Tropical Cyclone Report
Tropical Storm Agatha
(EP012010)
29-30 May 2010

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National Hurricane Center
13 August 2010
updated for rainfall totals and casualties 10 January 2011

Agatha was a short-lived tropical cyclone that made landfall on the Pacific coast of Guatemala. Heavy rains associated with the storm were responsible for 177 deaths in Central America.

a. Synoptic History

The origin of Agatha was complex. The primary contributor to the development was a tropical wave that moved westward from the coast of Africa on 8 May and crossed Central America into the eastern Pacific on 21 May. The associated shower activity increased on 24 May a few hundred nautical miles west of Costa Rica, and a broad low pressure area formed the next day as the first Dvorak satellite intensity estimates were made. Little development occurred during the next couple of days as the low drifted slowly westward to a position a few hundred nautical miles south of the Gulf of Tehuantepec. During this time, two other tropical waves crossed Central America and were absorbed into the elongated area of low pressure. What effects these systems had on how the system developed is unclear.

ASCAT scatterometer data on 28 May showed the circulation of the low becoming better defined. Based on this and subsequent convective trends, it is estimated that a tropical depression formed near 0000 UTC 29 May about 155 n mi southwest of Tapachula, 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 depression moved northeastward in deep-layer southwesterly flow between a mid/upper-level trough over the Gulf of Mexico and a mid/upper-level ridge over the western Caribbean Sea. A second ASCAT overpass indicated that the cyclone strengthened to a tropical storm about 6 h after genesis. Agatha reached a peak intensity of 40 kt at 1800 UTC 29 May, and then made landfall with the same intensity near Champerico, Guatemala at 2230 UTC that day. The surface circulation of Agatha weakened as it continued northeastward into the Sierra Madre Mountains, and it dissipated on 30 May over western Guatemala. The cyclone's mid-

[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.

level remnants may have contributed to the formation of a short-lived surface low, however, over the northwestern Caribbean on 31 May.

b. Meteorological Statistics

Observations in Agatha (Figs. 2 and 3) include satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB). Data and imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM) and Aqua satellites, the European METOP satellite, and the Defense Meteorological Satellite Program (DMSP) and WindSat satellites, among others, were also useful in constructing the best track of Agatha.

There were no surface observations of sustained tropical-storm-force winds from Agatha. La Unión, El Salvador, reported a wind gust of 43 kt at 1200 UTC 30 May.

Tides were 1-2 feet above normal on the coast of El Salvador on 29 May. Storm tide information is not available from Guatemala.

The main impact from Agatha was widespread heavy rain through portions of Central America. Rainfall totals of 4-8 inches occurred over southern Guatemala on 29 May, with Montufar reporting a 24-h total of 16.78 inches. Similar heavy rains occurred in El Salvador (Table 2), with Ilopango reporting a total of 8.17 inches. The rains from Agatha were part of a prolonged period of heavy rain in Central America from 25-30 May. During this period, Mazatenango, Guatemala, reported 22.27 inches of rain.

Tropical cyclone landfalls in Guatemala are rare events. During the period of reliable records in the eastern Pacific, only one other tropical storm has made landfall in Guatemala – Simone on 19 October 1968. In addition, Tropical Storm Barbara made landfall just west of the Mexico-Guatemala border – not far from where Agatha made landfall – on 2 June 1997.

c. Casualty and Damage Statistics

Agatha's heavy rains caused widespread flooding and mudslides in Guatemala, Honduras, and El Salvador. As of this writing, the National Coordinator of Disaster Reduction of Guatemala reported that 160 people died in that country from the impacts of Agatha, with an additional 47 people missing. As of this writing, reports from the United States Agency for International Development indicate an additional 18 fatalities in Honduras and 12 in El Salvador. While there is uncertainty as to exactly how many people died directly due to the storm, the death toll from Agatha appears to be 190.

