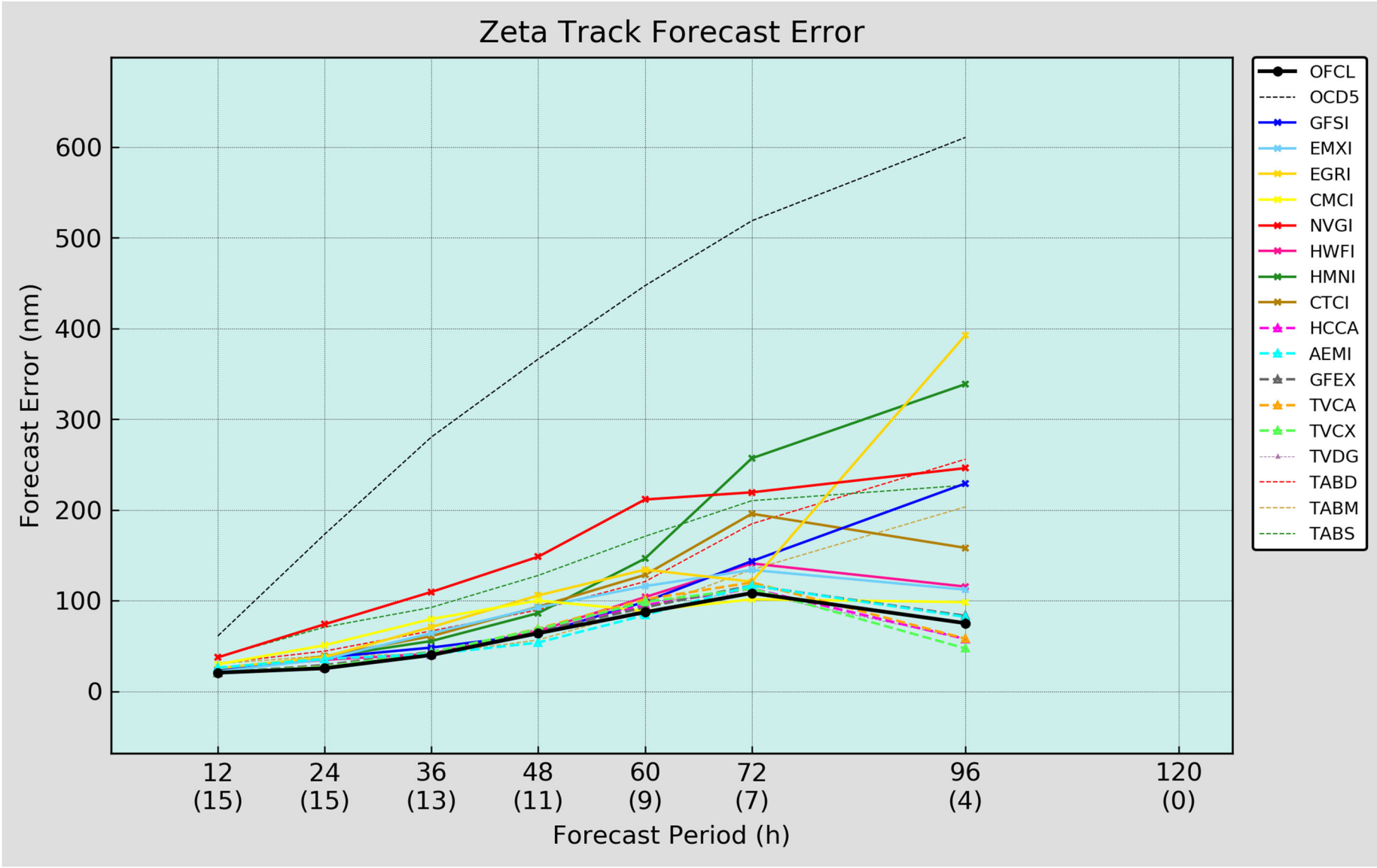

Figure 10. Homogeneous track forecast error comparison of NHC official forecasts (black) with selected guidance models (in n mi) for Hurricane Zeta, 24–29 October 2020.

