

Tropical Cyclone Report
Tropical Storm Colin
(AL042010)
2 - 8 August 2010

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Colin was a tropical storm that had a peak intensity of 50 kt while located over the western Atlantic about midway between Puerto Rico and Bermuda.

a. Synoptic History

The development of Colin resulted from the interaction of a surface trough and a tropical wave over the eastern Atlantic. The trough, located several hundred nautical miles southwest of the Cape Verde Islands, was generated by a slow-moving tropical wave that departed the west coast of Africa on 28 July. After the nearly stationary trough separated from the wave, the wave continued westward across the tropical Atlantic. A couple of days later, a second tropical wave, which was larger and moving faster than the trough, entered the eastern Atlantic. On 31 July, the combination of these two features led to the formation of a broad low pressure area about 750 n mi west-southwest of the Cape Verde Island early on 1 August. Showers and thunderstorms associated with the low increased in organization that day; however, the system did not have a well-defined circulation. On 2 August, data from the Advanced Scatterometer (ASCAT) instrument showed that the circulation became better defined, indicating the formation of a tropical depression at 1200 UTC. 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 1¹.

The depression moved quickly west-northwestward to the south of a strong subtropical ridge over the central Atlantic Ocean. Thunderstorm activity gradually became better organized and the depression attained tropical storm strength at 0600 UTC 3 August while centered about 840 n mi east of the Lesser Antilles. The cyclone, which previously had a forward speed of 15 to 20 kt, accelerated to 25 to 30 kt by 1200 UTC 3 August. The system was unable to maintain a closed surface circulation at that forward speed, and Colin degenerated into a trough of low pressure by 1800 UTC that day. The trough moved rapidly west-northwestward for about another 24 hours before decelerating. Although the system had degenerated to an open trough, it continued to produce tropical-storm-force winds. A reconnaissance flight investigating the system when it was passing to the northeast of the Leeward Islands on 4 August found peak 1000-ft flight winds of 47 kt, but the system no closed circulation.

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.

As the trough approached a weakness in the subtropical ridge over the western Atlantic on 5 August it continued to decelerate. As the system slowed down, conventional satellite and microwave images indicated that a well-defined low-level circulation formed by 1200 UTC 5 August. At that time, the low had organized convection and was producing tropical-storm-force winds. As a result, the system regained tropical storm status when it was located about 280 n mi north-northeast of San Juan, Puerto Rico.

Although upper-level winds were not favorable for significant intensification, deep convection formed close to the center late on 5 August (Fig. 4a). Data from reconnaissance aircraft around this time indicated that Colin reached a peak intensity of 50 kt at 2100 UTC 5 August. Shortly thereafter, strong upper-level westerly winds caused the thunderstorm activity to weaken and shear off to the east of the surface circulation center (Fig. 4b) and Colin's intensity fell to 40 kt, by 0600 UTC 6 August. The cyclone turned northward on 6 August and its forward motion slowed even more. The next day the tropical storm began moving northeastward and weakened further as the thunderstorm activity remained displaced to the east of the center. By 0000 UTC 8 August, Colin weakened to a tropical depression while located about 170 n mi south-southwest of Bermuda. During the next several hours the circulation became elongated and Colin again degenerated into a trough of low pressure, this time a little less than 100 n mi southwest of Bermuda. The remnant trough produced showers and wind gusts to near tropical storm force on Bermuda while it passed west of the island later that day. The trough dissipated early on 9 August about 150 n mi northwest of Bermuda.

b. Meteorological Statistics

Observations in Colin (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). Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from flights of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command. Data and imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM) and Aqua, 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 Colin.

The 50-kt peak intensity of Colin is based on a peak flight-level (<1000 ft) wind of 71 kt and an SFMR surface wind observation of 51 kt. There is some question as to whether or not these winds were representative of Colin's circulation or a smaller mesocyclone within deep convection just northeast of the center. Due to fuel limitations, the aircraft was unable to re-sample the area of highest winds on that flight. Since the cloud pattern associated with Colin had its maximum apparent organization near the time of the flight-level winds in question and the intensity both before and after this time was well established, these measurements are assumed to be representative of Colin's peak intensity.

