Tropical Cyclone Report
Tropical Storm Nicole
(AL162010)
28-29 September 2010

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Updated on 7 March for final Jamaican rainfall and casualty information

Nicole was an unusually large tropical cyclone over the northwestern Caribbean Sea. It bought gusty winds and heavy rains to eastern Cuba, Jamaica and southeastern Florida.

a. Synoptic History

A large area of low pressure was present over the northwestern Caribbean Sea, Gulf of Mexico and eastern Pacific Ocean on 26 September as the remnants of Tropical Storm Matthew moved westward into Central America. The low drifted east-northeastward and produced scattered convection on 27 September, with an ill-defined center located a couple hundred miles east of Cozumel, Mexico. At that time most of the convection was located well east of the center, and the surface circulation was elongated east to west. Early the next day, a center of circulation became better defined, and buoy data showed near gale-force winds located well southeast of the center. When organized convection persisted in bands east of the center near 1200 UTC, the low became a tropical storm, centered about 65 n mi south of the Isle of Youth, Cuba. The "best track" chart of the tropical cyclone's path is given in Figure 1, with the wind and pressure histories shown in Fig 2 and 3, respectively. The best track positions and intensities are listed in Table 1[1]. Nicole moved generally northeastward during its time as a tropical cyclone due to southwesterly deep-layer flow ahead of an approaching mid-latitude trough.

ASCAT data indicated that the system reached a peak intensity of about 40 kt shortly after formation. However, the storm had a very unusual structure, with a large area of light and variable winds near the center and an area of strong winds located about 200-300 n mi from the center. In addition, Nicole was rather lopsided on satellite images, with almost all of the significant weather well to the east and southeast of the center. As the storm approached Cuba, the area of strong winds contracted somewhat, though the satellite appearance remained asymmetric most of the time due to westerly shear. Surface observations indicate that Nicole's center of circulation, which was never particularly well defined, became untrackable between 1200-1500 UTC on 29 September over Cuba, marking the dissipation of Nicole as a tropical cyclone. A broad area of low pressure remained, however, and the low accelerated northeastward and began to take on frontal characteristics. The extratropical transition was complete by 0600 UTC 30 September in the northwestern Bahamas. By 1800 UTC that day,

[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.

however, the low had weakened into a trough, eventually becoming absorbed by a new low forming to its north over eastern North Carolina.

b. Meteorological Statistics

Observations in Nicole (Figs. 2 and 3) include satellite-based Dvorak and Hebert-Poteat technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB), and UW-CIMSS intensity estimates using the Advanced Microwave Sounding Unit (AMSU). In addition, flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from three flights of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command were included. Data and imagery from NOAA polar-orbiting satellites, Defense Meteorological Satellite Program (DMSP) satellites, radars from the United States and Cuba, National Aeronautics and Space Administration (NASA) satellites, including TRMM, and Aqua, the U.S. Navy WindSat, and the EUMETSAT ASCAT, among other satellites, were also useful in constructing the best track of Nicole.

Nicole was a rather unusual system for the Atlantic basin, with a structure somewhat resembling that of a monsoon depression of the Indian or western Pacific Oceans. The radius of maximum winds was quite large, at least 200 n mi from the center, although convection was within about 90-120 n mi, which was close enough to the center to warrant a tropical or subtropical classification. One notable difference is that while monsoon depressions can have a cold-core structure, AMSU data suggested that Nicole was warm-core in the middle to upper levels (Fig. 4), with the warm-core strengthening with time, more typical of a tropical cyclone.

The estimated peak intensity of this system was based on ASCAT and aircraft data. The peak flight-level winds were 46 kt at 850 mb on 29 September at 1742 UTC, with SFMR values of 36-39 kt around that time. ASCAT data from the previous day indicated maximum winds of about 40 kt.

The estimated minimum central pressure of 995 mb is based on pressure observations over Cuba.

Exceptionally heavy rainfall was noted over Jamaica in association with Nicole and its precursor low pressure area (Fig. 5) from 26 – 30 September. A long fetch of southwesterly winds and deep moisture even affected that island after Nicole moved into the Atlantic Ocean. The peak reported rainfall was 37.42 in at Belleisle, Jamaica. Most of the island received 1-2 feet of rain during that 5 day period of time. Areas of heavy rainfall were also reported over portions of southern Florida, the Keys and Cuba. The maximum reported amount in Florida was 12.64 in at North Key Largo, with the maximum in Cuba being 9.22 in at Cabo Cruz.

