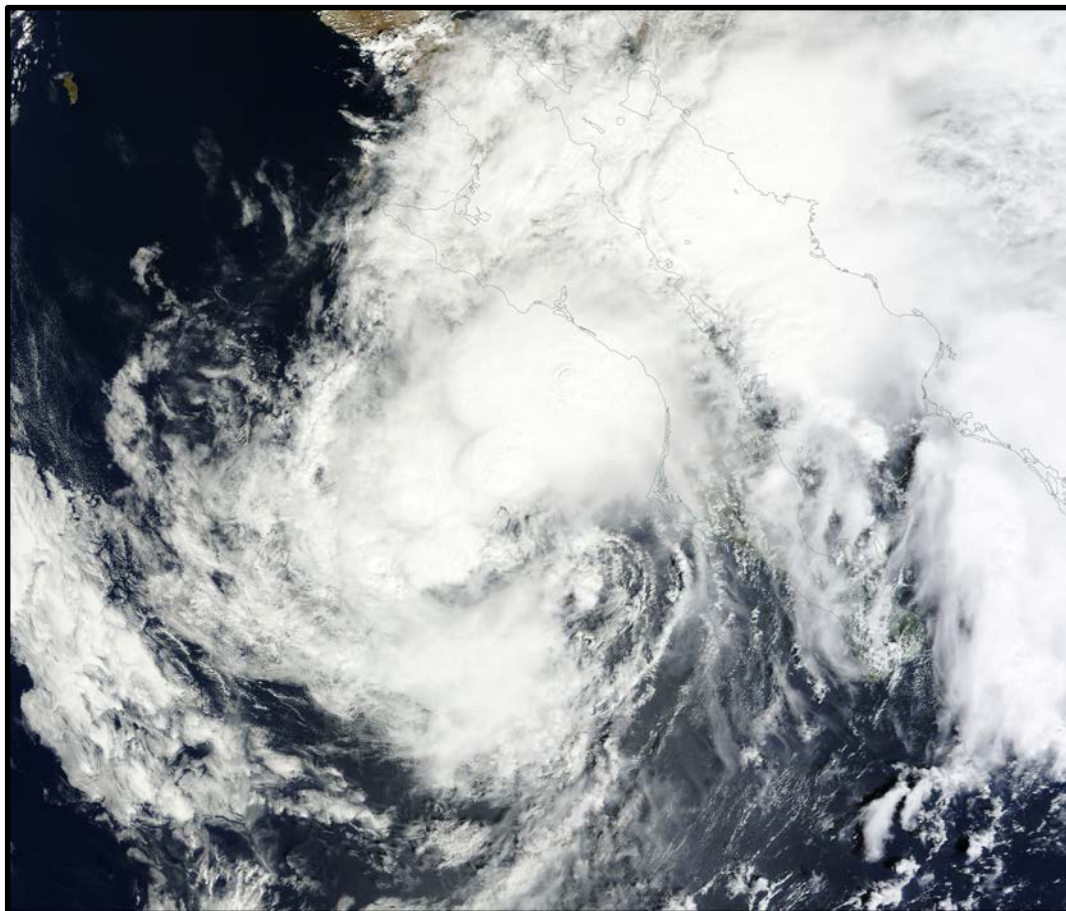# NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL DEPRESSION SIXTEEN-E
(EP162015)
20 – 21 SEPTEMBER 2015

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NASA MODIS VISIBLE SATELLITE IMAGE OF TROPICAL DEPRESSION SIXTEEN-E AT 1800 UTC 20 SEPTEMBER 2015.

Tropical Depression Sixteen-E was a short-lived tropical cyclone that made landfall and produced heavy rainfall in Baja California Sur and northwestern Mexico.

