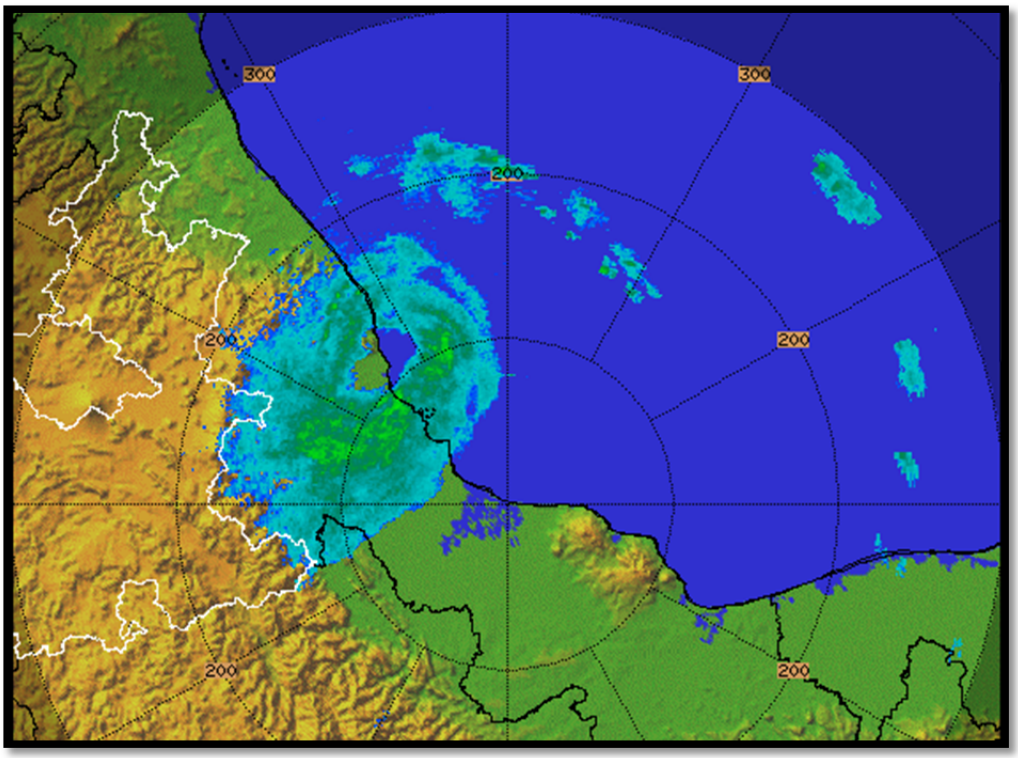
NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM FERNAND

(AL062013)

25 – 26 August 2013

Robbie Berg
National Hurricane Center
10 October 2013



ALVARADO MEXICO RADAR IMAGE OF TROPICAL STORM FERNAND AT 0445 UTC 26 AUGUST NEAR LANDFALL ALONG THE COAST OF MEXICO. IMAGE COURTESY OF THE NATIONAL METEOROLOGICAL SERVICE OF MEXICO.

Fernand was a short-lived tropical storm that formed in the southern Bay of Campeche and made landfall just to the north-northwest of Veracruz, Mexico. Heavy rainfall due to Fernand caused flash flooding and landslides that took the lives of 14 people.

Tropical Storm Fernand

25 – 26 AUGUST 2013

SYNOPTIC HISTORY

Two tropical waves appear to have had a role in Fernand's formation (Fig. 1). The first moved off the west coast of Africa early on 10 August and moved westward at about 15 kt until it reached the central tropical Atlantic on 14 August. The second moved off the coast of Africa on 13 August and spawned Tropical Storm Erin over the far eastern Atlantic. The waves became difficult to track for a few days due to a separation of their vorticity and associated moisture, but a single disturbance ultimately emerged just east of the Lesser Antilles and amplified over the eastern Caribbean Sea on 19 and 20 August. The system continued moving westward over the Caribbean Sea and reached the Yucatan Peninsula early on 24 August.