Ship reports of winds of tropical storm force associated with Nicole are given in Table 2, and selected surface observations from land stations and data buoys are given in Table 3. A wind gust to 55 kt was reported at the western tip of Jamaica near Negril, though no sustained data are available.

c. Casualty and Damage Statistics

The government of Jamaica indicates that 13 people died in Jamaica as a result of Nicole, primarily due to severe flooding. More than 300,000 households were without power on that island during the storm and the National Work Agency of Jamaica estimated that repairs to the country's infrastructure would cost approximately 235 million US dollars.

In the United States, no casualties were reported and the storm's effects were relatively minor. There was street flooding noted in Miami Beach and the upper Keys, with one residence having about a foot of water inside the home at the Florida Boy Scout Sea Base in the Keys.

d. Forecast and Warning Critique

The genesis of Nicole was fairly well anticipated by NHC and the global models. The system that eventually became Nicole was introduced in the Tropical Weather Outlook 48 h before genesis in the low category (<30%). It was upgraded to medium (30-50%) 24 h before genesis, though it only made the high category 6 h before it became a tropical storm.

A verification of NHC official track forecasts for Nicole is given in Table 4. The forecasts were considerably worse than the 5-yr average, though the sample is rather small for this short-lived system. One possible reason for the large errors was that the initial position uncertainty was quite high for Nicole.

Table 5 is a verification of NHC official intensity forecasts for Nicole. The errors were lower than average, though, again, the sample was small. In general the NHC official forecasts anticipated only a little strengthening, similar to what was observed.

A list of the coastal watches and warnings for Nicole is given in Table 6. There were no land-based observations of sustained tropical-storm-force winds in the United States, though there were gusts at near-shore stations.

Acknowledgements:

Thanks to the Met Service of Jamaica and WFOs Key West and Miami for their comprehensive post-storm reports that contained much of the data for this report.

Table 1. Best track for Tropical Storm Nicole, 28-29 September 2010.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
28 / 0000	19.4	84.1	1003	25	low
28 / 0600	19.8	83.5	1003	30	"
28 / 1200	20.4	83.0	1001	35	tropical storm
28 / 1800	21.0	82.7	999	40	"
29 / 0000	21.4	82.2	997	35	"
29 / 0600	21.7	81.6	996	35	"
29 / 1200	21.9	81.0	995	40	"
29 / 1500	22.2	80.5	995	40	low
29 / 1800	23.3	80.1	994	40	"
30 / 0000	24.7	79.6	994	40	"
30 / 0600	26.1	79.0	995	40	extratropical
30 / 1200	27.4	78.5	996	40	"
30 / 1800					absorbed
29 / 1200	21.9	81.0	995	40	maximum wind and minimum pressure

Table 2. Selected ship reports with winds of at least 34 kt for Nicole.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
29 / 0600	C6VQ8	19.2	75.1	190 / 35	1005.4
29 / 1300	WDE538	17.9	82.1	230 / 37	999.0
29 / 2200	C6FN4	22.3	77.6	170 / 35	997.0
30 / 0000	C6SE3	25.7	77.5	150 / 35	1000.0
30 / 0300	C6FN4	23.5	79.2	180 / 35	997.0
30 / 0600	WBN651	24.9	74.6	140 / 35	1001.0
30 / 0600	LADQ4	26.9	73.3	150 / 38	1007.8
30 / 1200	WPGK	25.6	75.8	170 / 37	1001.0
30 / 1200	3FCB8	27.6	74.8	140 / 40	1000.0

Table 3. Selected surface observations for Tropical Storm Nicole, 28-29 September, 2010.

