

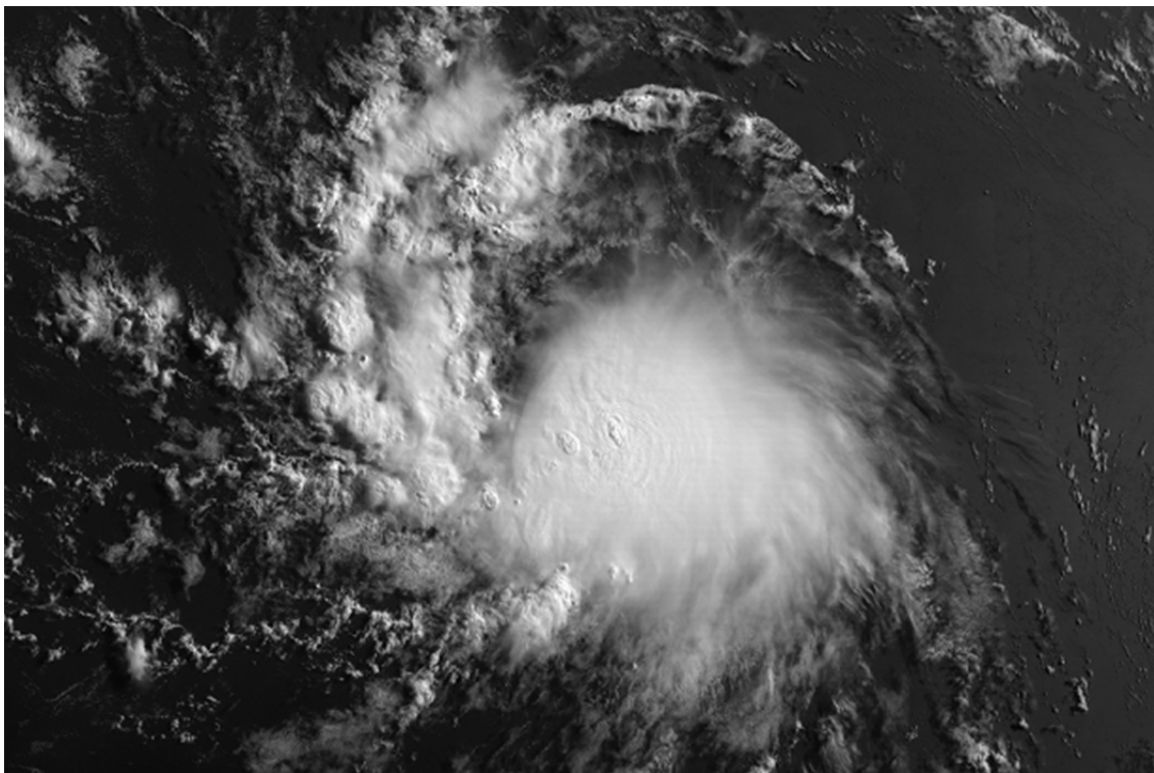


NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

TROPICAL STORM CHANTAL (AL032013)

7– 10 July 2013

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NOAA GOES-15 SATELLITE IMAGE OF TROPICAL STORM CHANTAL AT 1145 UTC 8 JULY

Chantal was a rare early July tropical storm that formed over the tropical Atlantic that rapidly passed through the central Lesser Antilles. It then dissipated over the central Caribbean Sea south of Hispaniola.

Tropical Storm Chantal

7– 10 JULY 2013

SYNOPTIC HISTORY

A large-amplitude tropical wave, accompanied by a burst of deep convection, moved off the west coast of Africa on 4 July during the active phase of the Madden-Julian Oscillation. The convection south of 10°N along the leading edge of the wave did not diminish after moving offshore and produced a small but distinct mid-level cyclonic circulation several hundred miles south of the Cape Verde Islands by early 5 July. Data from the European Space Agency's Advanced Scatterometer (ASCAT) that day indicated a sharp low-level surface trough was associated with the mid-level cyclonic center moving westward at 20 to 25 kt underneath a strong subtropical ridge over the eastern Atlantic. The surface trough continued moving rapidly westward and then west-northwestward at low latitude for the next couple of days but did not develop a closed circulation. Around 6 July, a convectively-coupled atmospheric Kelvin wave passed the surface trough, helping to create a more favorable large-scale environment for genesis. A tropical storm formed around 1200 UTC 7 July when scatterometer data from a pair of ASCAT passes indicated that the circulation became closed and well defined, with tropical-storm-force winds in a small area in the northeast quadrant of the circulation. The "best track" chart of Chantal'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 1¹.

