NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

TROPICAL STORM CHANTAL

(AL032025)

4–7 July 2025

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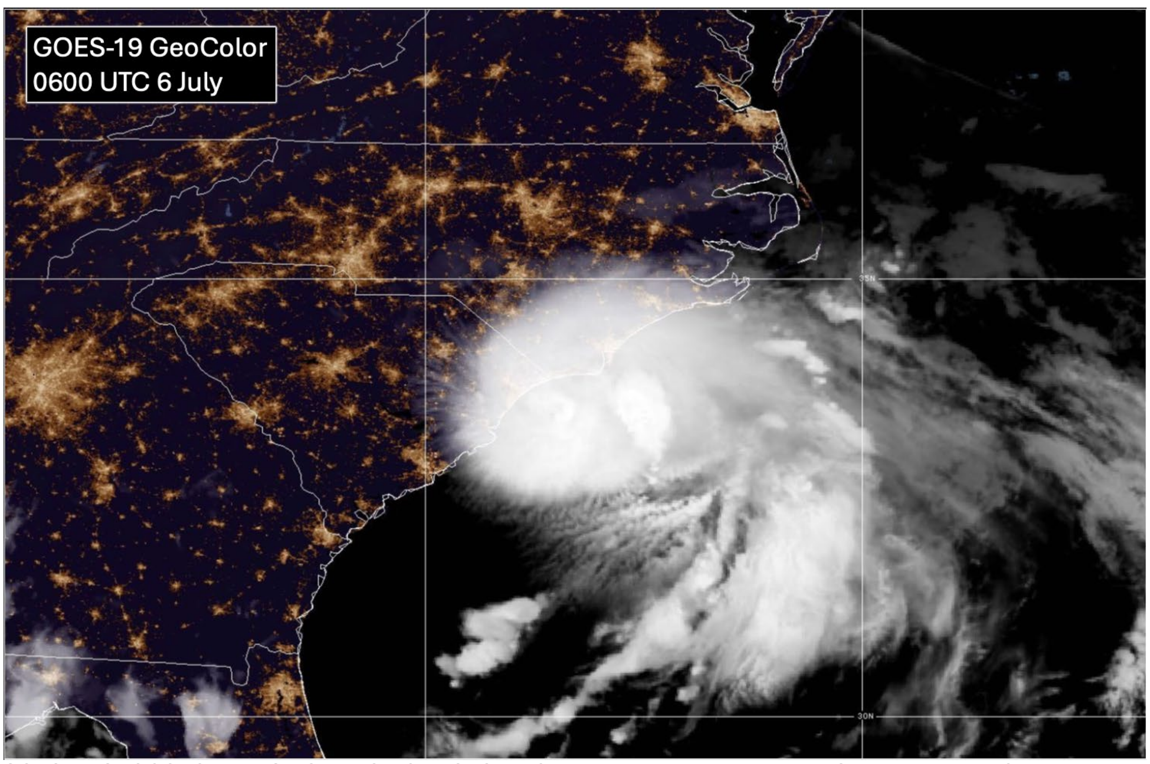

GOES-19 GEOCOLOR IMAGE OF TROPICAL STORM CHANTAL NEAR PEAK INTENSITY AT 0600 UTC 6 JULY 2025. IMAGE COURTESY OF NOAA/NESDIS/STAR.

Chantal was a tropical storm that formed offshore of the southeastern United States and made landfall in northeastern South Carolina early on 6 July. Chantal was responsible for 6 direct deaths in North Carolina, the majority of which were from heavy rainfall and associated flooding.

Tropical Storm Chantal

4–7 JULY 2025

SYNOPTIC HISTORY

Chantal's origins can be traced back to a remnant frontal boundary that decayed along and offshore of the northern Gulf and southeastern U.S. coasts in early July. As this feature lost its remaining temperature gradient, it degenerated into a trough of low pressure, but still enhanced disorganized showers and thunderstorms over Florida and the northern Gulf coast from 1–2 July. On 3 July, a part of this trough moved northeastward across the Florida Peninsula, and shower and thunderstorm activity gradually became more concentrated near the trough axis as it entered the western Atlantic east of Florida. Scatterometer data early on 4 July indicated that the trough had developed a well-defined surface circulation and later that day a burst of deep convection formed near and persisted just east of the center, resulting in the formation of a tropical depression by 1800 UTC 4 July, approximately 130 n mi south-southeast of Charleston, South Carolina. The depression intensified into Tropical Storm Chantal 12 h later at 0600 UTC 5 July. The "best track" chart of Chantal's path is given in Fig. 1, with the wind and pressure histories shown in Figs. 2 and 3, respectively. The best track positions and intensities are listed in Table 1[1].

At the time of formation, atmospheric steering currents were light and variable, due to a mid-latitude trough moving off the coast of New England, which created a weakness in the ridge to the north and northeast of the tropical cyclone. However, as this trough lifted out farther to the northeast, a narrow mid-level ridge built east of Chantal, allowing the cyclone to turn northward and north-northwestward on 5 July. Environmental conditions were not especially favorable for intensification, with moderate vertical wind shear and some dry mid-level air infiltrating the circulation on its western side. However, 28–29°C sea-surface temperatures enabled additional bursts of deep convection on 5 July, which resulted in gradual intensification. A combination of Air Force Reserve reconnaissance aircraft and NWS WSR-88D velocity data from Wilmington, North Carolina, indicated that Chantal reached a peak intensity of 50 kt at 0600 UTC 6 July, when the system was centered about 20 n mi to the south of Myrtle Beach, South Carolina (cover photo). Around this time, the convection was organized in a band along the northern flank of the cyclone (Fig. 4a). As the tropical cyclone approached the coast, the convective structure decayed, and Chantal made landfall at 0800 UTC 6 July as a 45-kt tropical storm near Litchfield Beach, South Carolina (Fig. 4b).

After landfall, Chantal steadily weakened, becoming a tropical depression just after 1200 UTC 6 July as the circulation moved north-northwestward and crossed into North Carolina. Even as the system weakened that afternoon, substantial low-level moisture and moderate wind shear contributed to the development of a band of enhanced precipitation near the Raleigh-Durham

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[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.

metro area (Figs. 4 c,d), resulting in significant flash and urban flooding during the evening and overnight on 6–7 July. This convection waned by 1200 UTC on 7 July, and Chantal became a post-tropical remnant low by 1200 UTC that day while it moved northeastward into Virginia. The remnant low persisted another 6–12 h before opening into a trough by 0000 UTC 8 July as it moved offshore of the Delmarva Peninsula.

METEOROLOGICAL STATISTICS

Observations in Chantal (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB), 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 and dropwindsonde observations from three flights of the 53rd Weather Reconnaissance Squadron of the U.S. Air Force Reserve Command (Fig. 5). 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), the Defense Meteorological Satellite Program (DMSP) satellites, and the Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats (TROPICS) satellites, among others, were also useful in constructing the best track of Chantal.

Ship reports of winds of tropical storm force associated with Chantal are given in Table 2, and selected surface observations from land stations and data buoys are given in Table 3. Of note, ship observations from PRIME ACE (callsign *3FAT9*) reported sustained winds of tropical storm force on 4–5 July, though quality control of these observations indicated the anemometer height was at least 32.5 m, and the ship exhibited a significant high wind bias. So, these observations are not considered representative of Chantal's intensity during this period.

Winds and Pressure

Chantal's peak intensity of 50 kt at 0600 UTC 6 July is supported by a combination of aircraft and radar observations. The highest 700-mb flight-level wind was 59 kt measured at 0451 UTC 6 July. This value translates to a sustained surface wind of around 50–55 kt using a standard 90% adjustment factor. Within the same hour, radial velocity data from the Wilmington, North Carolina WSR-88D radar (KLTX) also indicated a convective band with 60–70-kt winds at 3000–5000 ft occurring over a sufficiently large region (>4 adjacent bins, Fig. 6, left) with reflectivity above 40 dBz (Fig. 6, right). These values persisted on KLTX radar for approximately an hour (not shown). Using a reduction factor between 0.75 to 0.80 for these heights between the 925 to 850-mb level also supports a peak sustained wind of 50 kt at that time.

The estimated minimum central pressure of 1002 mb is primarily based on a dropsonde released in the center of Chantal at 0516 UTC 6 July, which reported a minimum pressure of 1004 mb with 18 kt of wind at the surface. Assuming a standard decrease in pressure of 1 mb per 10 kt of wind, this observation supports a minimum pressure of 1002 mb.

Chantal is estimated to have made landfall on the coast of far northeastern South Carolina as a 45-kt tropical storm with a 1003 mb central pressure, accounting for a decrease in radial velocity data from the WSR-88D before landfall. The highest sustained wind from a land observing station was 41 kt (gusting to 49 kt) at Springmaid Pier in Myrtle Beach, South Carolina at 0518 UTC 6 July. This station also observed the lowest coastal pressure of 1004.2 mb at 0918 UTC that day. Other wind gusts between 35–45 kt were observed at coastal and offshore locations along the South and North Carolina coastline, though only offshore marine buoys at Frying Pan Shoals (buoy 41013) and Edisto (buoy 41004) reported sustained tropical-storm-force winds.

Rainfall and Flooding

Chantal produced heavy rainfall in both South Carolina and North Carolina, though the most significant rainfall and flooding was observed in the northwestern portion of the Raleigh-Durham metro area in central North Carolina. Table 3 provides selected rainfall totals over the entire event in the United States, while Figure 7 provides an analysis of the total rainfall over the southeastern United States from 3–7 July 2025.

