Tropical Cyclone Report
Tropical Storm Norman
(EP142012)
28-29 September 2012

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Norman was a short-lived tropical storm that made landfall as a tropical depression near Topolobampo, Mexico.

a. Synoptic History

The tropical wave that played a role in the development of Norman moved off the west coast of Africa late on 12 September. After moving westward across the Atlantic basin with minimal shower activity, the system emerged over the eastern Pacific Ocean on 22 September, where deep convection gradually increased near the wave axis during the next few days. On 25 September, a large area of thunderstorms developed along the northern portion of the wave, likely due to its interaction with the Intertropical Convergence Zone, when the wave was located just to the southwest of Acapulco, Mexico. The northern part of the wave fractured the next day, and it then moved northwestward near the southwestern coast of Mexico. The disturbance was producing organized deep convection and winds of tropical storm force on 27 September, but scatterometer data indicated that there was no well-defined center at that time. A well-defined center became apparent early on 28 September, marking the formation of a tropical storm by 0600 UTC that day, about 100 n mi southeast of Cabo San Lucas. The "best track" chart of Norman'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].

After genesis, Norman moved northward toward the Gulf of California between a mid-to upper-level low to its west and a mid-level ridge over the Gulf of Mexico. The storm turned northwestward and weakened slowly over the Gulf of California during the next 12 to 24 h, due to southwesterly wind shear and its interaction with land. Norman became a tropical depression just before it made landfall over mainland Mexico near Topolobampo around 0500 UTC 29 September. After landfall, the shallow cyclone turned west-northwestward back over the Gulf of California, and it degenerated to a remnant low by 1200 UTC that day. The remnant low moved slowly west-southwestward and dissipated over the Baja California peninsula near Loreto shortly after 0600 UTC 30 September.

[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.

b. Meteorological Statistics

Observations in Norman (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), and objective Advanced Dvorak Technique (ADT) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Tropical Rainfall Measuring Mission (TRMM), 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 Norman.

The analyzed peak intensity of Norman at 0600 and 1200 UTC 28 September is based on elevated wind reports of 48 kt from the *Carnival Splendor* cruise ship (3EUS) at 1200 UTC 28 September, and 54 kt from the *Celebrity Infiniti* cruise ship (9HJD9) at 0400 UTC 28 September. Applying an adjustment to those elevated wind observations yields an intensity estimate of 45 kt. The Carnival Splendor also reported a minimum pressure of 995 mb, but this report appears to be too low based on surrounding data.

There were no reports of sustained tropical-storm-force winds on land; however, a 32-kt sustained wind was measured at Isla Maria Madre at 0830 UTC 28 September.

A complete list of ship reports of winds of tropical storm force associated with Norman are given in Table 2.

c. Casualty and Damage Statistics

Flooding was reported in the Mexican states of Colima, Jalisco, Nayarit, Sinaloa, Baja California Sur, Durango and Zacateca. Many roads were impassible in the city of La Paz. No monetary damage estimates are available, and there were no casualties reported in association with Norman.

d. Forecast and Warning Critique

The genesis of Norman was well predicted. The disturbance from which Norman developed was introduced in the Tropical Weather Outlook and given a "low" (< 30%) chance of genesis over the next 48 h at 1800 UTC 25 September, 2.5 days before it became a tropical storm. The probability of formation was increased to the "medium" (30 to 50%) category 42 h before genesis and the "high" (>50%) category 18 h before formation.

A verification of the track and intensity forecasts for Norman is not provided, since the sample is too small to be considered meaningful (there were only two 12 h forecasts and none at longer lead times).

The government of Mexico issued a tropical storm warning for mainland Mexico from La Cruz to Huatabampo at 1500 UTC 28 September. This warning was discontinued at 0000 UTC 29 August.