Chantal's rapid forward motion continued to the south of the same strong subtropical ridge over the central Atlantic, where strong mid- to upper-level northeasterly flow partially exposed the center on the northern or northeastern side of the deep convection. The shear was not strong enough, however, to prevent gradual strengthening. As the cyclone neared the Lesser Antilles late on 8 July and early on 9 July, Chantal continued racing west-northwestward in a region dominated by a fast-paced low- to mid-level easterly flow. The strong lower tropospheric winds resulted in considerable westerly vertical shear over Chantal, and the cloud pattern of the cyclone became less organized. Despite the degradation in the satellite appearance of Chantal, surface observations and aircraft data indicate that the storm reached a peak intensity of 55 kt around 1200 UTC 9 July while it moved through the central Lesser Antilles just to the south of Martinique. A substantial fraction of this intensity, however, is attributed to the strong low-level environmental flow in which Chantal was embedded.

As Chantal raced into the eastern Caribbean Sea with a forward speed close to 30 kt, the cyclone continued to lose organization. The Air Force Reserve Hurricane Hunter aircraft investigating the system between 0000 and 0600 UTC 10 July could not locate a circulation center, perhaps because the circulation was small and moving faster than estimated

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 *bt* directory, while previous years' data are located in the *archive* directory.

operationally. Deep convection, primarily north and east of the estimated low-level center, diminished near the estimated low-level center during this time but began to re-develop prior to 1200 UTC. The next reconnaissance mission into Chantal that morning found a low-level center about 145 n mi south-southwest of Santo Domingo, Dominican Republic. However, the cloud pattern was becoming less organized, and Chantal degenerated into an open wave as it continued moving westward south of Hispaniola late that morning. The mid-level remnants of Chantal turned northwestward over eastern Cuba and continued on this heading through the southern Bahamas later that day and through the central and northern Bahamas on 12 July. The system's remnants became untrackable over the western Atlantic northeast of the Bahamas by 13 July.

METEOROLOGICAL STATISTICS

Observations in Chantal (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 five flights 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), ASCAT, and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Chantal.

There were no ship reports of winds of tropical storm force associated with Chantal. Selected surface observations from land stations and data buoys are given in Table 2. During Chantal's passage through the Lesser Antilles, an automated weather station at Trinité (elevation 26 m) on Martinique reported peak 1-minute winds of 60 kt with gusts to 65 kt. Vauclin, Fort-de-France, and the Aimé Cesaire International Airport (TFFF) recorded maximum 1-minute winds of 44-48 kt. Rainfall totals of 1 to 4 inches (25 to 100 mm) were common on the island, with highest amounts over the far south (Fig. 5). Winds gusts on the island of Dominica, to the south of the center, were reported to be as high as 42 kt, but there were no reports of sustained tropical-storm-force winds there.

The 55-kt estimated peak intensity of Chantal is primarily based on a peak 1-minute surface wind of 60 kt (56 kt after a reduction to 10 m) around 1200 UTC 9 July, and maximum SFMR winds of 55 kt around the same time. A peak flight-level (850 mb) wind of 77 kt was also recorded at 1654 UTC. The minimum pressure of 1003 mb was observed by the aircraft at 1204 UTC that day, when the center was crossing the central Lesser Antilles. The estimated minimum pressure of Chantal is generally below aircraft estimates since the plane frequently encountered difficulty locating the center of the small and fast-moving tropical cyclone.

Chantal is the fastest-moving tropical cyclone observed in the deep Tropics (with a 6-hour forward motion of 28 kt) in the Atlantic basin (south of 20°N) in the observational record during the satellite era (1966-present).

CASUALTY AND DAMAGE STATISTICS

Heavy rains and tropical-storm-force winds buffeted portions of the central Lesser Antilles for a few hours during the morning of 9 July as Chantal passed through the region (Fig 5). High winds reportedly ripped roofs off of houses in Dominica and caused some electrical outages. Several landslides were reported as a result of the heavy rains. Elsewhere, the damage reported in the Lesser Antilles was minimal, and there were no casualties.

