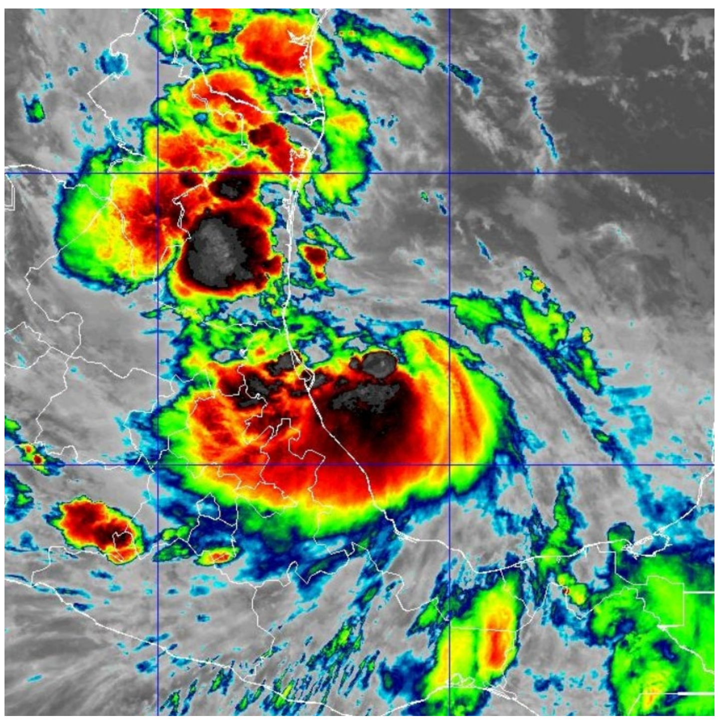
NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

TROPICAL STORM ALBERTO

(AL012024)

19–20 June 2024

Andrew B. Hagen and Heather Nepaul
National Hurricane Center
9 April 2025[1]



GOES-EAST INFRAFRED SATELLITE IMAGE OF TROPICAL STORM ALBERTO AT 0420 UTC 20 JUNE 2024, A FEW HOURS BEFORE IT MADE LANDFALL NEAR TAMPICO, MEXICO. IMAGE COURTESY OF NOAA/NESDIS/STAR.

Alberto was a large but short-lived tropical storm that formed in the southwestern Gulf of Mexico and made landfall near Tampico, Mexico. Alberto brought wind and rainfall impacts to much of the western Gulf of Mexico coast and is responsible for two direct deaths – one in Texas and one in Mexico.

[1] Original report dated 4 September 2024. This version provides a damage estimate for Mexico and increases the total fatalities in Mexico to 5.

Tropical Storm Alberto

19–20 JUNE 2024

SYNOPTIC HISTORY

Alberto's origins can be traced to a Central American Gyre[2] (CAG) that formed over Central America around 15 June and gradually progressed northwestward through 17 June. Initially, a concentrated area of showers and thunderstorms along the southern portion of the gyre was located near the Gulf of Tehuantepec on 15–16 June. As the CAG moved northwestward, the convection moved northward across southeastern Mexico and into the Bay of Campeche on 17 June. Concurrently, an area of low-level vorticity along the east side of the gyre also moved northwestward and was over the Yucatan Peninsula by 17 June. Surface observations, satellite imagery, and scatterometer data indicate that a broad area of low pressure, associated with the CAG, was centered over the Bay of Campeche about 90 n mi northwest of Ciudad del Carmen, Mexico, at 1800 UTC 17 June.

During the next 24 hours, the disturbance continued to drift northward and was centered about 175 n mi northwest of Campeche, Mexico, by 1800 UTC 18 June. The disturbance consisted of a large, elongated, northwest-to-southeast-oriented circulation with a 150–250-n mi wide area of light winds and a broad minimum in pressure. Scatterometer data revealed that the strongest winds of 30 to 35 kt were located about 360 n mi north of the estimated center over the north-central and northwestern Gulf of Mexico, enhanced by a tight synoptic pressure gradient on the north side of the low due to a strong high pressure ridge over the southeastern United States. Clusters of convection were present well to the north and south of the center, with very little convection near the center itself.

The broad low pressure system turned westward on 19 June as the ridge over the southeastern United States expanded west-southwestward. Within an environment of very warm water and weak vertical wind shear, deep convection on the south side of the circulation became persistent and moved closer to the center early that day, and it is estimated that Tropical Storm Alberto formed at 1200 UTC 19 June about 205 n mi east of Tampico, Mexico. The "best track" chart of Alberto'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[3].

After becoming a tropical storm, Alberto's radius of maximum winds (RMW) contracted later that day, and tropical-storm-force winds began occurring south of the center. Aircraft and

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[2] A Central American gyre (CAG) is a broad lower-tropospheric cyclonic circulation occurring near Central America. For more information please refer to Papin, P., L. F. Bosart, R. D. Torn, 2017: A Climatology of Central American Gyres. *Mon. Wea. Rev.*, 145, 1983-2000. http://journals.ametsoc.org/doi/pdf/10.1175/MWR-D-16-0411.1

[3] 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.

scatterometer data from late that evening showed that Alberto's maximum sustained winds had increased to 45 kt, and that the large area of tropical-storm-force winds extended northward more than 360 n mi from the center, and were affecting coastal portions of Texas as far north as Galveston Bay. Alberto accelerated westward and maintained its intensity until it made landfall near Tampico, Mexico, around 0900 UTC 20 June. The tropical cyclone quickly weakened after moving inland, dissipating by 1800 UTC that day as it moved westward over the high terrain of Mexico.

METEOROLOGICAL STATISTICS

Observations in Alberto (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, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from five flights of the 53rd Weather Reconnaissance Squadron of the U.S. Air Force Reserve Command (Fig. 4). 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 Alberto.

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

Winds and Pressure

Numerous surface observations from buoys and ships over the Gulf of Mexico as well as coastal stations in Texas measured winds of tropical storm force (Table 3) within the expansive wind field over the northern semicircle of the system on 18–19 June.

A maximum 850-mb flight-level wind of 61 kt and SFMR winds of 43 kt were measured around 0200 UTC on 20 June. A couple of hours later, ASCAT-C showed peak winds up to 43 kt about 90 n mi northeast of the center. Alberto's estimated peak intensity of 45 kt from 0000-0900 UTC 20 June is based on those data.

The minimum pressure of 992 mb at 0000 UTC 20 June is based on a dropsonde that measured a splash pressure of 993 mb with winds of 9 kt at 2339 UTC 19 June.

Storm Surge[4]

The combined effect of storm surge and tide produced inundation levels of 2 to 4 ft above ground level (AGL) along the Texas coast. Despite Tropical Storm Alberto making landfall near Tampico, Mexico, its large wind field resulted in widespread storm surge flooding for much of the western Gulf coast. Figure 5 shows peak storm surge observations from select National Ocean Service (NOS) tide gauges referenced to feet above Mean Higher High Water (MHHW), a proxy for inundation. The maximum water level observed was recorded by the NOS tide station at San Luis Pass, Texas, which measured 4.04 ft above MHHW.