There were no ship observations of tropical-storm-force winds associated with Colin.

c. Casualty and Damage Statistics

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

d. Forecast and Warning Critique

The genesis of Colin was well anticipated. The large area of disturbed weather from which Colin formed was first described in the Tropical Weather Outlook (TWO) at 1800 UTC 29 August, a little less than four days before genesis. The assigned probabilities were initially in the low category (<30%). The probabilities increased to the medium category (30-50%) about 42 h before genesis, and the high category (>50%) 24 h before tropical cyclone formation.

When Colin degenerated to a tropical wave on 3 August, it was thought that environmental conditions would become conducive for re-development into a tropical cyclone. The last issued official forecast had indicated that Colin could regenerate into a tropical cyclone, but re-development occurred about 78 h earlier than was shown in that forecast. The probability of re-development in the TWOs issued between the times Colin was a tropical cyclone remained in the low category until about 12 hours before reformation, when it was raised to the medium category.

A verification of NHC official track forecasts for Colin is given in Table 2a. Official forecast track errors were considerably larger than the previous 5-year (2005-09) mean official errors at each forecast time through 72 hours, albeit for only 5, 4, and 5 forecasts at 36, 48, and 72 h, respectively. The longer range (96 and 120 h) forecasts for Colin were lower than the 5-year mean. A homogeneous comparison of the official track errors with selected guidance models is given in Table 2b. For the relatively few forecasts that were verified for Colin, the short range (12-48 h) NHC forecasts were beaten by the GHMI and GFSI models. The GFSI had the lowest mean track forecast errors through 48 hours, while the multi-model consensus (TVCN) outperformed the official forecast at the extended range.

A verification of NHC official intensity forecasts for Colin is given in Table 3a. Official forecast intensity errors were lower than the mean official errors for the previous five-year period, except at 36 and 48 h where they were somewhat larger. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 3b. The NHC forecasts generally exhibited a high bias, especially the first few forecasts after Colin redeveloped into a tropical cyclone. These forecasts anticipated a decrease in the westerly shear, which did not occur. The GFDL and HWRF model forecasts also over-intensified the cyclone during that time, while the SHIPS and LGEM guidance indicated somewhat less strengthening. In the end, the shear did not decrease and Colin weakened and dissipated earlier than indicated in the official forecast.

Watches and warnings associated with Colin are listed in Table 4.

Table 1. Best track for Tropical Storm Colin, 2-8 August 2010. Positions and pressures given during the tropical wave stage are representative values for the low-level vorticity center.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
02 / 1200	12.5	40.7	1007	30	tropical depression
02 / 1800	12.9	42.4	1007	30	"
03 / 0000	13.3	44.4	1007	30	"
03 / 0600	13.7	46.6	1006	35	tropical storm
03 / 1200	14.3	49.3	1007	35	"
03 / 1800	15.3	52.2	1009	35	trough
04 / 0000	16.1	54.8	1009	35	"
04 / 0600	17.0	57.2	1009	35	"
04 / 1200	18.0	59.5	1009	35	"
04 / 1800	19.2	61.1	1009	40	"
05 / 0000	20.4	62.5	1009	40	"
05 / 0600	21.7	63.7	1009	40	"
05 / 1200	23.0	64.9	1008	40	tropical storm
05 / 1800	24.4	65.8	1007	45	"
05 / 2100	25.0	66.1	1005	50	"
06 / 0000	25.6	66.6	1006	50	"
06 / 0600	26.4	67.2	1007	40	"
06 / 1200	27.0	67.1	1007	40	"
06 / 1800	27.7	66.9	1008	40	"
07 / 0000	28.5	66.6	1008	40	"
07 / 0600	28.9	66.4	1009	35	"
07 / 1200	29.1	66.2	1010	35	"
07 / 1800	29.3	65.9	1012	35	"
08 / 0000	29.7	65.7	1012	30	tropical depression
08 / 0600	30.3	65.7	1013	30	"
08 / 1200					dissipated
05 / 2100	25.0	66.1	1005	50	minimum pressure