Tropical Depression Sixteen-E

20 – 21 SEPTEMBER 2015

SYNOPTIC HISTORY

Tropical Depression Sixteen-E appears to have originated from a tropical wave that crossed Central America on 10 and 11 September. This wave produced intermittent thunderstorm activity while it moved westward to the south of Mexico during the next several days, and a broad and elongated area of low pressure formed on the northern side of the wave axis on 15 September about 400 n mi south of the southern tip of the Baja California peninsula. While the low moved west-northwestward to northwestward, deep convection gradually increased during the next few days. By 19 September, thunderstorm activity became more concentrated near the low, but the center of circulation was not yet well defined while the system turned northward between a mid-level ridge to its east and a mid- to upper-level cut-off low to its west. Satellite data suggest that the low-level center became better defined the next day, and it is estimated that a tropical depression formed around 1800 UTC 20 September when it was located about 90 n mi west-southwest of San Carlos, Baja California Sur, Mexico. The "best track" chart of the tropical cyclone's path is given in Fig. 1, 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].

After genesis, the depression began moving north-northeastward toward the Baja California coast, and the associated convection had become displaced to the north of the center due to southerly shear. The depression changed little in strength by the time it made landfall around 0445 UTC 21 September, about 20 n mi east of Punta Abreojos, Mexico (Figure 2). The cyclone remained a tropical depression while it moved across the Baja California peninsula and the Gulf of California during the next several hours, and it made a second landfall on Isla Tiburon just west of mainland Mexico around 1345 UTC that day.   About an hour later, the system made its final landfall near Punta Chueca in the Mexican state of Sonora and dissipated shortly thereafter.

Although the cyclone dissipated over northwestern Mexico, moisture associated with its remnants spread north-northeastward over the southwestern United States. This resulted in locally heavy rainfall over portions of Arizona and New Mexico on 21 and 22 September.

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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.

METEOROLOGICAL STATISTICS

Observations in the depression (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), 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 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 this cyclone.

Winds and Pressure

The estimated 30-kt peak intensity of the depression is based on a blend of Dvorak classifications from TAFB and SAB, ASCAT passes, and ship data. It should be noted, however, that ASCAT data from around 0400-0500 UTC 21 September indicated that winds of tropical storm force did occur over a portion of the Gulf of California while the depression was making its first landfall over the west coast of Baja California Sur (Figure 5). Detailed analysis of these data, and scatterometer passes from the day prior, suggest that tropical-storm-force winds were ongoing in the Gulf of California, and they do not appear to be directly associated with the tropical cyclone's circulation and were likely enhanced by the local topography.

Although there were no surface or ship observations of tropical storm force, stations near the landfall locations reported gusts of that strength and had fairly low pressures of 1001-1002 mb (Table 2).

Rainfall and Flooding

The biggest hazard associated with the depression was widespread heavy rains. Rainfall accumulations of 3 to 5 inches were common across the northern portion of the Baja California Sur, northern Sinaloa, and Sonora on 21 September (Figure 6). The remnants of the depression brought similar rain totals to portions of Arizona and New Mexico on 21-22 September (Table 2).

CASUALTY AND DAMAGE STATISTICS

The heavy rain caused by the depression resulted in flooding in the city of El Fuerte and surrounding communities in the state of Sinaloa. According to media reports, the flooding rains caused damage to tourist infrastructure and contaminated the water systems for 22 communities. Four bridges were shut down during the event, and the flood caused damage to blueberry and
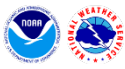
mango crops in that area. The preliminary estimate of damage in Sinaloa is around 300 million Mexican pesos (17.7 million USD).

FORECAST AND WARNING CRITIQUE

The genesis of this cyclone was fairly well anticipated. The lead times for the 48-h and 120-h Outlooks are the same since most of the genesis forecasts assessed the potential for development to be short term (Table 3). The system was introduced into the Tropical Weather Outlook (TWO) with a low (< 40 %) chance of formation 138 h before genesis. The probability reached the medium category (40-60 % chance of formation) 48 h before genesis and the high category (> 60% chance of formation) 24 h before tropical cyclone development.

A verification of NHC official track and intensity forecasts for this system is given in Tables 4 and 5, respectively. The sample size is too small to draw meaningful conclusions.

There were no coastal watches or warnings associated with this tropical cyclone.

ACKNOWLEDGMENTS

The author would like to thank the National Meteorological Service of Mexico for providing very valuable data and Figure 6 of this report.