Additional NOS tide gauges near Corpus Christi Bay, Matagorda Bay, and Galveston Bay recorded maximum water levels greater than 3 ft above MHHW. Peak water levels in these locations include 3.82 ft above MHHW in Nueces Bay, 3.45 ft above MHHW near Port Lavaca, and 3.71 ft above MHHW at Eagle Point, respectively. Minor storm surge flooding of 1 to 3 ft AGL also occurred along the southern Louisiana coast, with the highest measured water level of 2.91 ft above MHHW by the NOS tide station at Freshwater Canal Locks, Louisiana.

The storm surge forecast was 1 to 3 ft above normal tide levels along the immediate coast of northeastern Mexico. No measurements were collected in the impacted area, but storm surge likely occurred.

Rainfall and Flooding

Alberto produced heavy rain over portions of southern Texas. The heaviest rains of 5 to 8 inches occurred from around Rockport to the Corpus Christi area and extended westward (inland) from there (Fig. 6). The maximum amount of 10.5 inches occurred in Lamar, located just north of Rockport.

Heavy rain was also observed over portions of northeastern Mexico, with the heaviest rains in the Mexican states of Nuevo Leon, Tamaulipas, and southeastern Coahuila. Many locations across these areas received 8 to 16 inches (200 to 400 mm) of rain during the period 16–20 June (Fig. 7). El Cerrito, Nuevo Leon, reported the highest rainfall amount of 26.5 inches (673 mm) during the period, with 23.62 inches (600 mm) falling during a 24-h period ending at 1200 UTC 20 June.

Tornadoes

There were three tornadoes associated with Alberto in Texas. An EF-1 tornado near Bellville damaged 2 homes and 1 business on 19 June. Two brief EF-0 tornadoes moved through

[4] 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).

Rockport on 20 June, one being a waterspout that moved ashore. A few homes lost some shingles, and a couple of carports and sheds were destroyed.

CASUALTY AND DAMAGE STATISTICS

United States

One direct death[5] is attributable to Alberto in the United States. A 17-year-old drowned in a rip current in Galveston near the 25th St. Pier on 21 June[6]. According to the NOAA National Centers for Environmental Information (NCEI), the estimated U.S. damage from Alberto is $125 million, most of which occurred in Texas. A significant portion of this damage was likely due to storm surge, which caused damage at several points along the coast from Cameron County to Galveston County. On Padre Island, piers were destroyed, and roads were washed out. Properties were inundated, and several high-water rescues were performed in the North Beach area of Corpus Christi. Treasure Island (a beach community near San Luis Pass) reported damage to roadways. Some structures in Galveston's West End reported flood damage to surface storage areas. Numerous other areas along the coast of Texas reported closures of coastal roads and major beach erosion, with loss of protective dunes.

Mexico

Alberto also caused one direct death in Mexico. A 16-year-old child drowned in Monterrey, Mexico, when venturing into a swelled river to retrieve a soccer ball. Civil protection officials in the Mexican state of Nuevo Leon reported three indirect deaths due to electrocution. Two 12-year-old children were electrocuted in the municipality of Allende when they were crossing a puddle where a cable was hanging, and a man died from electrocution while making repairs to his home. According to government officials in Mexico, one additional fatality occurred but the cause is unknown, bringing the total number of deaths in Mexico to 5. According to Aon, Alberto produced $140 million in damage in Mexico[7].

FORECAST AND WARNING CRITIQUE

Genesis

The genesis of Alberto was well anticipated. The system from which Alberto developed was introduced in the Tropical Weather Outlook 168 h prior to genesis (Table 4). The 7-day

[5] 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.

[6] https://www.click2houston.com/news/local/2024/06/22/17-year-old-drowns-near-galveston-pleasure-pier-fifth-victim-since-memorial-day/

[7] https://assets.aon.com/-/media/files/aon/reports/2024/aon-q3-2024-global-catastrophe-recap.pdf

probabilities were raised to the medium (40-60%) and high (>60%) categories 150 and 66 h before genesis, respectively. A 2-day chance of formation was introduced in the outlook 72 h before formation, and 2-day probabilities were raised to the medium and high categories 60 and 48 h prior to genesis, respectively. Advisories were commenced on Potential Tropical Cyclone One at 2100 UTC 17 June because forecasters at NHC and Servicio Meterorologico Nacional in Mexico believed it posed a significant risk of becoming a tropical storm and bringing tropical-storm-force winds to portions of Mexico and Texas within 48 hours. The location of Alberto's genesis was well forecast (Fig. 8), with all of the predicted genesis areas capturing the location where Alberto formed.

Track and Intensity

A verification of NHC official track forecasts for Alberto is given in Table 5. Only three forecasts verified at 12 h, and one forecast verified at 24 h. The average track error at 12 h was about 42 n mi, which is greater than the mean official error for the previous 5-yr period. A verification of NHC official intensity forecasts for Alberto is given in Table 6. The average intensity errors of 3.3 and 5.0 kt, at 12 and 24 h respectively, are lower than the mean official errors for the previous 5-yr period. A homogeneous comparison of the official track and intensity errors with guidance models is not shown due to the small sample size.

Wind Watches and Warnings

Coastal wind watches and warnings associated with Alberto are given in Table 7. In the United States, the initial Tropical Storm Watch was issued from Port O'Connor, Texas, to the Mouth of the Rio Grande when advisories were initiated on Potential Tropical Cyclone One at 2100 UTC 17 June. The Tropical Storm Watch was upgraded to a Tropical Storm Warning 12 h later, at 0900 UTC 18 June, which was still before the system became a tropical cyclone. The 34-kt wind field grew in size north of the disturbance later that day, and the Tropical Storm Warning was expanded northeastward along the coast of Texas to San Luis Pass at 2100 UTC, about the same time that winds reached 34 kt at surface observation sites between Matagorda Bay and Galveston Bay. For the portion of the coast from Port O'Connor southward, tropical-storm-force winds did not begin until after 1800 UTC 19 June, which is after Alberto had already formed. For this stretch of coastline, the watch was issued about 45 h before Alberto's tropical-storm-force winds reached the coast, and the warning was issued about 33 h in advance.

Storm Surge Watches and Warnings

No storm surge watches or warnings[8] were issued for Alberto. However, the vulnerability of the Texas coast to elevated water levels from Alberto's large wind field necessitated the NWS providing messaging of storm surge risk information in the form of Coastal Flood Warnings handled by local NWS Weather Forecast Offices. The peak storm surge forecast was 2 to 4 ft AGL from Sargent, Texas, to Sabine Pass, Texas, which verified well with available observations (Fig. 5). Elsewhere, a peak storm surge forecast of 1 to 3 ft AGL was highlighted from the Mouth of the Rio Grande to Sargent, Texas, as well as from Sabine Pass, Texas, eastward to the

[8] The NHC issues storm surge watches and warnings for life-threatening inundation. Although Alberto's storm surge did cause significant damage (described above in the damage statistics section), no lives were lost due to storm surge.

Vermillion/Cameron Parish Line in Louisiana. The forecast verified relatively well in these locations, with most observations recording values near 3 ft MHHW, though slightly higher water levels were measured in the back bays of Matagorda Bay and Corpus Christi Bay.

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

The NHC began communication with emergency managers on 18 June as Alberto was developing in the southwestern Gulf of Mexico. A decision support briefing was provided to emergency managers and coordinated through the FEMA Hurricane Liaison Team embedded at the NHC. The briefing was a federal video-teleconference with FEMA HQ and FEMA Region 6.