Table 2a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Colin. 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	44.5	78.4	122.1	172.3	154.6	133.6	180.6
OCD5	69.6	127.7	171.7	270.6	529.7	491.2	368.2
Forecasts	12	8	5	4	5	5	4
OFCL (2005-9)	31.8	53.4	75.4	96.8	143.8	195.6	252.1
OCD5 (2005-9)	46.9	97.3	155.4	211.6	304.8	387.9	467.8

Table 2b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Colin. 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	41.0	78.4	122.1	172.3	160.8	142.0	200.6
OCD5	59.6	127.7	171.7	270.6	515.3	504.5	368.8
GFSI	39.9	60.1	80.2	115.1	185.1	270.2	444.7
GHMI	40.7	72.8	117.1	169.3	123.3	88.4	210.2
HWFI	50.0	88.4	131.6	145.6	115.1	147.4	407.2
EMXI	48.3	77.3	126.9	201.7	199.0	215.2	329.8
TVCN	43.7	81.2	118.9	159.2	139.2	141.4	139.9
TVCC	41.1	76.3	108.7	152.9	168.8	180.5	201.9
LBAR	41.4	71.6	92.8	167.2	392.3	377.3	435.3
BAMD	52.8	96.1	100.5	164.4	503.0	546.4	594.1
BAMM	44.4	80.4	89.9	151.3	271.3	233.6	301.6
BAMS	55.0	101.0	126.7	159.1	136.0	224.1	338.9
Forecasts	9	8	5	4	3	3	1

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Colin. 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	4.2	10.6	18.0	20.0	8.0	9.0	15.0
OCD5	5.3	9.8	15.8	21.8	16.0	26.2	34.5
Forecasts	12	8	5	4	5	5	4
OFCL (2005-9)	7.0	10.7	13.1	15.2	18.6	18.7	20.1
OCD5 (2005-9)	8.6	12.5	15.8	18.2	21.0	22.7	21.7

Table 3b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Colin. 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	4.2	10.6	18.0	20.0	8.0	9.0	15.0
OCD5	5.3	9.8	15.8	21.8	16.0	26.2	34.5
HWFI	5.8	10.8	14.4	14.3	15.6	12.6	5.3
GHMI	6.3	11.4	22.4	28.3	8.2	11.2	15.3
DSHP	5.0	9.3	12.4	17.3	16.8	21.4	25.3
LGEM	5.5	8.6	10.0	14.0	12.2	14.0	21.5
ICON	5.4	9.9	14.0	16.3	7.6	8.8	14.8
IVCN	5.3	10.5	16.0	17.3	7.2	8.4	14.8
Forecasts	12	8	5	4	5	5	4

Table 4. Watch and warning summary for Colin, 2-8 August 2010.

Date/Time (UTC)	Action	Location
5/2100	Tropical Storm Warning issued	Bermuda
8/1500	Tropical Storm Warning changed to Tropical Storm Watch	Bermuda
8/2100	Tropical Storm Watch discontinued	Bermuda