The flooding and mudslides also caused an estimated $1.1 billion (US) in property damage, with $982 million in Guatemala and $112 million in El Salvador. A spectacular example of damage documented by the news media was a 20-m-wide sinkhole that opened up in Guatemala City, destroying several buildings in the process.

d. Forecast and Warning Critique

The genesis of Agatha was well anticipated. The pre-Agatha disturbance was first mentioned in the Tropical Weather Outlook on 24 May, with a low probability (20% or less) of development during the next 48 h. This was increased to a medium (30-50%) probability on 25 May. The probability of development was raised to the high (60% or higher) category on 27 May about 36 h before genesis.

A verification of NHC official track forecasts for Agatha is given in Table 3. Official forecast track errors were 59 and 98 n mi at 12 and 24 h respectively, which are higher than the mean official errors for the previous five-year period. There are only 4 forecasts at 12 h, however, and 2 at 24 h.

A verification of NHC official intensity forecasts for Agatha is given in Table 4. Official forecast intensity errors were 9 and 13 kt at 12 and 24 h respectively, which are higher than the mean official errors for the previous five-year period. Again, there are only 4 forecasts at 12 h and 2 at 24 h.

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

Acknowledgements

The meteorological services of Guatemala and El Salvador provided the data from those countries. The National Coordinator of Disaster Reduction of Guatemala provided information on the death toll there, while United States Agency for International Development provided information on the death toll in Honduras and El Salvador.

Table 1. Best track for Tropical Storm Agatha, 29 - 30 May 2010.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
28 / 1800	12.7	94.3	1005	30	low
29 / 0000	12.8	94.1	1005	30	tropical depression
29 / 0600	13.0	93.6	1004	35	tropical storm
29 / 1200	13.3	93.1	1003	35	"
29 / 1800	13.9	92.5	1001	40	"
30 / 0000	14.6	91.9	1003	35	"
30 / 0600	15.2	91.6	1006	25	tropical depression
30 / 1200	15.7	91.4	1008	15	remnant low
30 / 1800					dissipated
29 / 1800	13.9	92.5	1001	40	minimum pressure
29 / 2230	14.4	92.1	1001	40	landfall near Champerico, Guatemala

Table 2. Selected storm total rainfall observations for Tropical Storm Agatha, 29 – 30 May 2010.

El Salvador:				
Location (ID):	**Rainfall (in)**		**Location (ID):**	**Rainfall (in)**
Acajutla (78650)	5.71		San Miguel (78670)	3.06
Ilopango (78663)	8.17		Santa Ana (78653)	5.91
La Unión (78672)	7.01			

Table 3. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Agatha, 29 – 30 May 2010. Mean errors for the five-year period 2005-9 are shown for comparison. Official errors that are smaller than the five-year means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	58.4	98.4					
OCD5	71.7	152.0					
Forecasts	4	2					
(EP) OFCL (2005-9)	30.8	51.5	71.6	89.6	120.9	155.0	192.0
(EP) OCD5 (2005-9)	38.9	75.3	115.7	155.8	226.9	275.1	321.5

Table 4. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Agatha, 29 – 30 May 2010. Mean errors for the five-year period 2004-8 are shown for comparison. Official errors that are smaller than the five-year means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	8.8	12.5					
OCD5	6.8	14.0					
Forecasts	4	2					
(EP) OFCL (2005-9)	6.3	10.5	13.8	15.5	17.5	19.0	18.8
(EP) OCD5 (2005-9)	7.1	11.6	15.0	17.4	18.7	19.8	19.4

Table 5. Watch and warning summary for Tropical Storm Agatha, 29 – 30 May 2010.