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)			
Cuba								
Cabo Cruz (78360)			29/1500	35				9.22
Guantanamo Bay (MUGM)	29/0856	1005.4	29/1529	34	46			
Jucaro (78345)								8.78
Sancti Spiritus (78349)								8.11
Pinar del Rio (78315)								6.45
Nuevitas (78353)								6.26
Cienfuegos (78244)								5.91
Camaguey (MUCM)								5.80
Jamaica								
Negril			29/1613		55			
Belleisle								37.42
Shrewsbury								28.06
Manchester Pastures								27.94
Barham								26.73
Marshall's Pen Sutton								26.06
Frome # 2								25.74
Seaview FP								24.96
Beckford Kraal								24.65
Frome Met Stn								23.65
Masemure								23.50
Warsop								22.48
Grimmith								22.24
Constant Spring FP								22.22
Raheen								21.56
Y.S. Falls								20.92
Old Moneymusk Climo								20.75
Newcastle								20.28
Holland								19.60

Grove Place								19.54
Bois Content								19.46
Savanna-la-mar								19.21
Mavis Bank								19.06
Thompson Town								19.02
Craig Head								18.90
Negril Point LH								18.84
Cotton Tree Gully								18.62
Castleton Gardens								18.46
Lawrence Tavern								18.11
Irish Town								18.02
Norbrook Park								17.93
Spur Tree Hill End								17.62
Waterloo Rd CIB								17.56
Crofts Hill								17.18
Marshalls Pen Alcan								17.12
Jacks Hill (Ivor)								17.04
Palisadoes								16.62
Bybrook								16.26
Mumby								15.49
New Works Farm								15.30
Charm Hole								15.24
Morelands								15.12
Hillside								14.92
Exeter								14.15
Black River								12.78
Boscobel								12.21
Sangster								11.33
Hampstead								9.44
Bromley								8.70
Buoys								
42057 (16.8°N 81.5°W)			29/1600	35	39			
International Civil Aviation Organization (ICAO) Sites								
Florida								
Pompano Beach Airpark	29/2253	997.1	29/0742		35			

(KPMP)								
Hollywood North Perry Airport (KHRL)	29/2334	997.2	28/2033		36			1.43
C-MAN Sites								
Sand Key Light (SANF1)			29/0413		34			
Sombrero Key Light (SMKF1)	29/2200	995.0	28/1922		39			
Molasses Reef Light (MLRF1)	29/2200	995.2	29/0330		40			
Fowey Rocks (FWYF1)	30/0000	996.1	29/0457		35			
Lake Worth (LKWF1)	29/2118	996.7	28/2154		38			
Other Sites								
Long Key, Florida Keys Aqueduct CWOP (CW0922)	29/2141	994.0	29/0211		35			
Virginia Key Handar (KVIK)	29/2347	995.6	28/2147		35			
Rainfall observations								
North Key Largo Handar								12.64
Islamorada 7.8 SW COCORAHS								12.28
Whipray Basin								10.96
Long Key FKAA CWOP								10.81
Duck Key (eastern Florida Bay)								10.19
Trout Cove								9.71
Little Blackwater Sound								9.45
Little Rabbit Key								9.37
Long Sound								9.12
Key Largo CWOP								9.03
Islamorada Fire Station 20								8.45
Bob Allen Key								8.21
Blackwater Sound								8.19
Little Madeira Key								7.85
Miami Beach								7.20
Homestead Bayfront								6.93
Homestead 11 SW								6.81
Cutler Bay 3 SSE								6.77
Westchester								6.57
Lake Worth 8 WSW								6.22
Johnson Key								6.12

Virginia Key/AOML								6.06
Lake Worth 1 NNW								6.04
NWS Miami								6.00

[a] Date/time is for sustained wind when both sustained and gust are listed.
[b] Except as noted, sustained wind averaging periods for land-based reports are 10 min; buoy averaging period is 1 min.
[c] Storm surge is water height above normal astronomical tide level.
[d] Storm tide is water height above mean lower low water.

