Tropical Cyclone Report
Hurricane Katia
(AL122011)
29 August - 10 September 2011

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Katia was a long-track, classical Cape Verde-type hurricane that attained category 4 status (on the Saffir-Simpson Hurricane Wind Scale), but remained over the open Atlantic Ocean throughout its lifetime as a tropical cyclone. However, as a large and powerful extratropical cyclone, Katia produced hurricane-force wind gusts over much of the northern British Isles, which caused some damage and loss of life.

a. Synoptic History

A vigorous tropical wave moved off the west coast of Africa on 27 August and was accompanied by a broad low pressure system. The large disturbance continued on a westward track around the southern periphery of a large subtropical ridge located to its north. Deep convection gradually increased and became better organized, and Dvorak satellite classifications were initiated early on 28 August. By 0600 UTC 29 August, the low pressure system had acquired sufficient convective organization to be designated as a tropical depression when it was located about 375 n mi southwest of the southwesternmost Cape Verde Islands. 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.

The depression moved westward to west-northwestward for the next 24 h and gradually strengthened despite being under the influence of 850-200 mb easterly vertical wind shear of more than 20 kt. The cyclone became a tropical storm around 0000 UTC 30 August about 425 n mi southwest of the Cape Verde Islands. Katia maintained a west-northwestward motion at near 15 kt for the next two days and steadily strengthened as the vertical shear gradually decreased to less than 10 kt. Katia reached hurricane intensity by 0000 UTC 1 September when it was located about 1175 n mi east of the Leeward Islands. After achieving hurricane status, Katia turned northwestward as it moved around the western periphery of a deep-layer subtropical ridge that extended from northwestern Africa westward across the Atlantic to near Bermuda. Despite the favorable low-shear conditions, Katia did not strengthen further for almost 72 h. Microwave satellite water vapor and other associated imagery indicate that mid-level dry air entrainment had been eroding the eyewall convection for the first 48 h of this period, which resulted in either a half-eyewall or a weak banding-eye feature. During the last 24 h of this prolonged non-development phase, the dry air entrainment process ceased; however, the vertical wind shear simultaneously increased from the southwest at more than 20 kt, and this likely prevented further intensification.

Around 0000 UTC 4 September, the vertical wind shear once again began to decrease as Katia moved beneath a synoptic-scale upper-level anticyclone, which allowed for the development of a favorable symmetrical outflow regime. Katia strengthened slowly for the next 24 h, but then began a period of rapid intensification. Around 1235 UTC 4 September, the hurricane's eye passed over or very near NOAA buoy 41044 (Fig. 4), which recorded a wind gust of 94 kt. Katia continued to strengthen and reached major hurricane status around 1200 UTC 5 September and reached its peak intensity of 120 kt just 12 h later when the cyclone was located about 470 n mi south of Bermuda (Fig. 5). Rapid weakening began almost immediately after Katia had reached its peak intensity. Microwave satellite imagery indicates that the rapid weakening phase was likely due to an eyewall replacement cycle (Fig. 6). Katia's intensity decreased from 120 kt down to 85 kt during this initial 24-h weakening period.

Increasing mid- and upper-level southwesterly steering flow ahead of a deep-layer trough located over the eastern United States caused Katia to slow down and move northward on 8 September, and then gradually turn northeastward on 9 September. During this time, the wind field of Katia expanded and weakening ceased, with the intensity leveling off at 75-80 kt despite southerly to southwesterly vertical wind shear of near 20 kt. Late on 9 September when Katia was located about 350 n mi northwest of Bermuda, the hurricane turned toward the east-northeast and began to accelerate. The increase in forward speed, to roughly 50 kt, brought the cyclone over the cold waters of the north Atlantic, and by early on 10 September. Katia had moved over sea-surface temperatures of near 22^{o} C. The combination of strong vertical wind shear and cold water resulted in the quick transition from a tropical cyclone into a powerful extratropical low pressure system by 1200 UTC that day when it was located about 250 n mi south-southeast of Cape Race, Newfoundland. The extratropical cyclone interacted with a significant mid-tropospheric trough later that same day and the added baroclinic effects resulted in a decrease in the central pressure. However, scatterometer data indicated that this drop in pressure was not accompanied by an increase in the intensity of the cyclone.

The large and powerful extratropical storm system turned northeastward early on 11 September and headed for the northern British Isles. The center skirted the northern coast of Scotland around 1200 UTC 12 September and produced sustained gale-force winds across most of the British Isles, and brought hurricane-force wind gusts to much of Scotland, Northern Ireland, and northern England. The cyclone continued northeastward for the next 24 h and the circulation of Katia was absorbed within a larger extratropical low pressure system over the North Sea by 0000 UTC 13 September before the latter system reached southwestern Norway.

b. Meteorological Statistics

Observations in Katia (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 Dvorak estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison (UW-CIMSS). Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from a flight 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 Katia.

There were no land station reports of sustained tropical-storm-force winds associated with Katia while it was a tropical cyclone.

Ship and buoy reports of winds of tropical storm force associated with Katia are given in Table 2. Katia passed over or near two NOAA buoys during its long trek over the western Atlantic between Bermuda and the east coast of the United States. At 1235 UTC 4 September, the eye of Katia passed directly over buoy 41044, which reported a minimum pressure of 968.3 mb, a 1-minute sustained wind of 78 kt, and a gust of 94 kt (Fig. 4). Four days later at 0819 UTC, Katia passed about 40 n mi west of buoy 41048, which recorded a minimum pressure of 976.4 mb and a 1-minute wind of 76 kt.