Table 1. Best track for Tropical Storm Norman, 28-29 September 2012.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
28 / 0600	21.5	108.7	997	45	tropical storm
28 / 1200	22.7	108.6	997	45	"
28 / 1800	23.9	108.6	999	40	"
29 / 0000	24.9	108.9	1001	35	"
29 / 0500	25.7	109.3	1003	30	tropical depression
29 / 0600	25.8	109.4	1003	30	"
29 / 1200	26.1	110.2	1005	25	low
29 / 1800	25.9	110.8	1007	25	"
30 / 0000	25.7	111.3	1008	20	"
30 / 0600	25.5	111.7	1009	20	"
30 / 1200					dissipated
29 / 0500	25.7	109.3	1003	30	landfall near Topolobampo, Mexico
28 / 0600	21.5	108.7	997	45	maximum wind and minimum pressure

Table 2. Selected ship observations with winds of at least 34 kt for Tropical Storm Norman, 28-29 September 2012.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
28 / 0300	DIBZ	20.5	106.9	160 / 36	1006.0
28 / 0400	3EUS	21.0	106.6	140 / 40	1008.0
28 / 0500	9HJD9	22.1	108.4	050 / 54	1007.0
28 / 1200	3EUS	22.4	109.2	010 / 48	995.0

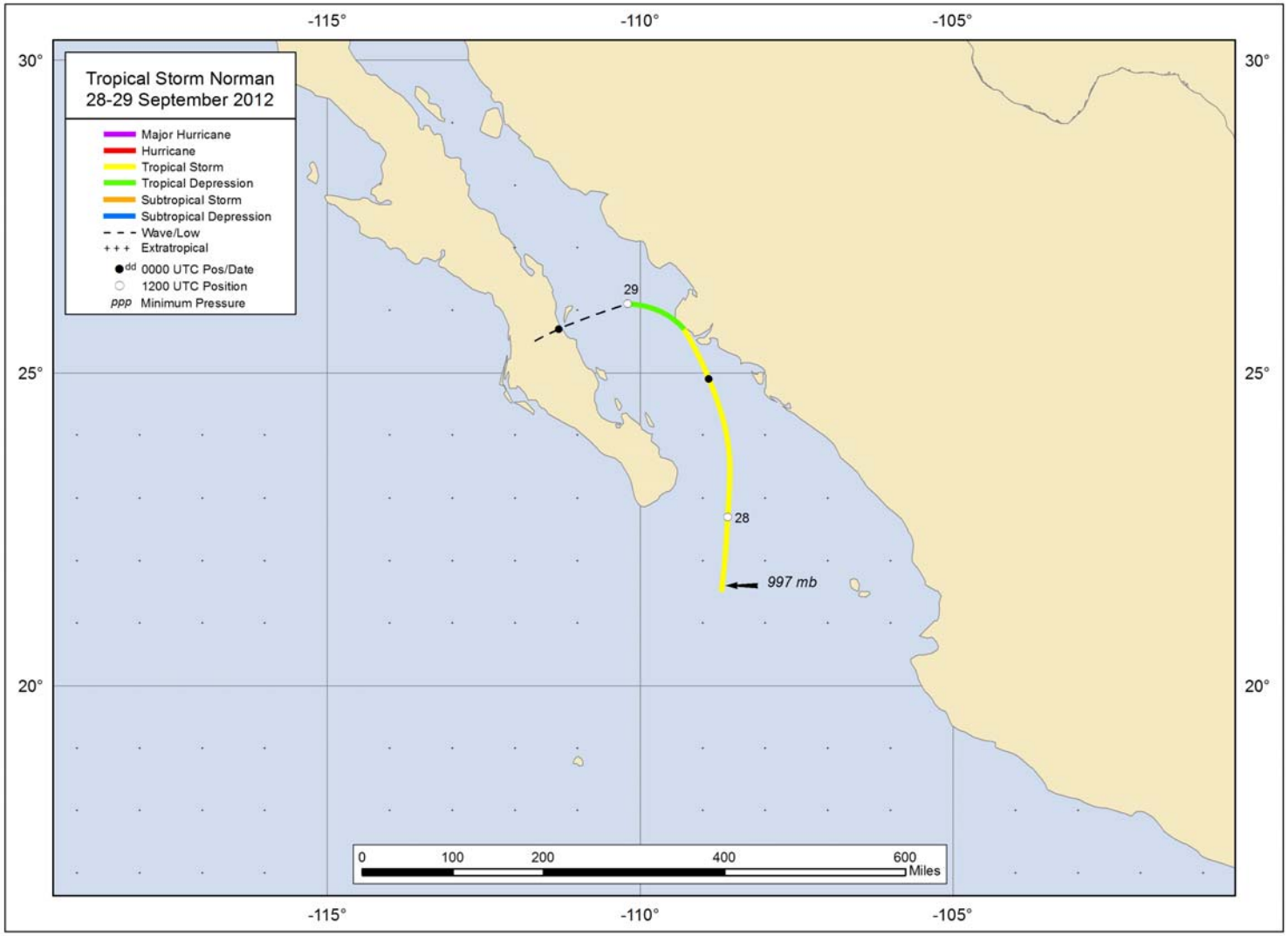

Figure 1. Best track positions for Tropical Storm Norman, 28-29 September 2012.