The highest rainfall total from the storm was 12.90 inches from a CoCoRaHS station located north of Pittsboro, North Carolina. Several other CoCoRaHS observations reported between 10–12 inches of rainfall near Pittsboro, with additional spots of greater than 10-inch rainfall totals observed north of Hillsborough and near Chapel Hill, both in Orange County, North Carolina. A more general area of 6–10 inches was observed across Chatham, Alamance, Orange, and Durham Counties. Farther south, another pocket of 6–8-inch totals was observed in Moore County near Pinehurst, North Carolina. Most of these heavy rainfall totals occurred in just a 6–9-h period as training rainbands from Chantal developed and pivoted over the region (Figs. 4c-d). Due to the high rainfall rates falling in these bands, several locations in this region exceeded their 1000-yr recurrence interval for 6-h rainfall (Fig. 8), which led to substantial flash and river flooding across the area.

Chantal's rainfall led to the rapid rise of several rivers on 6–7 July, resulting in more flooding (Fig. 9). For instance, the Eno River crested at 23.04 ft near Huckleberry Springs (Fig. 9a), which was the highest crest ever recorded. Another major flood stage record occurred along the Haw River near Bynum, which reached a peak height of 23.30 ft[2], exceeding the record crest set by Hurricane Fran in 1996 (Fig. 9b). Farther downstream, the same river in Alamance County also reached major flood stage at 32.50 ft, just shy of the all-time record also set during Fran (Fig. 9c). Farther south, the Little River at Niagara Carthage Road, located near Pinehurst, crested at 15.74 ft and reached minor flood stage (Fig. 9d).

In South Carolina, the highest rainfall total was 5.01 inches from a mesonet station at Loris in Horry County, with totals generally in the 4–6-inch range across northeastern South Carolina and the coastal areas of North Carolina. Despite the heavy rainfall in this region, the lower total amounts were spread out over a longer period than those in central North Carolina, limiting flooding issues.

[2] River gage site was damaged during flooding, but USGS did a post storm high water mark survey to establish this peak crest record.

Storm Surge[3]

The highest measured storm surge from Chantal was 2.69 feet above normal tide levels at a National Ocean Service (NOS) tide gauge at Springmaid Pier, South Carolina. When combined with the astronomical tide, Chantal's storm surge resulted in inundation levels of less than 1 foot above ground level along much of the southeastern United States. There were no reports of damage due to storm surge.

Tornadoes

Five tornadoes were associated with Chantal, all occurring in North Carolina between 5–6 July. The first was a short-lived EF-0 tornado that briefly touched down near the Wilmington International Airport on 5 July at around 0830 UTC, causing minor shingle damage to a home and some tree damage. The other 4 tornadoes occurred farther inland on 6 July and were all rated EF-1 in intensity. One touched down at the Raleigh Executive Jetport, causing damage to the airport hangar and several aircraft. Some nearby mobile homes were damaged, and several trees were snapped and uprooted. Another tornado was observed in southern Pittsboro, while the other two tornadoes occurred in Snow Camp and Mebane, respectively. The worst damage from these latter two tornadoes was at an automotive repair shop whose entire roof was torn off by the tornado in Snow Camp.

CASUALTY AND DAMAGE STATISTICS

There were 6 direct deaths[4] associated with Chantal, the majority associated with freshwater flooding that occurred in North Carolina. Four deaths were from individuals in vehicles that were submerged or swept away from floodwaters, and two fatalities were marine related, occurring late on 6 July when two men drowned after canoeing on a lake during heavy rainfall and flash flooding produced by Chantal. It should be noted there was one rip current death that occurred around 1600 UTC on 4 July in Kure Beach, North Carolina. However, this fatality occurred just before the formation of Chantal and is deemed more related to the pressure gradient from the larger synoptic weather pattern that helped generate strong rip current conditions north of the Chantal prior to its formation.

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[3] 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) or Mean Lower Low Water (MLLW). **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).

[4] 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.

As of this writing, damage from Chantal in the United States is estimated by the insurance firm Gallagher Re[5] at $500 million with flood damage being the largest contribution to this total. This total generally includes private insured loss along with the National Flood Insurance Program and U.S. Department of Agriculture crop losses associated with the storm.

The hardest hit areas were in Orange, Durham, and Chatham Counties, where substantial flooding was observed (Fig. 10). In Chatham County, over 80 roads were flooded, and 33 water rescues were conducted. Many of these rescues occurred near the Haw River where roadways and buildings were inundated in Bynum (Fig. 10, bottom left[6]). Water rescues were also performed in Orange County, with additional washed-out roadways, numerous stranded and submerged vehicles, and several apartments and residential homes flooded. Total damage across Orange County is believed to have exceeded $30 million. The flooding also prompted a partial closure of Interstate 40 westbound and Interstate 85 southbound, with evacuations ordered in Chapel Hill and Durham. Approximately 80 people were rescued from floodwaters in Durham County when the Eno River overflowed (Fig. 10, top left[7]), with 50 additional people rescued in Chapel Hill due to flooded roadways (Fig. 10 bottom right[8]). Farther south in Southern Pines and Pinehurst, several roads were washed out (Fig. 10, top right[9]), and a state of emergency was declared due to flooded roadways and a dam failure. In total, a state of emergency was issued for 13 counties in North Carolina to help long-term recovery efforts. More than 20,000 customers lost power due to Chantal across North Carolina according to Duke Power. The storm also disrupted agriculture in central North Carolina, with up to 10 percent loss of the crops in Person County.

Near where Chantal made landfall in northeastern South Carolina, damage was minor. Heavy rainfall was observed in Horry County, though with far less flooding than farther inland in North Carolina. Along the coastal area of Brunswick and New Hanover Counties in southeastern North Carolina, there was sporadic tree damage and power outages in Cape Fear, though impacts were also minor.

FORECAST AND WARNING CRITIQUE

Genesis

The genesis of Chantal was fairly well anticipated in the 7-day outlook for a non-tropical originating system, but the timing of formation was poorly predicted (Table 4). The decaying frontal boundary from which Chantal developed was introduced in the Tropical Weather Outlook with a low probability (<40%) at 1200 UTC 29 June, 126 h prior to formation. These 7-day probabilities increased into the medium category (40–60%) 66 h prior to formation, though the

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[5] Natural Catastrophe report from Gallagher Re: https://www.ajg.com/gallagherre/-/media/files/gallagher/gallagherre/news-and-insights/2025/october/natural-catastrophe-and-climate-report-q3-2025.pdf

[6] Image courtesy The Carolina Journal: https://www.carolinajournal.com/chantal-devastates-central-north-carolina-with-historic-flooding/

[7] Image from the Raleigh News & Observer: https://www.newsobserver.com/news/local/article310132815.html

[8] Image from Chapelboro.com: https://chapelboro.com/news/weather/flash-flooding-hits-orange-county-chapel-hill-evacuates-camelot-village-units

[9] Image courtesy of NC Newsline: https://ncnewsline.com/2025/07/09/chantal-wreaks-havoc-in-nc-as-state-lawmakers-try-to-repeal-an-ambitious-climate-change-goal/

outlook only reached the high category (>60%) at the time of Chantal's development. The 2-day outlook also provided less than adequate lead time, with the system introduced at 0600 UTC 3 July, only 36 h prior to formation. The probabilities were raised into the medium category 18 h before development, and like the 7-day outlook, the 2-day outlook was only reached the high category at the time of Chantal's development. In contrast, the location of formation was well forecast, with each tropical weather outlook issued capturing this area (Fig. 11), though the first few outlooks straddled the Florida Peninsula before focusing more off the Atlantic coast where Chantal formed.

Track

A verification of NHC official track forecasts (OFCL) for Chantal is given in Table 5a. Official track forecast errors were lower than the mean official errors for the previous 5-yr period for 12 h, but greater than the mean errors from 24–60 h. In general, NHC track forecasts took the center of Chantal too far west, showing an immediate north-northwestward motion after formation. Instead, the tropical storm initially moved east of due north, potentially related to convective asymmetries and shear influences, before turning north-northwestward just before landfall in South Carolina. This led to Chantal's track being on the eastern edge of the NHC track forecasts leading up to landfall (Fig. 12). A homogeneous comparison of the official track errors with selected guidance models is given in Table 5b. The only guidance aid that outperformed OFCL in 12 h was the Google DeepMind ensemble mean (GDMI), which was also a superior performer throughout the forecast period. Beyond 12 h, other aids also had lower track errors than NHC, including ECMWF and HWRF (EMXI, HWFI) at 36–48 h, the Canadian and HMON (CMCI, HMNI) from 24–48 h, and even the simple deep-layer steering beta advection model (TABD) from 24–48 h. By contrast, HAFS and GFS (HFAI, HFBI, GFSI) were poor track performers, with the GFS having track errors more than double the OFCL forecasts from 24–48 h.

Intensity

A verification of NHC official intensity forecasts for Chantal is given in Table 6a. Official intensity forecast errors were lower than the mean official errors for the previous 5-yr period for all forecast times. While Chantal did intensify a bit more than anticipated, potentially related to the storm spending a little more time over water, the NHC intensity and wind radii forecasts indicated it would remain an asymmetric tropical storm with most of the winds north and east of the center through landfall. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 6b. While the NHC intensity forecasts outperformed all guidance aids from 12–24 h, there were many more aids that slightly bested OFCL at 36 and 48 h, though these lead times had a low sample size with intensity errors remaining under 10 kt.

Wind Watches and Warnings

Coastal wind watches and warnings associated with Chantal are given in Table 7. Tropical Storm Watches were first issued from Edisto Beach to Little River Inlet in South Carolina when advisories were initiated at 2100 UTC 4 July, and these watches were extended northward to Cape Fear, North Carolina, by 0900 UTC 5 July. Soon after, the Tropical Storm Watch was upgraded to a Tropical Storm Warning at 1200 UTC 5 July for the existing watch (South Santee River, South Carolina to Cape Fear, North Carolina) and later extended farther northward to Surf City, North Carolina at 1500 UTC 5 July. The tropical storm watches provided about 24–36 h of lead time, with the 12h time range of issuance due to tropical storm watches being extended into North Carolina on 5 July. The tropical storm warnings provided between 18–21 h of lead time before tropical storm conditions began. The lack of confidence in significant strengthening precluded watch and warning lead times as long as typical, but for a lower end wind event, the watches and warnings provided sufficient lead time.