There was one U.S. Air Force Reserve aircraft reconnaissance flight into Katia on 6 September, which consisted of two eye penetrations. The maximum 700 mb flight-level wind observed was 114 kt at 1711 UTC in the northeastern eyewall during the outbound flight leg. A second wind maximum of 110 kt was observed a few minutes later at 1719 UTC. The maximum SFMR surface wind noted during the mission was 81 kt at 1826 UTC in the northwestern eyewall, while a second SFMR wind maxima of 80 kt was noted at 1710 UTC in the northeastern eyewall. Two synoptic surveillance flights to sample the environment surrounding Katia were also conducted on 6 and 7 September by the Gulfstream-IV jet aircraft from the NOAA Aircraft Operations Center.

The estimated maximum intensity of 120 kt and minimum pressure of 942 mb at 0000 UTC 6 September are based on a blend of subjective Dvorak intensity estimates of T6.0/115 kt from TAFB and SAB, and a 3-h average objective Dvorak intensity estimate (ADT) of T6.3/122 kt from UW-CIMSS.

c. Casualty and Damage Statistics

There were no reports of damage or casualties associated with Katia while it was a tropical cyclone. However, reports from news media outlets indicate that on 12 September as an extratropical cyclone, Katia produced wind gusts in excess of 70 kt, which caused widespread power outages to thousands of homes across much of Northern Ireland, northern England, and Scotland due to downed trees and powerlines. In addition to property damage that occurred that day, photographs captured several airplanes being blown off course while attempting to land at Leeds Bradford International Airport in West Yorkshire, England; all high-speed ferries from Portsmouth, England to France were halted and even the Tour of Britain bicycle race was cancelled.

Katia caused no casualties as a tropical cyclone. However, media reports indicate that Katia caused one direct death, one indirect death, and one injury during its extratropical stage. The direct death was a bus driver who was killed when a tree fell on his vehicle in County

Durham in northeastern England. The indirect death occurred when an automobile driver was killed in a multi-vehicle accident along highway M54 during squally weather in Lorry in south-central England. An 11-year old boy was injured and hospitalized after being hit by a portion of a roof that blew off a garage in Bradford in northern England.

d. Forecast and Warning Critique

The genesis of Katia was reasonably well forecast given its relatively short time over water as a disturbance after it moved off the west coast of Africa. The large system was first mentioned in the Atlantic Tropical Weather Outlook (TWOAT) with a "low" (0 to 20%) chance of formation 30 h before genesis occurred. Six hours after the disturbance was introduced into the Outlook, the genesis probability reached the medium category (between 30-50%). The formation probability reached the high (>50% percent) category 12 h before genesis occurred, and reached a probability of 100% 6 h before Katia first became a tropical depression.

A verification of NHC official track forecasts for Katia is given in Table 3a. Official forecast track errors were lower than the mean official errors for the previous 5-yr period at all forecast times. However, OCD5 climatology forecast errors were also lower than the 5-yr period, which indicates that Katia should have been easier than normal to forecast. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. OFCL track forecast errors were better than every forecast model at every forecast time period with only a few minor exceptions. The NHC official track forecasts were only slightly bested by the GDFL (GHMI) and ECMWF (EMXI) models at 36 h, and also only slightly outperformed at 120 h by the GHMI model and three of five consensus models -- TCON, TVCN, and GUNA.

A verification of NHC official intensity forecasts for Katia is given in Table 4a. The official forecast intensity errors were also lower than the mean official errors for the previous 5-yr period at all forecast times. However, OCD5 climatology forecast errors were also lower than the mean errors for the previous 5-yr period at all forecast times, indicating that Katia's intensity should have been easier than normal to forecast. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. Although the intensity forecasts were overall easier than average, there were some forecast challenges such as predicting the onset of rapid intensification and rapid weakening on 5 and 6 September. Even trying to accurately forecast the onset of steady strengthening that began on 4 September after 3 days of no change in intensity proved difficult. Figure 7 shows a plot of model intensity forecast for Katia at 1800 UTC 3 September when the cyclone was a 65-kt hurricane. None of the model guidance captured the overall intensification trend for the ensuing 48-h period, including Katia's peak intensity and the rapid intensification phase, the latter of which was only 24 h away from commencing. In the longer forecast periods, nearly every model had forecast intensification during the period that Katia rapidly weakened on 6 September. Ironically, the ECMWF model (EMXI) actually predicted that Katia would weaken rather strengthen during the next 72 h. But for the most part, the NHC intensity model guidance outperformed the official forecast at 48 h and beyond.

A tropical storm watch was issued for Bermuda at 1500 UTC 6 September and was discontinued at 2100 UTC on 8 September. No other watches or warnings were associated with Katia while the system existed as a tropical cyclone.

Acknowledgements

Special thanks to Rex Hervey of the NOAA National Data Buoy Center, Stennis Space Center, MS for the pressure, wind speed, and wind gust data plot graph for NOAA buoy 41044 used in Figure 4.