Date/Time (UTC)	Action	Location
29 / 1200	Tropical Storm Warning issued	Boca de Pijijiapan, Mexico to the El Salvador/Honduras border
30 / 0300	Tropical Storm Warning discontinued	All

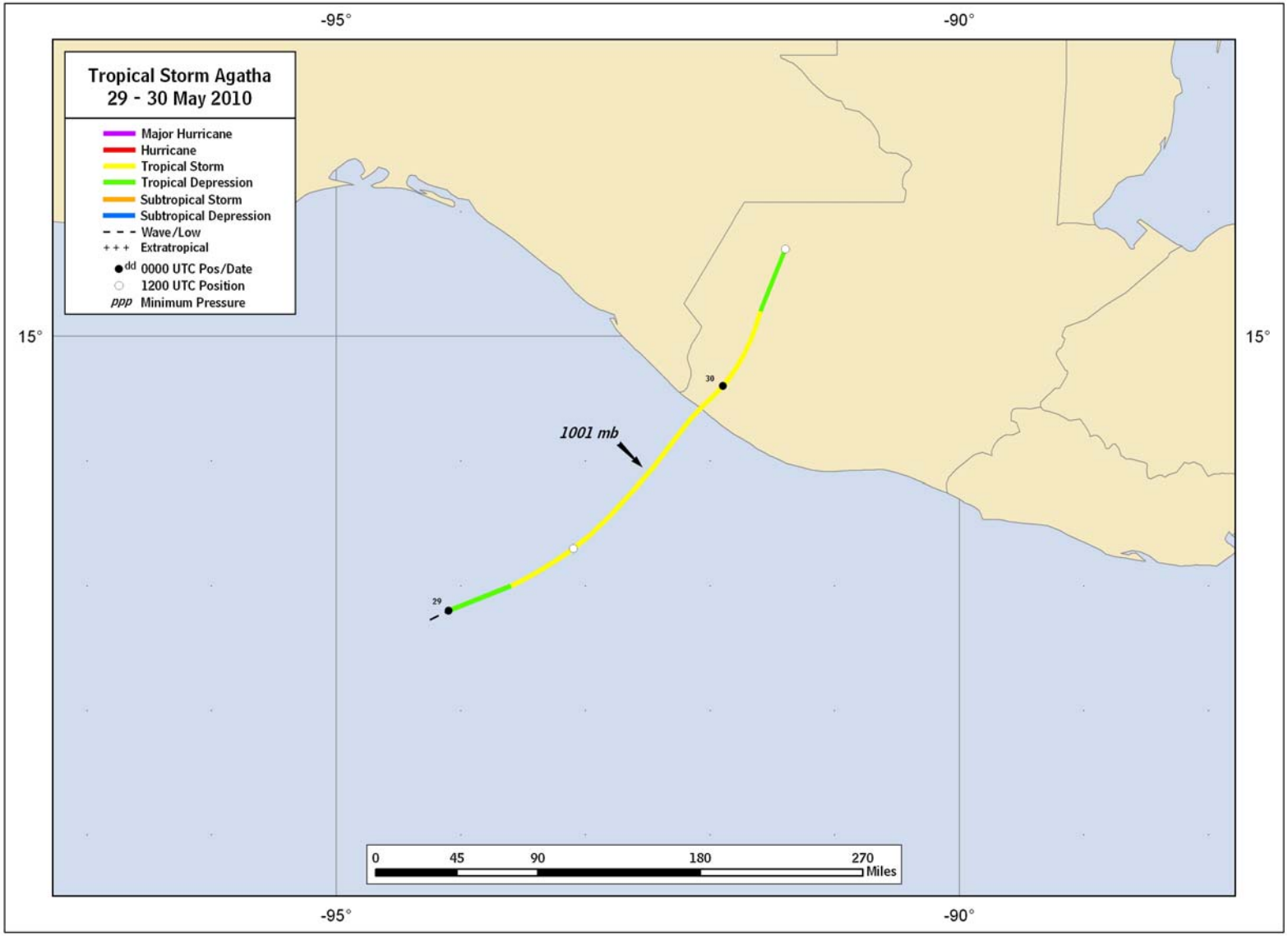

Figure 1. Best track positions for Tropical Storm Agatha, 29 – 30 May 2010.

