

Tropical Cyclone Report
Tropical Storm Alma
(EP012008)
29-30 May 2008

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Alma was the first eastern North Pacific basin tropical storm or hurricane to make landfall along the Pacific Coast of Central America since records began in 1949.

a. Synoptic History

Unlike most tropical cyclones in the eastern Pacific basin, it appears that Alma formed without the assistance of a tropical wave. Instead, Alma originated from a nearly stationary trough of low pressure that became established over the far eastern portion of the basin in late May. Alma's incipient low formed within the broad monsoon-like flow early on 27 May, about 225 n mi southwest of the coast of Nicaragua. This low may have been initiated by an eastward-propagating disturbance as suggested by Hovmöller diagrams of satellite imagery. The low pressure area moved eastward, steered by the larger cyclonic gyre over the area. The first Dvorak satellite intensity estimates were performed on the system by the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB) at 0545 UTC 28 May. Shower and thunderstorm activity continued to become organized around the low later that day, leading to the formation of a tropical depression by 0000 UTC 29 May, centered about 85 n mi west-northwest of Cabo Blanco, Costa Rica. This genesis location is farther east than any eastern North Pacific tropical cyclone on record (not including cyclones that originated in the Atlantic basin, crossed Central America and reformed in the eastern Pacific). 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.

After genesis the depression turned northward and strengthened, becoming a tropical storm six hours later. Alma continued to quickly intensify, and passive microwave satellite imagery revealed an eye-like feature around 1200 UTC (Fig. 4) 29 May. Alma reached an estimated peak intensity of 55 kt by 1800 UTC, while centered about 45 n mi southwest of Managua, Nicaragua. Alma maintained this intensity until landfall, which took place about 1945 UTC along the Pacific coast of Nicaragua, just southwest of Leon.

After crossing the coast of Nicaragua, Alma began to weaken, but the cyclone maintained tropical storm strength while it moved into southern Honduras just after 0000 UTC 30 May. Six hours later, Alma weakened to a tropical depression, and by 1800 UTC the low-level center dissipated over the mountains of western Honduras. A remnant low- to mid-level circulation, however, appears to have moved into the extreme western Caribbean and played a role in the development of Atlantic basin Tropical Storm Arthur on 31 May.

b. Meteorological Statistics

Observations in Alma (Figs. 2 and 3) include satellite-based Dvorak technique intensity estimates from TAFB and SAB. Data and imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM), the NASA QuikSCAT, the NASA Aqua, the Department of Defense Windsat, and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in tracking Alma.

Dvorak satellite intensity estimates provided the basis for estimating Alma's intensity during most of its lifetime. Alma's 45 kt estimated intensity in the best track at 1200 UTC 29 May, however, is based on scatterometer surface wind data from the QuikSCAT satellite.

During the hours leading up to Alma's landfall, several consecutive passive microwave satellites detected an incipient eye-like feature (Fig. 4). Conventional visible satellite imagery during that time showed evidence of a transient and ragged banding eye-like feature. The estimated peak intensity of 55 kt at 1800 UTC 29 May is based on subjective Dvorak intensity estimates of 55 kt from both TAFB and SAB. Despite the appearance of the eye-like feature, there is no quantitative data to suggest that Alma was stronger than 55 kt. Objective Automated Dvorak Technique (ADT) intensity estimates from the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin were slightly lower than the subjective Dvorak estimates during this time. The only report of sustained winds of tropical storm force in association with Alma was from an observing site in Corinto, Nicaragua. This site is just west of where Alma made landfall and it reported peak sustained winds of 40 kt at 2200 UTC 29 May (Table 2). The lowest minimum pressure reported in Nicaragua was 999.8 mb at 2100 UTC 29 May at Chinandega.