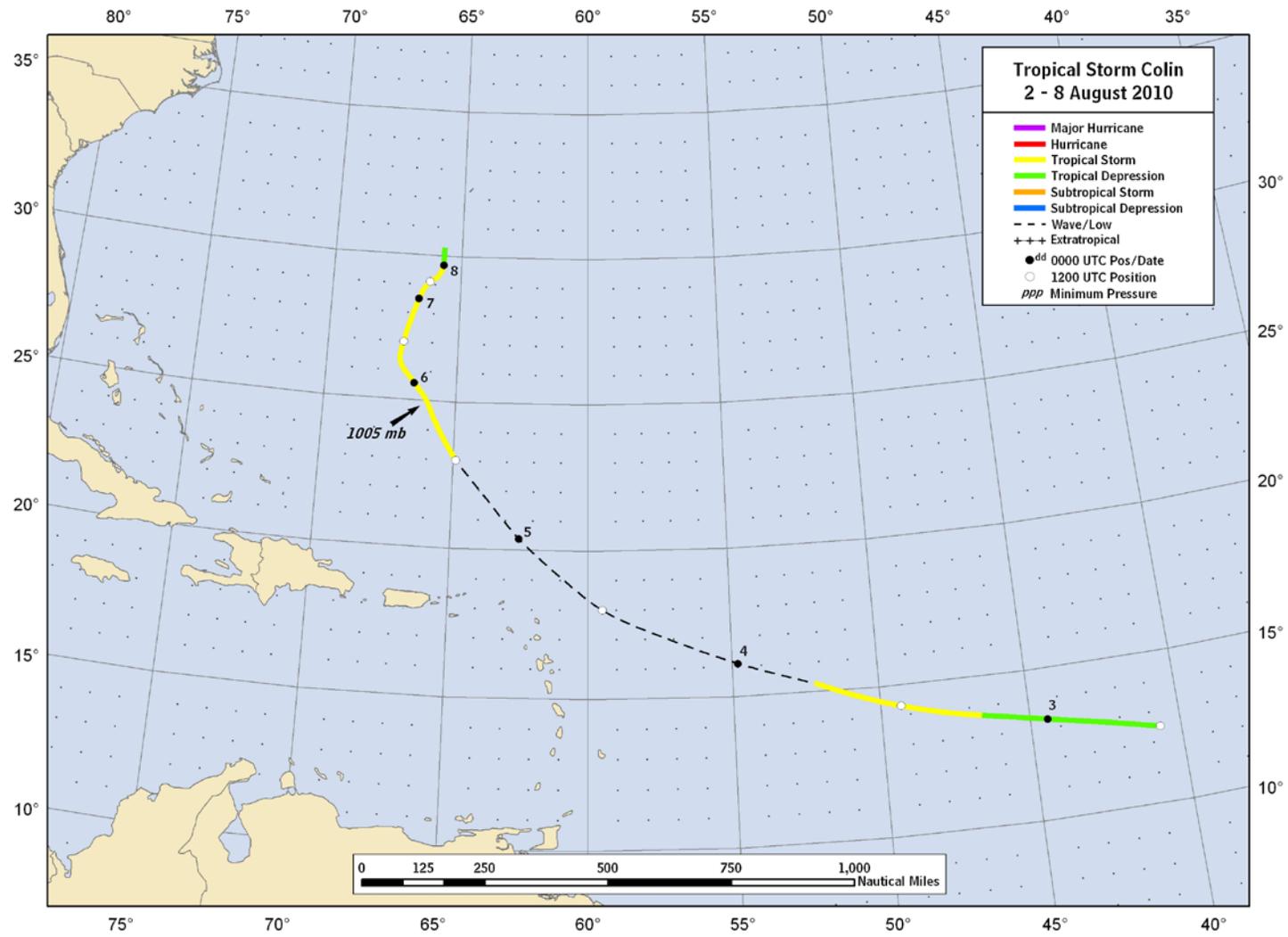


Figure 1. Best track positions for Colin, 2-8 August 2010.