NHC provided 4 live stream broadcasts from 17–19 June via YouTube Live and Facebook. The videos provided the latest information on the storm and were used by news agencies, local broadcast TV, and the general public. In addition to the live stream announcements, the latest public advisory, satellite imagery, and key messages were posted in English and Spanish on the NHC Facebook, Instagram and X pages.

ACKNOWLEDGEMENTS

Much of the data in this report came from Post Tropical Cyclone (PSH) Reports issued by NWS Weather Forecast Offices (WFOs) in Brownsville, Corpus Christi, and Houston, Texas; and Lake Charles, Louisiana. David Roth of the NOAA Weather Prediction Center produced the rainfall map for the United States. Data from the National Data Buoy Center, NOS Center for Operational Oceanographic Products and Services, and the National Meteorological Service of Mexico were also used in this report. The authors would like to thank those at NHC for their contributions to this report. Michael Spagnolo from FEMA supplied the IDSS briefing information; Maria Torres provided the live stream and social media information; Dr. Lisa Bucci created the reconnaissance summary figure (Fig. 4); Dr. Philippe Papin provided the genesis figure (Fig. 8). The National Centers for Environmental Information provided the monetary damage estimate for the United States.

Table 1. Best track for Tropical Storm Alberto, 19–20 June 2024.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
17 / 1800	19.9	92.7	1001	35	disturbance
18 / 0000	20.4	92.7	999	35	"
18 / 0600	20.9	92.7	999	35	"
18 / 1200	21.5	92.6	999	35	"
18 / 1800	22.0	92.6	999	35	"
19 / 0000	22.3	92.8	998	35	"
19 / 0600	22.4	93.5	998	35	"
19 / 1200	22.1	94.2	995	35	tropical storm
19 / 1800	21.8	94.8	995	40	"
20 / 0000	21.5	95.5	992	45	"
20 / 0600	22.0	96.7	993	45	"
20 / 0900	22.4	97.8	994	45	"
20 / 1200	22.4	98.8	998	35	"
20 / 1800					dissipated
20 / 0000	21.5	95.5	992	45	maximum winds and minimum pressure
20 / 0900	22.4	97.8	994	45	Landfall near Tampico, Mexico

Table 2. Selected ship reports with winds of at least 34 kt for Tropical Storm Alberto, 19–20 June 2024.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/ speed (kt)	Pressure (mb)
18 / 0000	BFUGCQ	19.9	87.0	110 / 43	1002.1
18 / 0000	9V9001	24.0	89.0	100 / 35	1005.5
18 / 0700	9V9001	23.2	87.7	110 / 39	1009.8
18 / 1200	GKHEAB	25.2	90.0	100 / 36	1004.3
18 / 2000	WGAE	28.8	93.4	090 / 40	1009.2
19 / 0600	WGAE	27.9	91.9	090 / 37	1008.1
19 / 1100	WGAE	27.9	91.1	120 / 35	1008.0
19 / 1800	WGAE	27.6	89.8	090 / 37	1011.5
19 / 1800	3E4612	25.6	91.8	120 / 38	1004.6
20 / 0000	3E4612	24.9	90.5	120 / 37	1002.7
20 / 0000	WGAE	26.9	88.5	090 / 35	1012.4

Table 3. Selected surface observations for Tropical Storm Alberto, 19–20 June 2024.

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 of Mexico Buoys and Platforms									
NOAA 42001 (25.93N 89.66W)	18/2230	1002.8	18/0517	35 (4 m, 1 min)	43				
NOAA 42002 (26.06N 93.65W)	19/0940	1000.6	18/0612	39 (4 m, 1 min)	45				
NOAA 42020 (26.97N 96.68W)	19/1100	1004.3	20/0429	35 (4 m, 1 min)	39				
NOAA 42035 (29.24N 94.41W)	18/1038	1008.4	19/2006	39 (4 m, 1 min)	45				
NOAA 42055 (22.14N 94.11W)	20/0033	996.7	20/0128	35 (4 m, 1 min)	39				
Garden Banks 783 (KGBK) (27.20N 92.20W)			19/0815	49 (58 m)	58				
Green Canyon 338 (KGRY) (27.63N 90.44W)			19/0435	39 (40 m)	42				
Texas									
International Civil Aviation Organization (ICAO) Sites									
Brownsville (KBRO) (25.91N 97.43W)	19/2330	1002.4	20/2100	31 (10 m, 2 min)	49				2.72
Corpus Christi (KCRP) (27.77N 97.51W)	19/1040	1006.6	19/2316	29 (10 m, 2 min)	43				6.37
McAllen (KMFE) (26.18N 98.24W)	20/0025	1005.2	20/2015	32 (10 m, 2 min)	42				4.74
Coastal-Marine Automated Network (C-MAN) Sites									
Port Aransas (PTAT2) (27.83N 97.05W)			20/0300	35 (15 m, 2 min)	43				
National Ocean Service (NOS) Sites									
Freeport (FPST2) (28.94N 95.29W)	19/0906	1007.1	19/1848	38 (15 m)	43	3.82	4.8	3.78	
Galveston Bay Entrance (North Jetty) (GNJT2) (29.36N 94.73W)	19/0954	1007.9	19/2200	38 (12 m)	45	3.37	4.02	2.91	
Galveston Pier 21 (GTOT2) (29.31N 94.79W)	18/0948	1007.5	19/0218	22	36	3.63	4.33	3.23	
Ingleside (MHBT2) (27.82N 97.21W)	19/0954	1005.3	20/0330	30 (22 m)	37	3.33		3.31	
La Quinta (LQAT2) (27.88N 97.29W)	19/1024	1005.6	18/0024	26 (18 m)	34	3.39	4.17	3.39	
Nueces Bay (NUET2) (27.83N 97.49W)	18/1048	1005.3				4.24	5.09	3.82	

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)				
Rockport (RCPT2) (28.02N 97.05W)	19/1012	1005.0	19/2248	29 (7 m)	38	3.21	4.51	3.21	
Viola Turning Basin (VTBT2) (27.84N 97.52W)	18/1036	1005.6	20/0454	26 (11 m)	34	3.85		3.71	
WeatherFlow Sites									
Matagorda Bay (XMGB) (28.59N 95.98W)	18/1121	1006.4	18/1901	36 (6 m)	44				
Surfside Beach (XSRF) (28.93N 95.29W)	19/1217	1006.3	20/0117	34	41				
Texas Coastal Ocean Observing Network (TCOON) sites									
Aransas Pass (ANPT2) (27.84N 97.04W)	19/0942	1004.8	20/0318	37 (14 m)	42	3.87	3.88	3.15	
Aransas Wildlife Refuge (AWRT2) (28.23N 96.80W)	19/0942	1006.3	20/0336	28	42	3.57	4.6	3.32	
Eagle Point (EPTT2) (29.48N 94.92W)	18/1036	1008.5	19/2218	30 (7 m)	37	3.97		3.71	
Galveston Railroad Bridge (GRRT2) (29.30N 94.90W)	18/1148	1007.8	19/2212	30 (8 m)	39	4.03	4.43	3.51	
Manchester (NCHT2) (29.73N 95.27W)						3.65	5.03	3.28	
Matagorda City (EMAT2) (28.71N 95.91W)	18/1006	1007.4	20/0024	30 (9 m)	38	3.58	4.41	3.39	
Morgan's Point (MGPT2) (29.68N 94.99W)	18/1030	1008.6	17/2254	29 (7 m)	40	3.37	4.56	3.21	
Packery Channel (PACT2) (27.63N 97.24W)	19/1142	1005.8	20/0536	34 (11 m)	42	3.28	3.82	3.03	
Port Aransas (RTAT2) (27.84N 97.07W)	19/0942	1005.9	20/0330	32 (11 m)	40	3.63	4.17	3.27	
Port Lavaca (VCAT2) (28.64N 96.61W)	18/1100	1006.7	20/1936	29	36	3.44		3.45	
Port O'Connor (PCNT2) (28.45N 96.39W)	19/0918	1006.8	20/0600	31 (9 m)	39	3.41	4.32	3.22	
Realitos Peninsula (RLIT2) (26.26N 97.29W)	19/2336	1002.8	20/0342	34	44	3.12		3.02	
Rollover Pass (RLOT2) (29.52N 94.51W)	18/1106	1008.8	19/2206	30 (11 m)	35	3.18	3.83	3.22	
San Luis Pass (LUIT2) (29.08N 95.12W)	19/1012	1008.3	19/2200	32	41	4.36	4.96	4.04	
Sargent (SGNT2) (28.77N 95.62W)						3.37	4.35	3.30	
Seadrift (SDRT2) (28.41N 96.71W)	18/1042	1006.6	20/1930	21 (10 m)	31	3.23	4.56	3.22	
SPI Brazos Santiago (BZST2) (26.07N 97.16W)	19/2342	1001.2	20/0324	36 (15 m)	43	3.44	2.74	2.5	
USS Lexington, Corpus Christi Bay (TAQT2) (27.81N 97.39W)	19/1006	1005.0				3.63	4.47	3.45	

