NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM LORENZO

(AL132013)

21 – 24 October 2013

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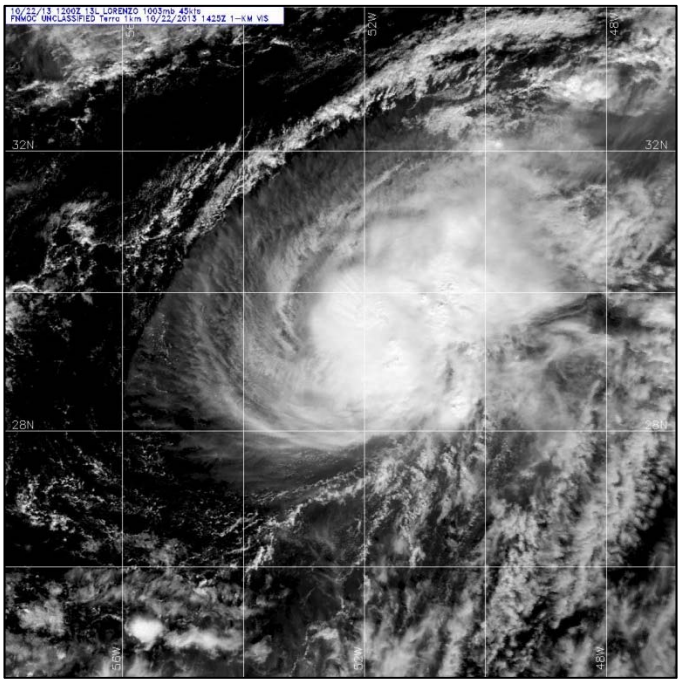
9 December 2013[1]



VISIBLE SATELLITE IMAGE OF TROPICAL STORM LORENZO AT 1425 UTC 22 OCTOBER FROM THE NASA TERRA SATELLITE. IMAGE COURTESY OF THE NAVY FLEET NUMERICAL AND OCEANOGRAPHY CENTER.

Lorenzo was a short-lived tropical storm that remained over the open waters of the central Atlantic.

[1] Original report date 22 November 2013. Corrected minimum pressure listed in Table 1.

Tropical Storm Lorenzo

21 – 24 OCTOBER 2013

SYNOPTIC HISTORY

The disturbance from which Lorenzo formed appears to have originated from the northern portion of a tropical wave that departed the west coast of Africa on 11 October. When the wave moved over the central Atlantic on 15 October, it encountered a mid- to upper-level trough that was located east of the Lesser Antilles. This caused an increase in convection near the northern portion of the wave. During the next few days, while the southern portion of the tropical wave continued westward, a weak surface trough developed in association with the northern portion of the wave and moved slowly west-northwestward over the central Atlantic. The surface trough began to sharpen about 600 n mi east-northeast of the northern Leeward Islands, when it interacted with a second mid- to upper-level trough located over the western Atlantic north of Puerto Rico. When the mid- to upper-level trough cut off to the north of Puerto Rico, the surface trough turned northwestward, and a broad surface low pressure area formed the next day about 675 n mi southeast of Bermuda. Despite some southwesterly vertical shear caused by the upper-level low, deep convection associated with the surface low began to increase late on 20 October. Early the next day the surface low became better defined, marking the formation of a tropical depression about 540 n mi east-southeast of Bermuda. 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[2].

Around the time of genesis, the upper-level low over the western Atlantic moved southwestward, which caused the vertical shear to decrease slightly over the tropical cyclone. The depression strengthened into a tropical storm as the cyclone began moving north-northeastward at 5 to 10 kt around the northwestern side of a mid-level ridge located over the central Atlantic. Around 0600 UTC 22 October, despite moderate westerly shear, a large burst of deep convection developed over the center, and the system strengthened further. Lorenzo reached its estimated peak intensity of 45 kt 6 h later, when early morning visible satellite imagery (cover photo) showed an increase in banding and a mid-level eye-like feature was briefly noted in microwave data (Fig. 4). The microwave imagery suggests that despite the increase in organization, west-northwesterly shear was still affecting the cyclone, since the mid-level center was displaced somewhat to the east-southeast of the low-level center. Around the time Lorenzo reached its peak intensity, the cyclone turned eastward in weak westerly low- to mid-level flow.

[2] 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.