Table 1. Best track for Hurricane Katia, 29 August - 10 September 2011

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
28 / 0000	9.5	19.0	1012	20	low
28 / 0600	9.4	20.3	1011	20	"
28 / 1200	9.3	21.6	1010	25	"
28 / 1800	9.3	22.9	1009	25	"
29 / 0000	9.3	24.2	1009	25	"
29 / 0600	9.5	25.6	1009	25	tropical depression
29 / 1200	9.9	27.0	1008	30	"
29 / 1800	10.6	28.2	1008	30	"
30 / 0000	11.0	29.6	1006	35	tropical storm
30 / 0600	11.5	31.1	1004	40	"
30 / 1200	12.0	32.9	1001	45	"
30 / 1800	12.6	34.6	997	50	"
31 / 0000	13.1	36.4	997	50	"
31 / 0600	13.6	38.2	994	55	"
31 / 1200	14.0	40.0	994	55	"
31 / 1800	14.4	41.8	990	60	"
01 / 0000	14.8	43.5	988	65	hurricane
01 / 0600	15.1	45.2	988	65	"
01 / 1200	15.3	46.9	988	65	"
01 / 1800	15.7	48.5	988	65	"
02 / 0000	16.2	50.0	988	65	"
02 / 0600	16.8	51.2	988	65	"
02 / 1200	17.4	52.1	987	65	"
02 / 1800	18.0	53.0	987	65	"
03 / 0000	18.4	53.9	987	65	"
03 / 0600	18.8	54.7	987	65	"
03 / 1200	19.4	55.4	986	65	"
03 / 1800	19.9	56.2	982	65	"
04 / 0000	20.4	57.1	978	70	"
04 / 0600	21.1	57.9	969	75	"
04 / 1200	21.7	58.8	961	85	"
04 / 1800	22.3	59.7	959	90	"
05 / 0000	23.0	60.6	957	90	"
05 / 0600	23.6	61.6	954	95	"
05 / 1200	24.2	62.6	950	100	"
05 / 1800	24.8	63.4	946	110	"
06 / 0000	25.6	64.0	942	120	"
06 / 0600	26.2	64.8	946	115	"
06 / 1200	26.7	65.6	954	105	"
06 / 1800	27.3	66.2	959	95	"
07 / 0000	27.7	66.9	964	85	"

07 / 0600	28.2	67.6	967	85	"
07 / 1200	28.8	68.4	969	80	"
07 / 1800	29.4	69.3	969	80	"
08 / 0000	30.3	69.9	968	80	"
08 / 0600	31.5	70.1	967	80	"
08 / 1200	32.8	70.2	966	80	"
08 / 1800	34.1	70.0	965	80	"
09 / 0000	35.6	69.4	964	80	"
09 / 0600	37.1	68.4	963	75	"
09 / 1200	38.5	67.1	961	75	"
09 / 1800	39.8	64.6	960	75	"
10 / 0000	41.0	60.5	958	75	"
10 / 0600	42.2	56.1	956	75	"
10 / 1200	43.5	50.6	954	75	extratropical
10 / 1800	45.4	43.7	954	75	"
11 / 0000	47.3	37.2	957	70	"
11 / 0600	49.1	31.3	960	70	"
11 / 1200	51.1	26.0	964	60	"
11 / 1800	52.8	21.1	966	60	"
12 / 0000	54.7	16.3	968	60	"
12 / 0600	56.2	11.6	970	60	"
12 / 1200	58.0	7.0	972	60	"
12 / 1800	59.5	0.0	974	60	"
13 / 0000					Merged with larger extratropical low
06 / 0000	25.6	64.0	942	120	minimum pressure and maximum intensity

Table 2. Selected ship and buoy reports with winds of at least 34 kt for Hurricane Katia, 29 August - 10 September 2011.

Date/Time (UTC)	Ship call sign or Buoy ID number	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
30 / 1800	9HXA5	10.1	33.8	230 / 40	1010.0
04 / 0550	41044*	21.7	58.7	040 / 41	1001.9
04 / 0650	41044*	21.7	58.7	040 / 41	999.5
04 / 0750	41044*	21.7	58.7	030 / 47	995.8
04 / 0850	41044*	21.7	58.7	040 / 51	992.1
04 / 0950	41044*	21.7	58.7	050 / 56	986.9
04 / 1050	41044*	21.7	58.7	070 / 54	983.3
04 / 1139	41044*	21.7	58.7	090 / 78	968.3
04 / 1150	41044*	21.7	58.7	100 / 72	970.2
04 / 1250	41044*	21.7	58.7	140 / 70	970.8
04 / 1350	41044*	21.7	58.7	170 / 56	986.1
04 / 1450	41044*	21.7	58.7	180 / 43	995.6
04 / 1550	41044*	21.7	58.7	190 / 39	998.8
04 / 1650	41044*	21.7	58.7	190 / 35	1001.2
06 / 0050	41049	27.5	63.0	100 / 35	1007.6
06 / 0150	41049	27.5	63.0	100 / 37	1007.6
06 / 0250	41049	27.5	63.0	110 / 35	1008.6
06 / 0450	41049	27.5	63.0	120 / 35	1007.5
06 / 0550	41049	27.5	63.0	120 / 37	1006.9
06 / 0650	41049	27.5	63.0	130 / 35	1007.5
06 / 0850	41049	27.5	63.0	130 / 35	1007.6
06 / 1150	41049	27.5	63.0	150 / 35	1009.3
07 / 1750	41048	32.0	69.6	090 / 37	1008.3
07 / 1850	41048	32.0	69.6	100 / 39	1006.9
07 / 1950	41048	32.0	69.6	090 / 37	1005.6
07 / 2050	41048	32.0	69.6	090 / 39	1005.0
07 / 2150	41048	32.0	69.6	100 / 43	1004.5
07 / 2250	41048	32.0	69.6	090 / 47	1004.0
07 / 2350	41048	32.0	69.6	090 / 47	1003.5
08 / 0050	41048	32.0	69.6	080 / 51	1001.1
08 / 0150	41048	32.0	69.6	090 / 54	998.6
08 / 0250	41048	32.0	69.6	090 / 60	995.4
08 / 0350	41048	32.0	69.6	110 / 66	990.9
08 / 0420	41048	32.0	69.6	105 / 76	-----
08 / 0450	41048	32.0	69.6	100 / 68	986.8
08 / 0550	41048	32.0	69.6	110 / 68	983.5
08 / 0620	41048	32.0	69.6	118 / 76	-----
08 / 0650	41048	32.0	69.6	130 / 64	980.3
08 / 0750	41048	32.0	69.6	140 / 60	978.2
08 / 0850	41048	32.0	69.6	160 / 54	976.8