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)				
Public/Other									
Lamar (28.14N 97.01W)									10.50
Woodsboro 4S (US1TXRF0003) (28.19N 97.31W)									7.83
NWS Cooperative Observer Program (COOP) Sites									
Robstown (ROBT2) (27.79N 97.66W)									7.42
Rockport (RPTT2) (28.02N 97.06W)									7.58
Sinton (419559) (28.11N 97.42W)									7.26
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Alice 8 W (TX-JW-19) (27.77N 98.19W)									7.31
Robstown 5 NNW (TX-NU-100) (27.87N 97.68W)									7.82
Robstown 6 ENE (TX-NU-68) (27.85N 97.57W)									6.91
Rockport 1 WNW (TX-AR-18) (28.05N 97.06W)									7.36
Rockport 3 NNW (TX-AR-6) (28.08N 97.06W)									9.05
Rockport 4 SW (TX-AR-14) (27.99N 97.09W)									6.66
Rockport 8 NNE (TX-AR-17) (28.15N 97.00W)									7.48
Woodsboro 8 SSE (TX-RF-10) (28.14N 96.26W)									7.57
Louisiana									
National Ocean Service (NOS) Sites									
New Canal Station (NWCL1) (30.03N 90.11W)			19/1806	27	33	3.3		3.2	
Shell Beach (SHBL1) (29.87N 89.67W)			19/1842	27	32	3.68		3.64	

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									
Tamaulipas									
Playa Tesoro Altamira (F9721) (22.48N 97.89W)	20/0800	996.3	18/2215	30	47				
Tampico (22.39N 97.93W)	20/0820	995.8	18/2340	18	38				
Nuevo Leon									
El Cerrito (25.30N 99.99W)									26.50

[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%)	72	168
Medium (40%-60%)	60	150
High (>60%)	48	66

Table 5. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Alberto, 19–20 June 2024. 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	41.8	**28.4**						
OCD5	81.8	61.3						
Forecasts	3	1						
OFCL (2019-23)	23.9	36.5	49.3	63.4	79.2	93.4	132.9	190.4
OCD5 (2019-23)	45.7	97.1	153.0	205.4	254.9	297.8	372.7	439.1

Table 6. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Alberto, 19–20 June 2024. 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	**3.3**	**5.0**						
OCD5	10.3	5.0						
Forecasts	3	1						
OFCL (2019-23)	5.0	7.3	8.5	9.7	10.4	10.9	12.9	15.5
OCD5 (2019-23)	6.6	10.2	13.1	15.6	17.2	18.6	21.8	22.6

Table 7. Wind watch and warning summary for Tropical Storm Alberto, 19–20 June 2024.

Date/Time (UTC)	**Action**	**Location**
17 / 2100	Tropical Storm Watch issued	Port O'Connor, TX to Boca de Catan, Mexico
18 / 0300	Tropical Storm Watch modified to	Port O'Connor, TX to Puerto de Altamira, Mexico
18 / 0900	Tropical Storm Watch changed to Tropical Storm Warning	Port O'Connor, TX to the mouth of the Rio Grande
18 / 1200	Tropical Storm Watch changed to Tropical Storm Warning	Mouth of the Rio Grande to Puerto de Altamira, Mexico
18 / 2100	Tropical Storm Warning modified to	San Luis Pass, TX to Puerto de Altamira, Mexico
19 / 1500	Tropical Storm Warning modified to	San Luis Pass, TX to Tecolutla, Mexico
20 / 0900	Tropical Storm Warning discontinued	San Luis Pass, TX to the mouth of the Rio Grande
20 / 1500	Tropical Storm Warning discontinued	All