Early on 23 October, strong northerly upper-level winds moved over Lorenzo, causing the tropical cyclone to weaken. Shear increased further by late in the day and the center of Lorenzo became exposed well to the northwest of the remaining deep convection. Lorenzo weakened to a tropical depression by 0000 UTC 24 October and degenerated to a remnant low 12 h later. The remnant low turned northeastward in the low-level southwesterly flow ahead of a cold front over the west-central Atlantic. The low continued to weaken over the next day or two and degenerated into an open trough by 1200 UTC 26 October about 730 n mi west-southwest of Flores Island in the Azores.

METEOROLOGICAL STATISTICS

Observations in Lorenzo (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. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Tropical Rainfall Measuring Mission (TRMM), 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 Lorenzo.

Microwave data (Fig. 4) indicate that Lorenzo reached a peak in organization around 1200 UTC 22 October when a mid-level eye-like feature was noted. Subjective Dvorak intensity estimates at that time ranged from 35 kt from TAFB to 55 kt from SAB, and ADT and AMSU wind speed estimates were around 45 kt. Since the mid-level eye feature was short-lived, the peak intensity of Lorenzo is estimated to be 45 kt, which is in agreement with the ADT and AMSU wind speed assessments. Although ADT intensity estimates increased to 53 kt late on 22 October, microwave data indicated that by that time the organization of the inner core decreased. The 45-kt estimated intensity through 0600 UTC 23 October is supported by Dvorak data T-numbers of T3.0 from both SAB and TAFB between 1800 UTC 22 October and 0600 UTC 23 October.

There were no reliable ship reports of winds of tropical storm force in association with Lorenzo.

CASUALTY AND DAMAGE STATISTICS

There were no reports of damage or casualties associated with Lorenzo.

FORECAST AND WARNING CRITIQUE

The genesis of Lorenzo was not expected. The disturbance from which Lorenzo formed was introduced into the Tropical Weather Outlook only 6 h before development occurred. At that time, the disturbance was assigned a low (less than 30%) chance of formation. The development of Lorenzo was also not well predicted by the global models. The small size of the precursor disturbance and the expected moderate vertical shear appear to be the primary reasons why the global models did not show significant development of the system.

A verification of NHC official track forecasts for Lorenzo is given in Table 2a. Official forecast (OFCL) track errors through 36 h were slightly lower than the mean official errors for the previous 5-yr period. NHC official track errors at 48 h were comparable to the long-term mean. A homogeneous comparison of the official track errors with selected guidance models is given in Table 2b. The only individual model that exhibited lower errors than the official forecasts at each verifying time was the HWFI. The TVCA and FSSE consensus models also slightly bettered the NHC forecasts at all verifying times.

A verification of NHC official intensity forecasts for Lorenzo is given in Table 3a. Official forecast intensity errors were much lower than the mean official intensity errors for the previous 5-yr period. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 3b. The NHC forecasts and the intensity model guidance performed quite well for Lorenzo. Both the NHC forecasts and the models correctly predicted only modest strengthening of the cyclone due to the expected moderate to strong vertical wind shear. The NHC forecasts had the lowest average errors at each verifying time except at 24 h, where they were slightly beaten by HWFI.

Table 1. Best track for Tropical Storm Lorenzo, 21-24 October, 2013.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
21 / 0600	27.6	55.9	1012	30	tropical depression
21 / 1200	28.2	55.6	1010	35	tropical storm
21 / 1800	28.8	55.0	1008	35	"
22 / 0000	29.1	54.2	1008	35	"
22 / 0600	29.3	53.3	1005	40	"
22 / 1200	29.4	52.4	1000	45	"
22 / 1800	29.5	51.5	1000	45	"
23 / 0000	29.5	50.6	1001	45	"
23 / 0600	29.5	49.8	1004	45	"
23 / 1200	29.4	49.3	1006	40	"
23 / 1800	29.3	48.9	1007	35	"
24 / 0000	29.4	48.4	1008	30	tropical depression
24 / 0600	29.7	48.0	1009	30	"
24 / 1200	30.1	47.7	1011	25	low
24 / 1800	30.5	47.2	1012	25	"
25 / 0000	30.7	46.7	1013	25	"
25 / 0600	31.0	46.1	1013	25	"
25 / 1200	31.3	45.7	1013	25	"
25 / 1800	31.6	45.3	1013	25	"
26 / 0000	32.1	44.7	1013	20	"
26 / 0600	32.8	43.9	1013	20	"
26 / 1200					dissipated
22 / 1200	29.4	52.4	1000	45	maximum winds and minimum pressure