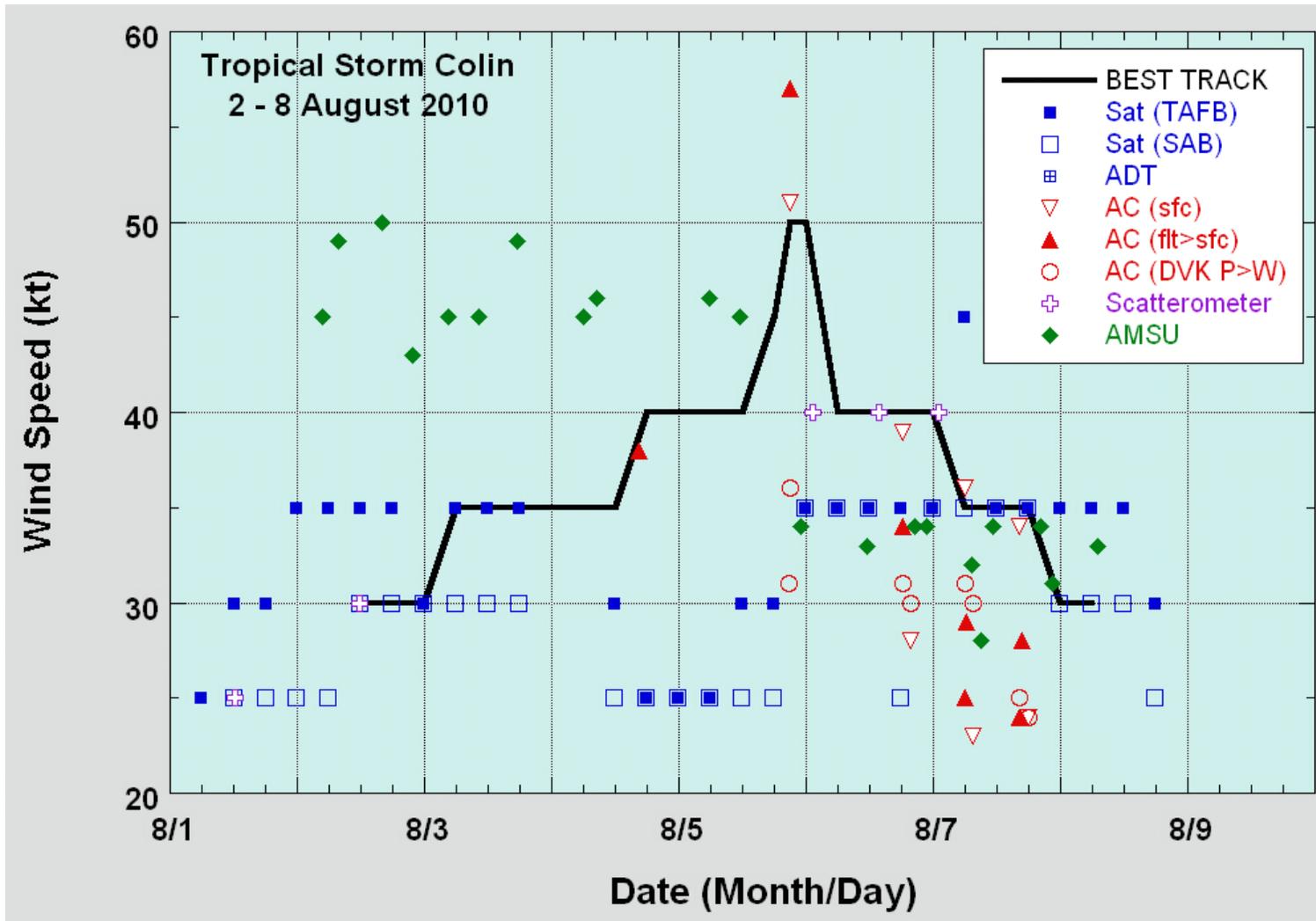


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Colin, 2-8 August 2010. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% adjustment factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC.