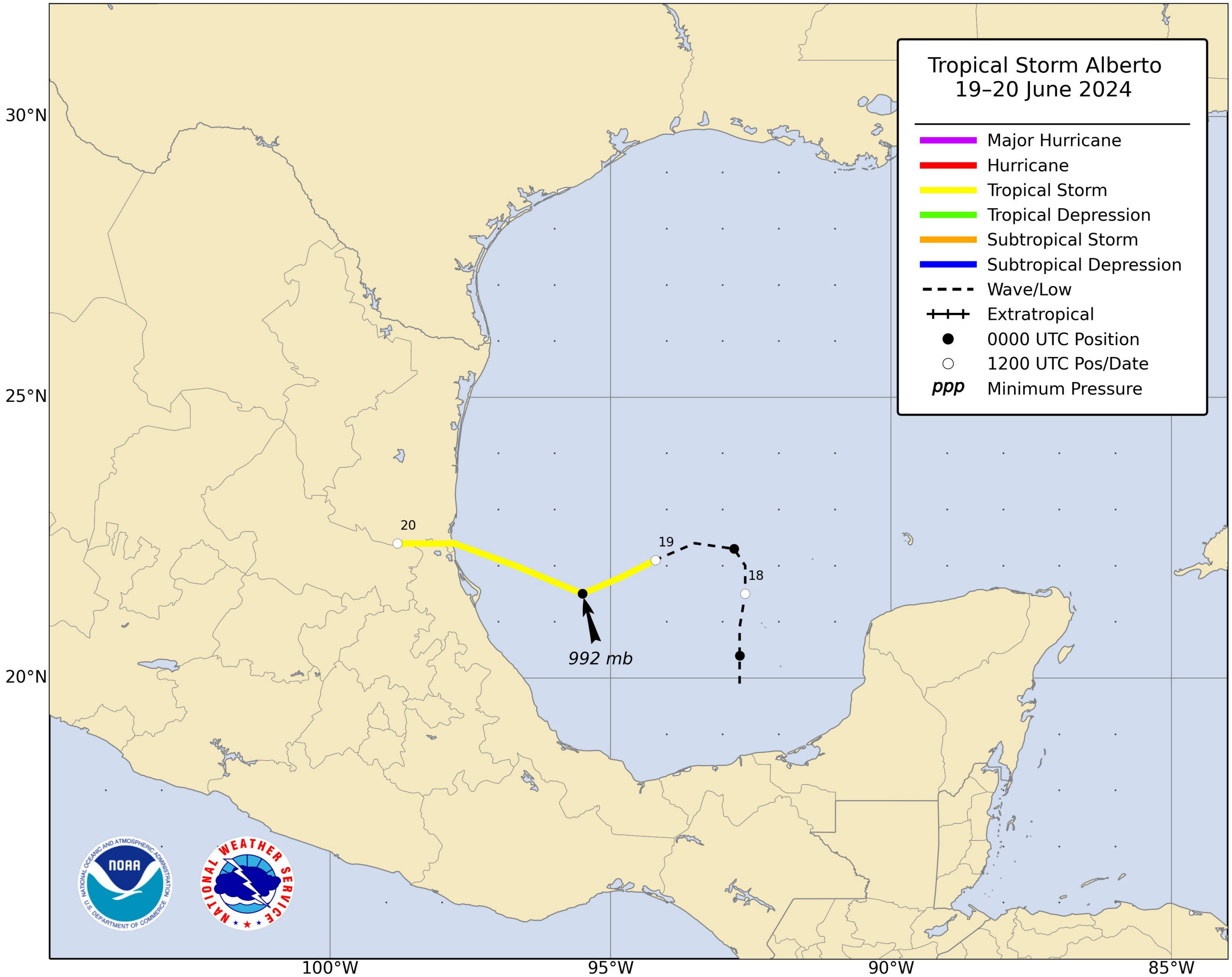

Figure 1. Best track positions for Tropical Storm Alberto, 19–20 June 2024.

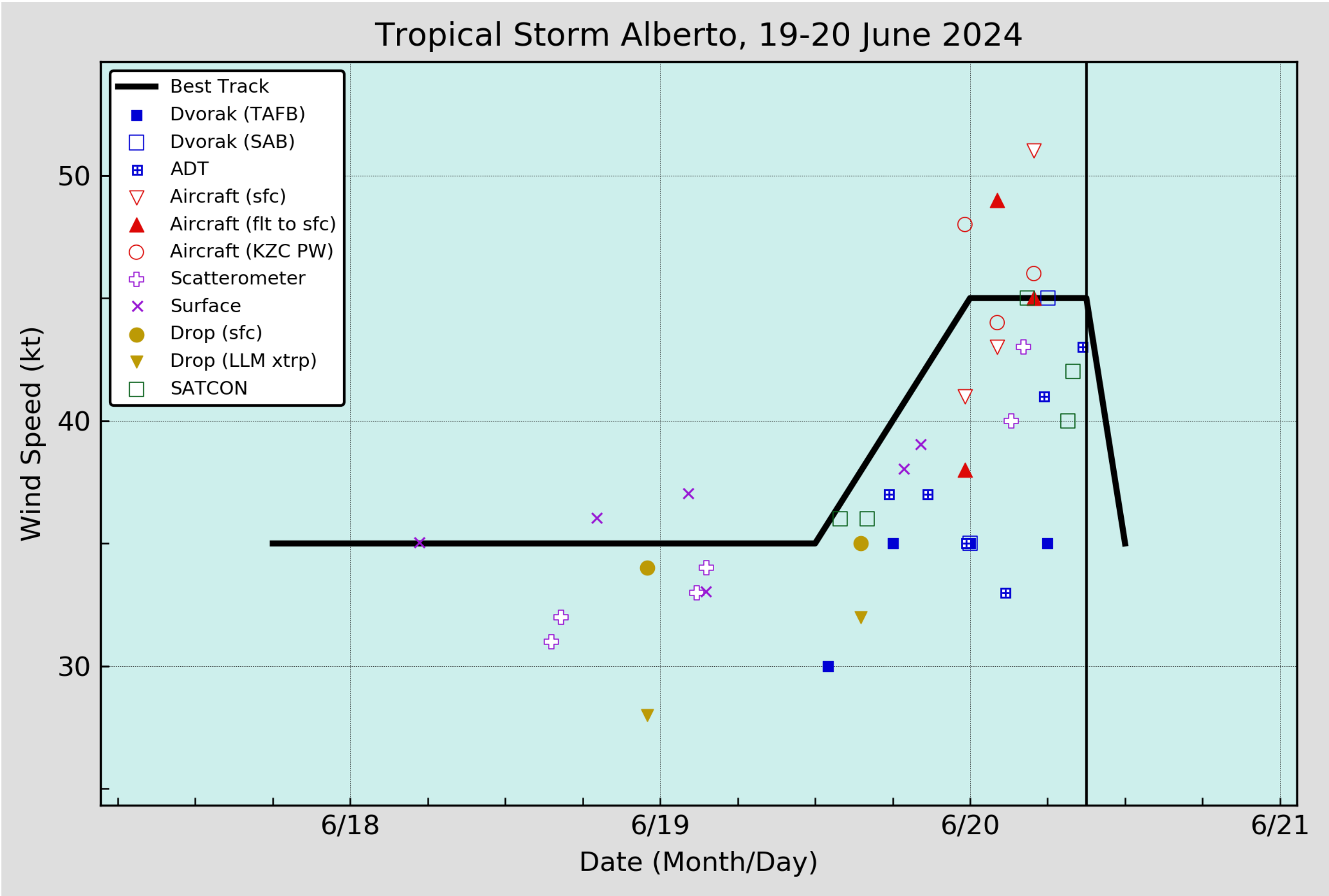

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Alberto, 19–20 June 2024. Aircraft observations have been adjusted for elevation using 90%, 80%, and 75% adjustment factors for observations from 700 mb, 850 mb, and 925 mb, respectively. 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 solid vertical lines correspond to landfalls.