In Hispaniola, heavy rains associated with Chantal caused flooding over portions of the island, but the fast-moving nature of the system precluded a more severe flooding event. In the Dominican Republic, there was one direct death when a 26-year old firefighter from the community of Maimon was killed as he was swept away by flood waters when he tried to clear a drain.

FORECAST AND WARNING CRITIQUE

The genesis of Chantal was not well forecast. The tropical wave from which Chantal developed was introduced into Tropical Weather Outlook 36 h prior to genesis with a low chance (less than 30%) of development. The likelihood of genesis was increased to a medium chance (30 to 50%) 18 h before genesis but never reached the high category. Although atmospheric conditions were generally favorable for tropical cyclone development, global models showed a weak representation of the system that became Chantal. That and the fast movement of the seedling disturbance were negative factors that forecasters considered to be impediments to development (and, in fact, Chantal did not survive long as a tropical cyclone).

A verification of NHC official track forecasts for Chantal is given in Table 3a. Official forecast track errors were 30-60% greater than the mean official errors for the previous 5-yr period, though the sample size is small by 36 h. The track model guidance underestimated the rapid forward motion of Chantal, which led to some large along-track official forecast errors. For example, at 36 h, the forecast track position bias was about 90 n mi slow. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. The European Center for Medium-Range Forecasting (ECMWF) model and the Florida State Superensemble (FSSE) consistently outperformed the official forecast as well as the remainder of the track guidance.

A verification of NHC official intensity forecasts for Chantal is given in Table 4a. Official forecast intensity errors were slightly lower than the mean official errors for the previous 5-yr period at 24 h and 36 h. The greater than average official intensity errors at 48 h are related to forecasts calling for Chantal be stronger over the Caribbean. The sample at 48 h, however, is too small to draw any meaningful conclusions. The dissipation of Chantal was never explicitly forecast, although this possibility was mentioned in a couple of tropical cyclone discussions. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. While no single model excelled, DSHP and LGEM performed better than the rest of



the intensity guidance through 36 h. The FSSE and GHMI intensity output, however, was the best overall guidance.

Watches and warnings associated with Chantal are given in Table 5. Because the storm formed only a short time before reaching the Lesser Antilles, tropical storm warnings were issued for portion of that area less than 12 h prior to the onset of tropical-storm-force winds. Tropical storm watches were upgraded to warnings for Puerto Rico, the U.S. Virgin Islands, and much of Hispaniola while the center of Chantal approached. However, tropical storm conditions did not occur at these locations.

Table 1. Best track for Tropical Storm Chantal, 7-10 July 2013.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
07 / 1200	9.3	41.4	1011	35	tropical storm
07 / 1800	9.5	43.8	1011	35	"
08 / 0000	9.8	46.1	1010	35	"
08 / 0600	10.1	48.4	1009	35	"
08 / 1200	10.7	50.6	1008	40	"
08 / 1800	11.4	52.9	1007	45	"
09 / 0000	12.1	55.2	1006	50	"
09 / 0600	13.0	57.7	1005	50	"
09 / 1200	13.9	60.3	1003	55	"
09 / 1800	14.8	62.9	1006	55	"
10 / 0000	15.6	65.6	1008	45	"
10 / 0600	16.2	68.4	1010	40	"
10 / 1200	16.7	71.2	1011	40	"
10 / 1800					dissipated
09 / 1200	13.9	60.3	1003	55	Maximum wind and minimum pressure

Table 2. Selected surface observations for Tropical Storm Chantal, 7-10 July 2013.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (mm)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt) ^b	Gust (kt)	
Martinique						
Lamentin Airport (TFFF) elevation: 3 m	09/1400	1011.7	09/1500	44	52	35.3
Fort-de-France elevation: 143 m	09/1400	1010.4	09/1600	45	66	
Trinité elevation: 26 m	09/1300	1014.0	09/1400	60	65	8.3
St. Anne elevation: 22 m			09/1500	40	47	77.5
Vauclin elevation: 12 m				48 ^{c,d}	72	
Saint Pierre elevation: 27 m				32 ^d	59	
Anse D'Arlet elevation: 7 m						118.8
Trois-Îlets elevation: 42 m						101.0
Saint-Luce elevation: 44 m						78.2
Rivière-Pilote elevation: 80 m						80.0
Font-Denis-Cadet elevation: 510 m			09/1445		93	
Dominica						
Canefield Airport (TDCF)			09/1700		42	
Melville Hall Airport (TDPD)			09/1600		38	

^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 reports are 2 min; buoy averaging periods are 8 min.