Alma and its incipient low produced heavy rainfall over much of Central America. Reports show that the largest amounts fell in Costa Rica and Nicaragua (Table 2). The highest storm total (28-29 May) recorded in Costa Rica was 14.82 in at Quepas. The highest amounts reported in Nicaragua were 11.72 in at Punto Sandino and 10.52 in at Chinandega.

c. Casualty and Damage Statistics

Media reports indicate that Alma was responsible for two direct deaths, with nine people currently missing. One of the direct deaths occurred in Honduras when a young girl was swept away while trying to cross a raging stream. The other death occurred offshore when a fishing vessel sank; two other persons onboard remain missing. A second small fishing boat with seven people on board also remains missing as of this writing.

Alma is also responsible for seven indirect deaths. Two of the indirect deaths occurred in Nicaragua and were the result of electrocutions from downed power lines. Weather associated with Alma was partially to blame for an aircraft accident in Tegucigalpa, Honduras around 1600 UTC 30 May. A Transportes Aéreos del Continente Americano (TACA) Airbus A-320 carrying 133 passengers and crew skidded off the runway at the Toncontin International Airport. Three people on the plane and two others on the ground perished.

According to a report from the United Nations (UN) Office for the Coordination of Humanitarian Affairs (OCHA), the hardest hit areas in Costa Rica were the cities of Guanacaste and Punta Arenas. In these areas more than a thousand homes were damaged and 150 were destroyed. Over 100 roads and bridges in Costa Rica were damaged, which left many communities isolated for several days. According to some reports, the flooding from Alma in Costa Rica was worse than the flooding experienced from Hurricane Cesar (1996) or Mitch (1998). Monetary losses in Costa Rica are estimated at \$33 million U.S. dollars.

The OCHA report indicated that about 200 homes were damaged in the Nicaraguan provinces of Leon and Chinandega, while in Honduras about 175 homes suffered damage. No monetary damage totals are available from Nicaragua or Honduras.

d. Forecast and Warning Critique

The genesis of Alma was well anticipated. The area of disturbed weather from which Alma formed was first introduced in the Tropical Weather Outlook about 48 h prior to development and the possibility of tropical depression formation was explicitly mentioned in the outlook beginning about 18 h before genesis. Categorical chances of development on the NHC's experimental graphical Tropical Weather Outlook initially indicated a low (<20%) chance of genesis from about 36-48 h prior to formation. The chances were increased to medium (20-50%) about 36 hours prior to formation, and to high (>50%) about 12 hours prior to genesis.

The average official track errors for Alma (with number of cases in parenthesis) were 24 (5), 55 (3), and 85 (1) n mi for the 12, 24, and 36 h forecasts, respectively. Due to the small number of forecasts, a meaningful comparison of the official forecast with the various track models is not possible. The mean NHC track errors for Alma are comparable with the recent 5-year (2003-2007) mean errors. All of the NHC forecasts accurately predicted landfall along the northwest coast of Nicaragua, though the first couple of forecasts predicted a slower forward speed. This resulted in the tropical storm making landfall a little earlier than initially predicted.

Average official intensity errors were 9, 7, and 0 kt for the 12, 24, and 36 h forecasts, respectively. For comparison, the average long-term official intensity errors are 6, 11, and 14 kt, respectively. The first two NHC intensity forecasts exhibited a low bias as they predicted only modest intensification of Alma.

Table 3 is a summary of coastal watches and warnings issued in association with Alma. Hurricane warnings were issued at 1600 UTC 29 May by the governments of Honduras and Nicaragua, in conjunction with a Special Forecast Advisory issued by NHC that indicated that Alma could become a hurricane prior to landfall.

