NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM DOLLY

(AL052014)

1 – 3 September 2014

John L. Beven II
National Hurricane Center
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MODIS IMAGE OF DOLLY FROM THE TERRA SATELLITE AT 1730 UTC 2 SEPTEMBER. IMAGE COURTESY OF NASA.

Dolly was a disorganized tropical storm that made landfall near Tampico, Mexico.

Tropical Storm Dolly

1 – 3 SEPTEMBER 2014

SYNOPTIC HISTORY

Dolly originated from a tropical wave that moved westward from the coast of Africa on 19 August. The wave showed little distinction until it reached the eastern Caribbean Sea on 27 August, at which time the associated convection increased. Addition development was slow until 30 August, when the convection became better organized during possible interaction with an eastward-moving atmospheric Kelvin wave. A low pressure area formed on 31 August over the Yucatan Peninsula of Mexico, and the associated circulation and convection became better organized on 1 September when the low reached the Bay of Campeche. It is estimated that a tropical depression developed near 1800 UTC that day about 295 n mi east-southeast of Tampico, 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. 2 and 3, respectively. The best track positions and intensities are listed in Table 1[1].

The cyclone spent its life in an area of upper-level northwesterly flow between a ridge over Mexico and a low over the Bahamas. It was also to the south of a mid-level ridge along the northern coast of the Gulf of Mexico, which produced a general west-northwestward or westward steering flow, which resulted in northwesterly vertical shear that likely limited intensification. The depression initially moved north-northwestward, and it became a tropical storm early on 2 September. A turn toward the northwest occurred at 0600 UTC 2 September as Dolly reached a peak intensity of 45 kt. Later that day, Dolly weakened slightly and turned west-southwestward, reaching the coast of Mexico just south of Tampico near 0400 UTC 3 September. After landfall, Dolly weakened and moved generally westward into the mountains of eastern Mexico, where it dissipated on 4 September.

METEOROLOGICAL STATISTICS

Observations in Dolly (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. Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from four flights of the 53rd Weather Reconnaissance Squadron (WRS) of the U. S. Air Force Reserve Command and the NASA Global Hawk aircraft. Data and

[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.

imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Tropical Rainfall Measuring Mission (TRMM), the NASA Global Precipitation Mission (GPM) satellite, 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 Dolly.

Dolly was a disorganized cyclone through its lifetime, and the somewhat erratic track is related to its structural features. During the north-northwestward motion between genesis and 1200 UTC 2 September, the center was at the northeastern or northern end of an elongated trough. Scatterometer data near 0400 UTC 2 September suggest that a closed circulation did not exist at that time, although the data are inconclusive and conflict with earlier and subsequent aircraft observations. After 1200 UTC 2 September, the cyclone changed structure, with multiple vorticity centers rotating around a west-southwestward-moving mean center. One such center was apparent in scatterometer data and dropsonde data from the Global Hawk from 1500-1800 UTC, and shortly thereafter a Hurricane Hunter aircraft located another vorticity center well to the southeast of the previous center. A third prominent vorticity center was seen in Mexican radar data early on 3 September, which moved around the north side of the mean center and made landfall near Altamira about 0500 UTC.

Winds and Pressure

The 53rd WRS Hurricane Hunters made three flights into Dolly, and there was a research mission conducted by the NASA Global Hawk. The maximum flight-level wind reported by the Hurricane Hunters was 54 kt at 925 mb at 0458 UTC 2 September. The SFMR estimated winds were as high as 60 kt near that time. However, these winds are suspect due to rainfall contamination issues, and other SFMR winds of 40-45 kt appear to be more reliable. Based on the aircraft and scatterometer data, Dolly is given a peak intensity of 45 kt near 0600 UTC 2 September. The minimum pressure of 1000 mb is based on dropsonde data from the Global Hawk on 2-3 September.

There was one surface observation of sustained tropical-storm-force winds: NOAA buoy 42055 reported 1-min mean winds of 37 kt at 0854 UTC 2 September (anemometer height 5 m), along with a peak gust of 41 kt at 0940 UTC that day. The Mexican automated station at Barra del Tordo in the state of Tamaulipas reported a peak gust of 42 kt at 2000 UTC 3 September.

Storm Surge

There was no reported storm surge from Dolly.