08 / 0950	41048	32.0	69.6	190 / 58	978.4
08 / 1050	41048	32.0	69.6	200 / 58	983.8
08 / 1150	41048	32.0	69.6	200 / 52	988.7
08 / 1250	41048	32.0	69.6	200 / 51	992.7
08 / 1350	41048	32.0	69.6	210 / 43	996.1
08 / 1450	41048	32.0	69.6	210 / 43	998.8
08 / 1550	41048	32.0	69.6	210 / 39	1000.9
08 / 1650	41048	32.0	69.6	220 / 37	1003.0
08 / 1750	41048	32.0	69.6	220 / 35	1004.3
08 / 1850	41048	32.0	69.6	220 / 35	1005.0
09 / 0000	KNBD	41.9	70.2	010 / 40	1015.4
09 / 0130	44063	39.0	76.4	090 / 70	1013.6
09 / 0200	44063	39.0	76.4	120 / 93	1013.5
09 / 0700	ZCDG8	40.5	69.7	020 / 40	1007.3
09 / 0900	ZCDG8	40.8	70.5	020 / 43	1007.3
09 / 2300	44137	42.3	62.0	020 / 35	989.1
10 / 0000	44137	42.3	62.0	020 / 37	989.6
10 / 0500	44141	43.0	58.0	000 / 47	982.3
10 / 0600	44141	43.0	58.0	010 / 37	984.5
10 / 0700	44141	43.0	58.0	350 / 41	987.8
10 / 0800	44141	43.0	58.0	340 / 35	992.2
10 / 0800	44138	44.3	53.6	030 / 35	980.7
10 / 0900	44140	42.9	51.5	150 / 37	973.7
10 / 1200	44140	42.9	51.5	080 / 62	-----
10 / 0900	44138	44.3	53.6	020 / 35	979.7
10 / 1000	44140	42.9	51.5	160 / 43	963.5
10 / 1200	44140	42.9	51.5	310 / 62	967.1
10 / 1300	44140	42.9	51.5	310 / 37	981.1
10 / 1500	44140	42.9	51.5	290 / 37	991.8
10 / 1800	VEP717	46.7	48.7	350 / 54	989.0
11 / 1200	PCER	46.4	23.0	220 / 40	995.4

* anemometer height 5 m

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Katia. Mean errors for the 5-yr period 2006-10 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 (Katia)	**20.7**	**31.6**	**43.4**	**48.7**	**65.3**	**100.2**	**164.8**
OCD5 (Katia)	37.0	72.3	116.7	161.2	208.5	215.0	226.4
Forecasts	47	45	43	41	37	33	29
OFCL (2006-10)	31.0	50.6	69.9	89.5	133.2	174.2	214.8
OCD5 (2006-10)	47.7	98.3	156.4	218.1	323.3	402.2	476.1

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Katia. 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	18.3	25.9	35.8	39.4	53.1	87.6	166.7
OCD5	27.6	57.4	101.8	146.2	203.4	216.6	247.9
GFSI	22.9	36.2	49.4	60.0	94.6	129.7	191.6
GHMI	21.4	27.0	**35.6**	47.0	78.3	115.0	**154.7**
HWFI	24.9	41.6	60.9	75.3	110.7	157.9	219.0
GFNI	23.0	37.4	51.2	66.4	102.8	142.6	220.7
NGPI	24.7	43.6	64.4	81.9	121.0	169.7	265.3
EGRI	21.0	33.1	50.9	71.7	146.3	274.0	424.1
EMXI	20.7	26.4	**34.9**	44.4	72.7	142.5	226.5
CMCI	25.2	39.1	54.0	72.3	135.2	198.7	255.1
TCON	19.1	28.3	39.8	48.5	71.8	103.1	**162.7**
TCCN	20.1	30.6	44.4	52.2	76.0	118.9	175.9
TVCN	18.7	27.1	37.8	46.5	66.7	101.2	**164.5**
TVCC	19.5	29.1	41.4	48.6	72.0	118.9	178.2
GUNA	18.6	27.3	37.5	45.8	65.8	99.0	**161.7**
FSSE	19.6	28.4	38.8	46.5	71.2	104.8	182.6
AEMI	21.8	35.0	50.7	63.3	86.3	127.3	217.2
BAMS	32.2	54.1	84.1	118.6	185.8	192.0	181.3
BAMM	22.7	35.7	58.5	83.9	130.7	156.0	190.2
BAMD	23.9	45.1	65.8	87.2	120.0	129.3	196.5
Forecasts	37	36	36	35	32	28	24

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Katia. Mean errors for the 5-yr period 2006-10 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 (Katia)	**6.2**	**9.8**	**12.2**	**14.9**	**14.9**	**14.4**	**13.4**
OCD5 (Katia)	7.3	10.3	12.1	13.3	14.7	10.4	9.7
Forecasts	47	45	43	41	37	33	29
OFCL (2006-10)	7.2	11.0	13.2	15.1	17.2	17.9	18.7
OCD5 (2006-10)	8.5	12.3	15.4	17.8	20.2	21.9	21.7