No storm surge watches or warnings were issued with Chantal.

Impact-Based Decision Support Services (IDSS) and Public Communication

NHC Public Affairs provided four social media posts, primarily in text format, and one brief recorded video with the NHC Director on Thursday, 3 July. These updates were promoted across all NHC social media platforms from 2–7 July. The short-form video reached 158K views while the system was in the medium chance of development category. A social media post shared on 6 July, the day the storm made landfall, achieved the highest reach at 693K views.

ACKNOWLEDGEMENTS

Data in Table 3 were compiled from Post Tropical Cyclone Reports and Public Information Statements issued by NWS Forecast Offices (WFOs) in Wilmington, NC, Raleigh, NC and Charleston, SC, in addition to reports from the Weather Prediction Center, National Data Buoy Center, and NOS Center for Operational Oceanographic Products and Services. Dr. Lisa Bucci provided the aircraft missions graphic (Fig. 5).

Table 1. Best track for Tropical Storm Chantal, 4–7 July 2025.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
04 / 0600	30.0	79.6	1012	25	low
04 / 1200	30.5	79.3	1012	30	"
04 / 1800	30.7	79.1	1011	30	tropical depression
05 / 0000	30.7	79.0	1011	30	"
05 / 0600	30.8	78.9	1010	35	tropical storm
05 / 1200	31.0	78.8	1009	35	"
05 / 1800	31.6	78.6	1006	40	"
06 / 0000	32.3	78.6	1004	45	"
06 / 0600	33.3	78.9	1002	50	"
06 / 0800	33.6	79.0	1003	45	"
06 / 1200	33.9	79.1	1005	35	"
06 / 1800	34.6	79.1	1006	25	tropical depression
07 / 0000	35.5	78.9	1006	25	"
07 / 0600	36.3	78.4	1009	25	"
07 / 1200	37.2	77.0	1011	25	low
07 / 1800	37.9	75.9	1012	20	"
08 / 0000					dissipated
06 / 0600	33.3	78.9	1002	50	maximum winds & minimum pressure
06 / 0800	33.6	79.0	1003	45	landfall on Litchfield Beach, South Carolina

Table 2. Selected ship reports with winds of at least 34 kt for Tropical Storm Chantal, 4–7 July 2025.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/ speed (kt)	Pressure (mb)
04 / 1200	3FAT9	30.2	77.4	250 / 53	1013.1
05 / 0000	3FAT9	29.1	73.3	260 / 49	1018.1
07 / 1900	KABP	36.8	72.5	200 / 37	1017.6

Table 3. Selected surface observations for Tropical Storm Chantal, 4–7 July 2025.

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)				
South Carolina									
International Civil Aviation Organization (ICAO) Sites									
North Myrtle Beach (KCRE) (33.82N 78.72W)	06/0853	1006	06/0453	26	42				
Myrtle Beach (KMYR) (33.68N 78.93W)	06/0853	1004.8	06/1037	22	29				
Charleston Executive Airport (KJZI) (32.70N 80.00W)	06/0555	1010.1	05/1855	23	34				
WeatherFlow Sites									
Lake Arrowhead (XARW) (33.78N 78.77W)			06/0526		34				
Folly Beach (XFSE) (32.64N 79.97W)	06/0711	1009	05/1636	28	38				
Isle of Palms (XIOP) (32.64N 79.97W)	06/0638	1009	05/2008	29	38				
Fort Sumter (XSUM) (32.75N 79.87W)	06/0630	1010	05/1845	28	37				
Schutes Folly (XSHF) (32.77N 79.91W)	06/0617	1010	05/1857	29	37				
Battery Point (XCHS) (32.76N 79.95W)	06/1818	1010	05/2023	23	33				
National Ocean Service (NOS) Sites									
Myrtle Beach Springmaid Pier (MROS1) (33.66N 78.92W)	06/0918	1004.2	06/0518	41	49				
Public/Other									
3 SW Myrtle Beach (WFXB-TV) (33.67N 78.94W)			06/0530		47				
Huntington SP Jetty (HUNTSP) (33.52N 79.03W)			06/0523		45				
Winyah Bay (WINBAY) (33.19N 79.18W)			06/0419		44				
Waties Causeway 1 (WATCSWY) (33.85N 78.59W)			06/0504		36				

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)				
Charleston Tide Gage (CHTS1) (32.78N 79.92W)	06/0618	1009	05/2018	30	41				
Loris (Mesonet) (34.06N 78.89W)									5.01
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Longs 1.3 NW (SCHR00645) (33.95N 78.75W)									4.86
Little River 4.7 WNW (SCHR0137) (33.91N 78.70W)									4.25
North Myrtle Beach 1.8E (SCHR0143) (33.83N 78.64W)									4.07
North Carolina									
International Civil Aviation Organization (ICAO) Sites									
Wilmington (KILM) (34.27N 77.90W)	06/0953	1011.4	06/1725	22	35				
Southport (KSUT) (33.93N 78.07W)			06/0640	18	38				
Lumberton Regional Airport (KLBT) (34.61N 79.06W)									4.97
WeatherFlow Sites									
Lockwoods Folly Inlet (XLOC) (33.92N 78.23W)			06/0944		34				
Oak Island (XOKI) (33.91N 78.12W)			06/0651		37				
Federal Point (XFED) (33.96N 77.94W)			06/1720		36				
National Ocean Service (NOS) Sites									
Wrightsville Beach Johnnie Mercers Pier (JMPN7) (34.21N 77.79W)	06/0854	1010.9	06/1718	28	36				
Hydrometeorological Automated Data System (HADS) Sites (NWS)									
Lumber River State Park (LRPN7) (34.39N 79.00W)									5.09
Lumberton (LBRN7) (34.63N 79.03W)									4.82

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)				
Wilmington 7 SE (WLMN7) (34.14N 77.88W)									4.04
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Pittsboro 7.7 N (NCCH0043) (35.83N 79.18W)									12.90
Pittsboro 8.8 NNE (NCCH0064) (35.84N 79.14W)									11.53
Pittsboro 5.9 N (NCCH0018) (35.81N 79.17W)									10.70
Hillsborough 8.4 NNE (NCOR0074) (36.19N 79.06W)									10.49
Hillsborough 7.4 NW (NCOR0006) (36.15N 79.19W)									10.43
Pittsboro 5.0 NE (NCCH0015) (35.78N 79.12W)									10.37
Pittsboro 3.3 NNW (NCCH0041) (35.77N 79.19W)									10.35
Chapel Hill 4.5 WSW (NCOR0021) (79.11N 35.90W)									10.22
Chapel Hill 5.9 SW (NCCH0056) (35.86N 79.10W)									10.05
Chapel Hill 2.5 N (NCOR0051) (35.96N 79.04W)									9.87
Carrboro 0.7 NNE (NCOR0091) (35.93N 79.08W)									9.82
Durham 6.7 WNW (NCOR0099) (36.03N 79.02W)									9.80
Meban 3.0 SSW (NCAL0039) (36.05N 79.29W)									9.73
Chapel Hill 4.7 SW (NCOR0048) (35.88N 79.10W)									9.57

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Estimated Inundatio n (ft)[e]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Durham 4.6 WNW (NCDH0078) (36.01N 78.99W)									8.46
Pinehurst 4.6 NNE (NCMR0044) (35.24N 79.42N)									7.45
Whispering Pines 1.0 SW (NCMR0012) (35.25N 79.39W)									7.20
Aberdeen 0.7 NW (NCMR0040) (35.15N 79.43W)									6.94
Whispering Pines 2.1 NE (NCMR0012) (35.28N 79.36W)									5.79
Castle Hayne 1.6 NNW (NCPD0013) (34.38N 77.91W)									4.41
Lumberton 8.6 SSE (NCRB0017) (34.51N 78.98W)									4.39
Wilmington 2.8 SE (NCNH0082) (34.18N 77.88W)									4.15
Wilmington 1.9S (NCNH0094) (34.18N 77.91W)									4.04
Leland 4.3 WSW (NCBR0114) (34.21N 78.07W)									4.03
Citizen Weather Observer Program (CWOP)									
Southport (STHPRT) (33.92N 78.02W)			06/0644		42				
NWS Cooperative Observer Program (COOP) Sites									
Moncure 2.4 N (35.65N 79.07W)									11.92
Georgia									
International Civil Aviation Organization (ICAO) Sites									
Claxton Airport (KCWV) (32.20N 81.87W)	06/2155	1013.3	04/2215	23	39				
NWS Cooperative Observer Program (COOP) Sites									
Adairsville 5 SE (90044) (34.34N 84.83W)									2.82

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)				
Offshore									
NOAA Buoys									
Wrightsville Beach Offshore (41037) (33.99N 77.36W)	06/0908	1012	06/0208	25	35				
Sunset Beach Nearshore (41024) (33.84N 78.48W)	06/0908	1006.9	06/1008	29	41				
Frying Pan Shoals (41013) (33.44N 77.76W)	06/0525	1009.4	06/0340	38	42				
Edisto Buoy (41004) (32.50N 79.10W)	06/0440	1006.0	06/0006	35	44				
Capers Nearshore (41029) (32.80N 79.62W)	06/0708	1007.8	05/1608	29	41				
Fripp Nearshore (41033) (32.28N 80.41W)	06/0708	1011.1	05/1708	25	37				
Charleston Wave Buoy (41066) (32.54N 79.66W)	06/0608	1008.6	05/1608	31	41				

[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] For most locations, storm tide is water height above the North American Vertical Datum of 1988 (NAVD88). Storm tide is water height above Mean Lower Low Water (MLLW) for NOS stations in Puerto Rico, the U.S. Virgin Islands, and Barbados.
[e] Estimated inundation is the maximum height of water above ground. For some USGS storm tide pressure sensors, inundation is estimated by subtracting the elevation of the sensor from the recorded storm tide. For other USGS storm tide sensors and USGS high-water marks, inundation is estimated by subtracting the elevation of the land derived from a Digital Elevation Model (DEM) from the recorded and measured storm tide. For NOS tide gauges, the height of the water above Mean Higher High Water (MHHW) is used as a proxy for inundation.