Table 1. Best track for Tropical Storm Alma, 29-30 May 2008.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
29 / 0000	10.1	86.5	1003	30	tropical depression
29 / 0600	10.7	86.7	1002	35	tropical storm
29 / 1200	11.3	86.8	1000	45	"
29 / 1800	12.0	86.9	994	55	"
30 / 0000	12.9	87.1	998	45	"
30 / 0600	14.1	87.4	1004	30	tropical depression
30 / 1200	15.0	88.0	1006	25	"
30 / 1800					Dissipated
29 / 1800	12.0	86.9	994	55	Maximum wind and minimum pressure
29 / 1945	12.3	87.0	994	55	Landfall near Leon, Nicaragua

Table 2. Selected surface observations for Tropical Storm Alma, 29-30 May 2008.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) ^c	Storm tide (ft) ^d	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt) ^b	Gust (kt)			
Nicaragua^e								
Chinandega	29/2100	999.8	30/0000	28				10.51
Corinto			29/2200	40				9.42
Leon			29/1900	26				4.65
Managua								2.72
Masatepe								5.74
Nandaime								5.20
Monterosa								9.60
Ineter Central								3.25
Punto Morazan								6.46
S.J. Achuapa								4.84
Gallo Nombre de Jesus								6.67
Villa Nueva								4.59
El Sauce								5.95
Telica								6.23
Somotillo								5.82
Pueblo Nuevo								3.02
Matagalpa								3.69
Los Quesos								5.87
Jinotega								4.63
San Isidro								6.61
Punto Sandino								11.72
Granada								3.17
Masaya								6.07
Honduras^e								
Puerto Lempira								4.45
Choluteca								4.46

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) ^c	Storm tide (ft) ^d	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt) ^b	Gust (kt)			
Costa Rica^f								
Liberia								3.33
Hacienda Mojica								9.89
La Ceiba								13.93
Santa Rosa								5.00
Nicoya								3.57
Jaco								10.06
Damas								11.69
P. Seco								13.27
Quepos								14.82
Golfito								6.80
Coto 47								3.40
Rio Claro								3.13
San Jose								4.55
Alajuela								7.99
Pavas								5.73
Cigefi								4.09
Atenas								4.82
Upala								5.19
Catie								4.40

^a Date/time is for sustained wind when both sustained and gust are listed.

^b Except as noted, sustained wind averaging periods for C-MAN and land-based ASOS reports are 2 min; buoy averaging periods are 8 min.

^c Storm surge is water height above normal astronomical tide level.

^d Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level).

^e Rainfall total between 29-30 May.

^f Rainfall total between 28-29 May.

Table 3. Watch and warning summary for Tropical Storm Alma, 29-30 May 2008.

Date/Time (UTC)	Action	Location
29/ 0300	Tropical Storm Warning issued	Pacific coast of Costa Rica
29/ 0900	Tropical Storm Warning issued	Pacific coast of El Salvador
29/ 1200	Tropical Storm Warning issued	Pacific coast of Nicaragua and the Pacific coast of Honduras
29/ 1600	Tropical Storm Warning replaced with a Hurricane Warning	Pacific coast of Nicaragua and the Pacific coast of Honduras
29/ 1600	Hurricane Watch issued	Pacific coast of El Salvador
29/ 2100	Hurricane Warning replaced with a Tropical Storm Warning	Pacific coast of Nicaragua and the Pacific coast of Honduras
29/ 2100	Hurricane Watch discontinued	Pacific coast of El Salvador
29/ 2100	Tropical Storm Warning discontinued	Pacific coast of Costa Rica south of Jaco
30/ 0300	Tropical Storm Warning discontinued	Remainder of the Pacific coast of Costa Rica
30/ 0900	Tropical Storm Warning discontinued	Pacific coast of Honduras and the Pacific coast of El Salvador
30/ 1200	Tropical Storm Warning discontinued	Pacific coast of Nicaragua