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Katia. 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	6.3	10.2	12.9	15.8	15.9	14.5	12.3
OCD5	7.5	10.6	**12.2**	**13.4**	**14.9**	**10.9**	**10.1**
HWFI	7.5	11.7	13.7	**14.8**	16.6	17.0	13.9
GHMI	7.5	11.1	13.8	**14.1**	18.0	19.7	16.7
GFNI	7.8	10.8	14.9	18.3	20.8	23.7	25.8
DSHP	6.9	10.2	13.7	16.3	18.4	**14.2**	**9.7**
LGEM	7.4	10.4	12.9	**14.8**	**15.6**	**10.9**	**7.1**
ICON	6.8	10.2	**12.5**	**13.5**	**14.9**	**13.2**	**9.8**
IVCN	6.8	**9.9**	**12.4**	**14.0**	15.9	14.9	**11.8**
FSSE	7.1	10.5	13.8	**14.5**	16.0	15.8	16.5
Forecasts	44	42	40	38	34	30	26

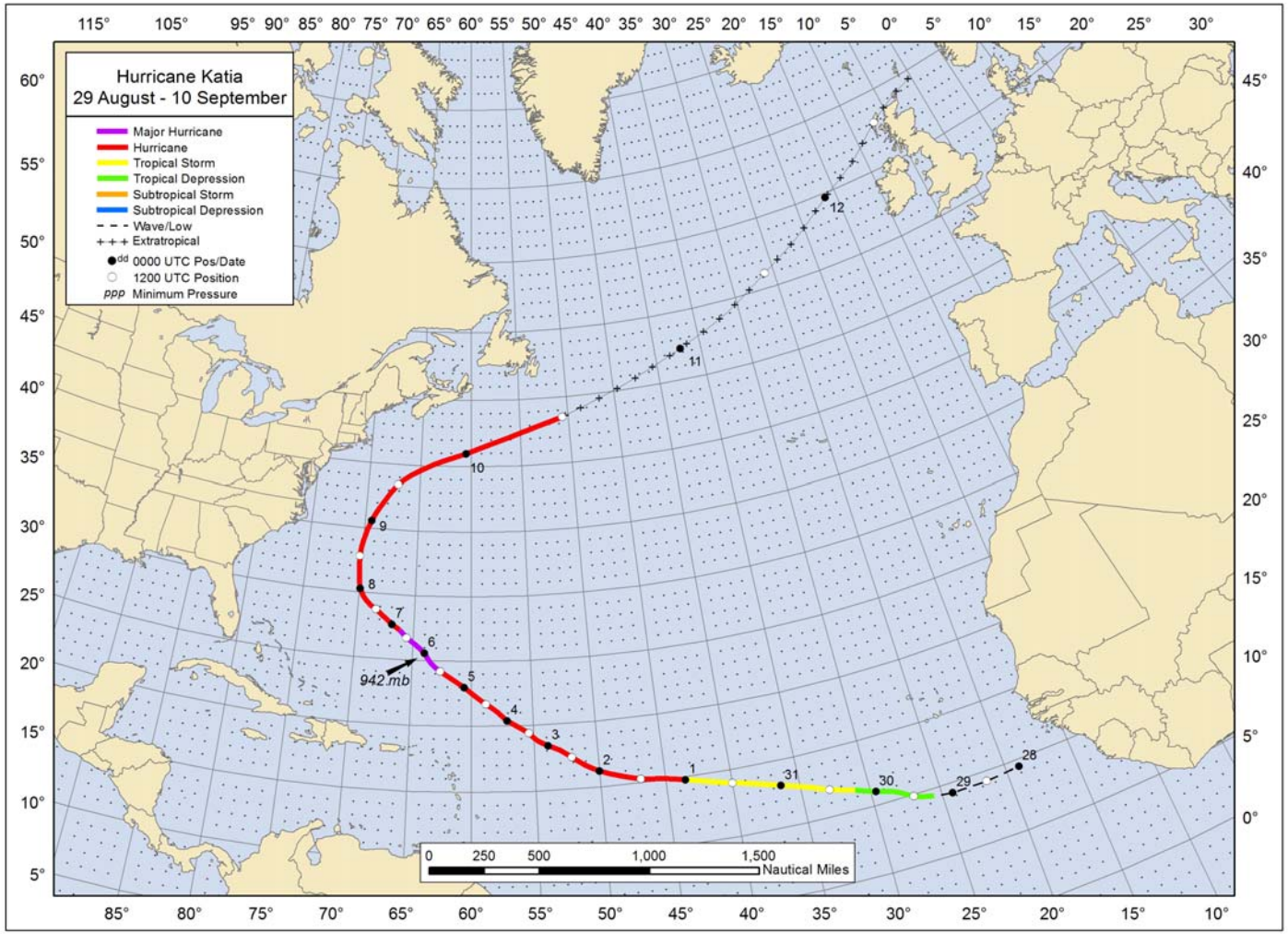

Figure 1. Best track positions for Hurricane Katia, 29 August - 10 September 2011. Track during the extratropical stage is based partly on analyses from the NOAA Ocean Prediction Center.