The circulation of the system became better defined while it moved westward across the Yucatan Peninsula and southeastern Mexico. Once it reached the Bay of Campeche early on 25 August, the system quickly became organized, and it is estimated that a tropical depression formed around 1200 UTC 25 August about 35 n mi north-northeast of Coatzacoalcos, Mexico. The depression intensified to a tropical storm within the next few hours and had 45-kt winds by 1800 UTC while centered about 60 n mi east-southeast of Veracruz, Mexico. Strengthening continued while Fernand moved west-northwestward toward the coast, and the cyclone made landfall with 50-kt winds at 0445 UTC 26 August near Zempoala, Mexico, about 25 n mi north-northwest of Veracruz. Fernand weakend to a tropical depression while it moved farther inland over mountainous terrain, and the center dissipated just after 1800 UTC that day near Tulancingo, Mexico. The "best track" chart of Fernand'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].

METEOROLOGICAL STATISTICS

Observations in Fernand (Figs. 3 and 4) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB). Observations also include flight-level and stepped frequency microwave radiometer (SFMR) observations from one flight of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command. 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

[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.

Scatterometer (ASCAT), Defense Meteorological Satellite Program (DMSP) satellites, and Alvarado, Mexico radar data from the National Meteorological Service of Mexico were also useful in constructing the best track of Fernand.

Selected surface observations from land stations and data buoys are given in Table 2. There were no ship reports of winds of tropical storm force associated with Fernand.

Winds and Pressure

Fernand's estimated maximum intensity of 50 kt at landfall along the coast of Mexico is based on SFMR data from the Air Force Reserve reconnaissance mission, ASCAT data, and surface observations near the coast. The maximum flight-level (1500 ft.) wind reported by the mission was 52 kt, which would be consistent with an intensity of 40-45 kt. Peak SFMR winds between 54 kt and 60 kt were measured on three separate aircraft passes through Fernand's center (Fig. 3), and these values adjust to between 48 kt and 52 kt after accounting for heavy rain. An ASCAT pass from 0308 UTC 26 August just before landfall showed winds as high as 47 kt. Also, the highest surface wind reported was 45 kt from a sensor on Sacrifice Island near Veracruz at 2340 UTC 25 August, which was on the southwestern side of the circulation. A 63-kt wind gust was measured at Veracruz Harbor at 0020 UTC 26 August, suggesting that hurricane-force gusts likely occurred along portions of the coast.

Rainfall and Flooding

Fernand generally produced storm total rainfall amounts of 5-9 inches over the states of Veracruz, San Luis Potosí, and Hidalgo, especially on the eastern slopes of the Sierra Madre Orientals. The highest rainfall total reported during the two-day period when Fernand was a tropical cyclone was 8.55 inches in the city of Veracruz. Rainfall totals of 8.46 inches and 7.36 inches were reported at Sierra Gorda and Temamatla, respectively, in San Luis Potosí, and the highest total reported in Hidalgo was 5.45 inches at Tulancingo. Additional rain likely fell in some of these areas due to lingering moisture after Fernand dissipated 26 August.

CASUALTY AND DAMAGE STATISTICS

Veracruz Governor Javier Duarte de Ochoa reported that 13 people died in landslides in the state due to the heavy rain caused by Fernand: nine in Yecualta, three in Tuxpan, and one in Atzalán[2]. Another man drowned in floodwaters in Oaxaca. News reports indicated that damage occurred in 19 municipalities, and flooding occurred along six rivers and streams in the region. One hundred houses were damaged in mudslides, and over 100,000 homes lost power

[2] 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.

during the storm. In Oaxaca, officials said that 10% of highways and major roads in the state were damaged.

No monetary damage estimates are available from Mexico at this time.