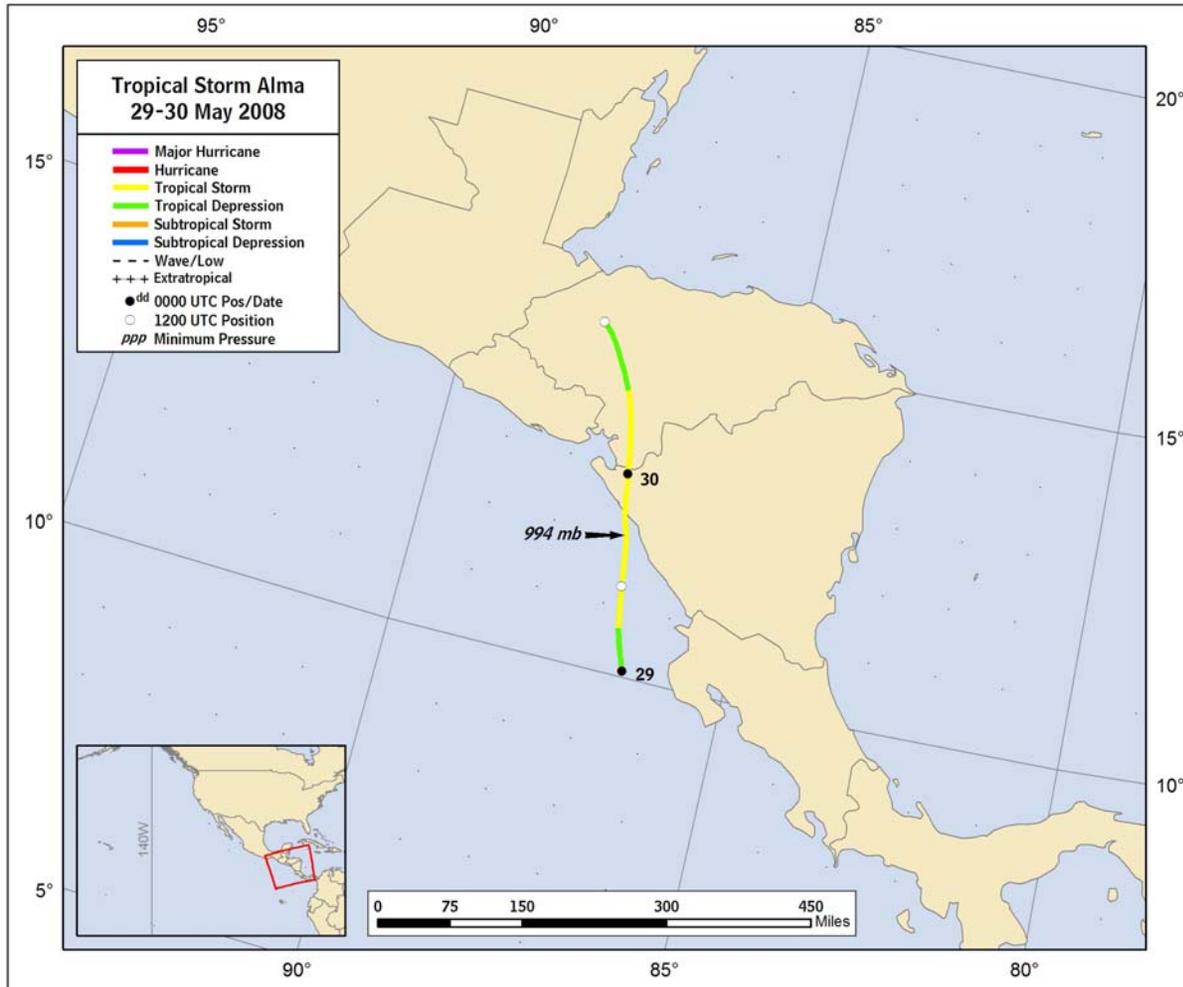


Figure 1. Best track positions for Tropical Storm Alma, 29-30 May 2008.