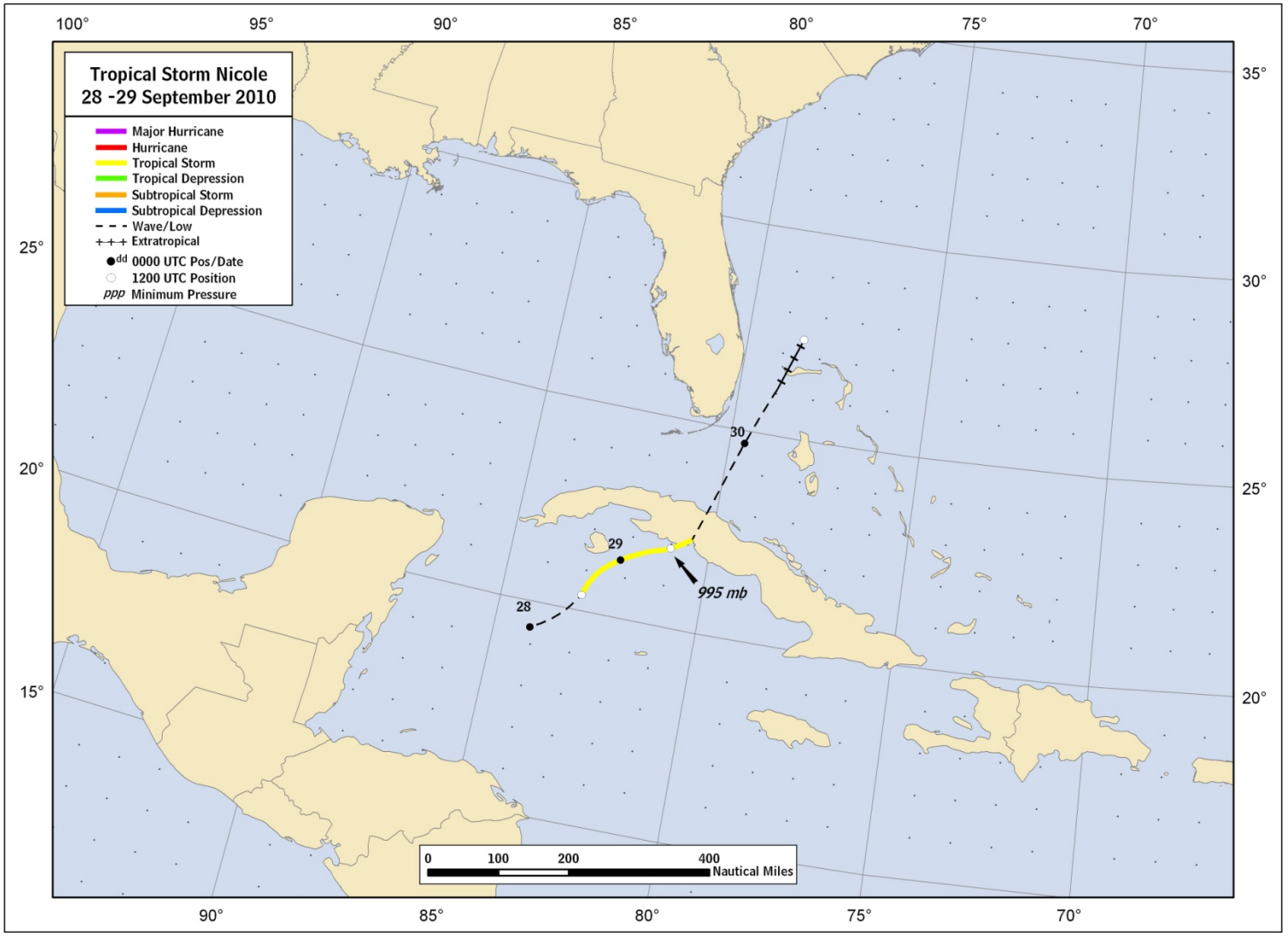

Figure 1. Best track positions for Tropical Storm Nicole, 28-29 September 2010.