^c Estimated wind

^d 10-minute average wind



Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Chantal. 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	46.0	79.6	94.7	101.7			
OCD5	70.6	144.6	232.5	293.4			
Forecasts	9	7	5	3			
OFCL (2008-12)	28.6	45.8	62.2	78.6			
OCD5 (2008-12)	47.5	99.7	161.4	224.0			



Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Chantal. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 3a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	46.0	79.6	94.7	101.7			
OCD5	70.6	144.6	232.5	293.4			
GFSI	54.2	87.4	102.9	98.7			
GHMI	54.9	88.5	109.0	114.1			
HWFI	53.4	89.8	114.6	139.0			
EMXI	43.4	71.0	92.3	120.0			
CMCI	57.0	82.8	95.4	99.9			
TVCA	47.2	79.2	95.4	105.0			
FSSE	44.2	67.0	77.8	75.1			
AEMI	50.3	81.5	101.5	110.4			
BAMS	48.7	76.7	100.0	133.2			
BAMM	61.1	98.7	138.2	182.6			
BAMD	48.7	76.7	100.0	133.2			
Forecasts	9	7	5	3			

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Chantal. 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	6.7	9.3	11.0	15.0			
OCD5	7.8	9.1	12.0	10.0			
Forecasts	9	7	5	3			
OFCL (2008-12)	6.6	10.1	12.2	14.1			
OCD5 (2008-12)	7.8	11.6	14.0	15.6			

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Chantal. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 4a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	6.7	9.3	11.0	15.0			
OCD5	7.8	9.1	12.0	10.0			
HWFI	5.8	9.4	12.2	5.3			
GHMI	5.2	9.0	14.6	9.3			
DSHP	6.6	6.0	10.2	18.3			
LGEM	6.8	6.6	10.4	15.3			
ICON	5.7	7.1	12.0	12.0			
IVCN	5.7	7.1	12.0	12.0			
FSSE	5.7	6.9	12.0	8.3			
Forecasts	9	7	5	3			

Table 5. Watch and warning summary for Tropical Storm Chantal, 7-10 July 2013.

Date/Time (UTC)	Action	Location
8 / 0300	Tropical Storm Watch issued	St. Vincent
8 / 0300	Tropical Storm Warning issued	Barbados/Dominica
8 / 0300	Tropical Storm Warning issued	St. Lucia
8 / 0900	Tropical Storm Warning issued	Guadeloupe/Martinique
8 / 1500	Tropical Storm Watch issued	Puerto Rico
8 / 2100	Tropical Storm Watch changed to Tropical Storm Warning	Puerto Rico
8 / 2100	Tropical Storm Watch issued	U.S. Virgin Islands
8 / 2100	Tropical Storm Watch issued	Cabo Engano to southern border of the Dominican Republic/Haiti
9 / 0300	Tropical Storm Watch changed to Tropical Storm Warning	Cabo Engano to southern border of the Dominican Republic/Haiti
9 / 0300	Tropical Storm Watch issued	Cabo Engano to Cabo Frances Viejo
9 / 0300	Tropical Storm Watch issued	Haiti
9 / 0900	Tropical Storm Watch modified to	Cabo Engano to northern border of the Dominican Republic/Haiti



Date/Time (UTC)	Action	Location
9 / 1200	Tropical Storm Watch issued	Turks and Caicos/Southeastern Bahamas
9 / 1500	Tropical Storm Watch discontinued	St. Vincent
9 / 1500	Tropical Storm Watch discontinued	Cabo Engano to northern border of the Dominican Republic/Haiti
9 / 1500	Tropical Storm Watch discontinued	Haiti
9 / 1500	Tropical Storm Watch issued	Le Mole St. Nicholas to southern border of the Dominican Republic/Haiti
9 / 1500	Tropical Storm Warning discontinued	Barbados/Dominica
9 / 1500	Tropical Storm Warning discontinued	Cabo Engano to southern border of the Dominican Republic/Haiti
9 / 1500	Tropical Storm Warning issued	Dominica
9 / 1500	Tropical Storm Warning issued	Dominican Republic
9 / 1500	Tropical Storm Warning issued	Le Mole St. Nicholas to northern border of the Dominican Republic/Haiti
9 / 1500	Hurricane Watch issued	Barahona to Samana
9 / 1800	Tropical Storm Warning discontinued	St. Lucia
9 / 2100	Tropical Storm Watch changed to Tropical Storm Warning	Turks and Caicos/Southeastern Bahamas