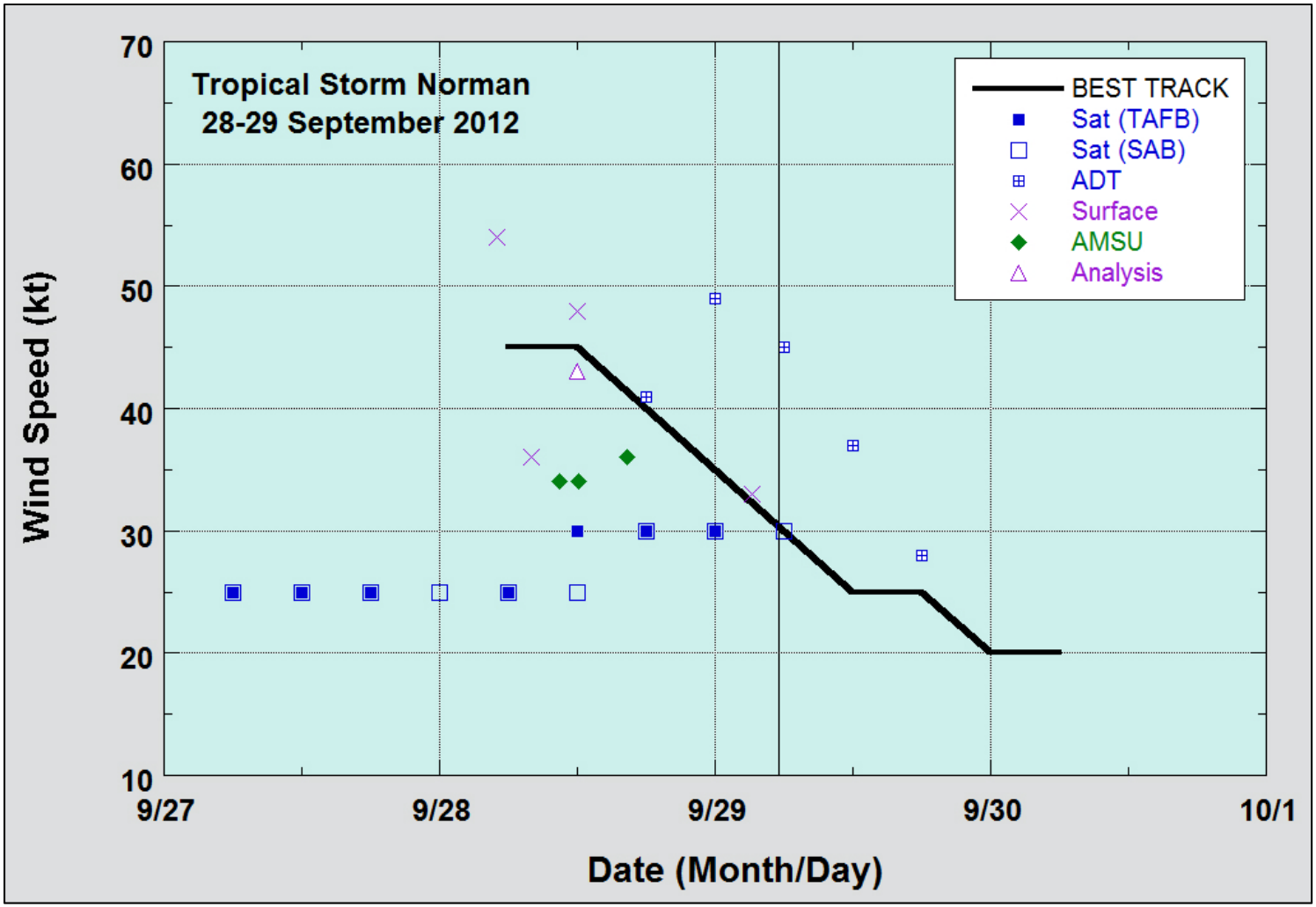

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Norman, 28-29 September 2012. Advanced Dvorak Technique estimates represent CI numbers. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC. The solid vertical line corresponds to the landfall time.