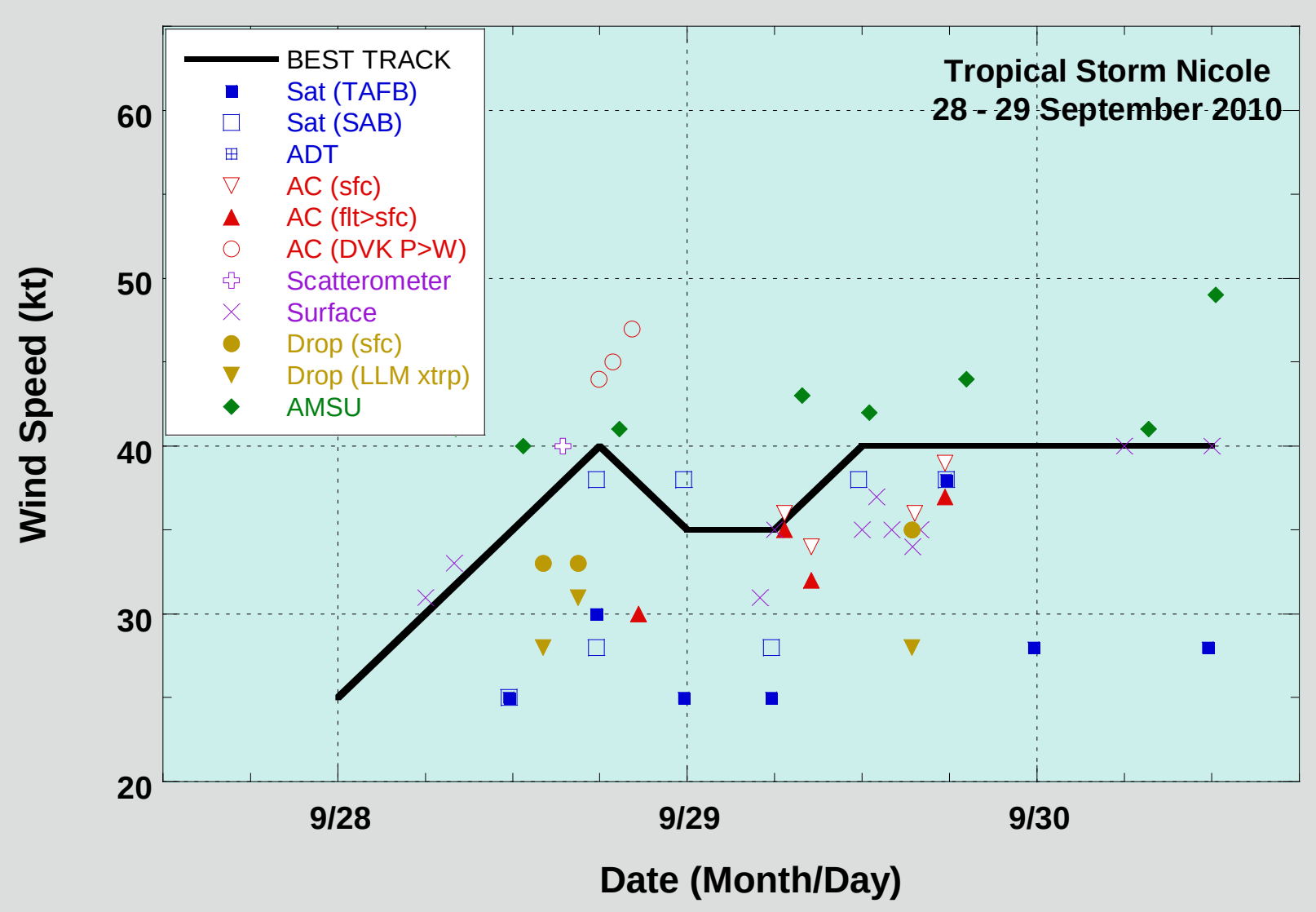

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Nicole, 28-29 September 2010. Dashed vertical lines correspond to 0000 UTC. AMSU Data is from the UW-CIMSS Technique.