Date/Time (UTC)	Action	Location
9 / 2100	Tropical Storm Watch discontinued	Le Mole St. Nicholas to S bdr Haiti/DR
9 / 2100	Tropical Storm Watch issued	Central Bahamas
9 / 2100	Tropical Storm Warning discontinued	Guadeloupe/Martinique
9 / 2100	Tropical Storm Warning discontinued	Dominica
9 / 2100	Tropical Storm Warning discontinued	Le Mole St. Nicholas to northern border of the Dominican Republic/Haiti
9 / 2100	Tropical Storm Warning issued	Haiti
10 / 0600	Hurricane Watch discontinued	All
10 / 0900	Tropical Storm Watch discontinued	U.S. Virgin Islands
10 / 0900	Tropical Storm Warning discontinued	Puerto Rico
10 / 1500	Tropical Storm Watch issued	Jamaica
10 / 1800	Tropical Storm Warning discontinued	Dominican Republic
10 / 2100	Tropical Storm Watch discontinued	All
10 / 2100	Tropical Storm Warning discontinued	All

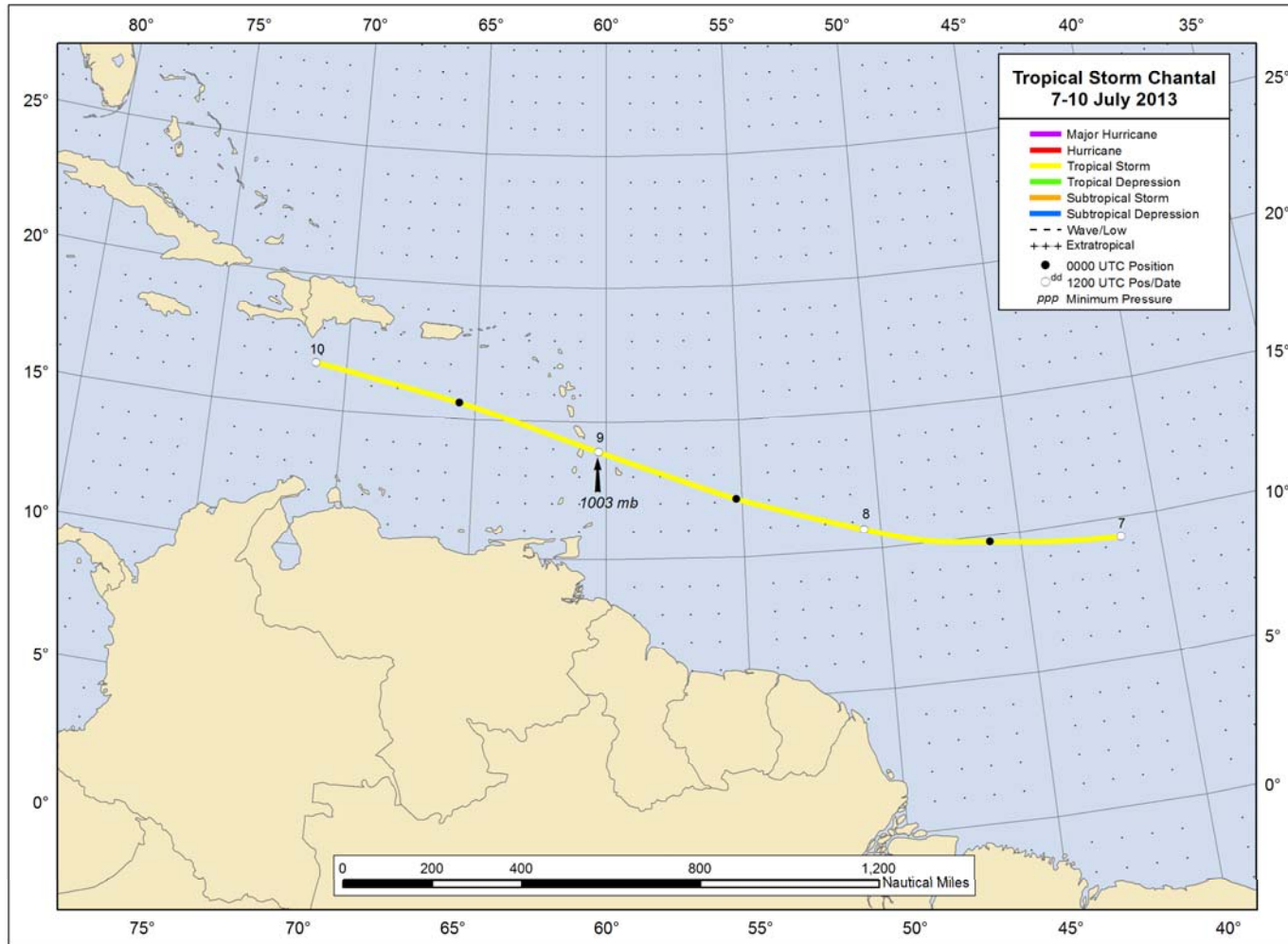


Figure 1. Best track positions for Tropical Storm Chantal, 7-10 July 2013.