Table 2a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Lorenzo. 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	**23.2**	**39.0**	**55.5**	79.1			
OCD5	40.4	94.3	157.3	229.3			
Forecasts	10	8	6	4			
OFCL (2008-12)	28.6	45.8	62.2	78.6	116.6	160.0	206.4
OCD5 (2008-12)	47.5	99.7	161.4	224.0	329.7	417.5	493.1

Table 2b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Lorenzo. 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 2a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	25.7	42.7	59.3	84.2			
OCD5	45.1	100.0	163.7	243.0			
GFSI	**23.7**	43.5	61.2	88.4			
GHMI	34.8	59.0	85.5	114.4			
HWFI	**22.5**	**34.7**	**47.6**	**53.4**			
EMXI	26.7	**39.3**	**48.0**	**70.2**			
CMCI	**21.6**	**33.6**	**52.1**	87.6			
AEMI	30.4	52.0	67.1	95.5			
FSSE	**23.4**	**37.4**	**49.5**	**74.4**			
TVCA	**24.3**	**42.5**	**58.0**	**74.5**			
LBAR	35.2	46.0	60.9	148.4			
BAMD	40.6	70.8	122.0	202.1			
BAMM	33.1	65.3	98.4	163.0			
BAMS	42.5	70.2	79.7	89.1			
Forecasts	8	7	5	3			

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Lorenzo. 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	**3.0**	**3.8**	**2.5**	**2.5**			
OCD5	6.2	10.1	10.5	14.8			
Forecasts	10	8	6	4			
OFCL (2008-12)	6.6	10.1	12.2	14.1	15.4	15.1	16.1
OCD5 (2008-12)	7.8	11.6	14.0	15.6	17.9	18.0	17.9

Table 3b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Lorenzo. 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	3.3	3.6	2.0	1.7			
OCD5	6.8	11.0	12.6	16.7			
GHMI	5.9	7.1	6.4	7.0			
HWFI	4.3	**3.4**	4.8	3.0			
DSHP	5.4	7.6	7.2	7.0			
LGEM	6.1	9.6	8.0	7.3			
ICON	5.0	5.6	4.0	4.0			
IVCN	5.0	5.6	4.0	4.0			
FSSE	4.1	4.9	5.2	3.3			
NF	9	7	5	3			