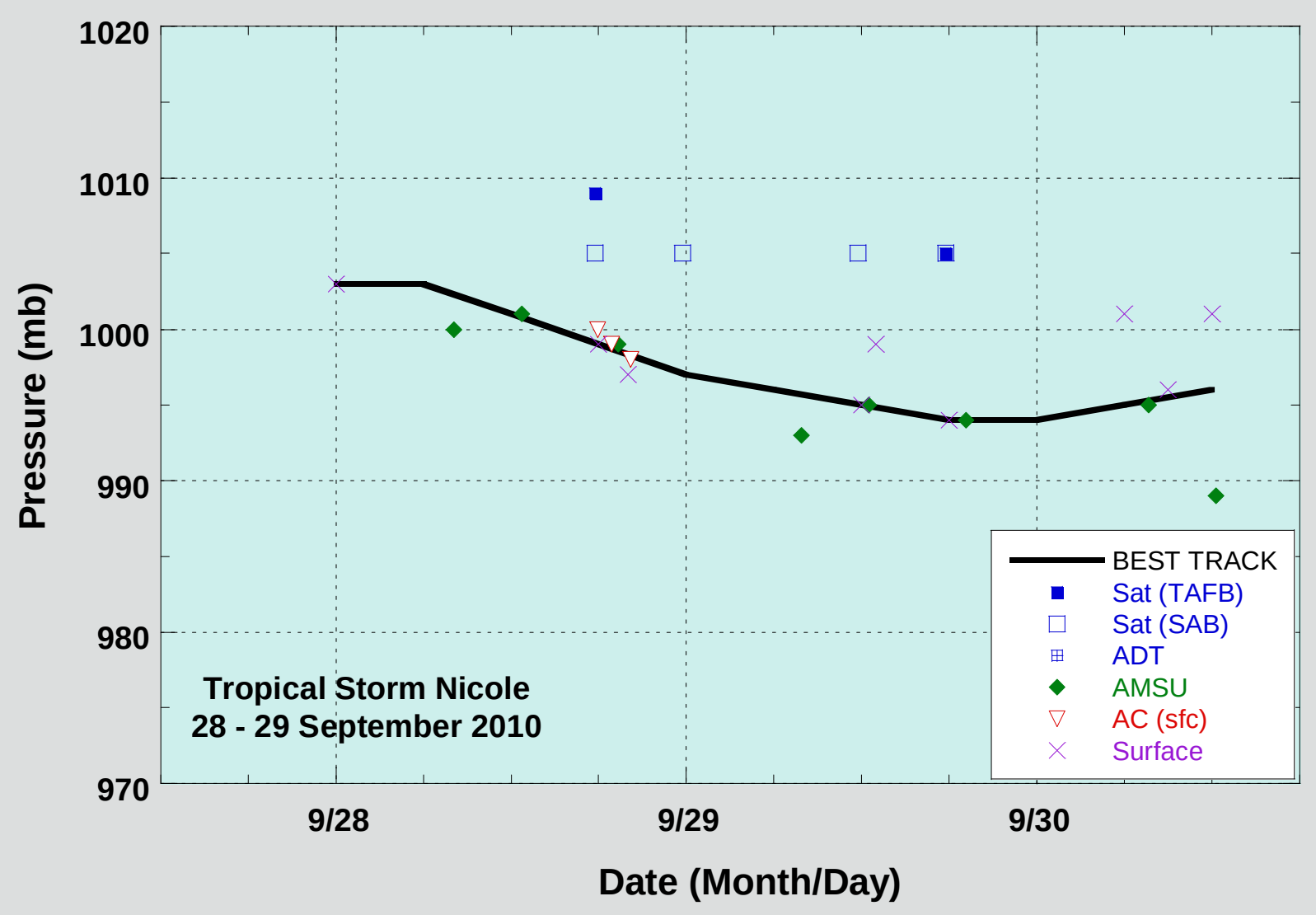

Figure 3. Selected pressure observations and best track minimum central pressure curve for Nicole. Dashed vertical lines correspond to 0000 UTC. AMSU Data is from the UW-CIMSS Technique.