Rainfall and Flooding

Dolly caused locally heavy rains over portions of eastern Mexico. The Servicio Meteorológico Nacional of Mexico reports that widespread rainfall totals of 4-8 inches occurred over portions of the states of Tamaulipas, Veracruz, Hildago, San Luis Potsi, and Nuevo León over the period of 1-4 September. Some totals exceed 10 inches, with a maximum reported total of 15.23 inches at La Encantada in the state of Tamaulipas.

Tornadoes

There were no tornadoes reported with Dolly.

CASUALTY AND DAMAGE STATISTICS

Dolly caused no known direct fatalities. Media reports indicate that one death[2] was associated with Dolly – a man who died in the storm due to "natural causes", suggesting that the death is best classified as indirect. There were media reports of wind damage to homes near Cabo Rojo, Mexico, as well as damage due to freshwater flooding in portions of the state of Veracruz. There are no reliable monetary figures for the damage.

FORECAST AND WARNING CRITIQUE

Forecasting Dolly's genesis was problematic. An area of disturbed weather was first mentioned in the Tropical Weather Outlook (TWO) over the tropical Atlantic as early as 24 August. However, this disturbance appears to be linked to the tropical wave east of the pre-Dolly wave. The wave that spawned Dolly did not appear in the TWO until 27 August. At that time (114 h before genesis), it was given a low chance (less than 30%) of development in the extended range (48-120 h, Table 2). The system was first given a low chance of development in the short range (0-48 h) on 29 August, at which time it was also given a medium chance (30%-50%) in the extended range. The chance of development was raised to medium in the short range on 31 August. The system was given a high chance (greater than 50%) of development in the extended range later that day, and a high chance was given in the short range early on 1 September.

A verification of NHC official track forecasts for Dolly is given in Table 3, and a verification of NHC official intensity forecasts is given in Table 4. Dolly was a tropical cyclone for only 42 h, and the number of forecasts is too small to draw any meaningful conclusions. One issue was that while the cyclone was correctly forecast to make landfall in eastern Mexico, the erratic direction of the forward motion was poorly forecast.

Watches and warnings associated with Dolly are given in Table 5.

[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.

Table 1. Best track for Tropical Storm Dolly, September 1-3, 2014.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
01 / 1200	19.2	92.3	1009	25	low
01 / 1800	20.0	93.2	1009	30	tropical depression
02 / 0000	21.3	93.4	1007	35	tropical storm
02 / 0600	22.3	94.3	1005	40	"
02 / 1200	22.8	95.6	1005	45	"
02 / 1800	22.2	96.7	1003	40	"
03 / 0000	22.0	97.3	1001	40	"
03 / 0100	22.0	97.4	1000	40	minimum pressure
03 / 0400	22.0	97.7	1002	40	Landfall just south of Tampico, Mexico
03 / 0600	21.9	98.0	1004	35	"
03 / 1200	21.8	98.8	1005	25	low
03 / 1800	21.7	99.8	1005	20	"
04 / 0000	21.6	101.0	1002	15	"
04 / 0600					dissipated
03 / 0100	22.0	97.4	1000	40	minimum pressure
03 / 0400	22.0	97.7	1002	40	Landfall just south of Tampico, Mexico

Table 2. Number of hours in advance of formation for Tropical Storm Dolly 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 (<30%)	72	114
Medium (30%-50%)	30	72
High (>50%)	12	24

Table 3. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Dolly, 1 – 3 September 2014. 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	71.4	61.0	**30.5**				
OCD5	92.2	107.5	18.8				
Forecasts	5	3	1				
(AL) OFCL (2009-13)	28.8	45.5	61.2				
(AL) OCD5 (2009-13)	48.2	100.1	160.2				

Table 4. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Dolly, 1 – 3 September 2014. 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	8.0	**6.7**	**5.0**				
OCD5	10.4	9.7	2.0				
Forecasts	5	3	1				
OFCL (2009-13)	6.3	9.7	11.9				
OCD5 (2009-13)	7.4	11.1	13.8				

Table 5. Watch and warning summary for Tropical Storm Dolly, 1 – 3 September 2014.