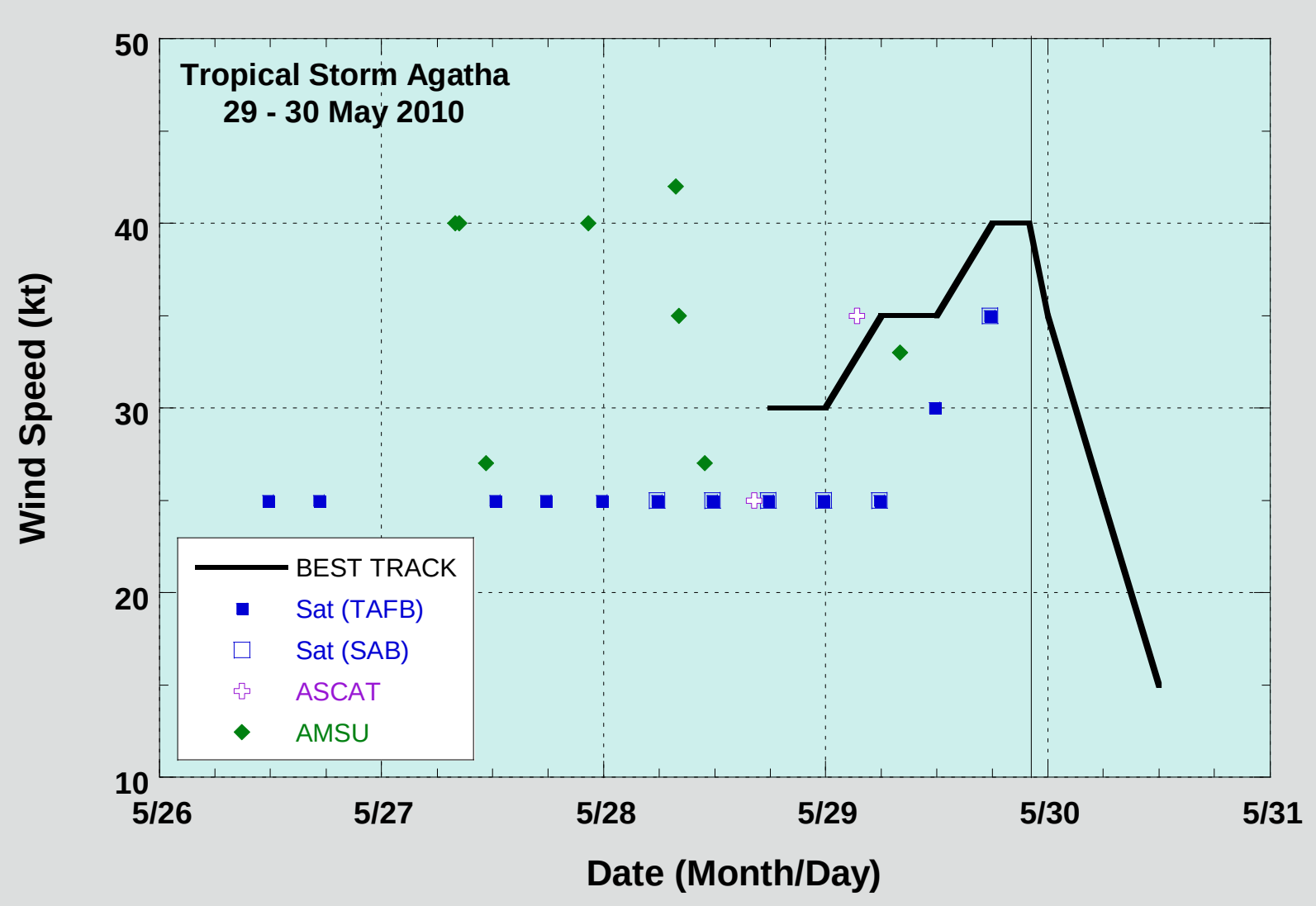

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Agatha, 29 – 30 May 2010. Solid vertical line denotes landfall. Dashed vertical lines correspond to 0000 UTC. Advanced Microwave Sounding Unit (AMSU) intensity estimates provided by the Cooperative Institute for Meteorological Satellite Studies at the University of Wisconsin.