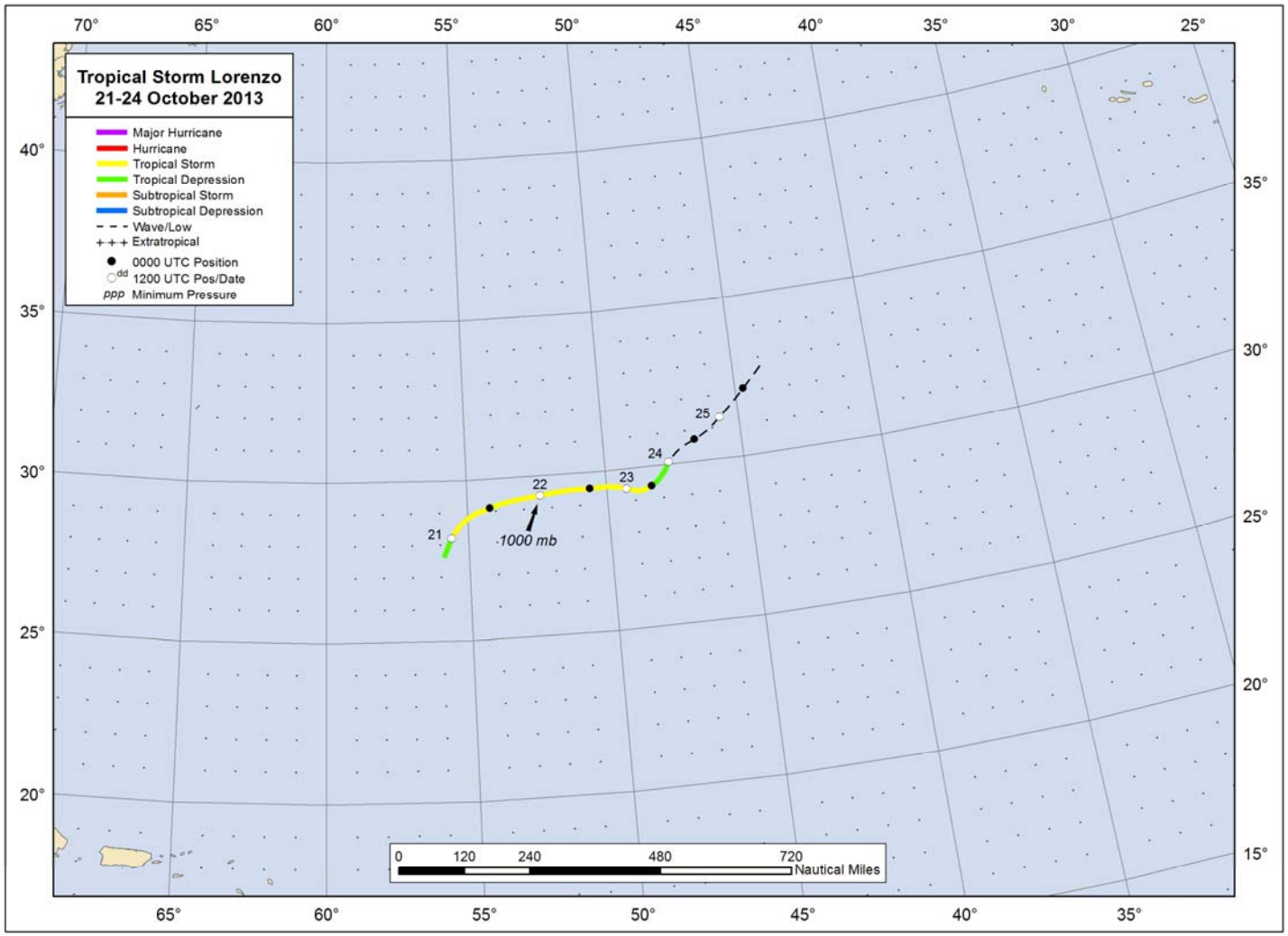


Figure 1. Best track positions for Tropical Storm Lorenzo, 21-24 October 2013.