FORECAST AND WARNING CRITIQUE

The genesis of Fernand was not forecast with much lead time. The disturbance that became Fernand was first introduced in the Tropical Weather Outlook at 0000 UTC 24 August and given a low (< 30%) chance of genesis during the next 48 h, which was 36 h before it became a tropical depression. The chance of formation was increased to medium (30-50%) 18 h before genesis, and high (> 50%) only 6 h before genesis. Numerical models did not show much development in the days before genesis, perhaps because Fernand was a small system.

A verification of NHC official track and intensity forecasts for Fernand is not provided since the sample of forecasts (two forecasts at 12 h) is too small to be considered meaningful.

Watches and warnings associated with Fernand are given in Table 3.

Table 1. Best track for Tropical Storm Fernand, 25-26 August 2013.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
25 / 1200	18.7	94.2	1006	30	tropical depression
25 / 1800	18.9	95.1	1004	45	tropical storm
26 / 0000	19.2	95.9	1001	50	"
26 / 0600	19.7	96.6	1002	45	"
26 / 1200	20.1	97.3	1005	30	tropical depression
26 / 1800	20.5	98.2	1009	25	low
27 / 0000					dissipated
26 / 0000	19.2	95.9	1001	50	minimum pressure and maximum sustained winds
26 / 0445	19.5	96.3	1001	50	landfall near Zempoala, Mexico (25 n mi NNW of Veracruz)

Table 2. Selected surface observations for Tropical Storm Fernand, 25-26 August 2013.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)[c]
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Mexico						
Veracruz						
Veracruz Airport (MMVR) (19.15N 96.19W)	26/0245	1003.6	26/0006	30	40	1.60
Veracruz Harbor (VERV4) (19.20N 96.11W)	26/0200	1002.4	26/0020	42 (9 m / 10 min)	63	
Sacrifice Island (SACV4) (19.17N 96.09W)	26/0200	1002.7	25/2340	45 (9 m / 10 min)	60	
La Mancha Beach (LMBV4) (19.59N 96.38W)	26/0500	1006.8	26/0520	40 (9 m / 10 min)	53	
Veracruz (19.14N 96.11W)	26/0200	1002.2				8.55
Coatzacoalcos (18.14N 94.51W)	25/2200	1007.0				
Alvarado (18.72N 95.63W)			25/1800		40	1.83
El Salado (19.04N 95.97W)	25/2300	1003.7	26/0100		38	
Los Hules (21.19N 98.29W)						3.70
Citlaltepec (21.33N 97.88W)						3.68
Xalapa (19.51N 96.90W)						3.13
San Luis Potosí						
Sierra Gorda (21.50N 99.17W)						8.46
Temamatla (21.23N 98.76W)						7.36
Tierra Blanca (21.24N 98.86W)						5.06
Gallinas (21.91N 99.25W)						4.87
Requetemu (21.42N 98.89W)						4.69
Hidalgo						
Tulancingo (20.08N 98.36W)						5.45
National Ocean Service (NOS) Sites						
Bay of Campeche (42055) (22.20N 94.00W)	26/0750	1012.6	26/0946	29 (5 m / 1 min)	37	

[a] Date/time is for sustained wind when both sustained and gust are listed.
[b] Anemometer elevation and averaging time period provided, if non-standard and known.
[c] Rainfall totals include rain measured between 25 and 26 August.

Table 3. Watch and warning summary for Mexico from Tropical Storm Fernand, 25-26 August 2013.

Date/Time (UTC)	Action	Location
25/2100	Tropical Storm Warning issued	Veracruz to Tampico
26/0300	Tropical Storm Warning modified to	Veracruz to Barra de Nautla
26/1500	Tropical Storm Warning discontinued	All