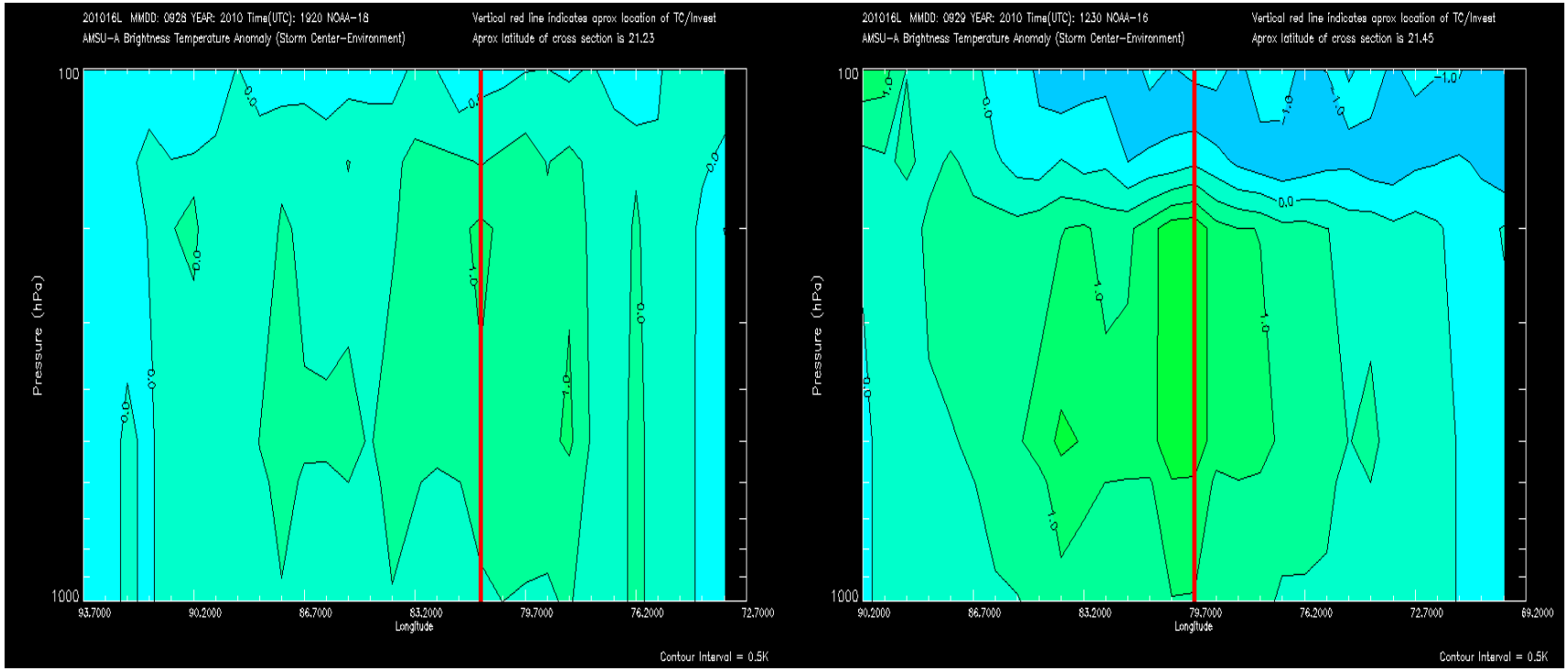

Figure 4. AMSU cross-sections at 1920 UTC 28 Sep (left) and 1230 UTC 29 Sep (right). The large red line is the longitude of the center of Nicole. Note the intensification of the warm core aloft during this time. Data courtesy of UW-CIMSS.

Table 4. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Nicole. 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 (Nicole)	62.9	97.4					
OCD5 (Nicole)	44.0	92.7					
Forecasts	3	1					
OFCL (2005-9)	31.8	53.4					
OCD5 (2005-9)	46.9	97.3					

Table 5. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Nicole. 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 (Nicole)	**1.7**	**0.0**					
OCD5 (Nicole)	6.0	0.0					
Forecasts	3	1					
OFCL (2005-9)	7.0	10.7					
OCD5 (2005-9)	8.6	12.5					

Table 6. Watch and warning summary for Tropical Storm Nicole.

Date/Time (UTC)	Action	Location
28 / 1500	Tropical Storm Watch issued	Jupiter Inlet to Sebastian Inlet FL
28 / 1500	Tropical Storm Watch issued	East Cape Sable to Chokoloskee FL
28 / 1500	Tropical Storm Warning issued	Cayman Islands
28 / 1500	Tropical Storm Warning issued	Matanzas to Ciego de Avila Cuba
28 / 1500	Tropical Storm Warning issued	NW Bahamas to Central Bahamas
28 / 1500	Tropical Storm Warning issued	Jupiter Inlet to East Cape Sable
29 / 0900	Tropical Storm Watch discontinued	Jupiter Inlet to Sebastian Inlet
29 / 0900	Tropical Storm Warning modified to	Sebastian Inlet to East Cape Sable
29 / 1500	Tropical Storm Watch discontinued	All
29 / 1500	Tropical Storm Warning discontinued	Sebastian Inlet to East Cape Sable
29 / 1800	Tropical Storm Warning discontinued	Matanzas to Ciego de Avila
29 / 2100	Tropical Storm Warning discontinued	All