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	**168-Hour Outlook**
Low (<40%)	36	126
Medium (40%-60%)	18	66
High (>60%)	0	0

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Chantal, 4–7 July 2025. 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	**20.9**	41.9	65.1	82.5	97.5			
OCD5	38.0	82.9	142.8	204.0	252.6			
Forecasts	9	7	5	3	1			
OFCL (2020-24)	23.0	34.3	45.8	58.7	73.5	89.8	128.7	185.4
OCD5 (2020-24)	45.1	95.7	150.9	203.1	252.7	295.4	366.2	426.6

Table 5b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Chantal, 4–7 July 2025. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be 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	19.5	41.6	60.5	88.7				
OCD5	32.8	80.9	155.9	194.8				
GFSI	33.9	80.6	134.5	184.7				
EMXI	26.4	43.0	**49.4**	**39.3**				
CMCI	23.8	**31.1**	**38.3**	**53.8**				
NVGI	27.0	54.9	77.3	91.0				
HFAI	27.3	70.2	96.2	100.6				
HFBI	27.5	62.7	94.7	124.6				
HWFI	23.4	46.5	**45.4**	**55.4**				
HMNI	24.0	**39.4**	**49.3**	**38.3**				
CTCI	22.6	**41.5**	70.8	104.0				
HCCA	20.8	44.6	67.0	**82.9**				
FSSE	27.4	51.6	77.3	88.9				
TVCA	22.7	52.8	76.7	89.1				
TVDG	24.7	55.9	80.5	97.5				
TVCX	24.3	51.5	74.3	**84.6**				
AEMI	32.3	73.1	107.0	138.7				
GFEX	29.2	61.8	90.0	109.6				
GDMI	**15.6**	**33.4**	**47.4**	**64.2**				
TABS	33.2	69.2	113.2	153.7				
TABM	26.9	50.6	84.0	108.5				
TABD	24.8	**35.2**	**41.0**	**27.6**				
Forecasts	6	5	3	2				

Table 6a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Chantal, 4–7 July 2025. 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	**2.8**	**5.0**	**6.0**	**5.0**	**0.0**			
OCD5	4.9	8.9	12.8	22.7	26.0			
Forecasts	9	7	5	3	1			
OFCL (2020-24)	5.1	7.3	8.6	10.0	10.5	10.9	12.4	13.6
OCD5 (2020-24)	6.8	10.6	13.8	16.5	17.9	19.2	21.4	19.9

Table 6b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Chantal, 4–7 July 2025. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be 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	1.7	5.0	5.0	5.0				
OCD5	6.7	8.4	16.7	22.0				
HFAI	4.8	7.2	**3.7**	6.0				
HFBI	5.2	7.4	**4.7**	5.5				
HWFI	6.8	9.4	5.3	5.5				
HMNI	7.0	11.2	7.7	5.0				
CTCI	5.8	10.2	8.0	**4.0**				
DSHP	5.0	6.4	5.0	**4.5**				
LGEM	5.8	8.4	**2.7**	**3.0**				
HCCA	4.5	6.0	**2.7**	**1.5**				
FSSE	4.7	6.6	**2.3**	**0.0**				
IVCN	4.7	8.0	**2.3**	**1.0**				
ICON	4.8	7.8	**1.0**	**1.5**				
IVDR	4.8	8.6	**3.0**	**1.0**				
GFSI	7.5	13.0	7.7	6.5				
EMXI	7.2	10.6	**3.3**	**1.5**				
GDMI	5.2	6.6	**3.3**	**2.0**				
Forecasts	6	5	3	2				

Table 7. Watch and warning summary for Tropical Storm Chantal, 4–7 July 2025.

Date/Time (UTC)	Action	Location
4 / 2100	Tropical Storm Watch issued	Edisto Beach, SC to Little River Inlet, SC
5 / 0900	Tropical Storm Watch issued	Little River Inlet, SC to Cape Fear, NC
5 / 1200	Tropical Storm Watch changed to Tropical Storm Warning	South Santee River, SC to Cape Fear, NC
5 / 1500	Tropical Storm Warning issued	Cape Fear, NC to Surf City, NC
6 / 0900	Tropical Storm Watch discontinued	Edisto Beach, SC to South Santee River, SC
6 / 1500	Tropical Storm Warning discontinued	South Santee River, SC to Surf City, NC

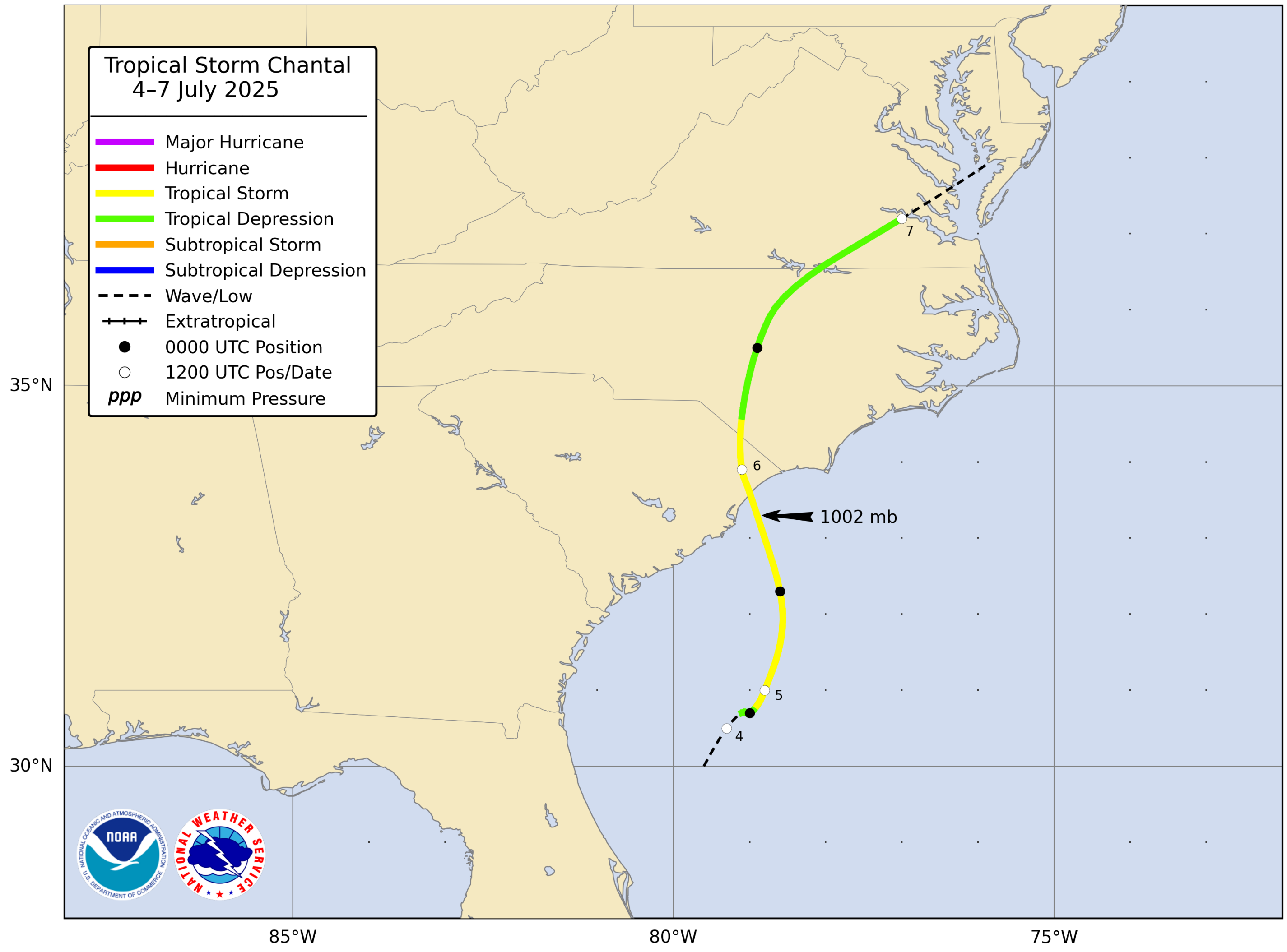

Figure 1. Best track positions for Tropical Storm Chantal, 4–7 July 2025. Tracks over the United States are partially based on analyses from the NOAA Weather Prediction Center.