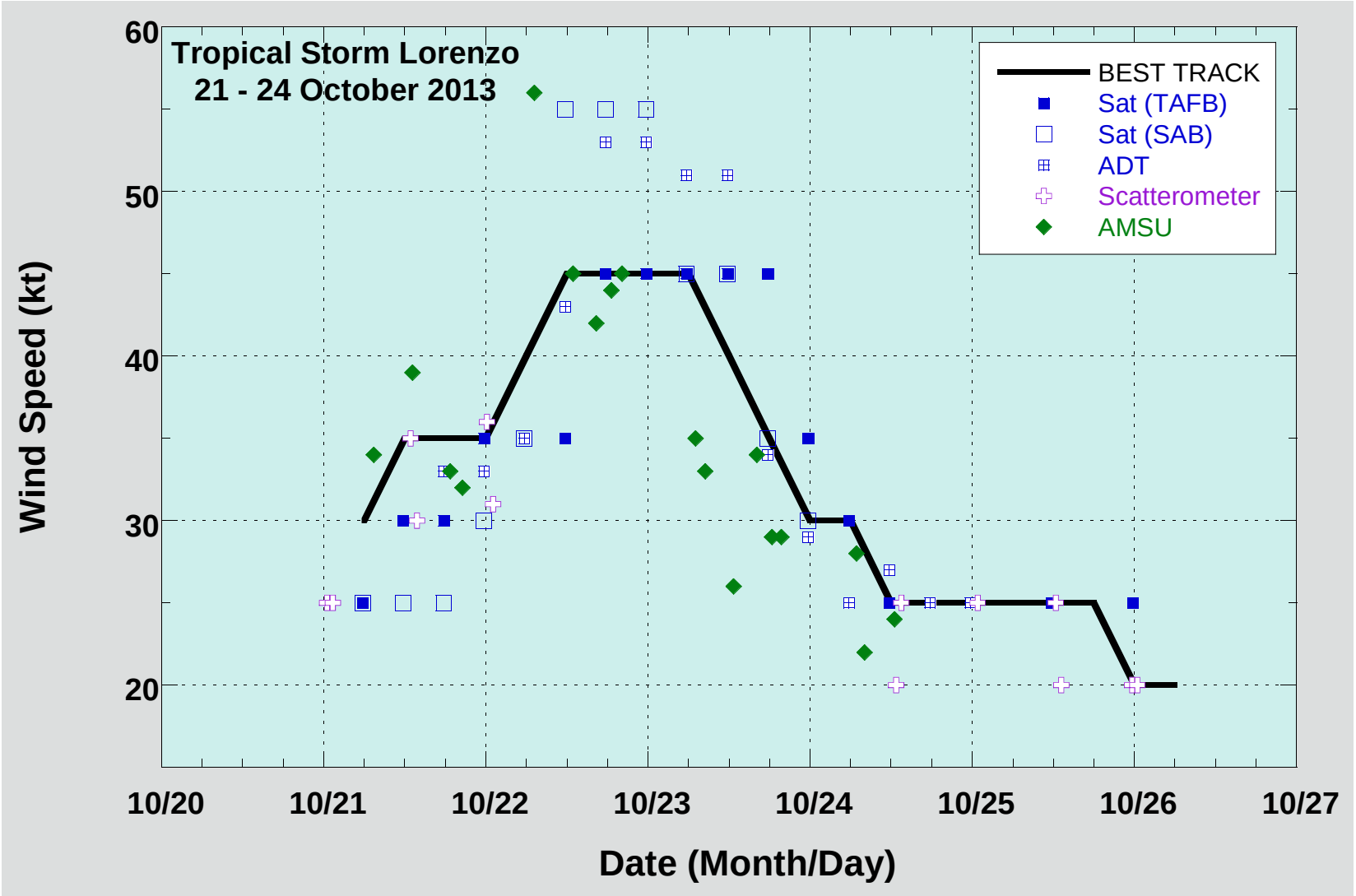


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Lorenzo, 21-24 October 2013. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC.