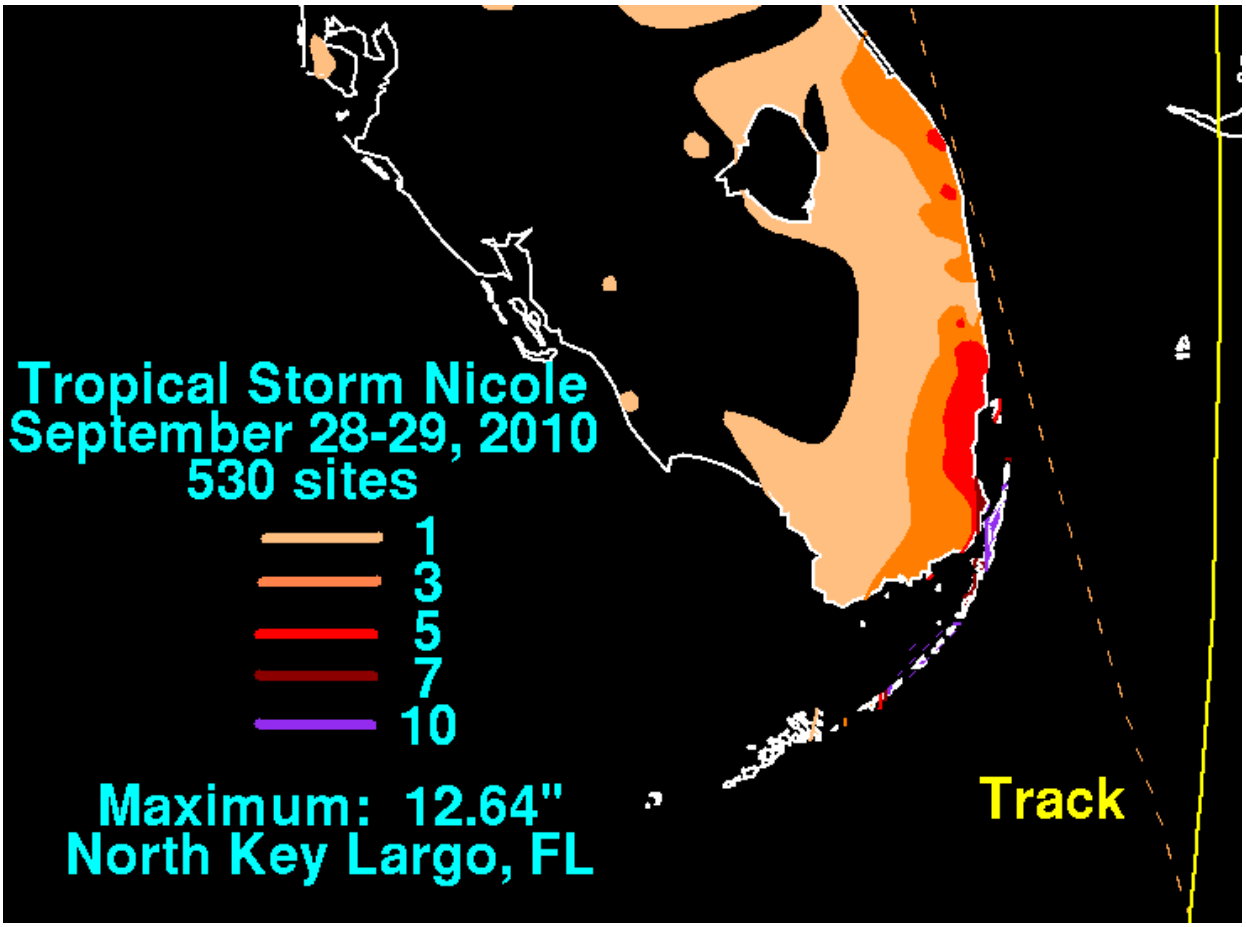

Figure 5. Map of the rainfall totals from Nicole in south Florida. Figure courtesy David Roth of the Hydrometeorological Prediction Center.