Table 1.   Best track for Tropical Depression Sixteen-E, 20-21 September 2015.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
20 / 1800	24.3	113.7	1003	30	tropical depression
21 / 0000	25.5	113.4	1002	30	"
21 / 0445	26.6	113.1	1001	30	"
21 / 0600	26.8	113.0	1001	30	"
21 / 1200	28.3	112.5	1001	30	"
21 / 1345	28.8	112.3	1002	30	"
21 / 1500	29.2	112.2	1003	30	"
21 / 1800					dissipated
21 / 0445	26.6	113.1	1001	30	minimum pressure
21 / 0445	26.6	113.1	1001	30	landfall near Punta Abreojos, Mexico
21 / 1345	28.8	112.3	1002	30	landfall near Isla Tiburon, Mexico
21/ 1500	29.2	112.2	1003	30	landfall near Punta Chueca, Mexico

Table 2.   Selected surface observations for Tropical Depression Sixteen-E, 20-21
                September 2015.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in/mm)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)	Sustained (kt)	Gust (kt)	
Mexico						
Bahia Kino			21/1130	21	30	4.46
Hermosillo			21/1040	16	32	4.16
Empalme			21/0730	19	38	2.24
Santa Rosalia			20/2300	16	35	3.76
San Juanico	21/0502	1002.0	21/0347	23	30	0.84
San Carlos	21/1032	1001.7	21/0746	28	38	1.19
United States						
Arizona						
Dan Saddle						3.94
Calabasas Canyon						3.31
Rio Rico						3.23
Italian Trap						3.23
Tubac						3.20
Green Valley						2.94
New Mexico						
Mogollon						3.34
Pleasanton						1.72
Albuqureque						1.17

Table 3.   Number of hours in advance of formation associated with the first NHC Tropical Weather Outlook forecast in the indicated likelihood category. Note that the timings for the "Low" category do not include forecasts of a 0% chance of genesis.

	Hours Before Genesis	
	48-Hour Outlook	**120-Hour Outlook**
Low (<40%)	138	138
Medium (40%-60%)	48	48
High (>60%)	24	24

Table 4.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for the Tropical Depression Sixteen-E. 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	72	96	120
OFCL	36.0						
OCD5	70.7						
Forecasts	2						
OFCL (2010-14)	23.4						
OCD5 (2010-14)	36.6						