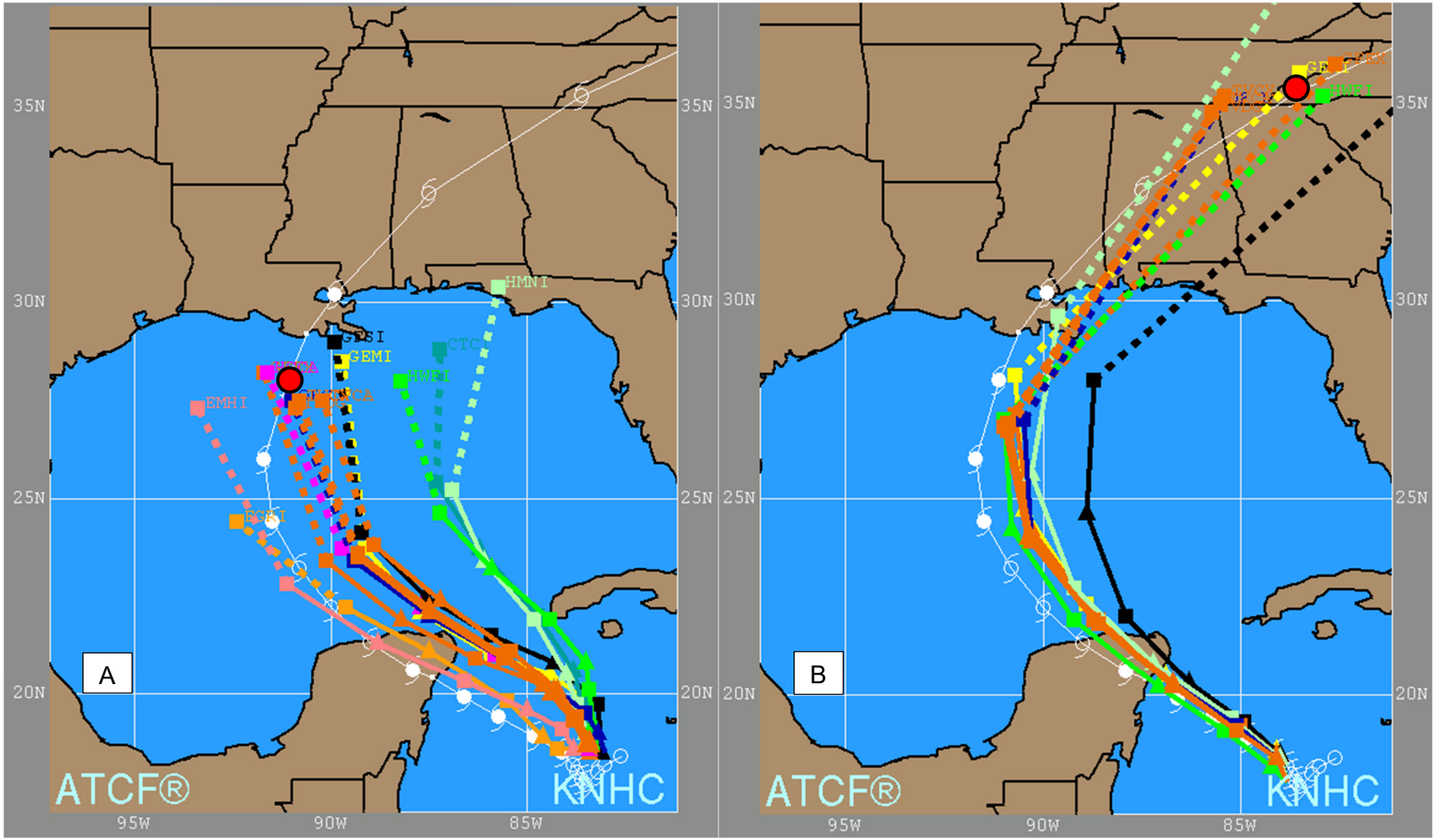

Figure 11. NHC official forecast and track guidance through 96 h for 1800 UTC 24 October (a) and 1200 UTC 25 October (b). The white line with the hurricane symbols is the best track of Zeta. The red dots indicate the verifying positions at the end of the forecasts.