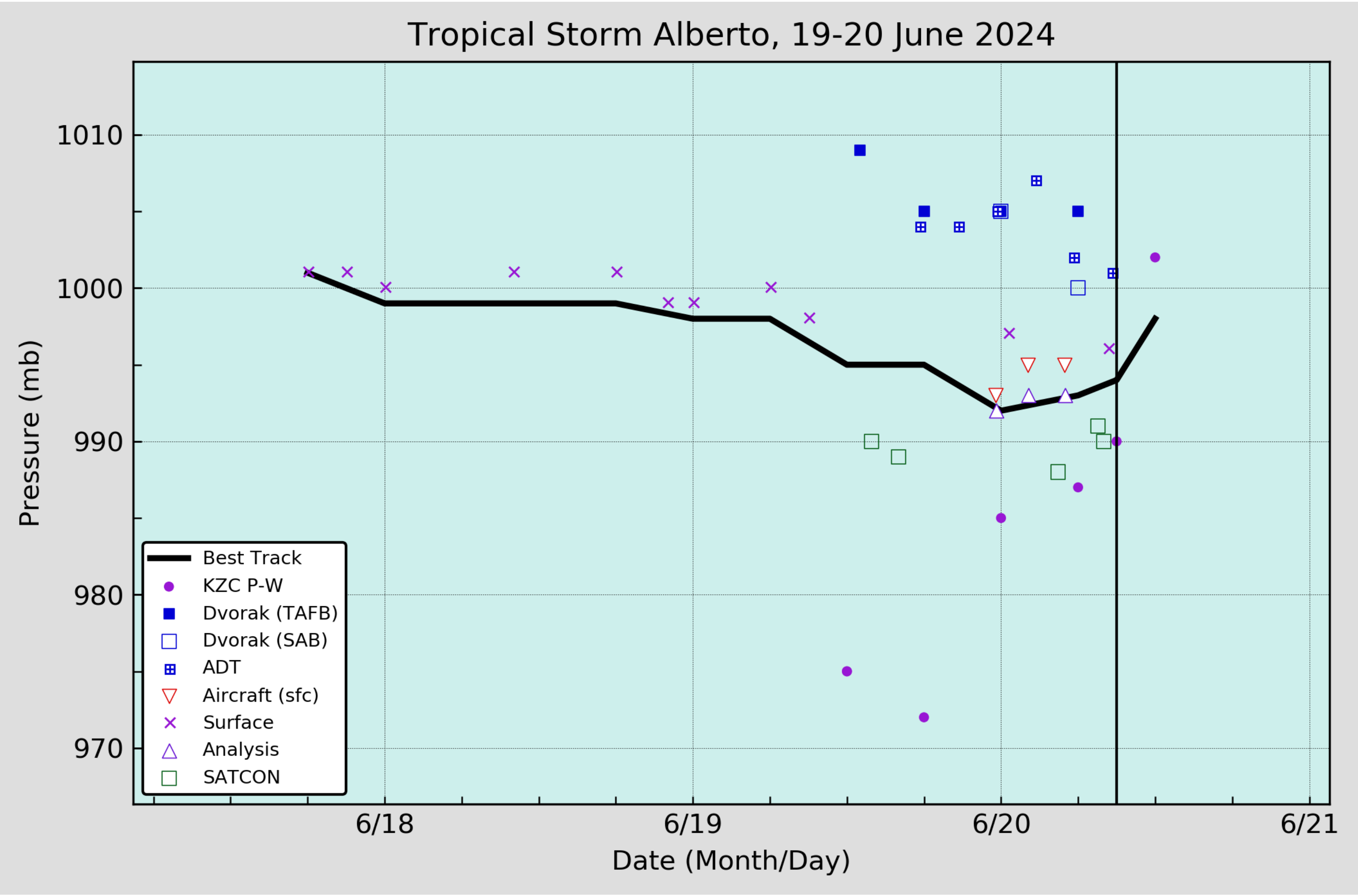

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Alberto, 19–20 June 2024. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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.

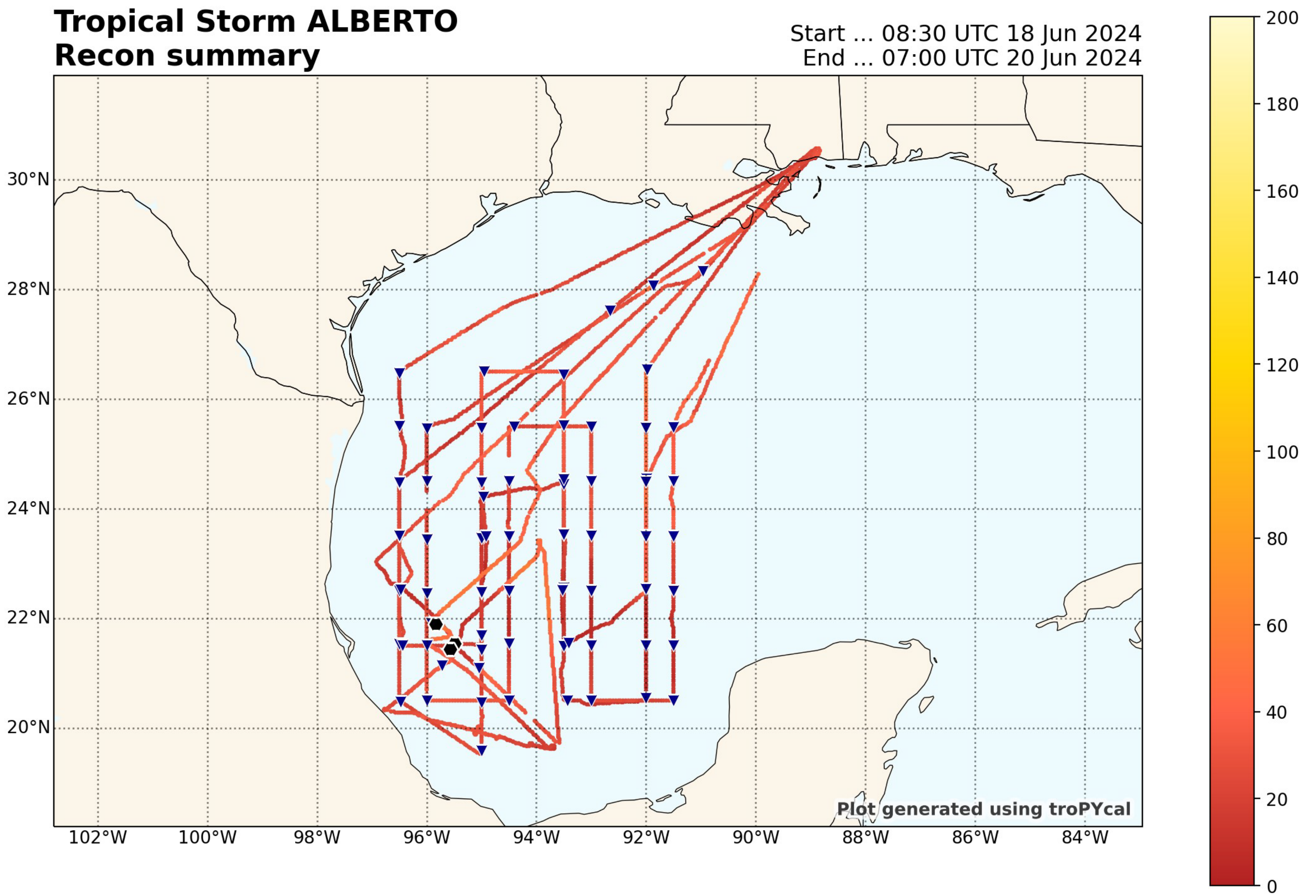

Figure 4. Air Force Reserve Hurricane Hunter aircraft flight tracks (red) from reconnaissance missions into Alberto. The black hexagonal markers denote center fixes, and the blue triangles indicate dropsonde locations. The color coding of the flight tracks is based on the observed flight-level wind speed with the color legend to the right of the map representing the color associated with the various wind speeds in knots.