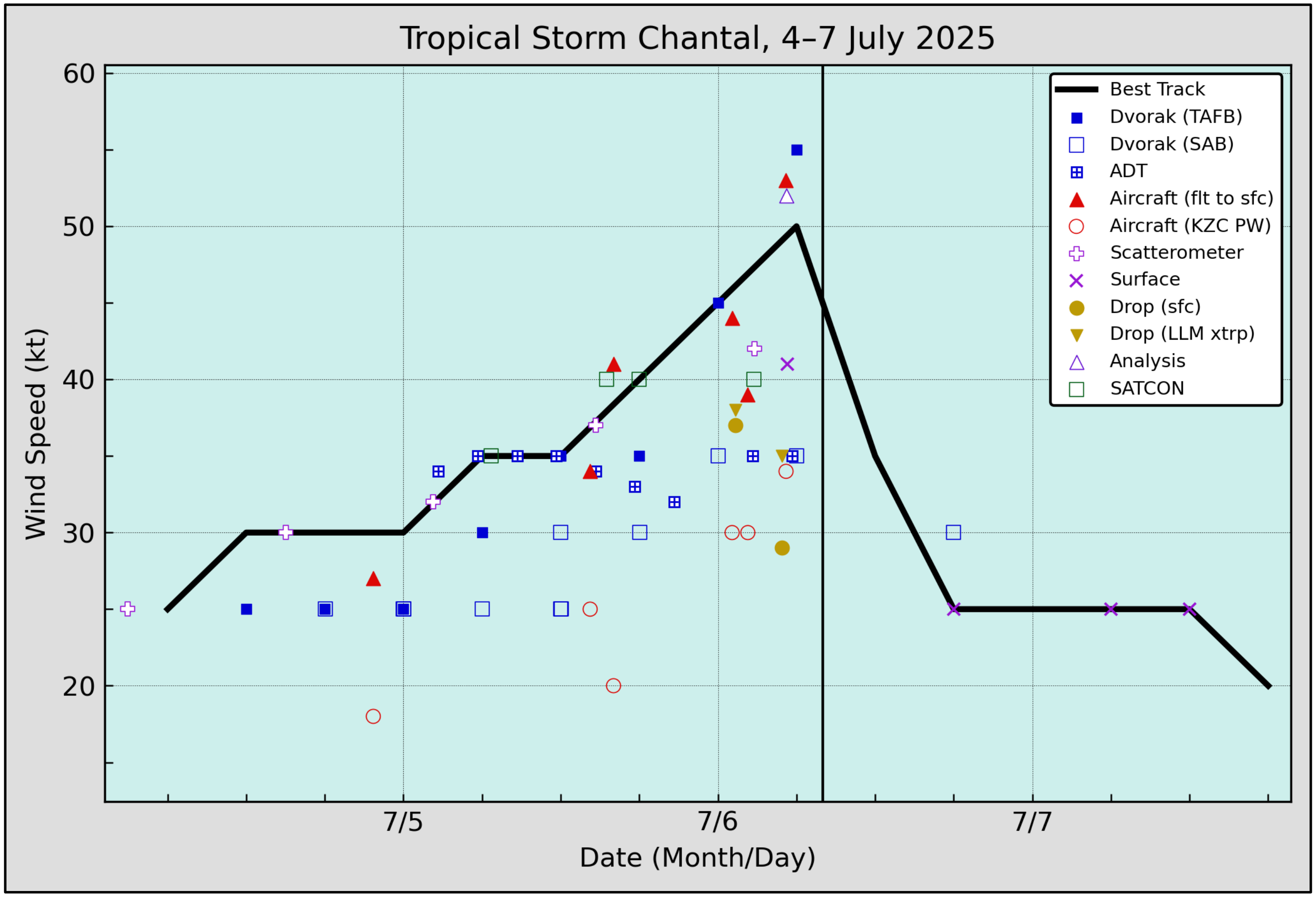

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Chantal, 4–7 July 2025. Aircraft observations have been adjusted for elevation using 90% and 80% adjustment factors for observations from 700 mb and 850 mb, respectively. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM). 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 the solid vertical line corresponds to landfall.

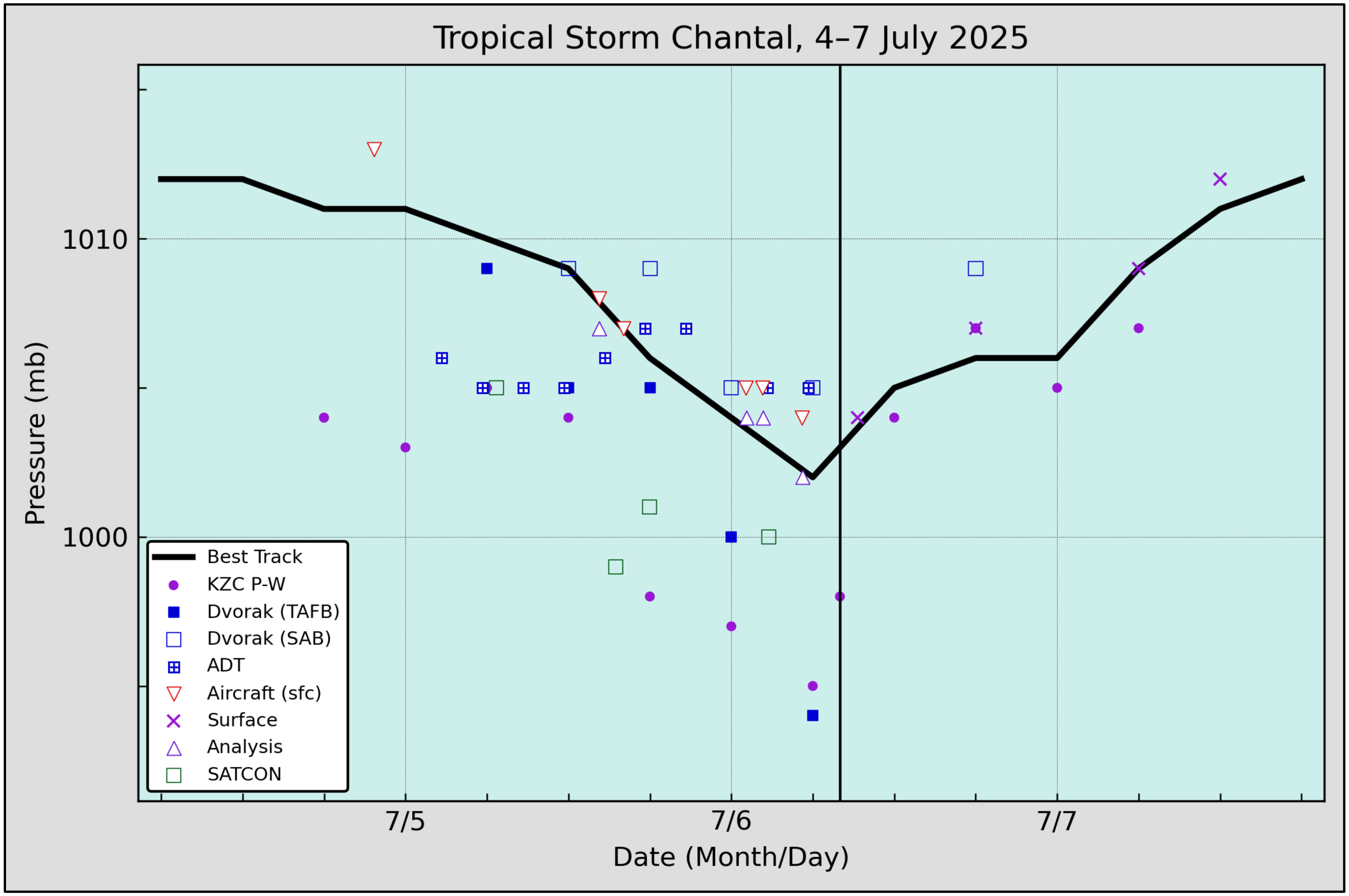

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Chantal, 4–7 July 2025. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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 the solid vertical line corresponds to landfall.

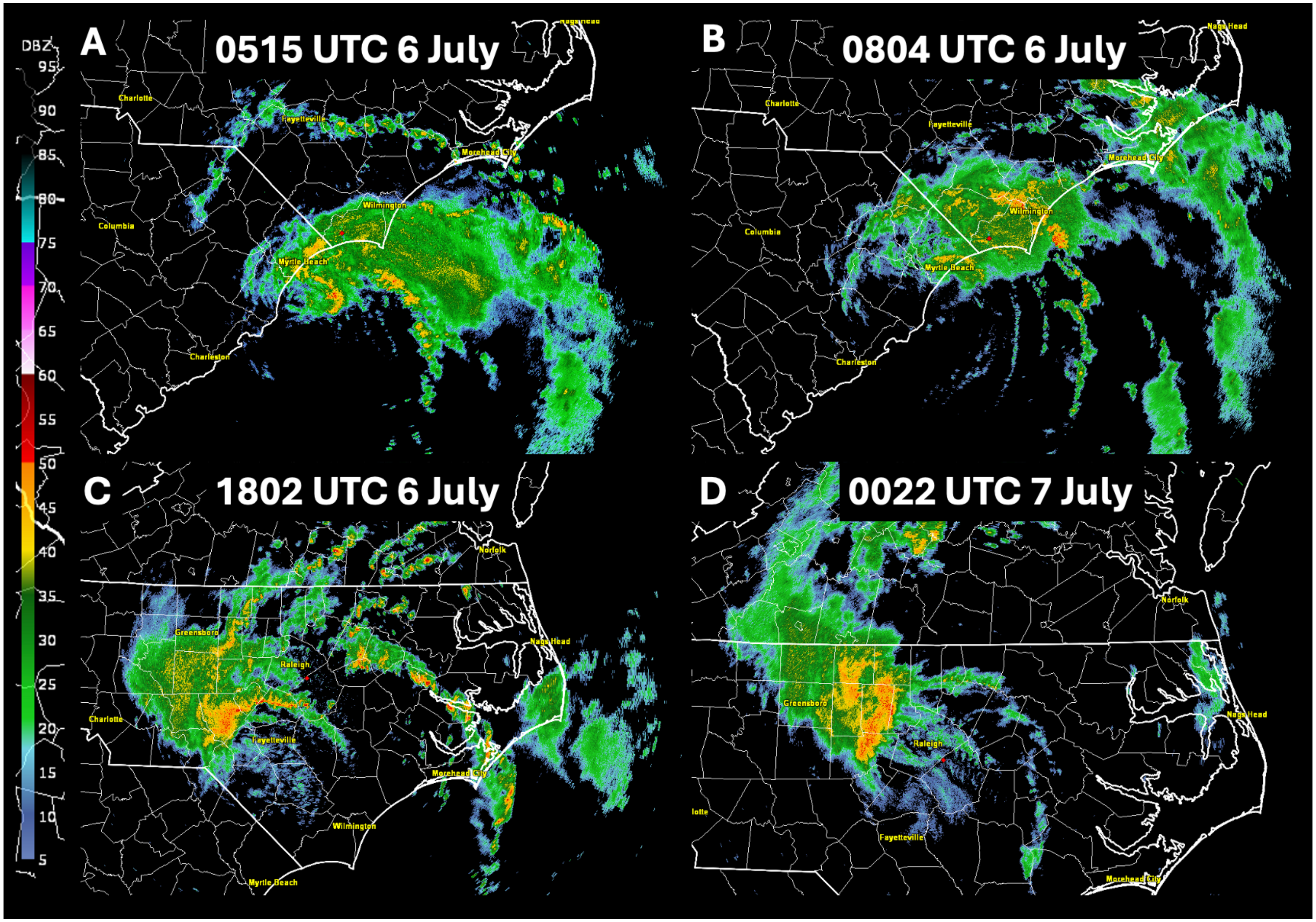

Figure 4. Radar reflectivity images of Chantal shortly before, during, and after landfall. Panel (a) is KLTX 0.5 deg radar reflectivity at 0515 UTC 6 July, panel (b) is KLTX 0.5 deg radar reflectivity at 0804 UTC 6 July near the time of Chantal's landfall, panel (c) is KRAX 0.2 deg radar reflectivity at 1802 UTC 6 July, and panel (d) is KRAX reflectivity at 0022 UTC 7 July.