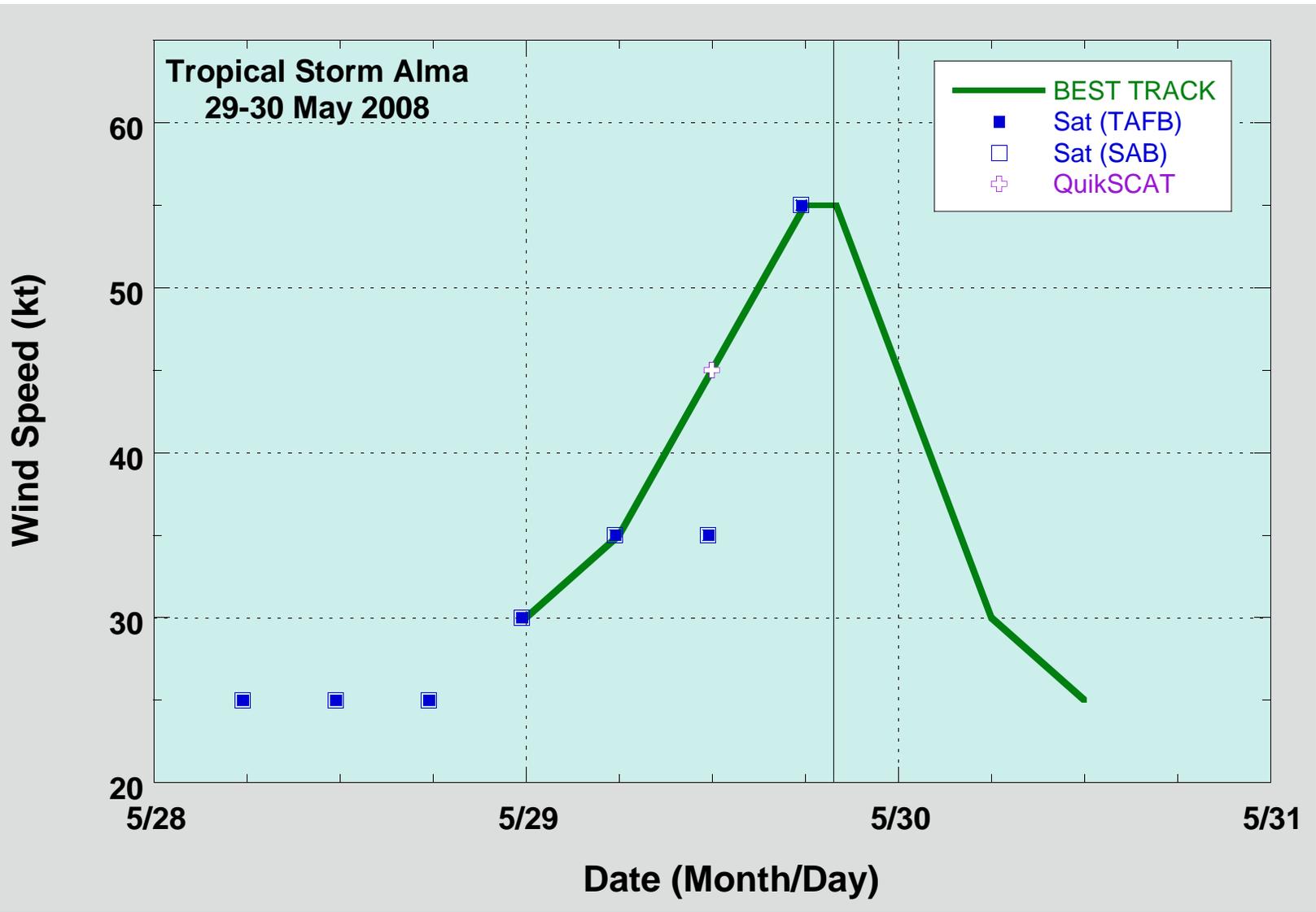


Figure 2. Selected wind observation, Dvorak analysis estimates, and best track maximum sustained surface wind speed curve for Tropical Storm Alma, 29-30 May 2008. Thin solid vertical line denotes landfall.