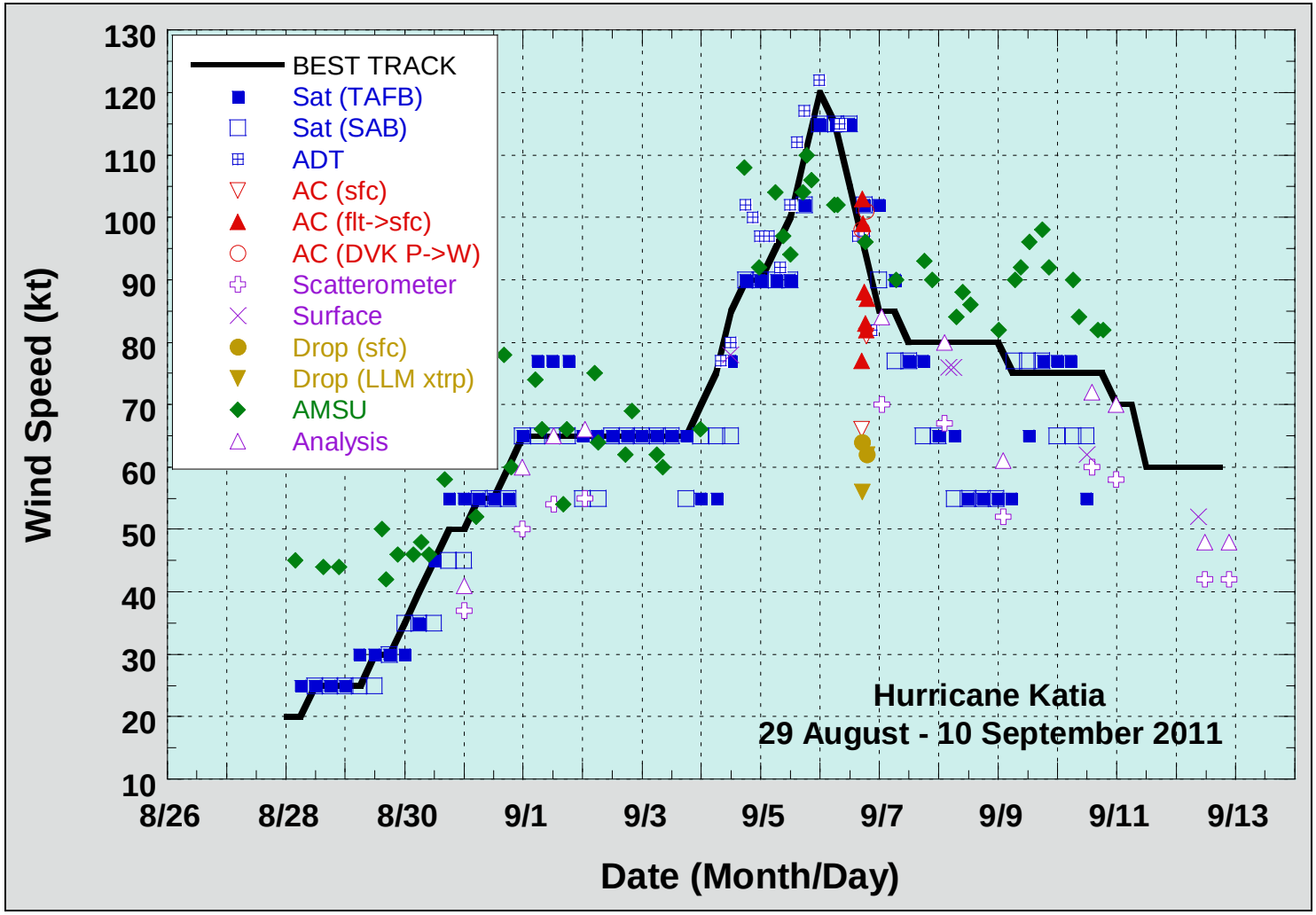

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Katia, 29 August -10 September 2011. Aircraft observations have been adjusted for elevation using a 90% adjustment factor for observations from the 700 mb flight-level. Dropwindsonde observations include actual 10 m winds (sfc). Advanced Dvorak Technique estimates represent linear averages over a three-hour period centered on the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Estimates during the extratropical stage are based partly on analyses from the NOAA Ocean Prediction Center. Dashed vertical lines correspond to 0000 UTC.