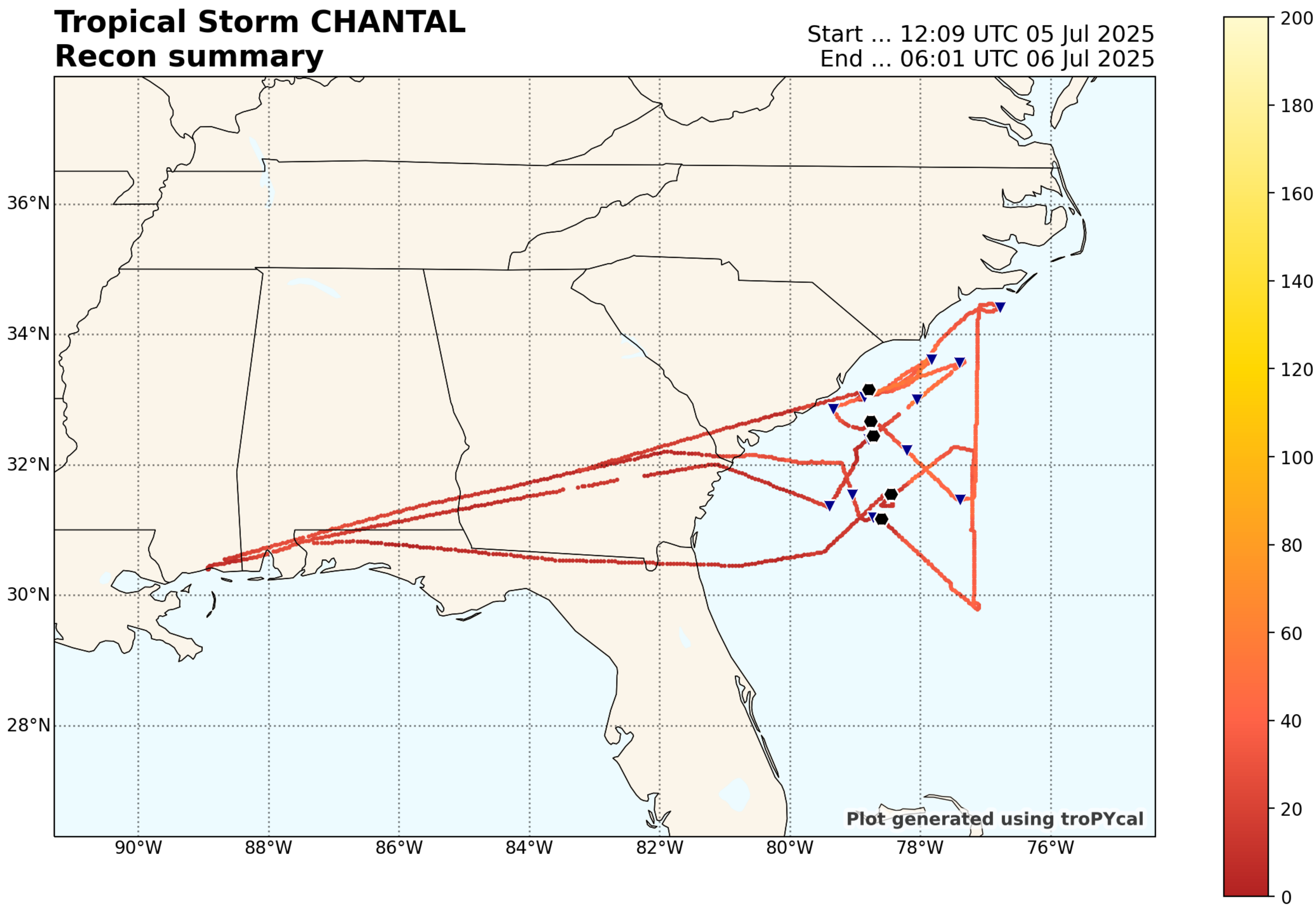

Figure 5. Air Force Reserve aircraft flight tracks (red) from reconnaissance missions into Chantal. The black markers denote center fixes, and the blue triangles indicate dropsonde locations. The color coding of the flight tracks is based on the observed flight-level wind speed with the color legend to the right of the map representing the color associated with the various wind speeds in knots.

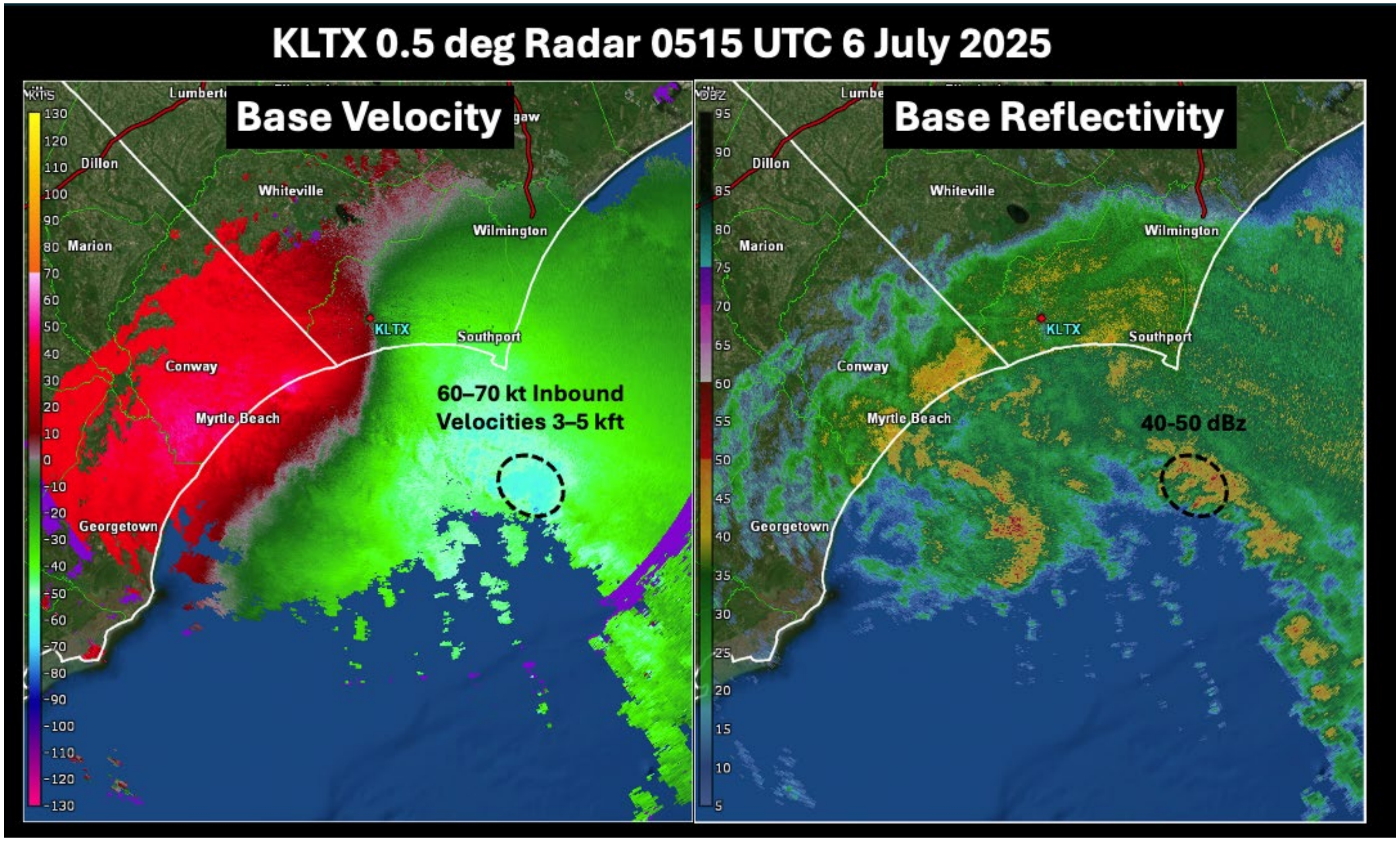

Figure 6. Snapshot of Wilmington, NC (KLTX) radial velocity (a) and base reflectivity (b) at 0515 UTC 6 July. Annotated is the region of 60–70 kt inbound velocity data associated with 40–50 dBz echoes. These retrievals were persistent in time and area over an hour (not shown).