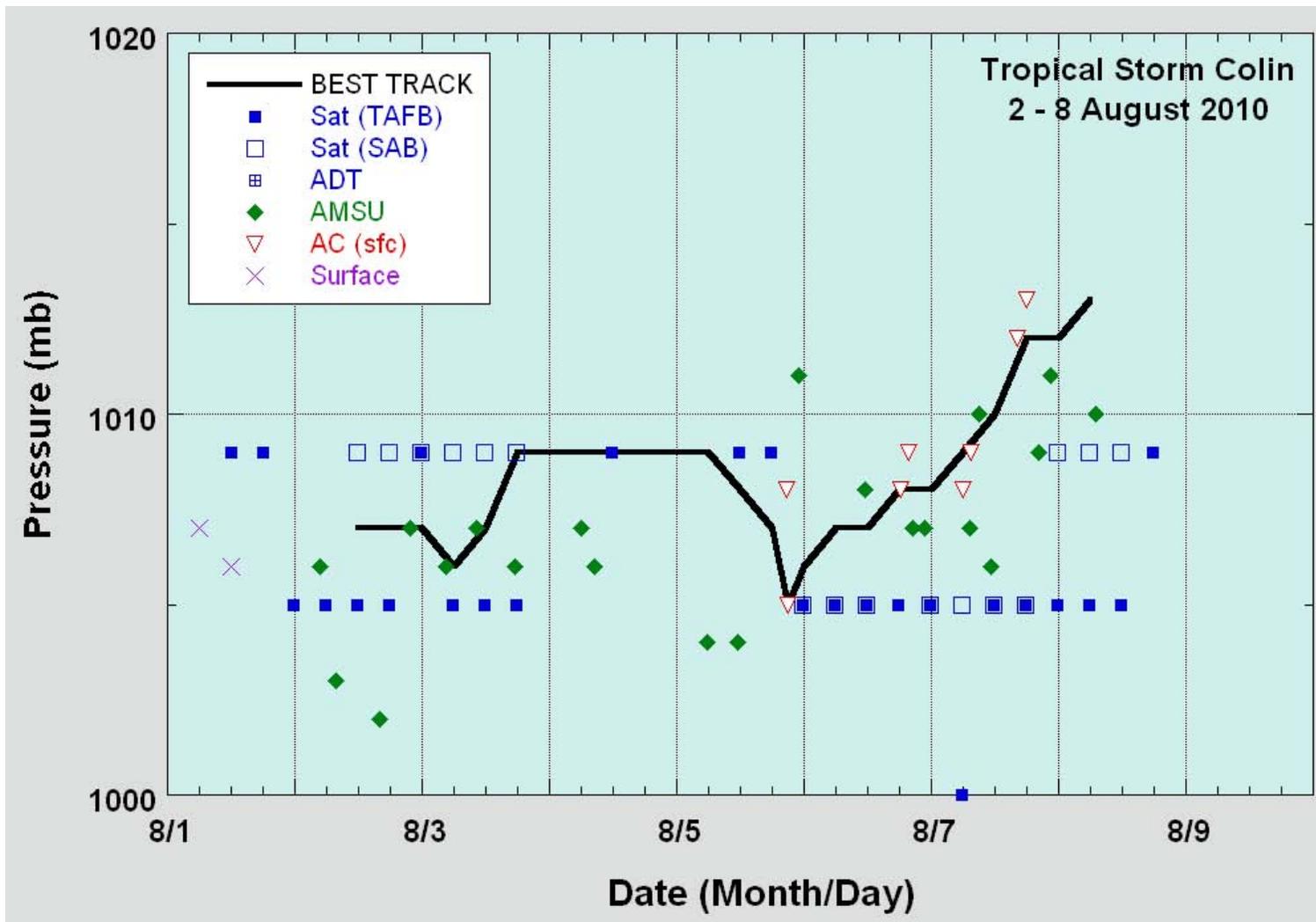
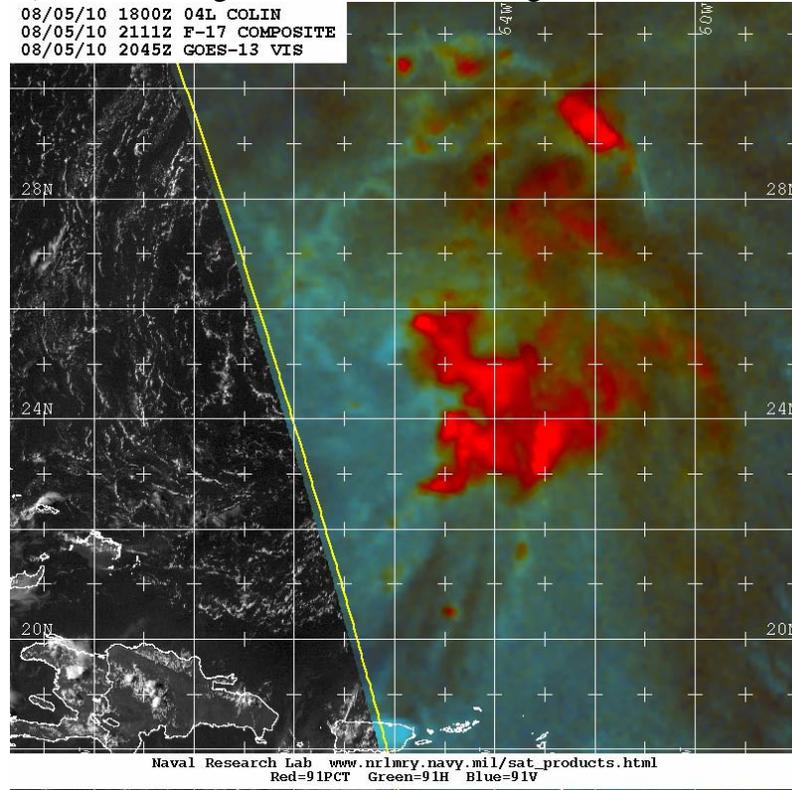