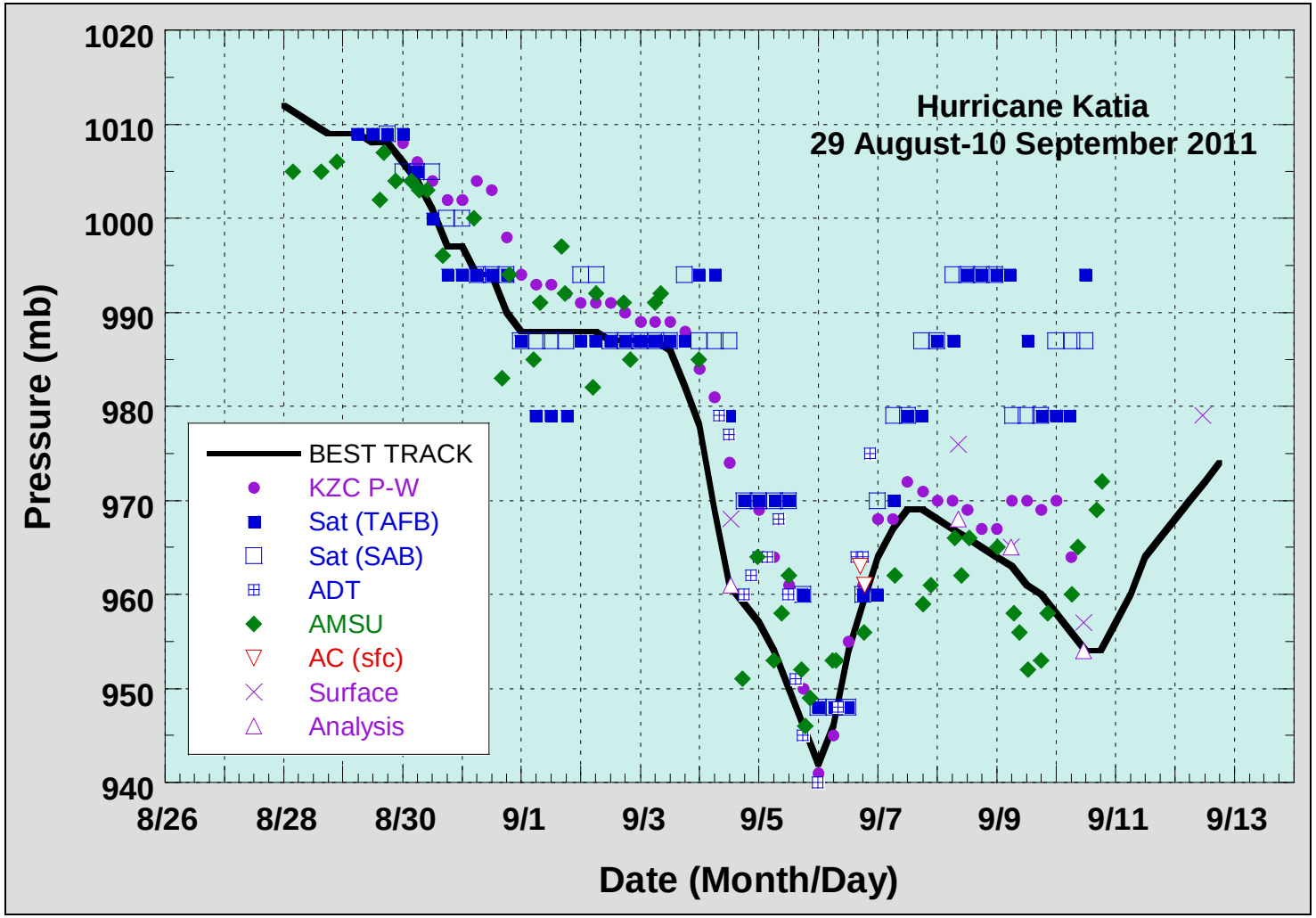

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Katia, 29 August – 10 September 2011. Advanced Dvorak Technique estimates represent linear averages over a three-hour period centered on the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. The KZC P-W values are obtained by applying the Knaff-Zehr-Courtney pressure-wind relationship to the best track wind data. Estimates during the extratropical stage are based on analyses from the NOAA Ocean Prediction Center. Dashed vertical lines correspond to 0000 UTC.