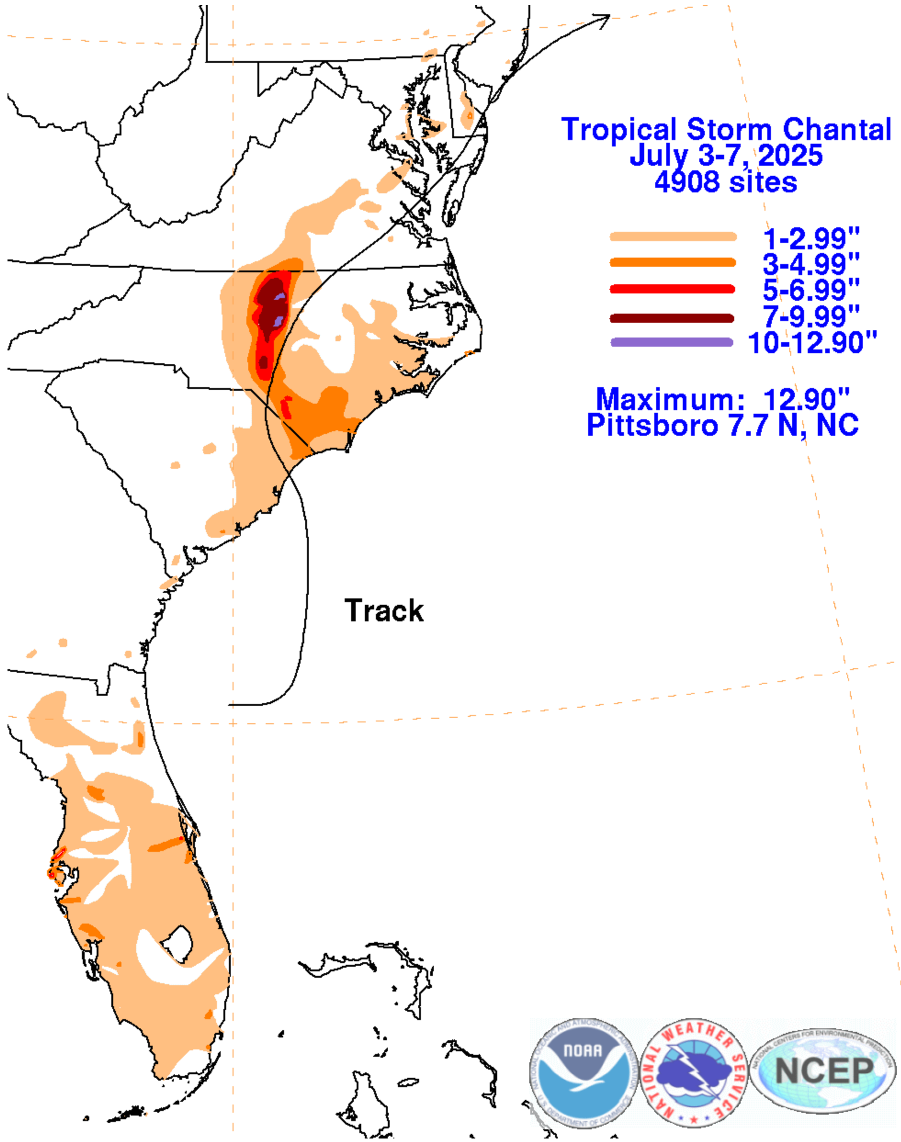

Figure 7. Rainfall accumulation (inches) between 3–7 July 2025 in the United States from Tropical Storm Chantal. Image courtesy of David Roth and Zack Taylor from the NOAA Weather Prediction Center. The track is based on the NHC operational assessment.

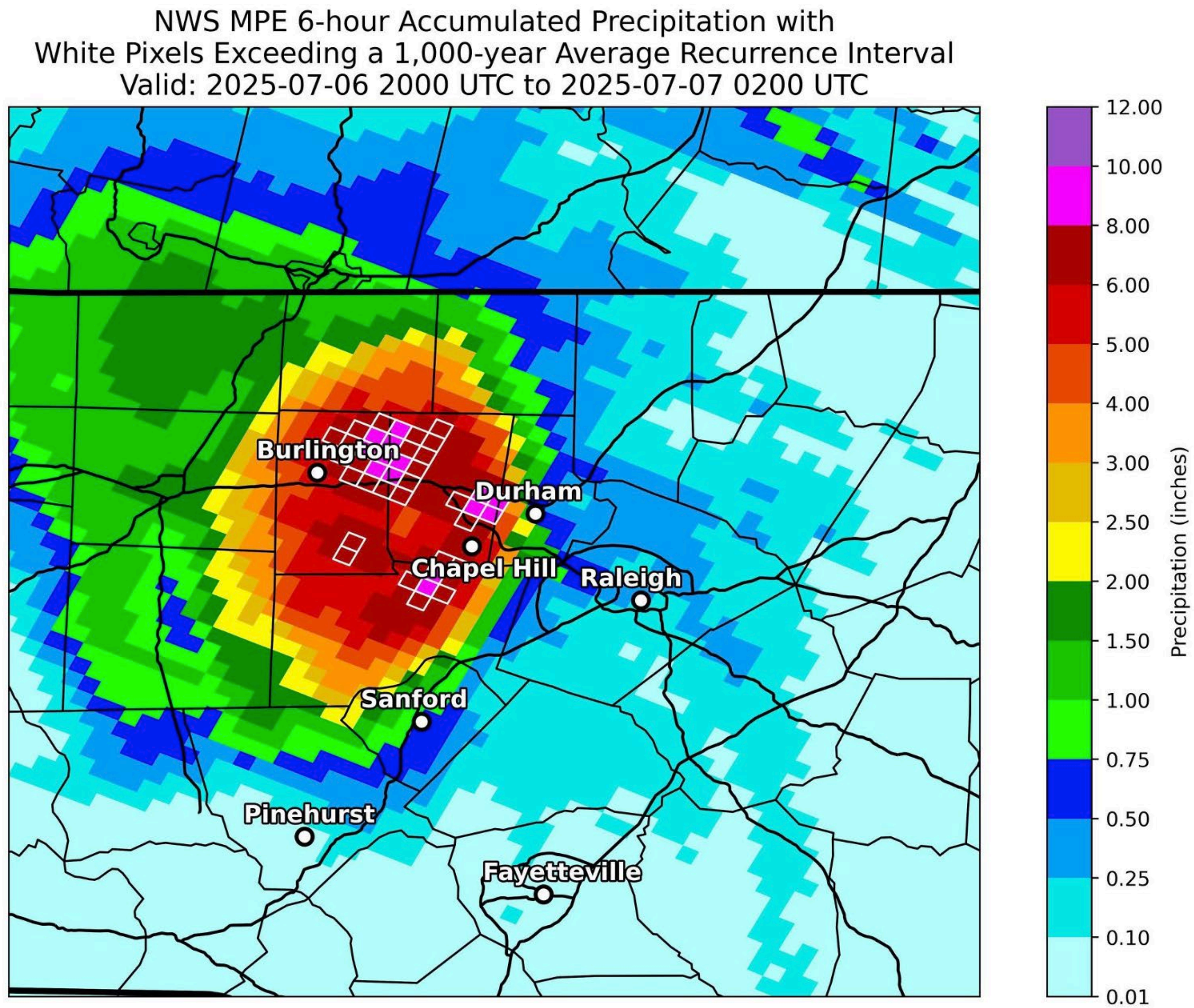

Figure 8. National Weather Service Multi-Sensor Precipitation Estimation from 2000 UTC 6 July to 0200 UTC 7 July (shaded, inches). The white boxes in the figure denote where the precipitation total exceeds the 1000-year average recurrence interval.