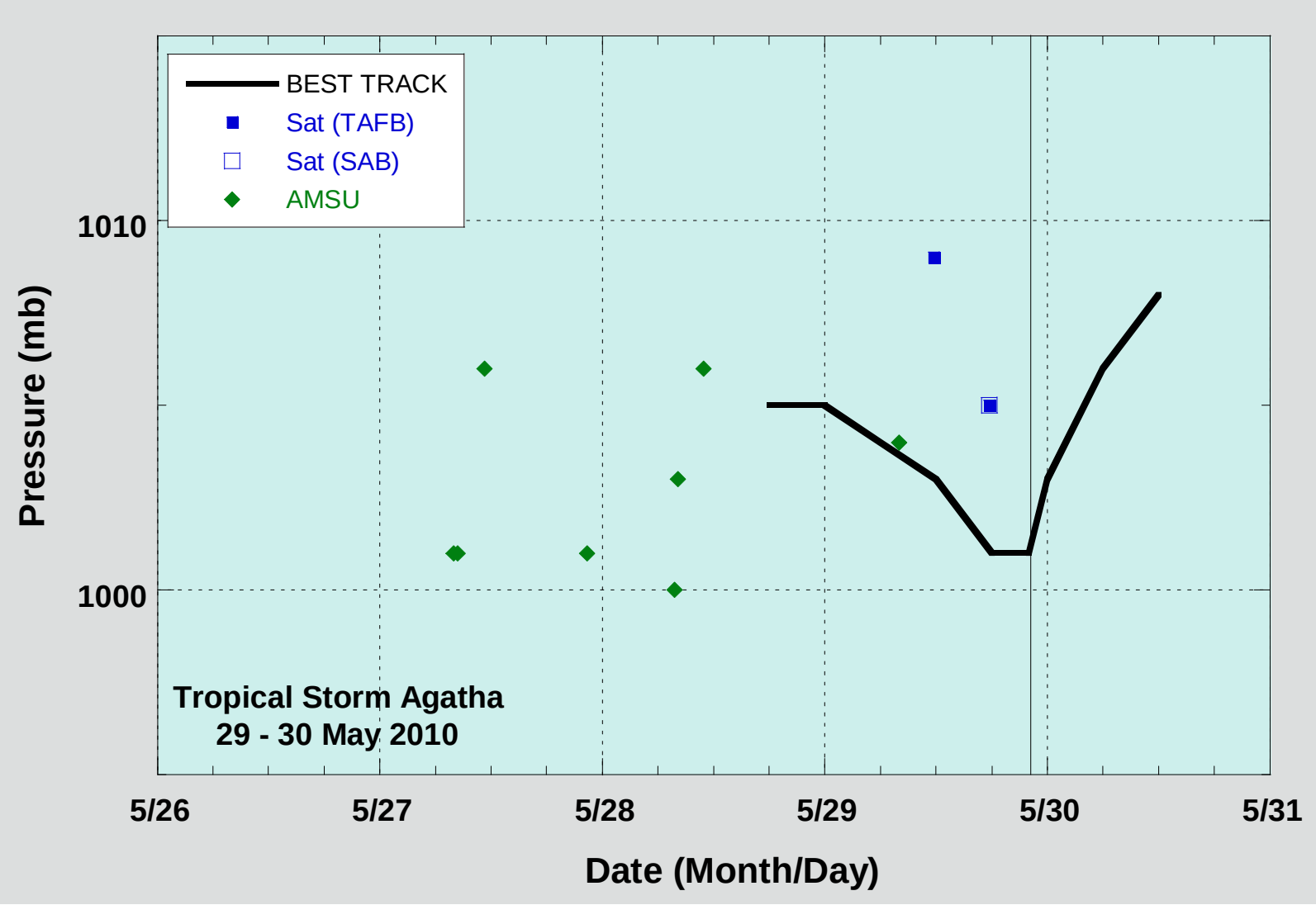

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Agatha, 29 – 30 May 2010. Solid vertical line denotes landfall. Dashed vertical lines correspond to 0000 UTC. Advanced Microwave Sounding Unit (AMSU) intensity estimates provided by the Cooperative Institute for Meteorological Satellite Studies at the University of Wisconsin.