Date/Time (UTC)	Action	Location
01 / 2100	Tropical Storm Warning issued	Gulf coast of Mexico from Tuxpan to La Pesca
02 / 0900	Tropical Storm Warning issued	Gulf coast of Mexico from La Pesca to Barra El Mezquital
02 / 1500	Tropical Storm Warning discontinued	Gulf coast of Mexico from Tuxpan to Cabo Rojo
03 / 0000	Tropical Storm Warning discontinued	Gulf coast of Mexico from Boca de Catan to Barra El Mezquita
03 / 1200	All warnings discontinued	Gulf coast of Mexico

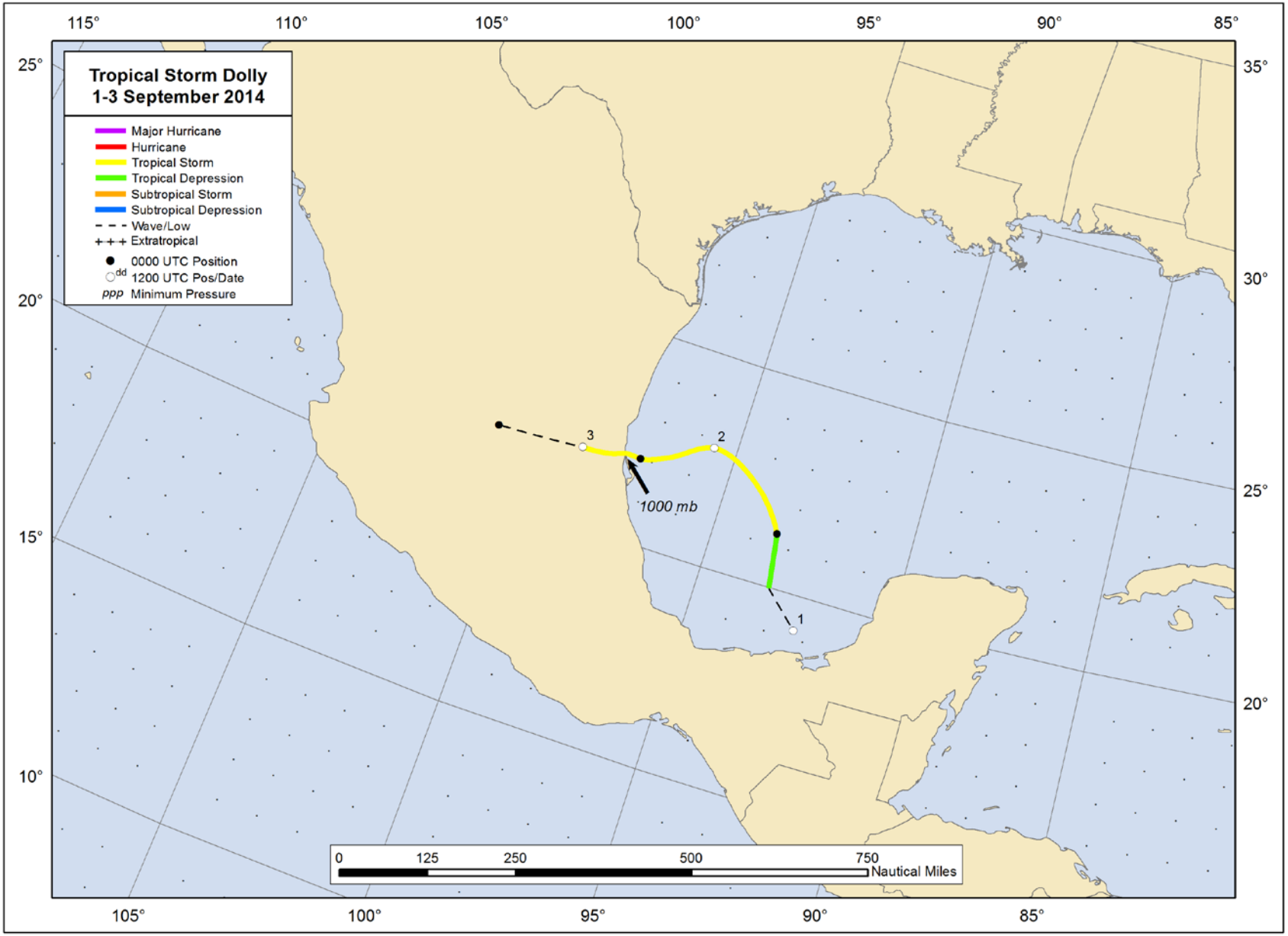

Figure 1. Best track positions for Tropical Storm Dolly, 1 – 3 September 2014.