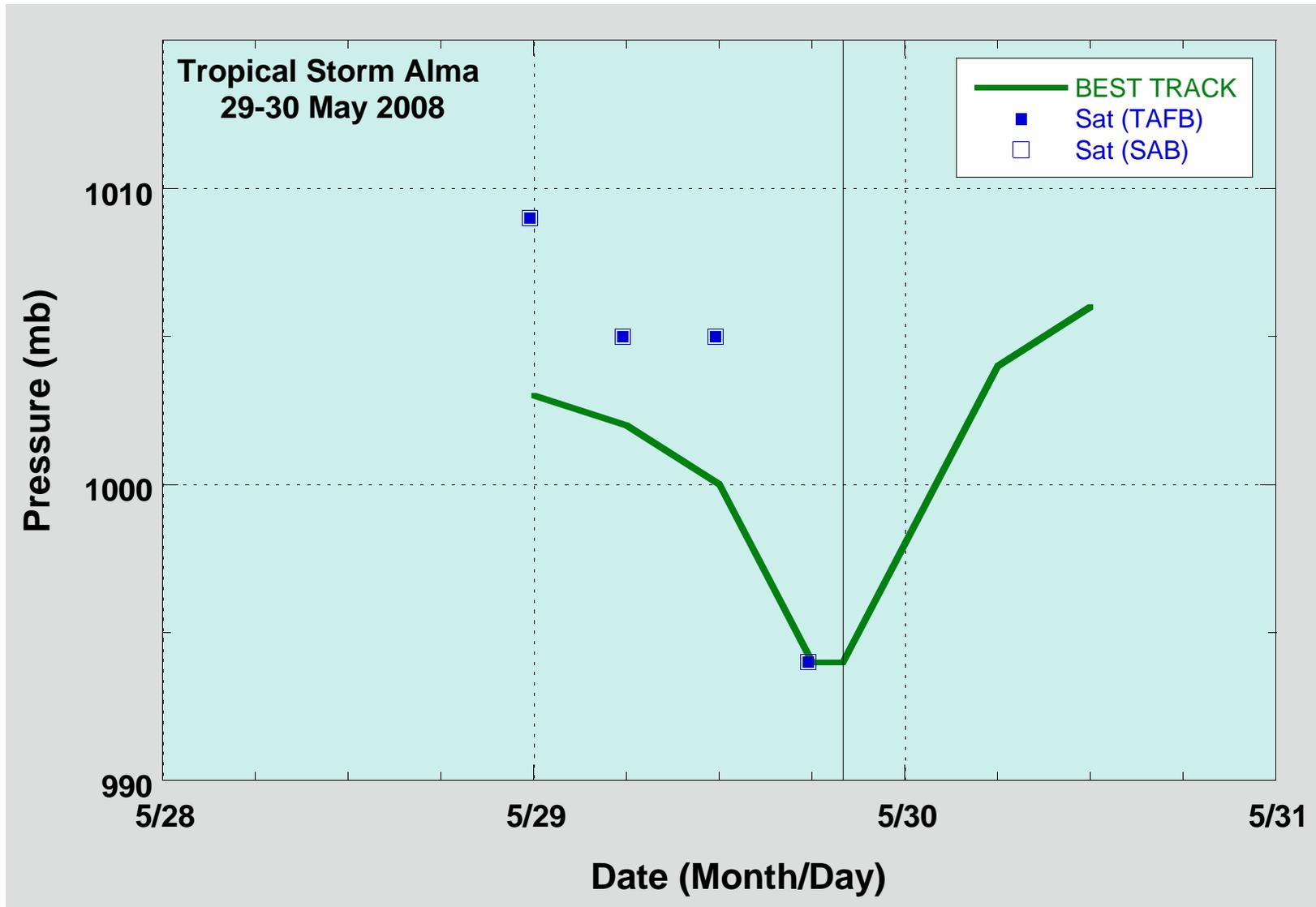


Figure 3. Dvorak pressure analyses and best track minimum central pressure curve for Tropical Storm Alma, 29-30 May 2008. Thin solid vertical line denotes landfall.