Table 5.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for the Tropical Depression Sixteen-E. 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	72	96	120
OFCL	0.0						
OCD5	2.5						
Forecasts	2						
OFCL (2010-14)	5.9						
OCD5 (2010-14)	7.7						
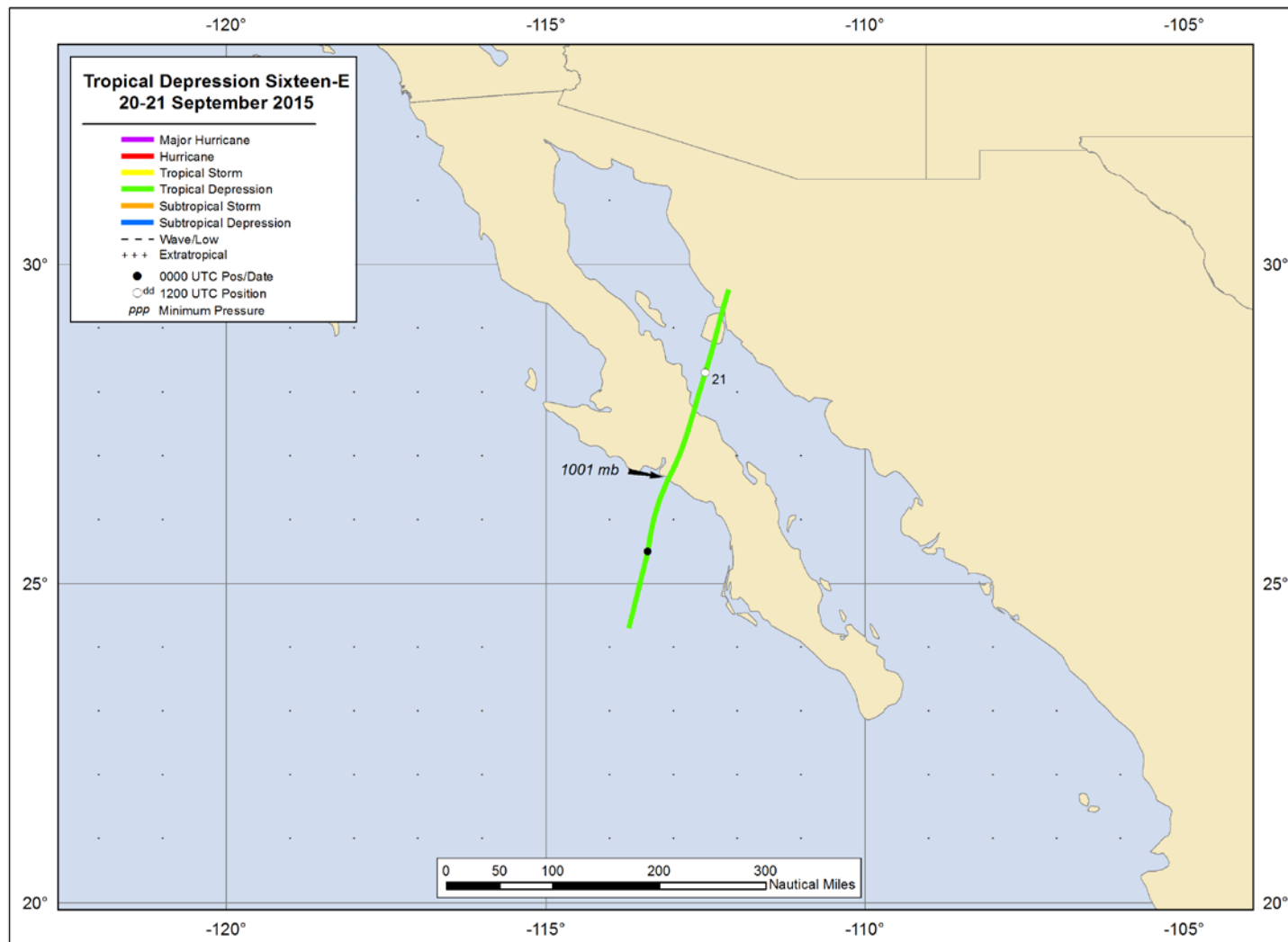