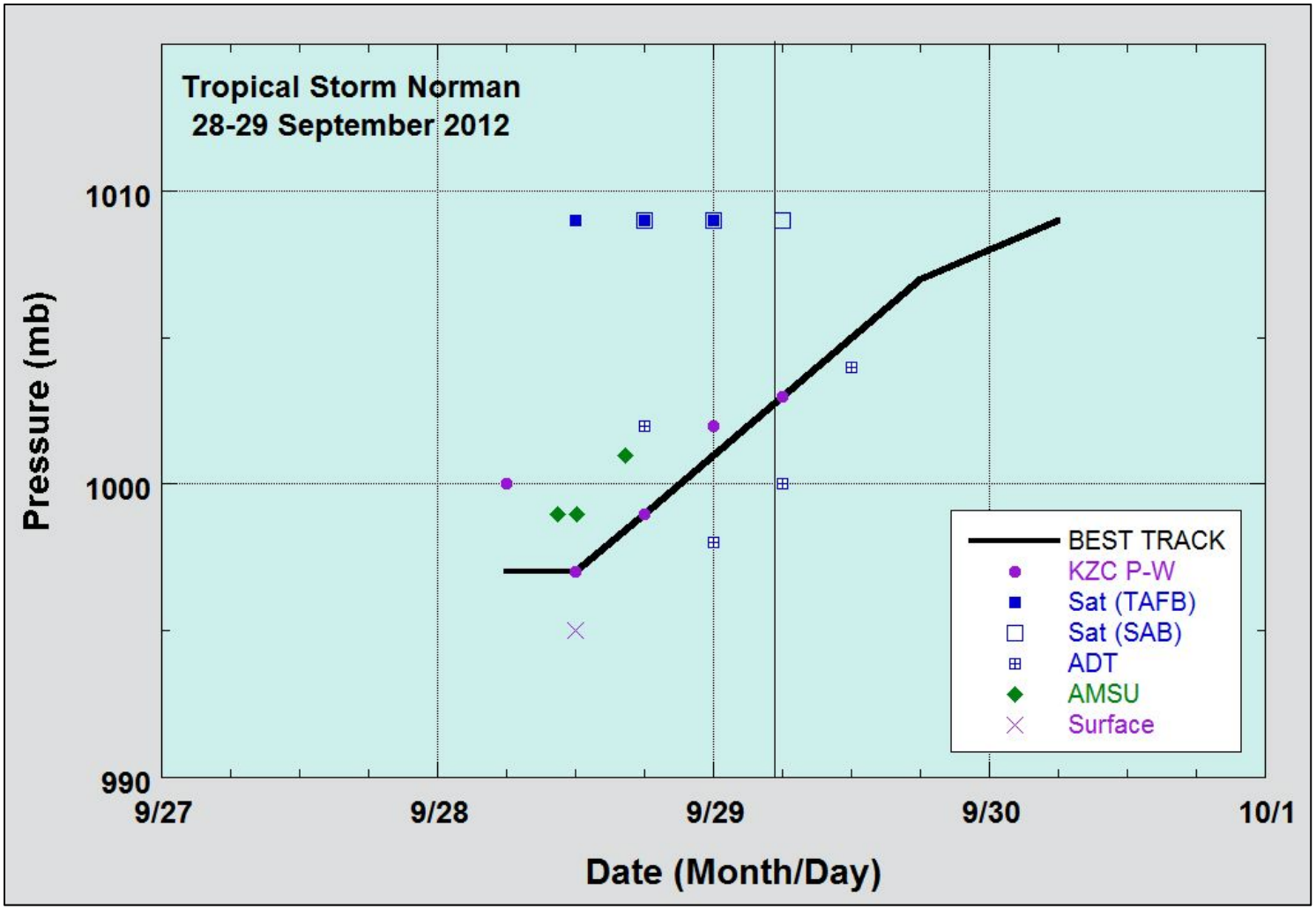

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Norman, 28-29 September 2012. Advanced Dvorak Technique estimates represent CI numbers. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. The KZC P-W values are obtained by applying the Knaff-Zehr-Courtney pressure-wind relationship to the best track wind data. Dashed vertical lines correspond to 0000 UTC. The solid vertical line corresponds to the landfall time.