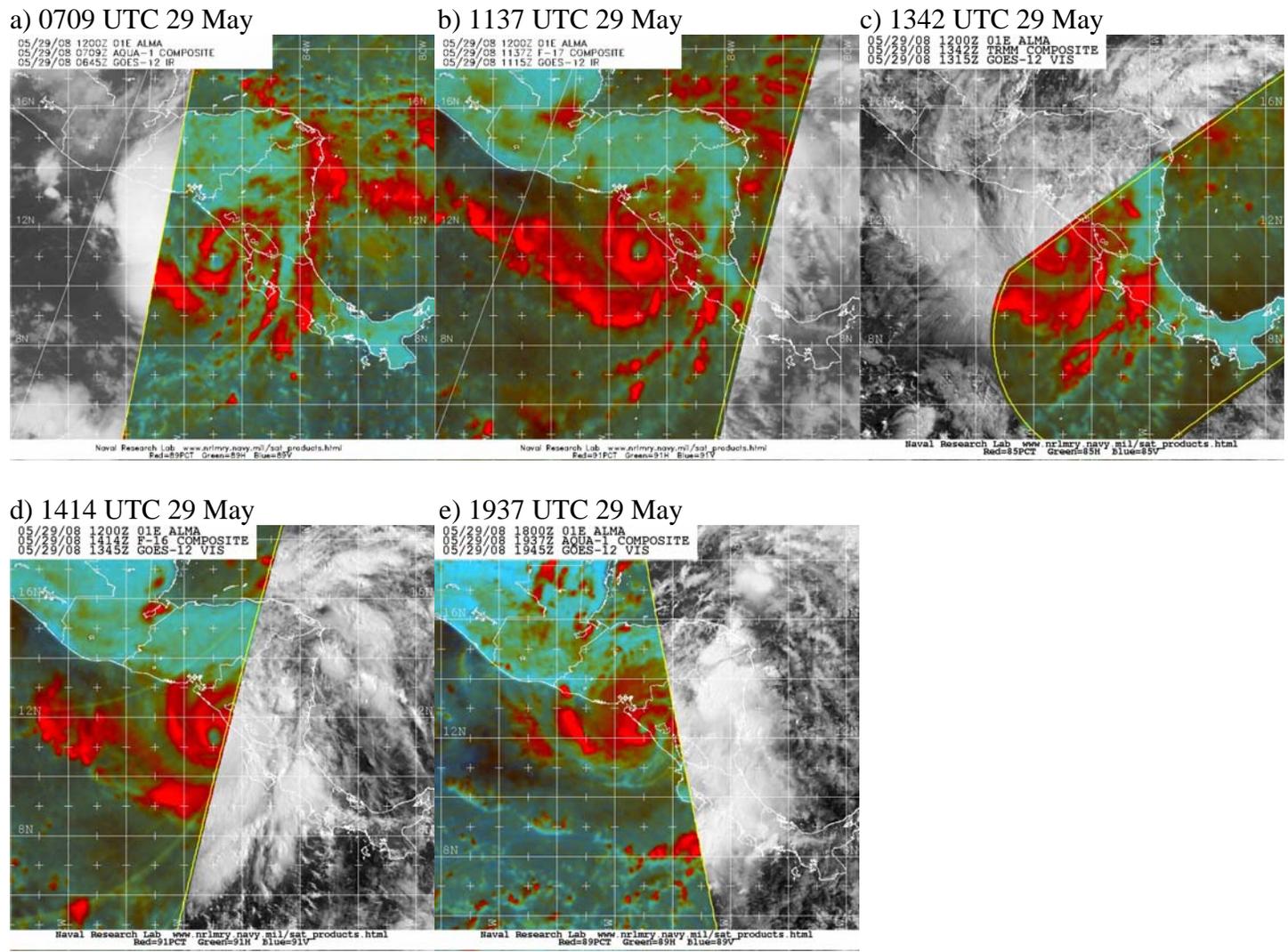


Figure 4. Series of composite 85-91 GHz passive microwave images of Tropical Storm Alma on 29 May 2008. The images show the evolution of an eye-like feature and the subsequent landfall along the Pacific coast of Nicaragua. Images courtesy of the Navy Research Laboratory (NRL).