Figure 1.   Best track positions for Tropical Depression Sixteen-E, 20-21 September 2015.
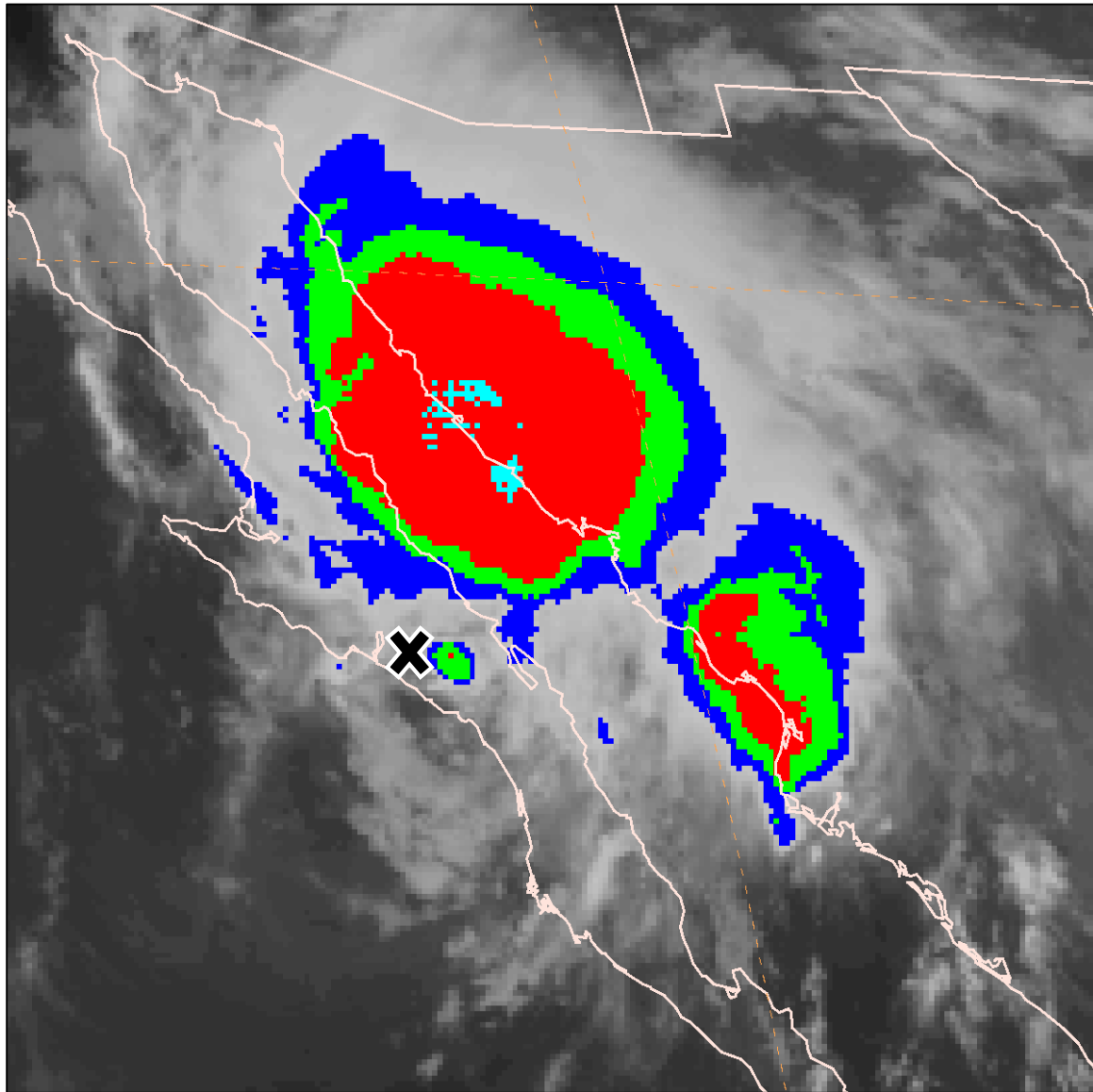
Figure 2.   GOES-W satellite image at 0500 UTC 21 September of Tropical Depression Sixteen-E around the time it made landfall in Baja California Sur. The 'x' denotes the estimated center position.
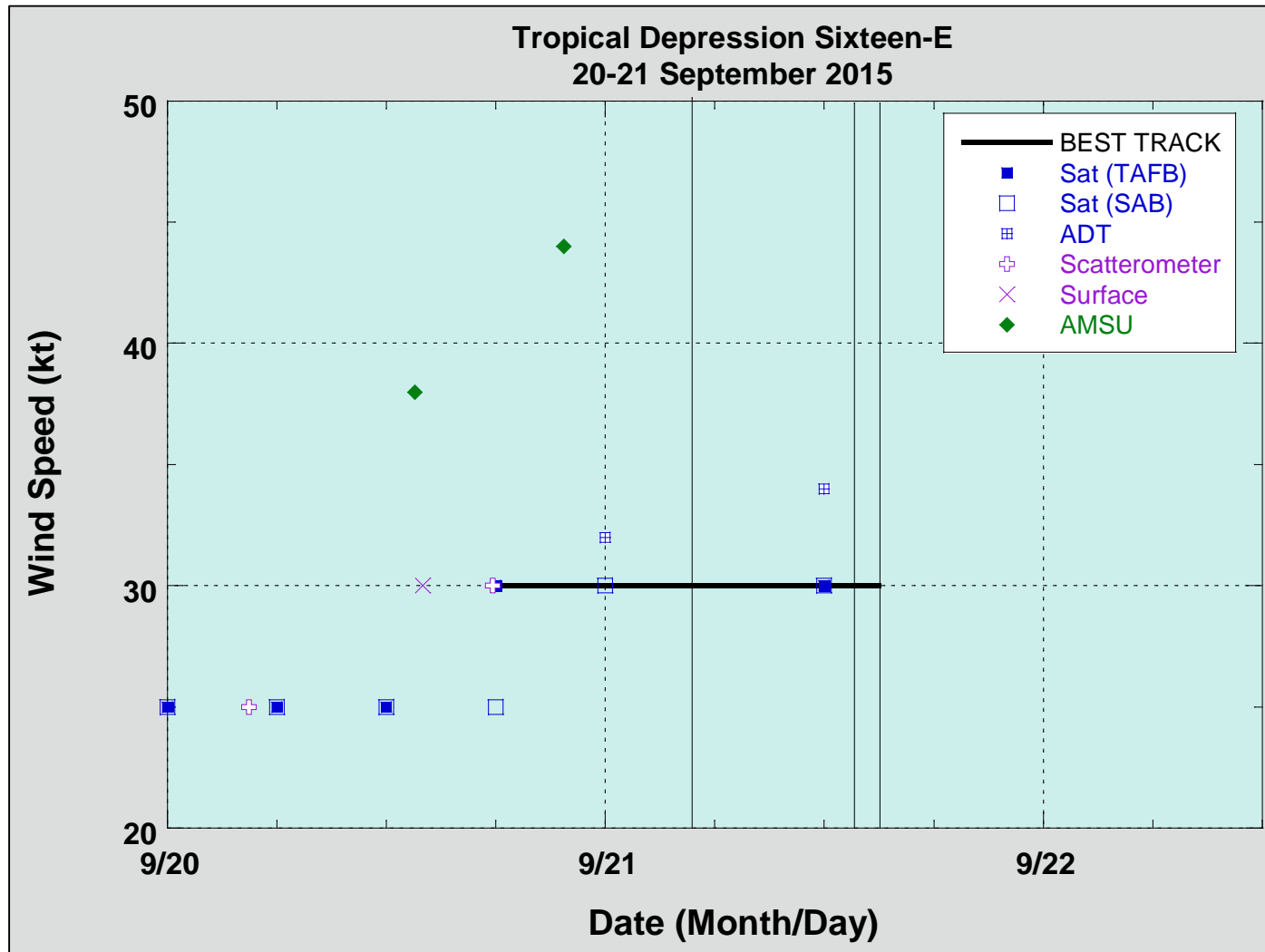