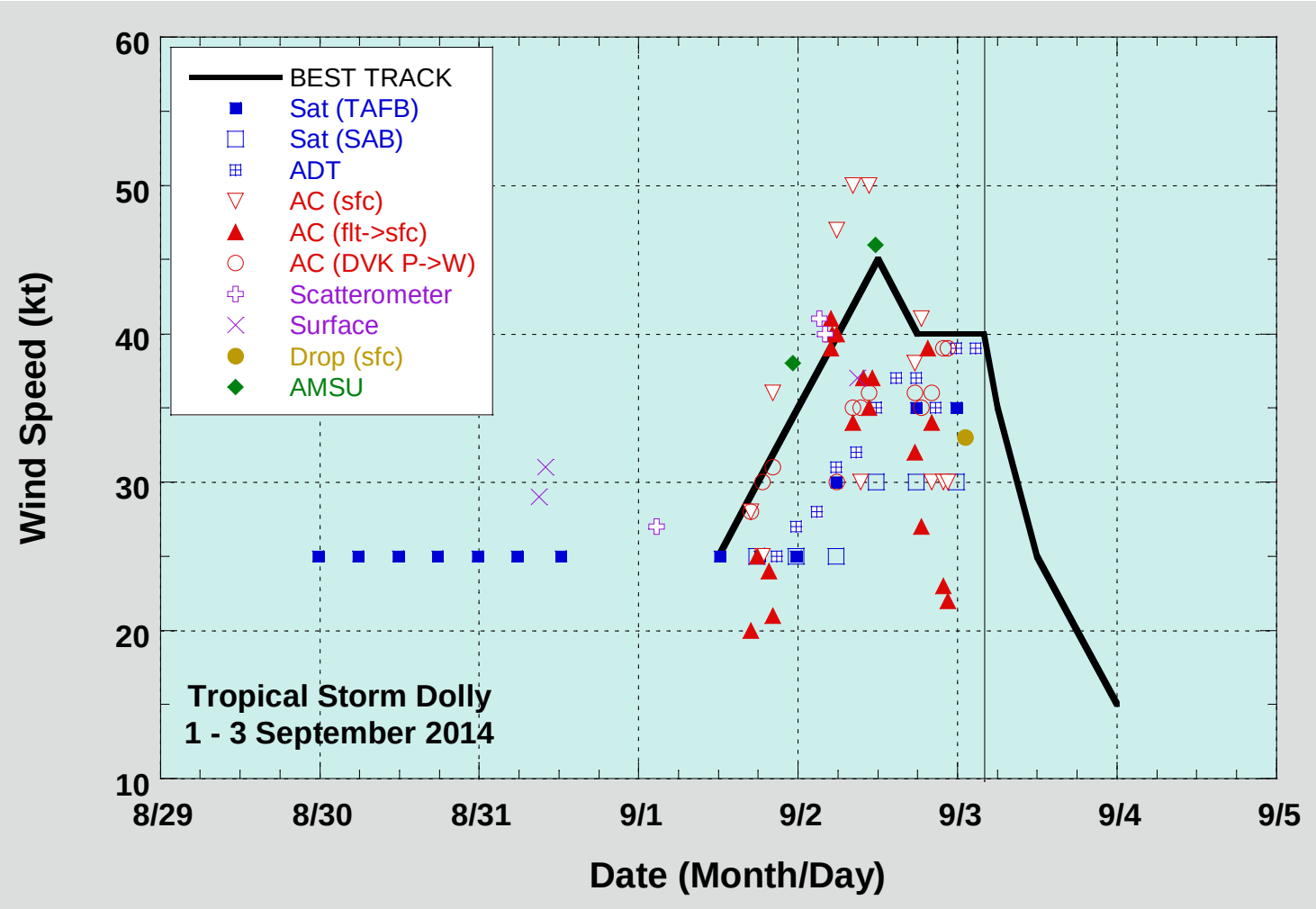

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Dolly, 1 – 3 September 2014. Aircraft observations have been adjusted for elevation using 80%, 75%, and 80% adjustment factors for observations from 850 mb, 925 mb, and 1500 ft, respectively. 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. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC, and the solid vertical lines corresponds to landfall.