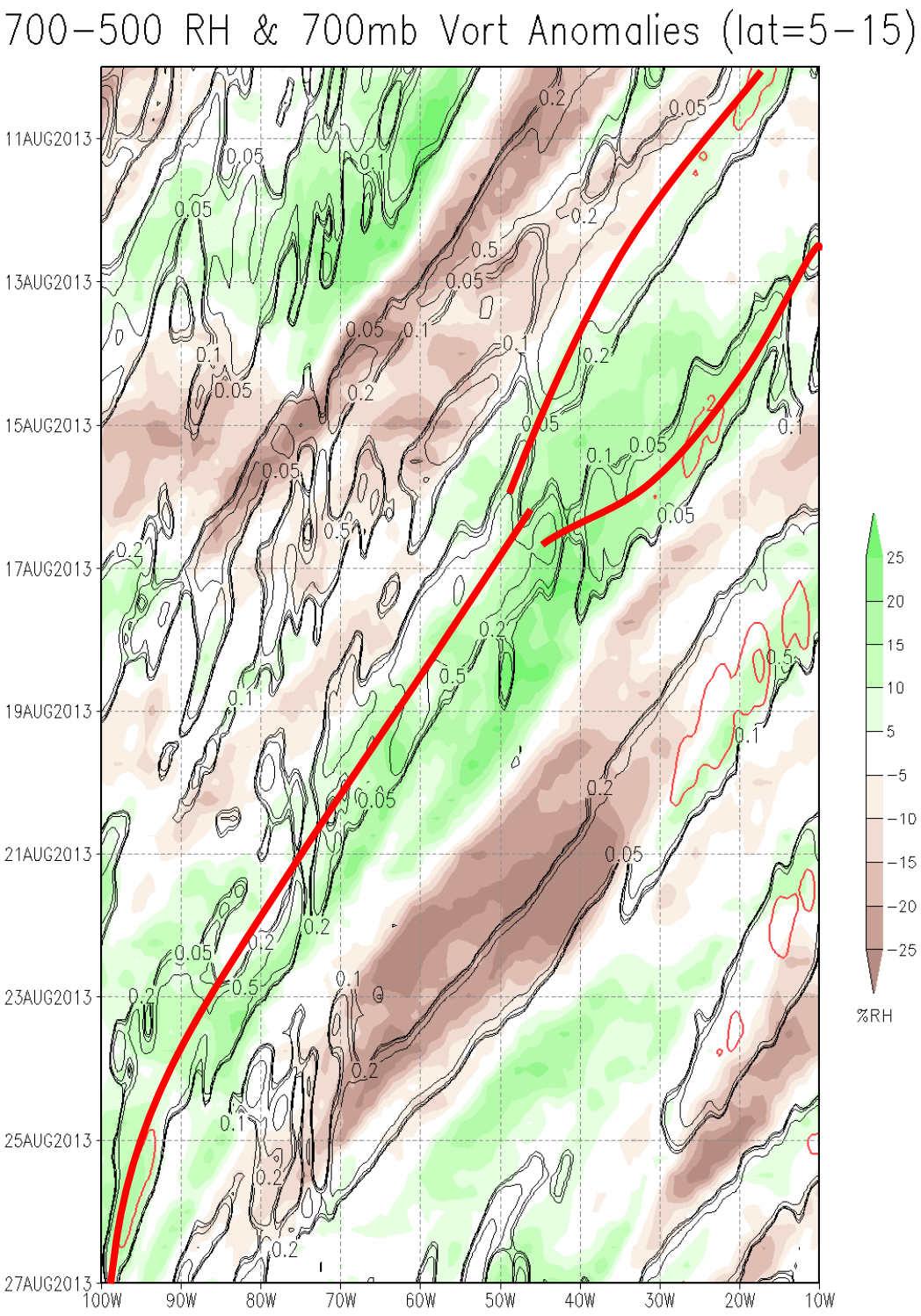


Figure 1. Hovmöller diagram of 700-500 mb relative humidity (shaded) and 700-mb relative vorticity anomalies (contours) based on GFS analyses, averaged between 5°N and 15°N from 10 August through 27 August 2013. The solid red lines denote the tropical waves that contributed to the formation of Fernand.