Figure 3.   Selected wind observations and best track maximum sustained surface wind speed curve for the Tropical Depression Sixteen-E, 20-21 September 2015.   Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.
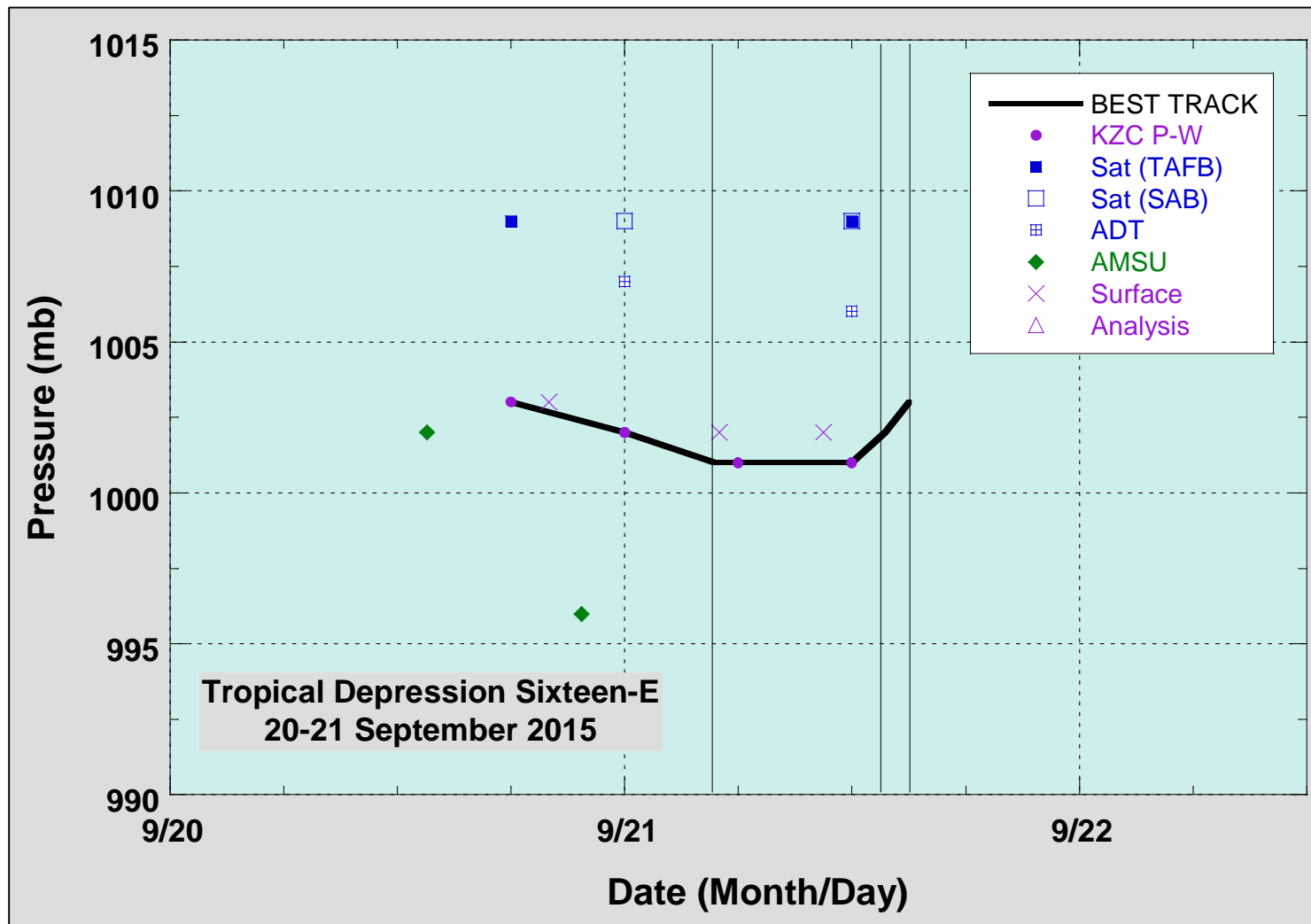
Figure 4.   Selected pressure observations and best track minimum central pressure curve