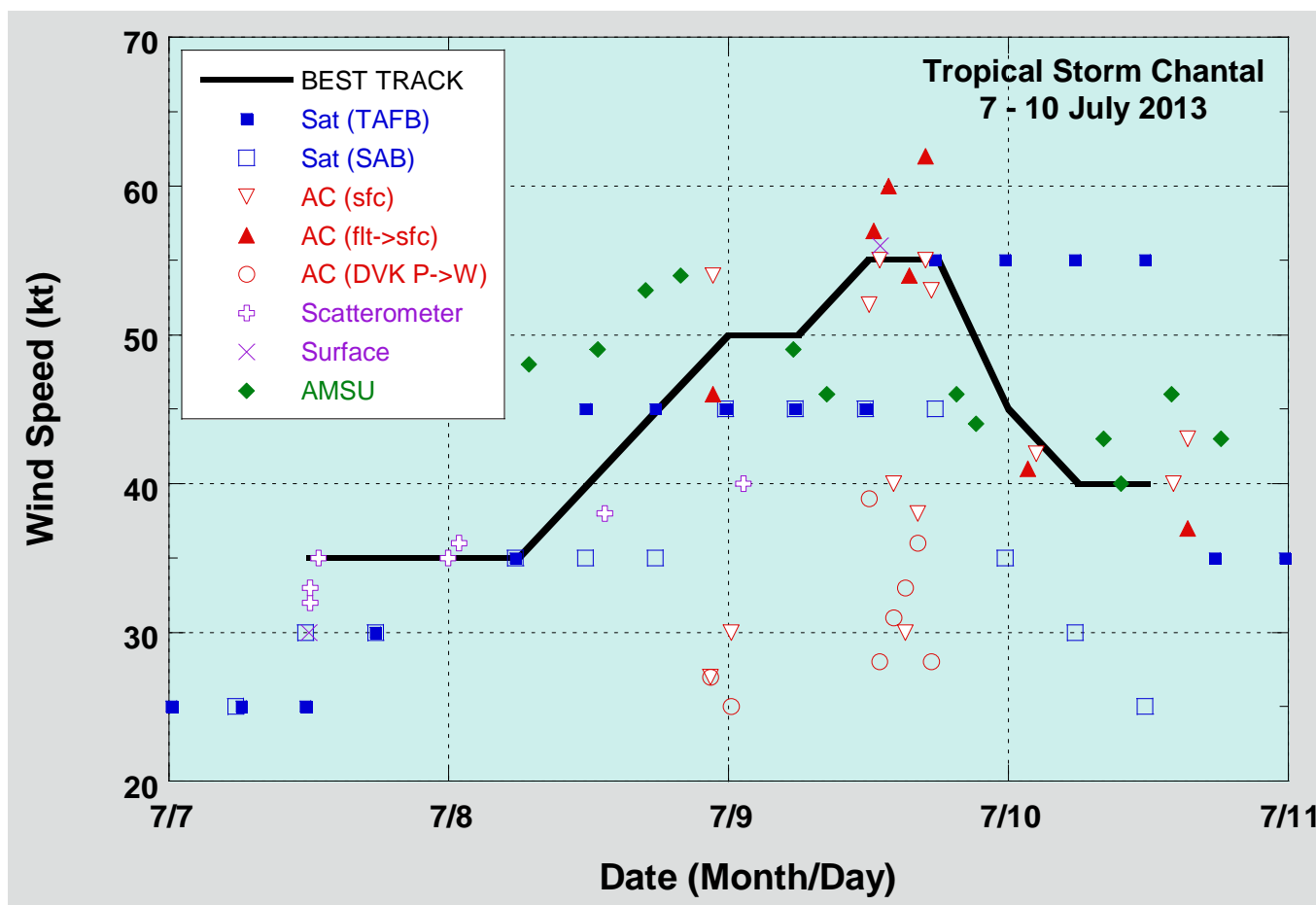


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Chantal, 7-10 July 2013. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% adjustment factors for observations from 850 mb and 1500 ft, respectively. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC.