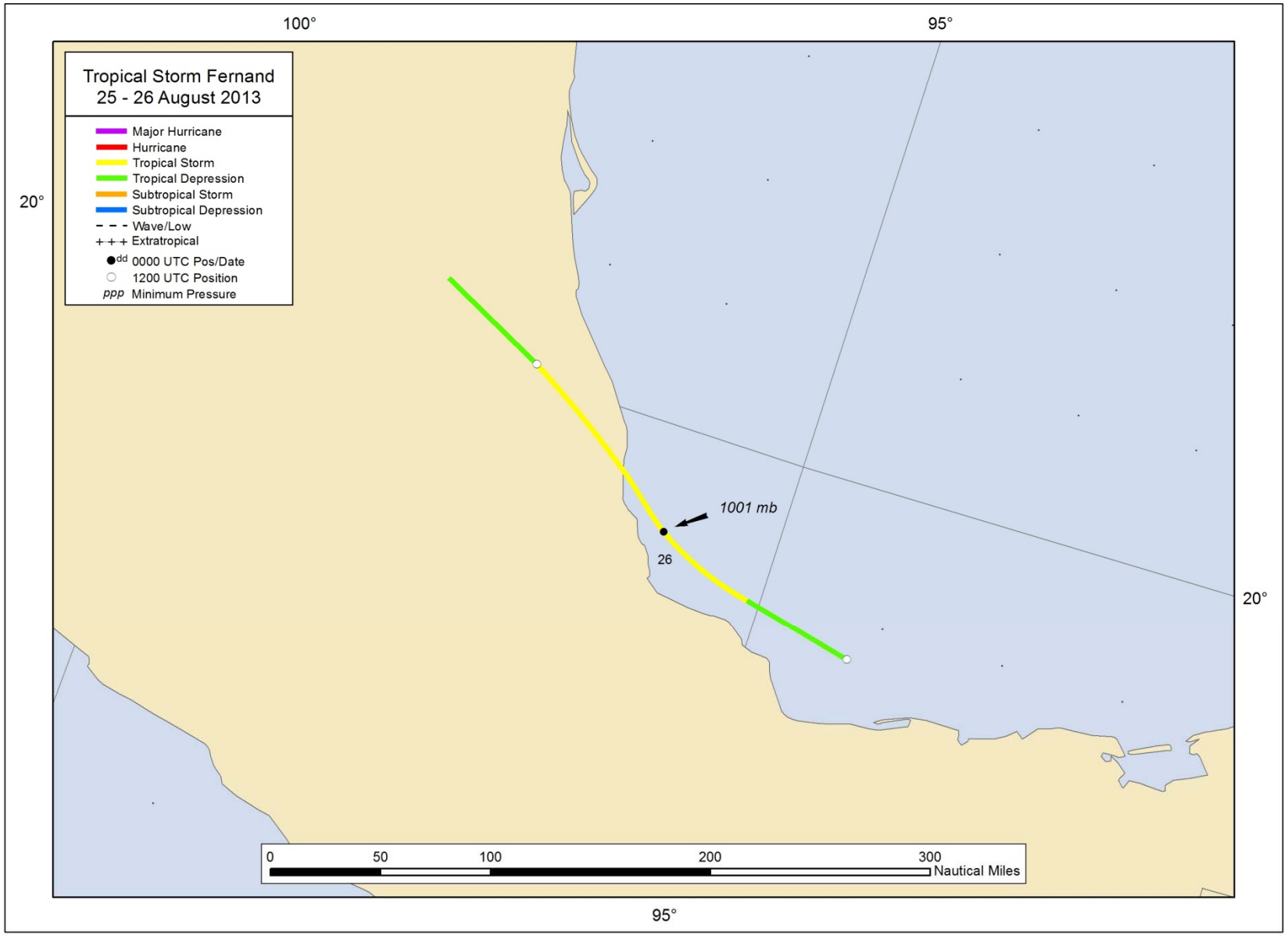


Figure 2. Best track positions for Tropical Storm Fernand, 25-26 August 2013.