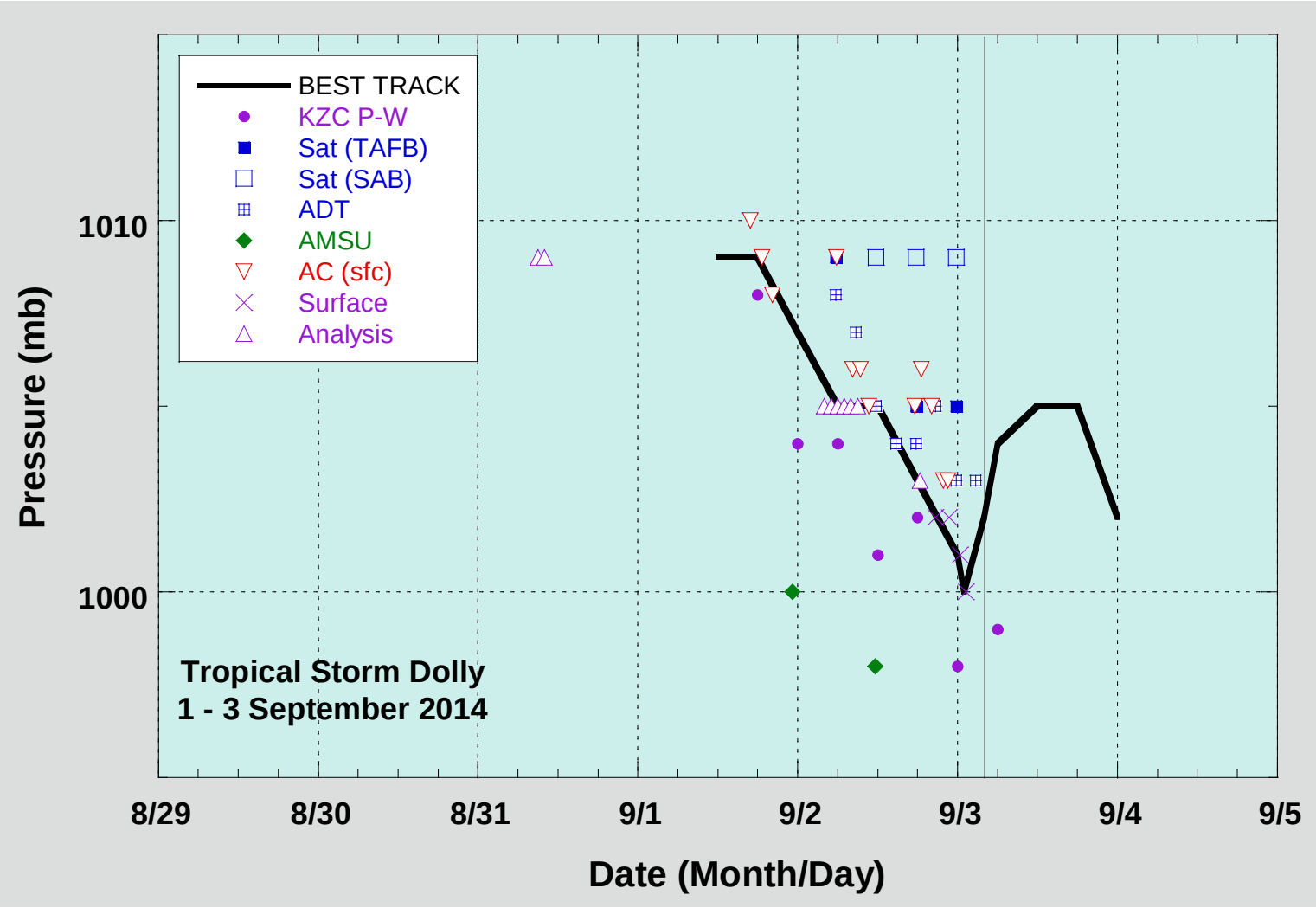

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Dolly, 1 – 3 September 2014. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological 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 the solid vertical line corresponds to landfalls.