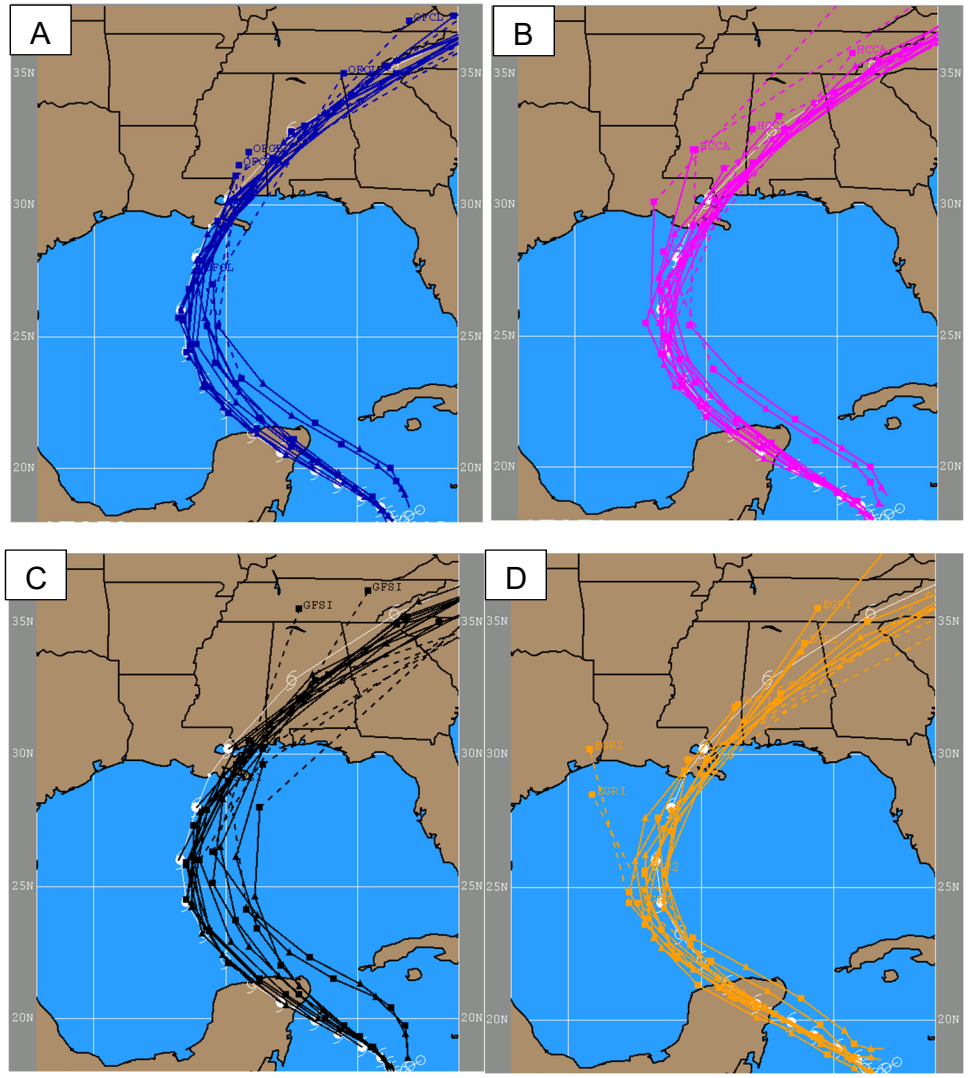

Figure 12. (a) All NHC official track forecasts made for Zeta through Louisiana landfall, (b) as in (a) but for HCCA model track forecasts, (c) as in (a) but for GFS model track forecasts, (d) as in (a) but for UKMET model track forecasts.