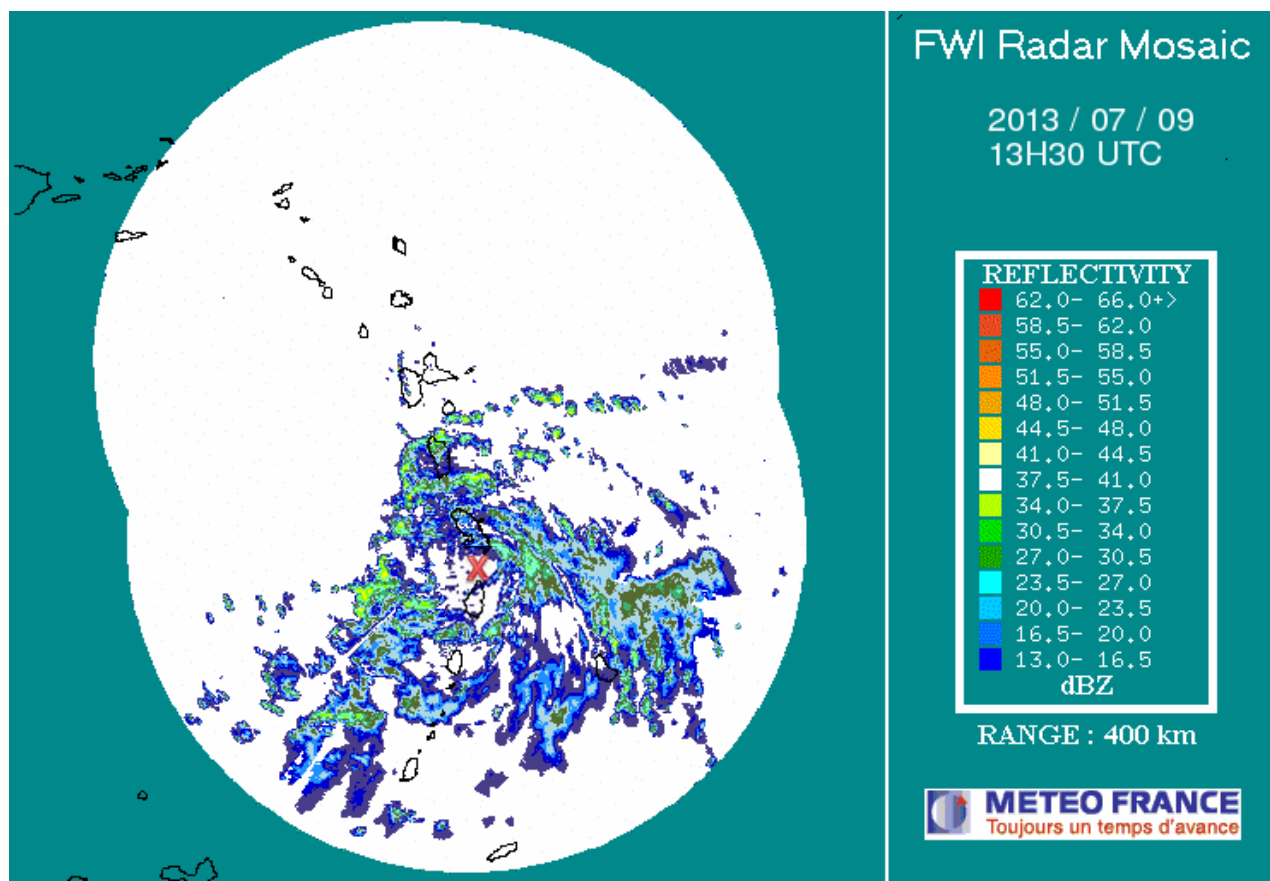


Figure 4. 1330 UTC 9 July 2013 radar image showing the center of Chantal passing in between Martinique and Dominica. Image courtesy of Météo France. The symbol X indicates the center of Chantal.