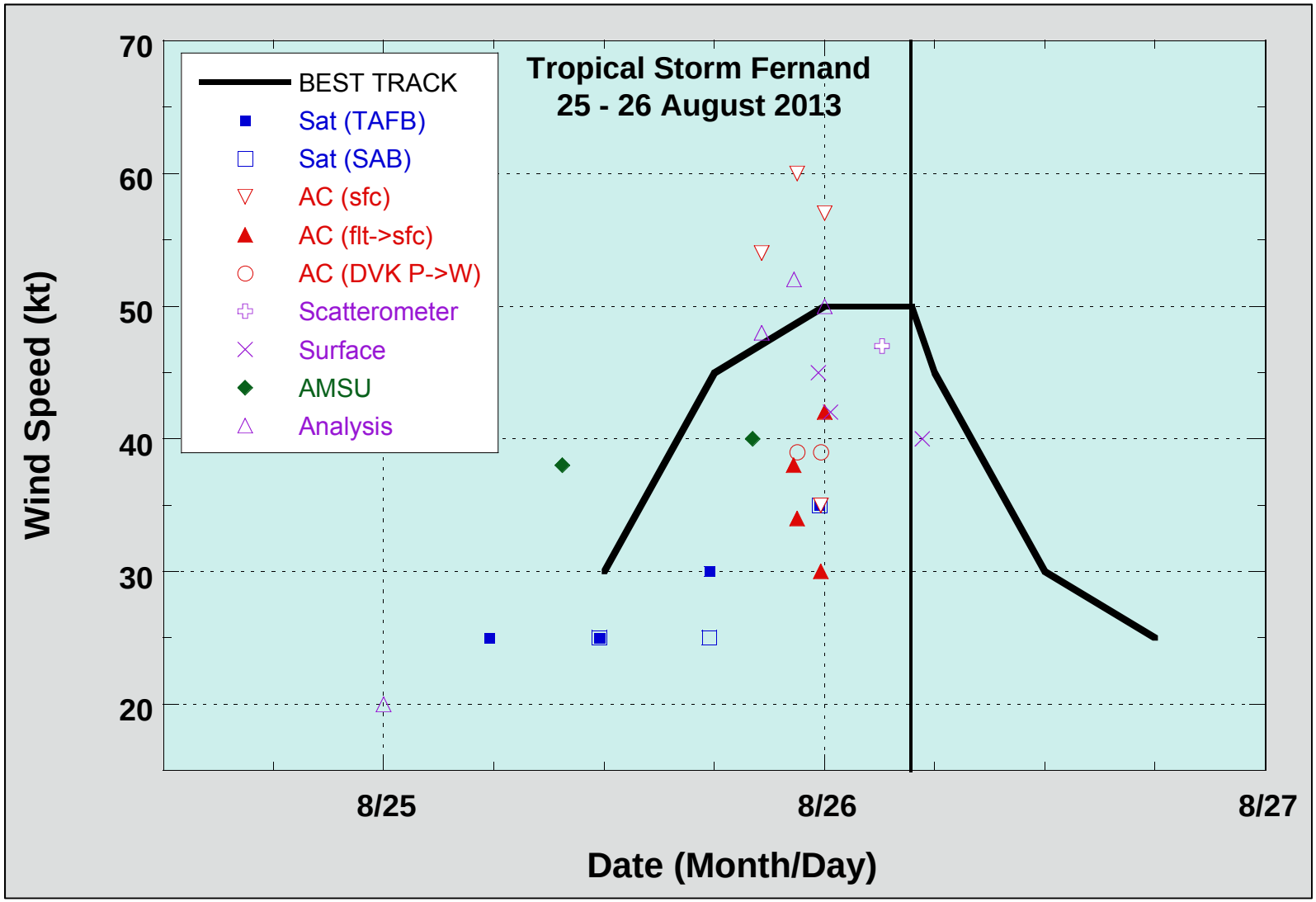


Figure 3. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Fernand, 25-26 August 2013. Aircraft observations have been adjusted for elevation using an 80% adjustment factor for observations from 1500 ft. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC, and the solid vertical line corresponds to landfall in Mexico.