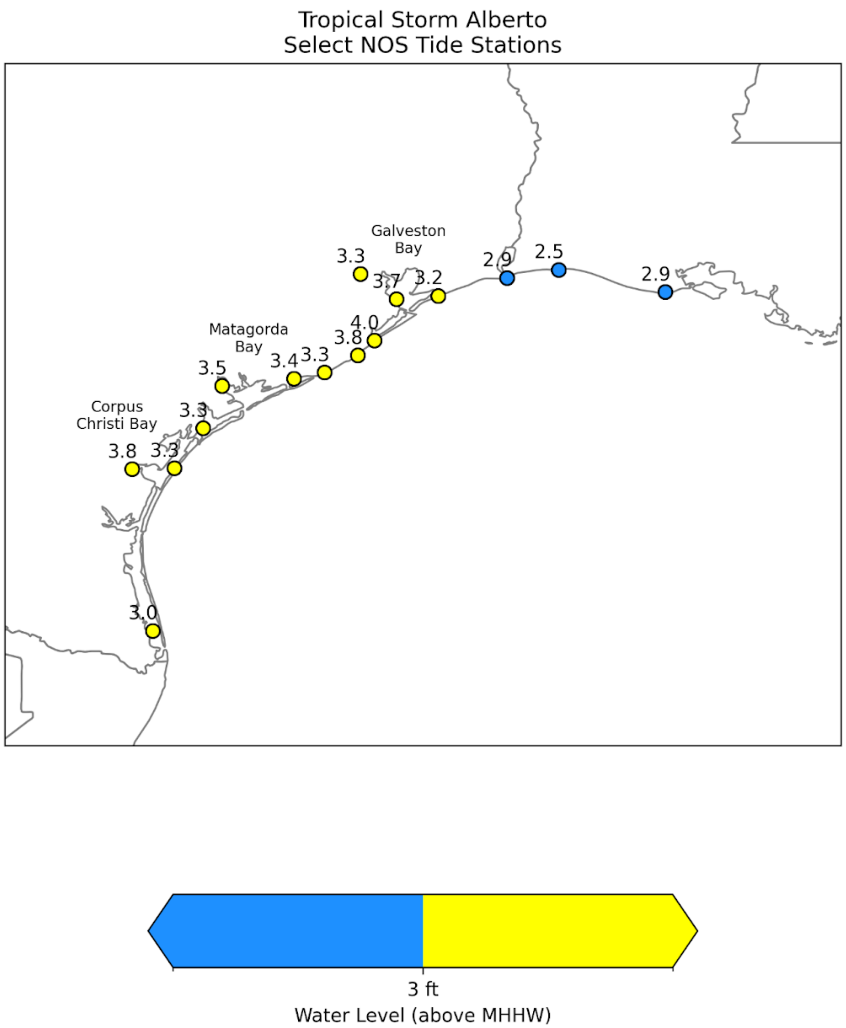

Figure 5. Maximum water levels measured during Tropical Storm Alberto from select NOS tide gauges (circles). Water levels are referenced as above Mean Higher High Water (MHHW), used as a proxy for inundation (above ground level) on normally dry ground along the immediate coastline.

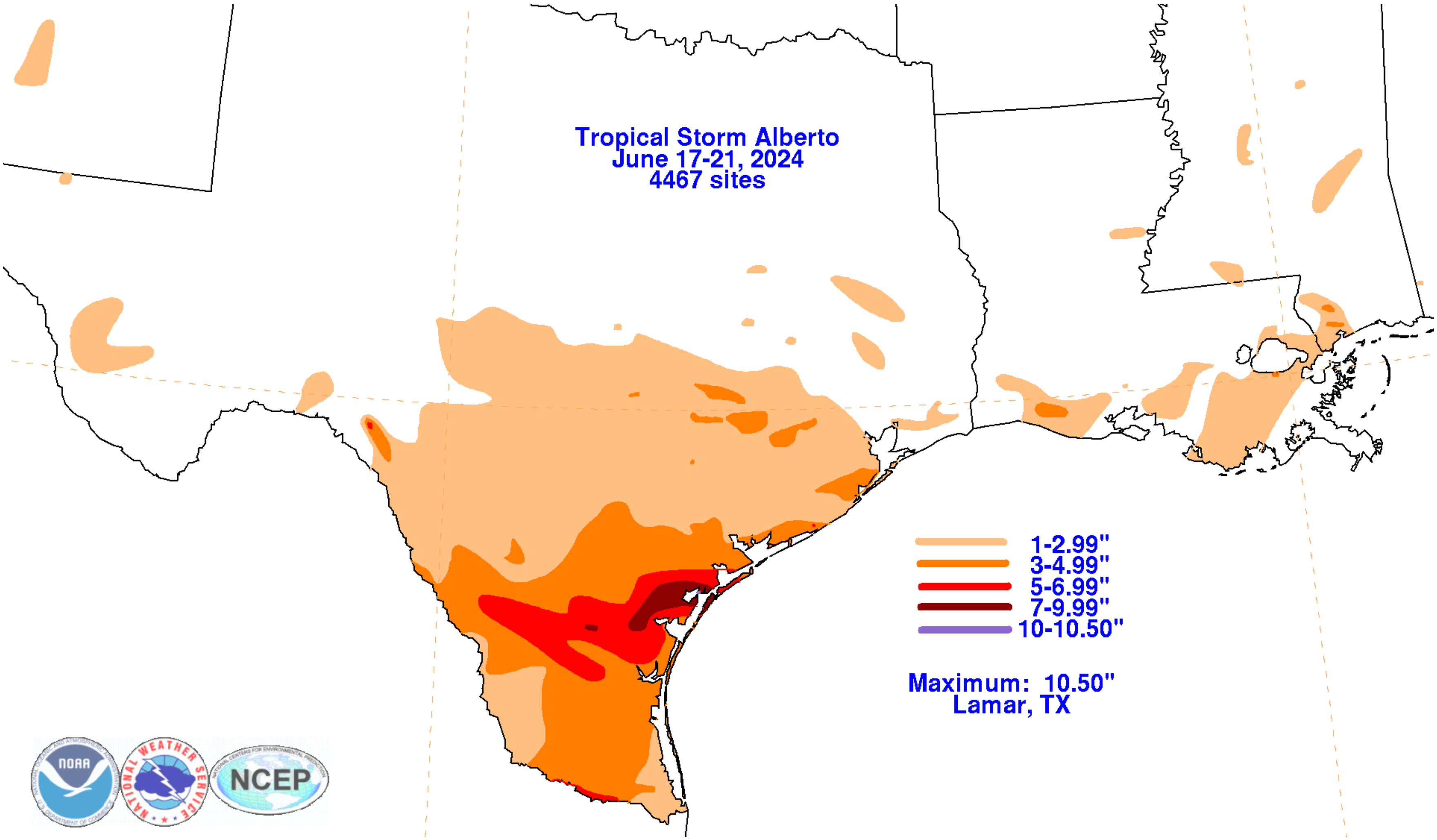

Figure 6. Total rainfall (inches) from Tropical Storm Alberto across the southern U.S. Image courtesy of David Roth from NOAA's Weather Prediction Center.