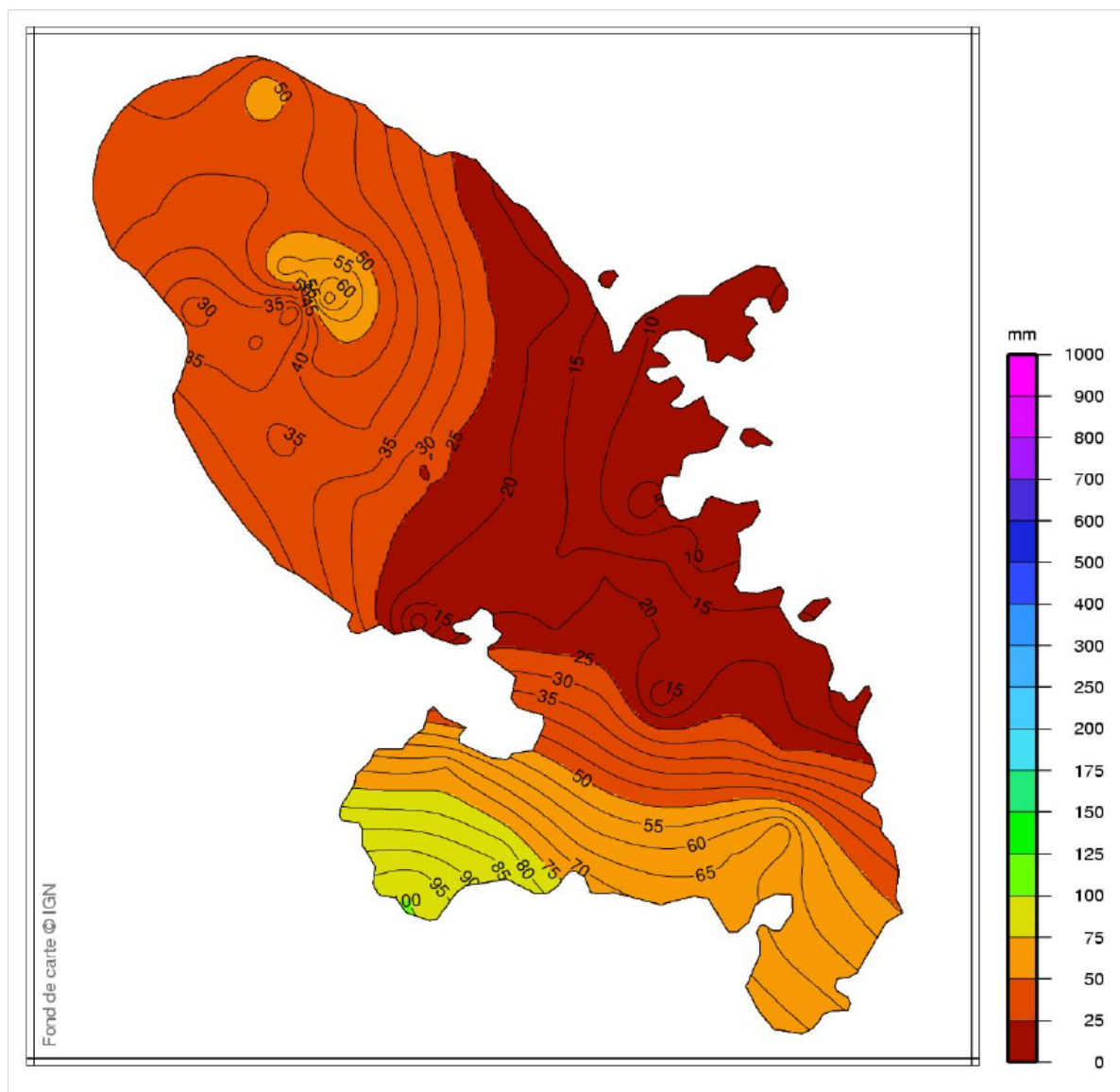


Figure 5. Storm total rainfall over Martinique. Courtesy of Météo France.