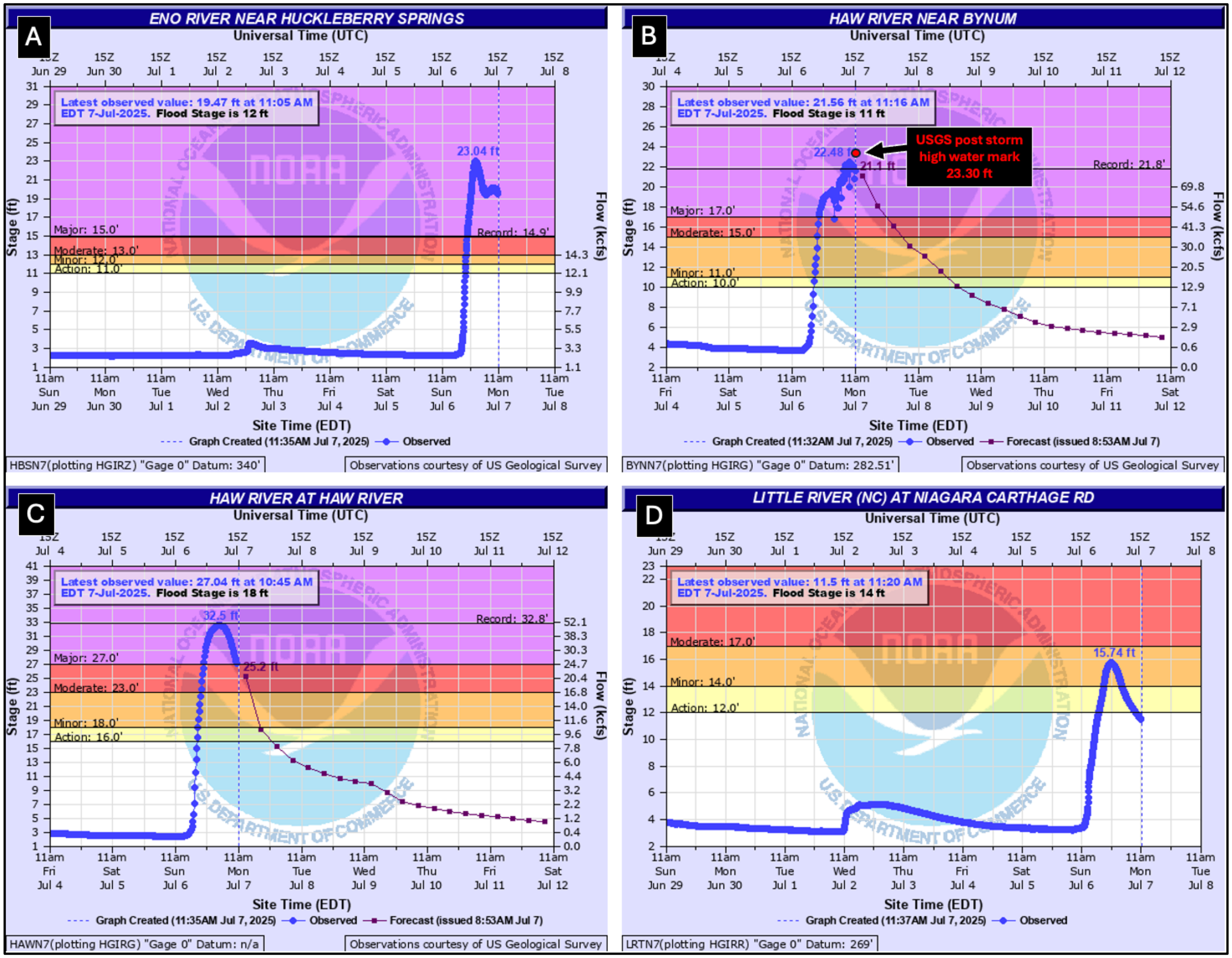

Figure 9. River gauge heights observed during the passage of Tropical Storm Chantal across North Carolina on 6–7 July for (a) Haw River near Bynum, (b) Eno River near Huckleberry Springs, (c) Haw River farther downstream in Alamance County, and (d) Little River at Niagara Carthage Road. The magenta area in each plot indicates the area of major flood stage, which was exceeded for both the Haw and Eno Rivers.

Figure 10. Select photos illustrating the impacts associated with Chantal when it affected North Carolina with heavy rainfall and flooding on 6–7 July. Footnotes providing sources of these figures are provided on page 6 of the Chantal report.

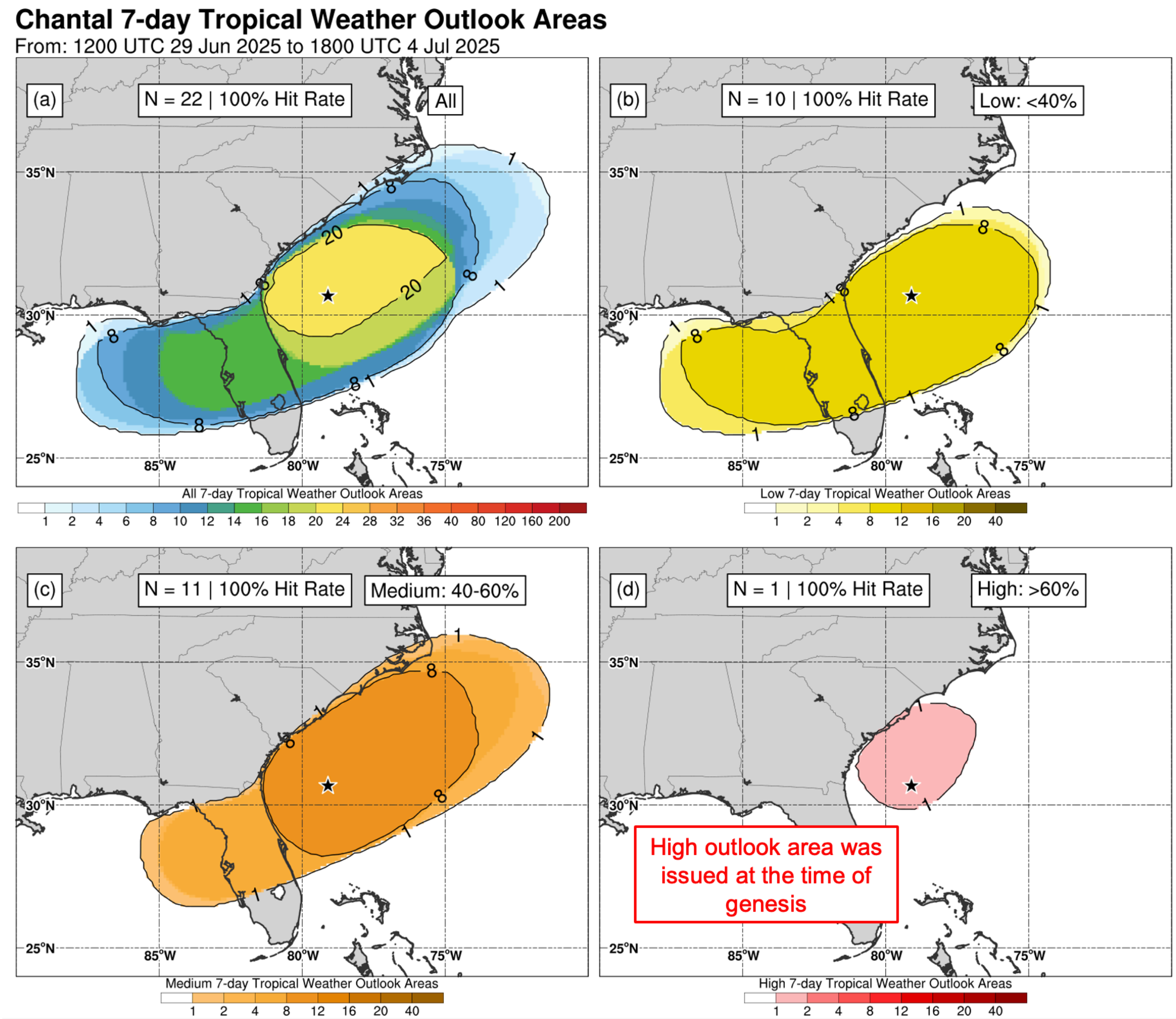

Figure 11. Composites of 7-day tropical cyclone genesis areas depicted in NHC's Tropical Weather Outlooks prior to the formation of Chantal for (a) all probabilistic genesis categories, (b) the low (<40%) category, (c) medium (40–60%) category, and (d) high (>60%) category. The location of genesis is indicated by the black star.

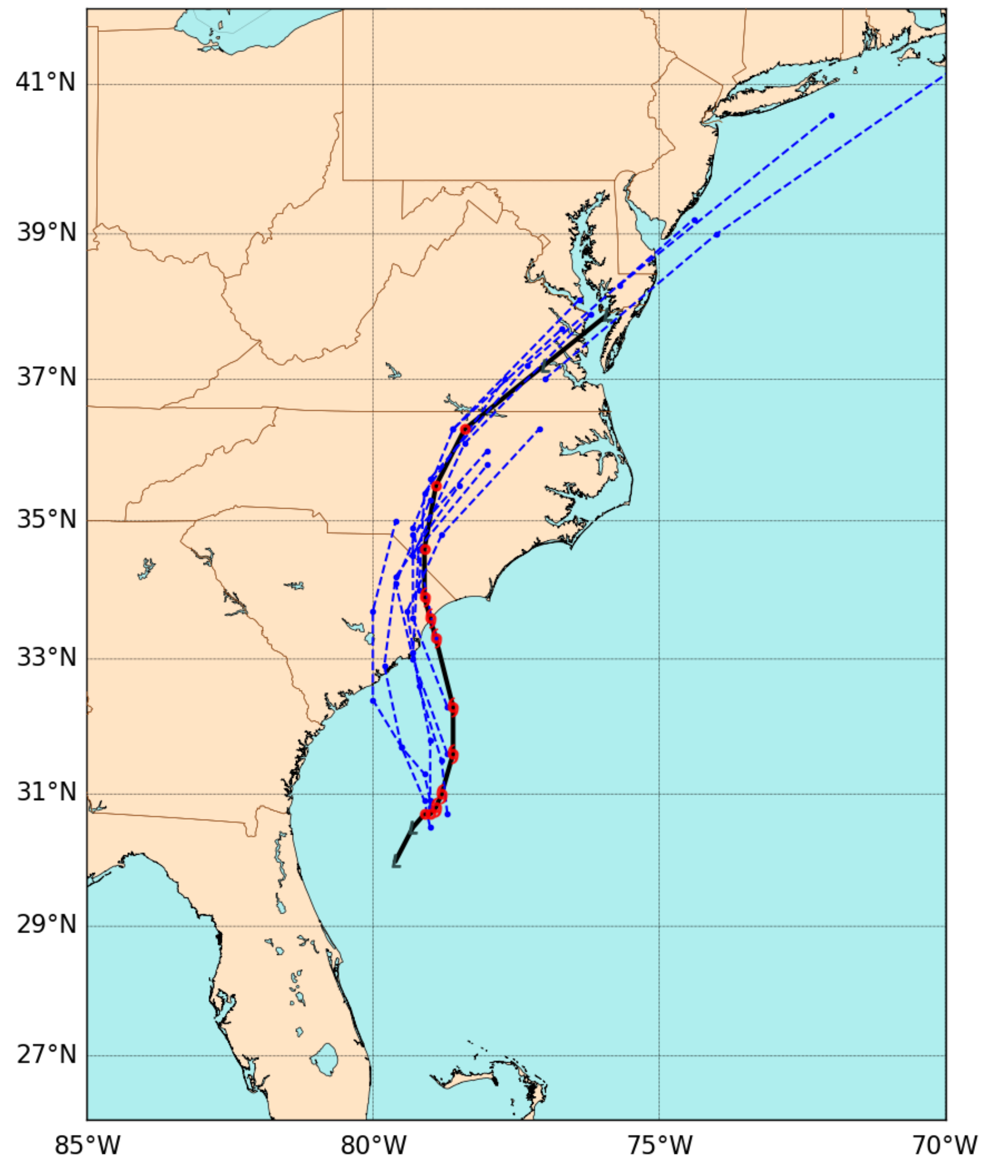

Figure 12. Official track forecasts (blue lines, with 0, 12, 24, 36, 48, 60 h positions indicated) for Tropical Storm Chantal, 4–7 July. The best track is given by the black line.