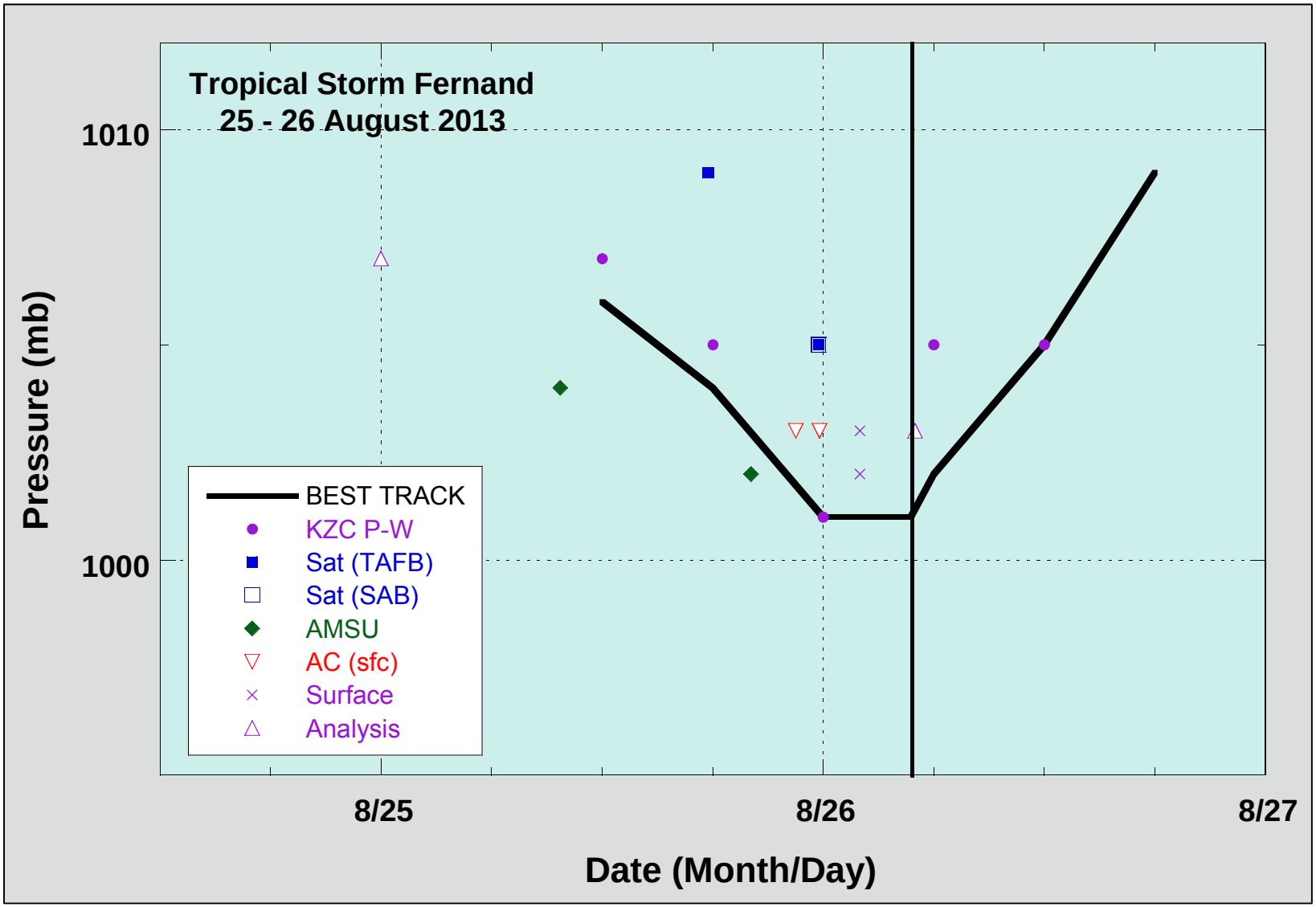


Figure 4. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Fernand, 25-26 August 2013. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC, and the solid vertical line corresponds to landfall in Mexico.