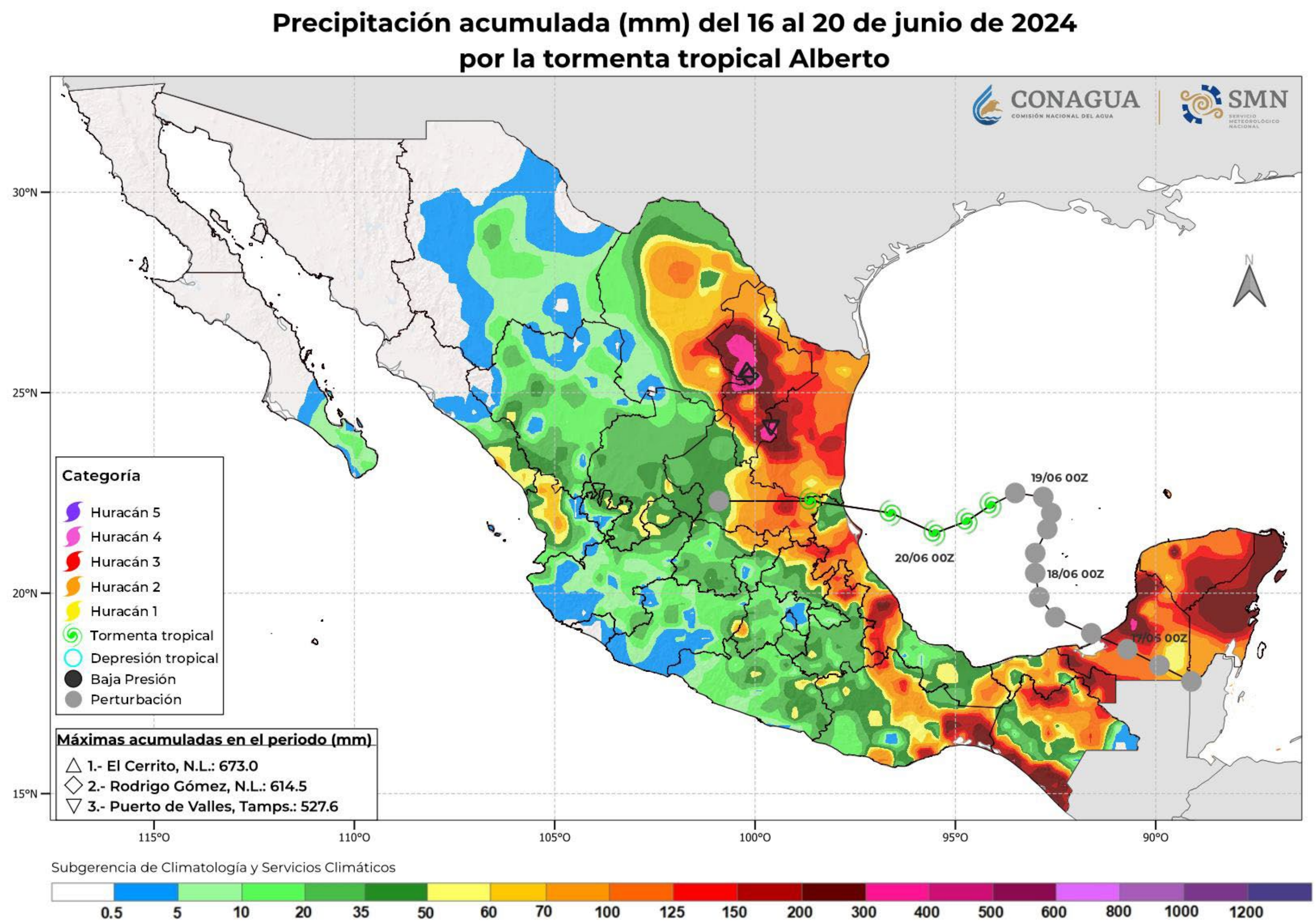

Figure 7. Rainfall accumulations (mm) in Mexico from 16-20 June, including the effects of Tropical Storm Alberto. Not all of the rainfall shown is directly due to Alberto. Alberto's track is based on operational location and intensity estimates. Image courtesy of CONAGUA, the national meteorological service of Mexico.

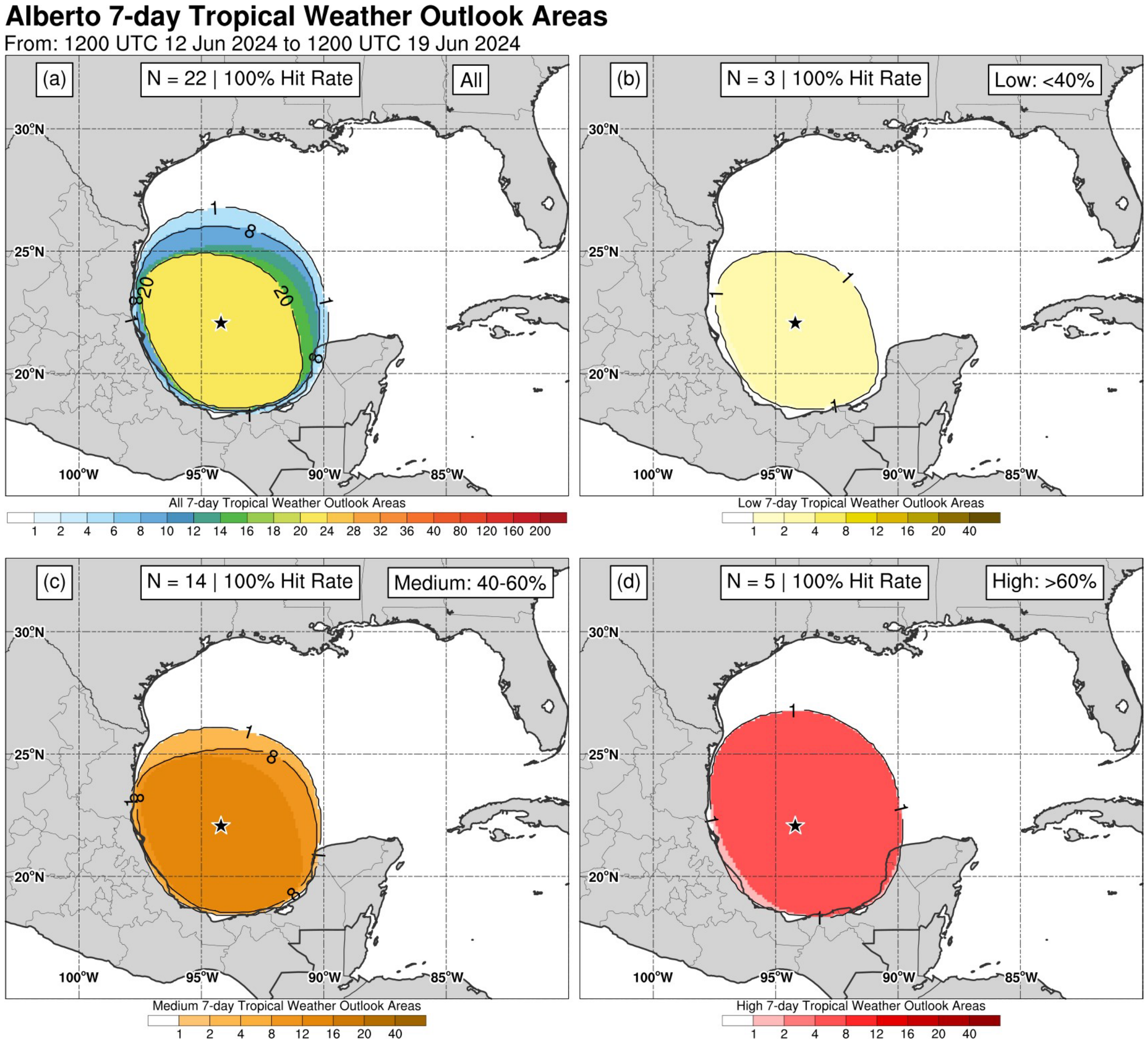

Figure 8. Composites of 7-day tropical cyclone genesis areas depicted in NHC's Tropical Weather Outlooks prior to the formation of Tropical Storm Alberto for (a) all probabilistic genesis categories, (b) the low (<40%) category, (c) medium (40–60%) category, and (d) high (>60%) category. The location of genesis is indicated by the black star.