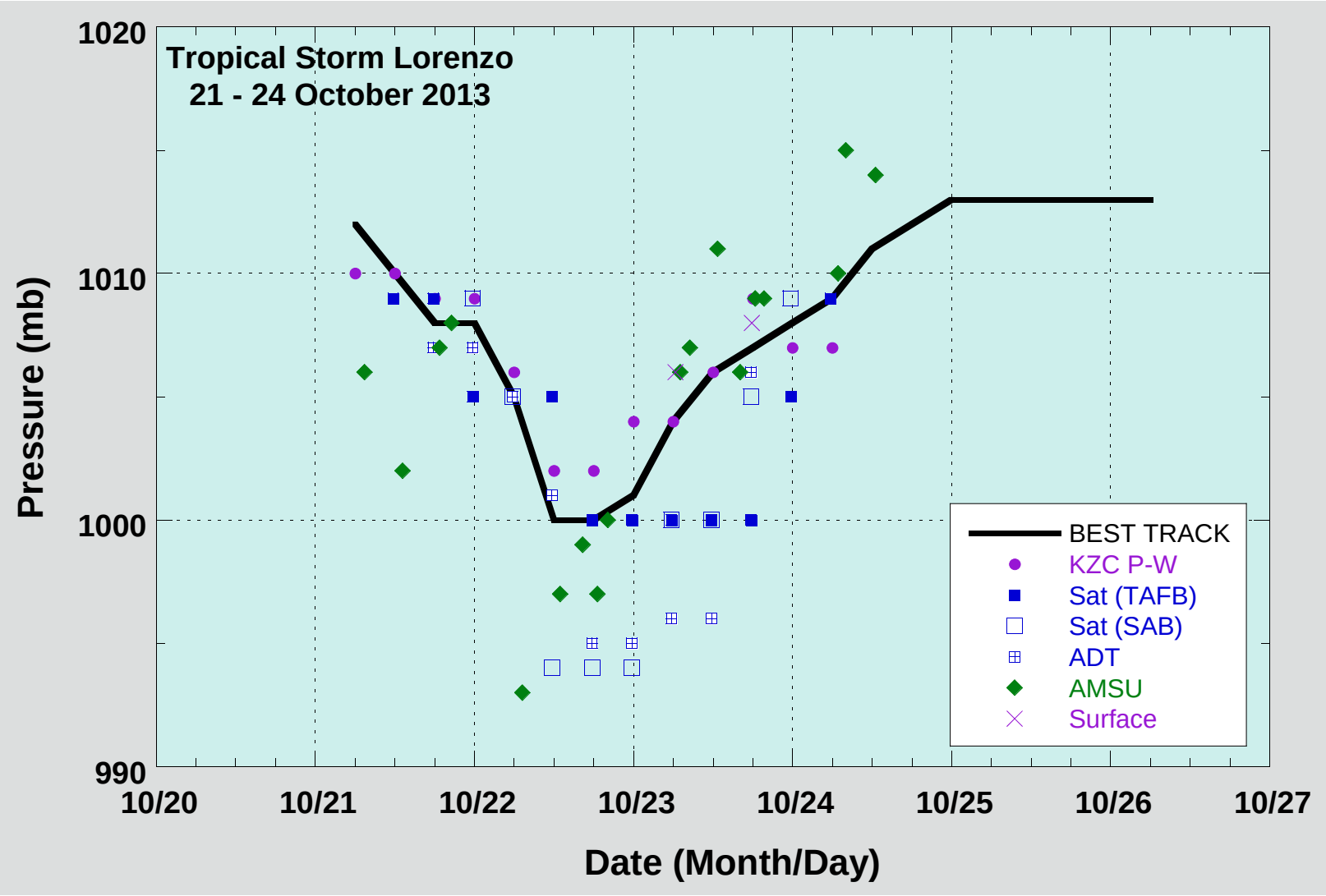


Figure 3. Selected pressure observations and best track minimum central pressure curve for Lorenzo, 21-24 October 2013. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite 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.

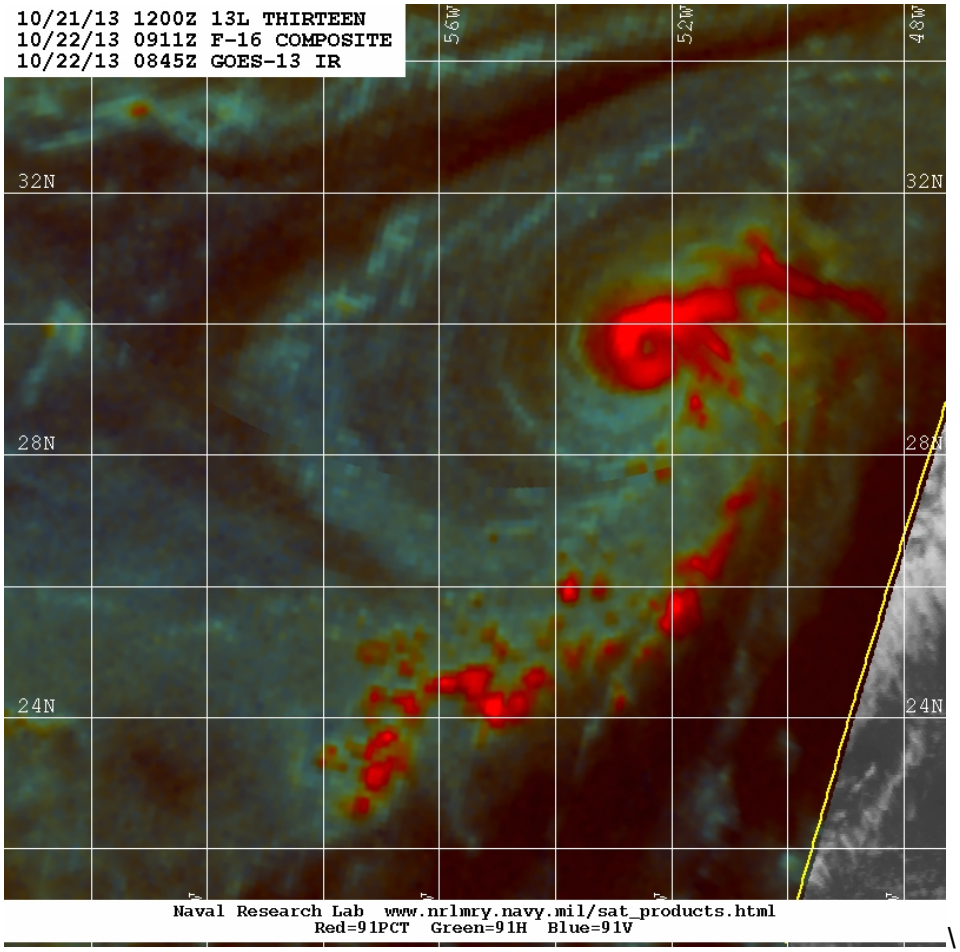


Figure 4. Special Sensor Microwave Imager/Sounder (SSMIS) composite 91-GHz image of Lorenzo near peak intensity. Image courtesy of the Navy Research Laboratory.