for the Tropical Depression Sixteen-E, 20-21 September 2015. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative 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 solid vertical lines correspond to landfalls.
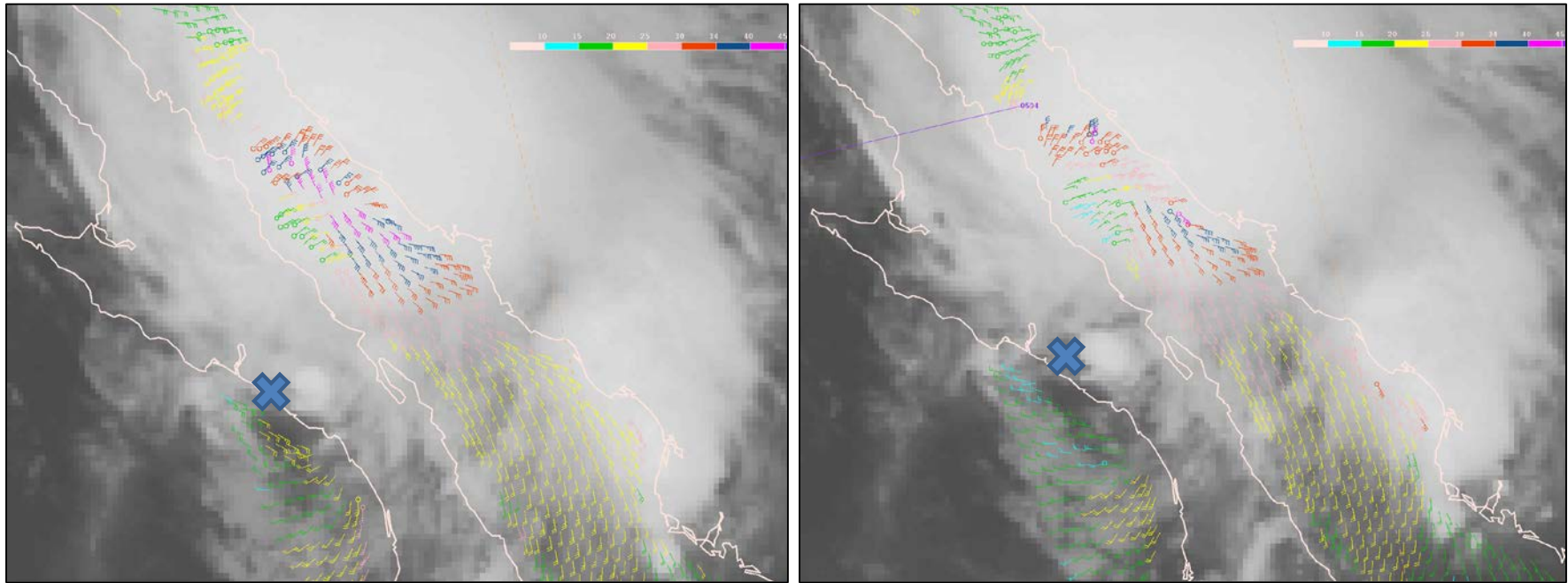
Figure 5.   ASCAT-A overpass of Tropical Depression Sixteen-E at 0408 UTC 21 