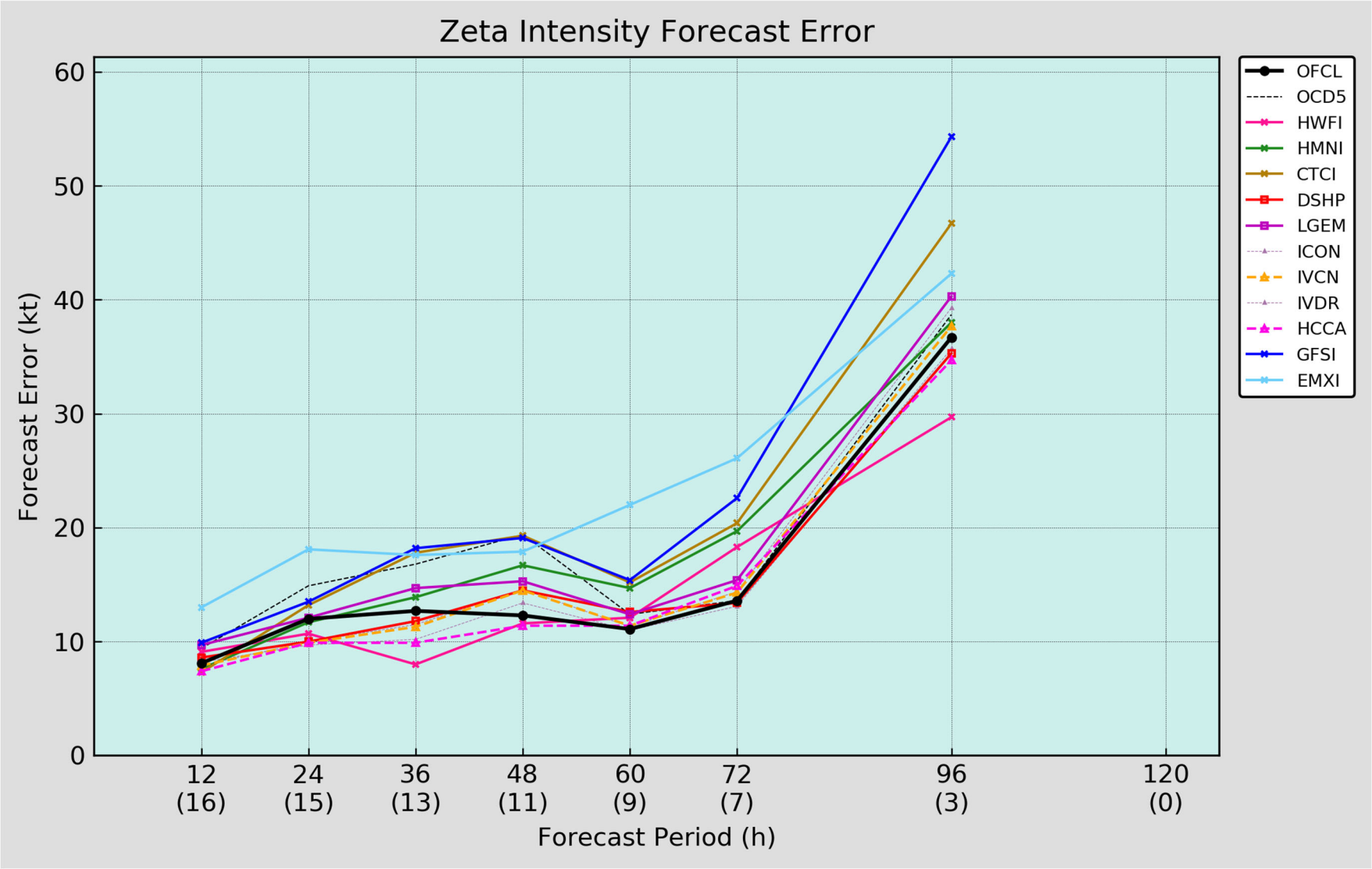

Figure 13. Homogeneous intensity forecast error comparison of NHC official forecasts (black) with selected guidance models (in kt) for Hurricane Zeta, 24–29 October 2020.