Figure 3. Selected pressure observations and best track minimum central pressure curve for Colin, 2-8 August 2010. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC.

A) TRMM image from 2111 UTC 5 August 2010



B) AMSR-E image from 0622 UTC 6 August 2010

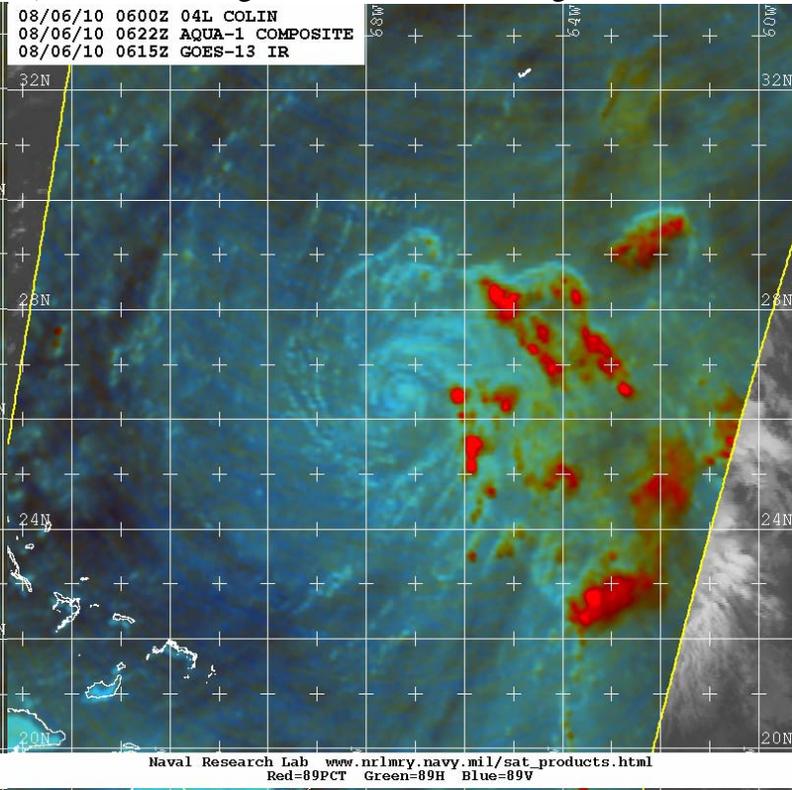


Figure 4. Microwave satellite images of the approximate times that Colin reached peak intensity (A) and about nine hours later (B). Note the dramatic decrease in deep convection (red) near the center of Colin during this 6-h period. Images courtesy of the Naval Research Laboratory.