September (left) and ASCAT-B overpass at 0504 UTC 21 September (right). The 'x' denotes the estimated center position.
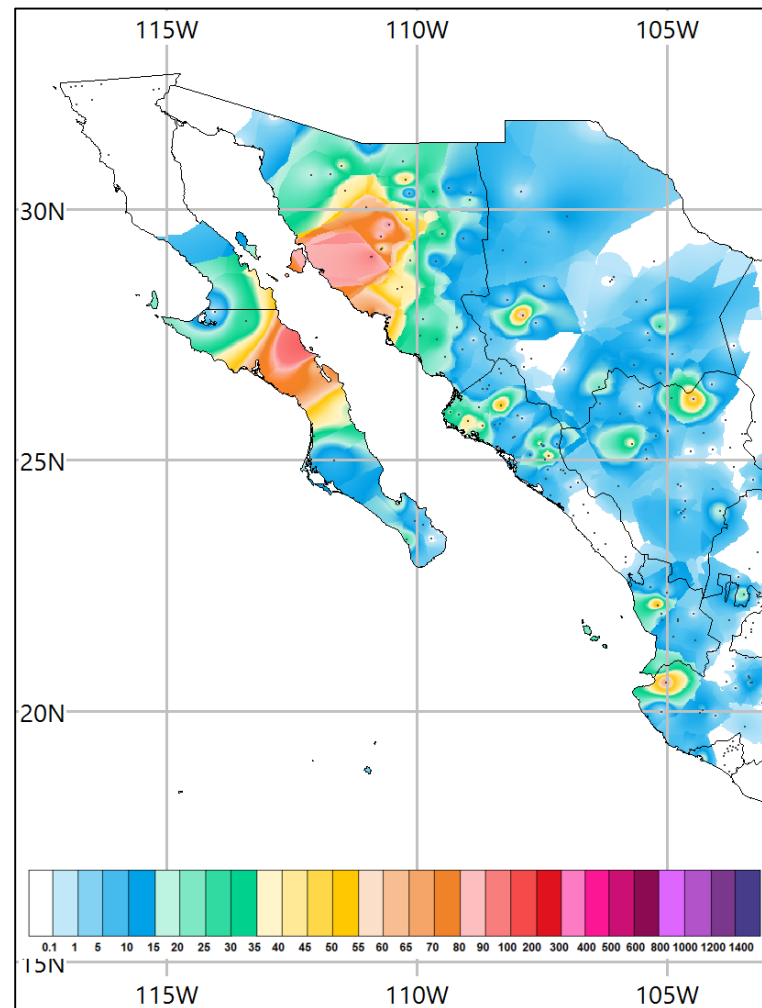
Figure 6.   Total rainfall (mm) over the Baja California peninsula and northwestern Mexico on 21 September 2015. Image provided by the National Meteorological Service of Mexico.