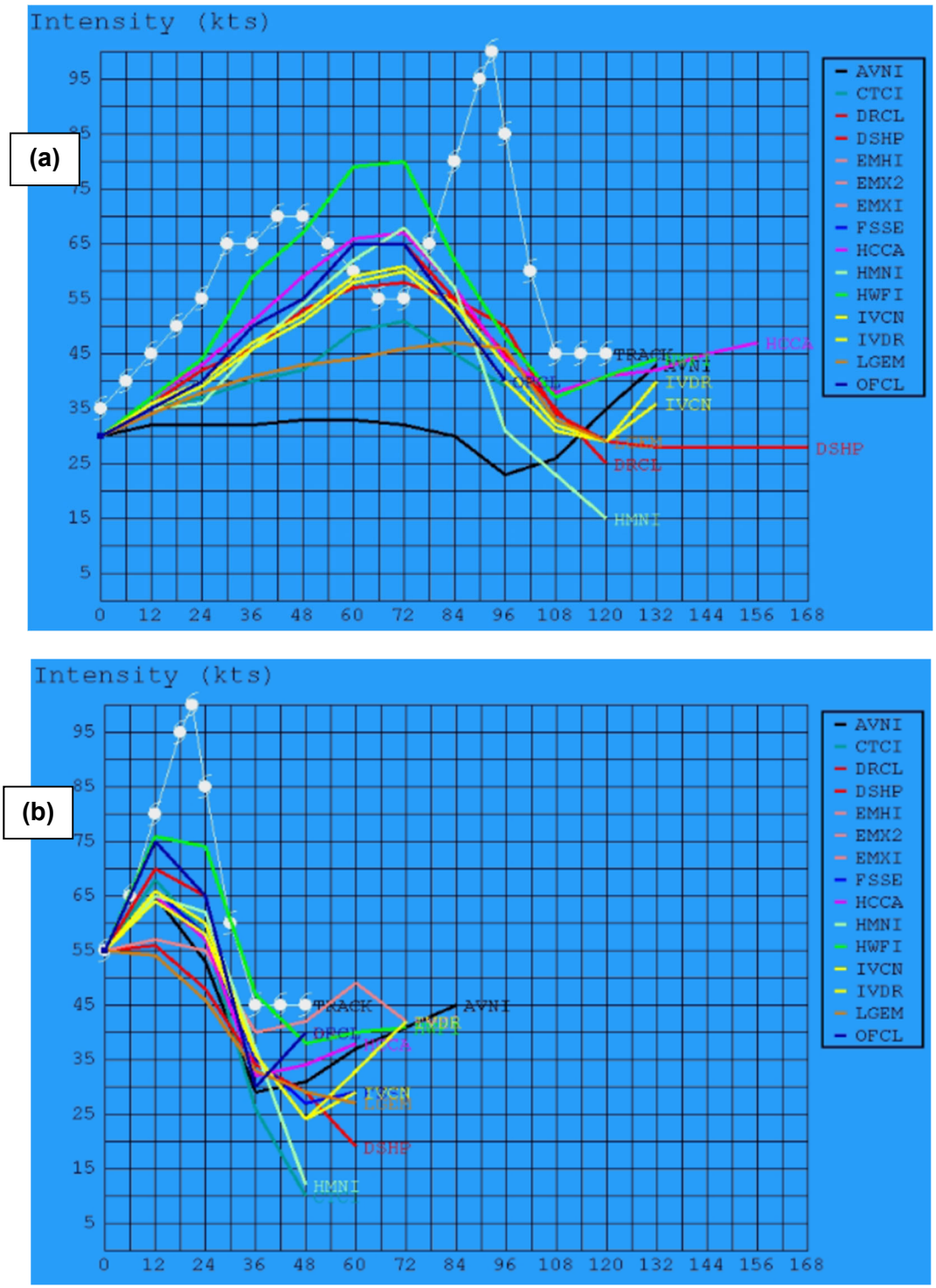

Figure 14. (a) NHC official forecast and intensity model solutions (colored lines, kt) from 0000 UTC 25 October, about 48 h before landfall in Yucatan. (b) NHC official forecast and intensity model solutions (kt) from 0000 UTC 28 October, 21 h before landfall in Louisiana. The best track intensity (kt) is indicated by the white line and symbols.

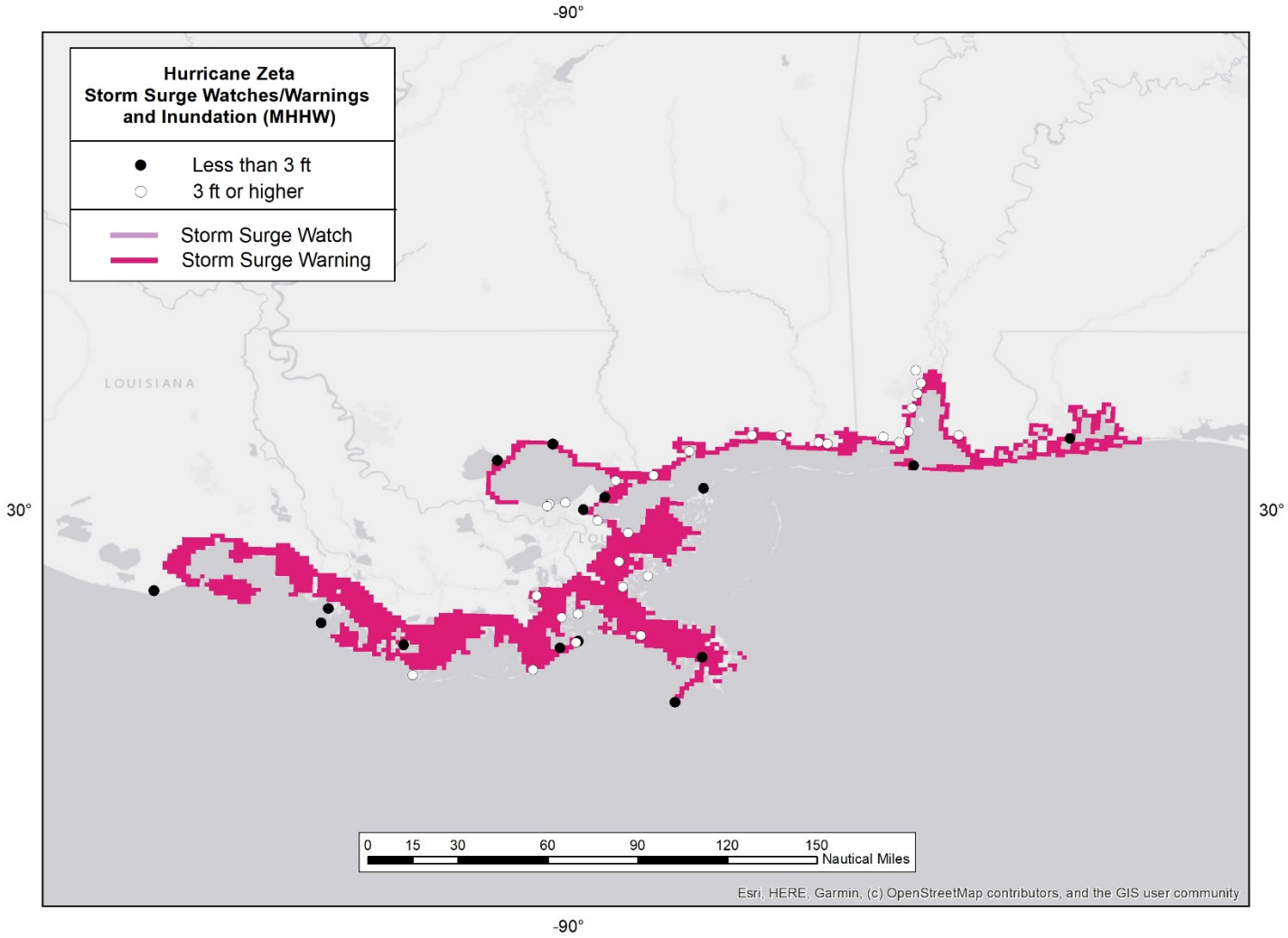

Figure 15. Maximum water levels measured during Hurricane Zeta from tide and stream gauges (circles), as well as areas covered by storm surge watches (lavender) and warnings (magenta). Water levels are referenced as feet above Mean Higher High Water (MHHW), which is used as a proxy for inundation (above ground level) on normally dry ground along the immediate coastline. Black markers denote water levels less than 3 ft above ground level, and white markers denote water levels 3 ft or higher above ground level.