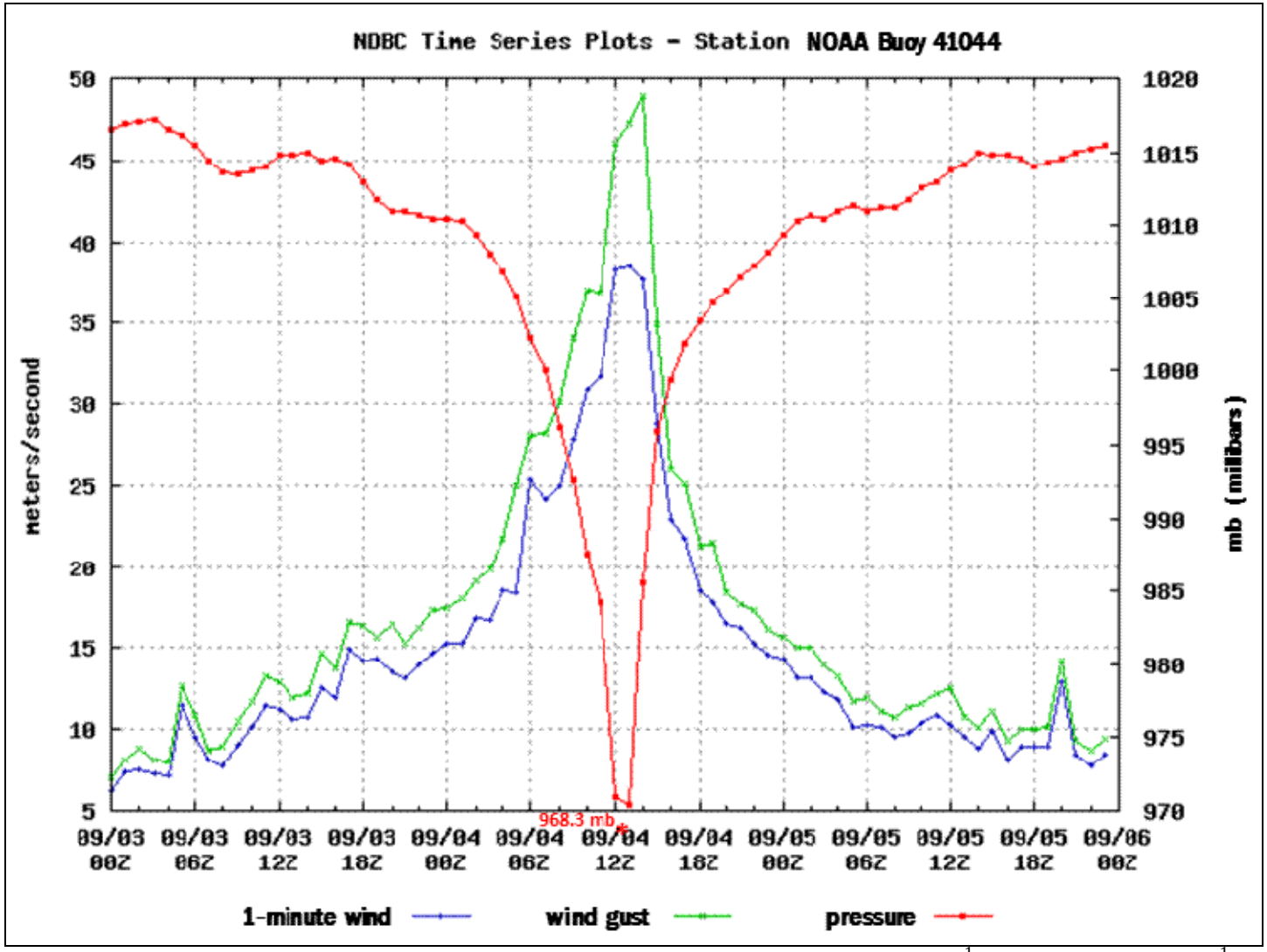

Figure 4. Hourly time series plots of pressure (mb), 1-minute mean wind speed (ms^{-1}), and wind gusts (ms^{-1}) from NOAA buoy 41044 (location 21.65°N 58.69°W) during the period 3-6 September 2011. The eye of Katia passed over or very near the buoy at approximately 1235 UTC 4 September when a minimum pressure of 968.3 mb (red asterisk) was recorded. (graph courtesy of Rex Hervey, NOAA National Data Buoy Center).

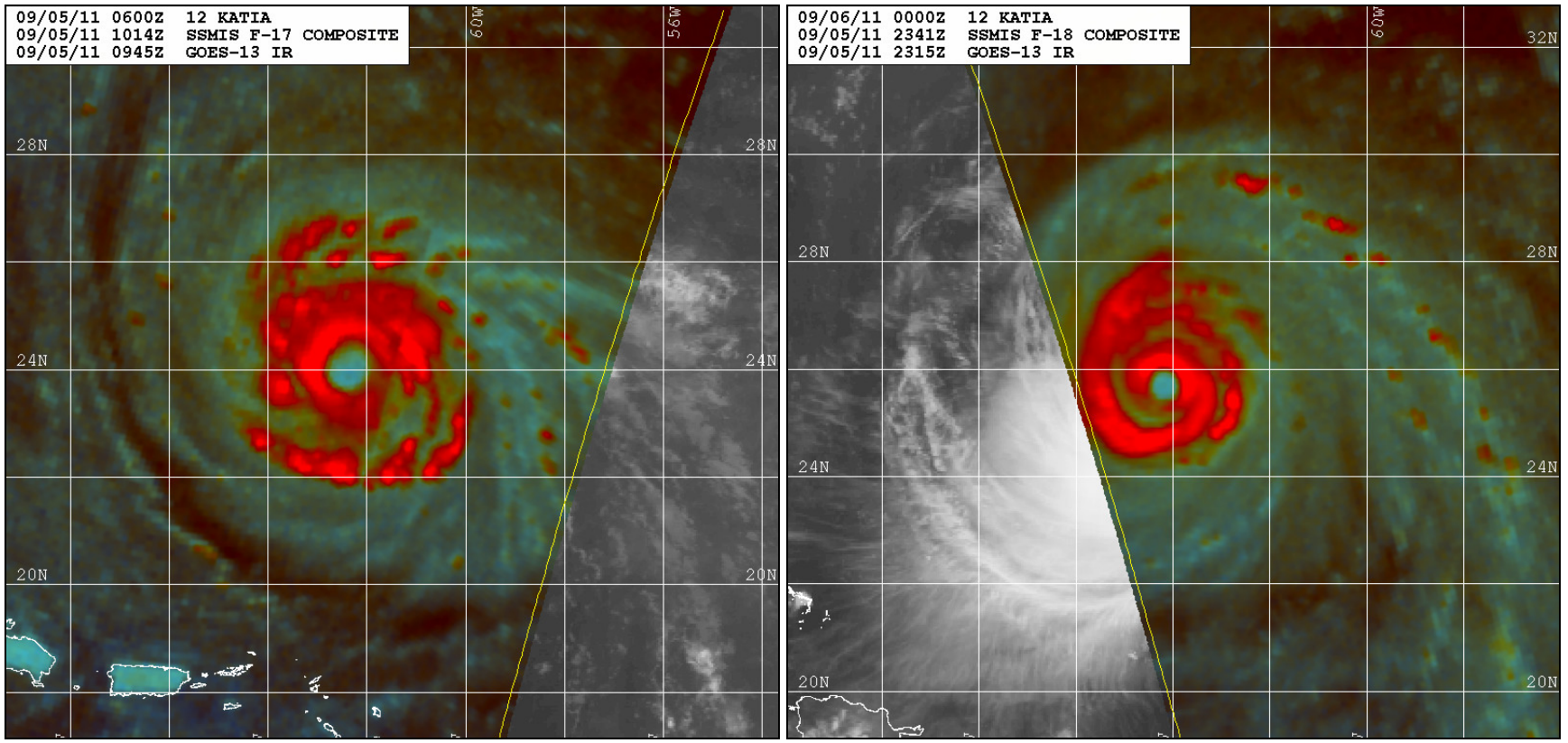

Figure 5. SSMI/S 91 GHz microwave images on 5 September at 1014 UTC (left) and 2341 UTC (right) when Katia was near an intensity of 95 kt and near its peak intensity of 120 kt, respectively. A twenty-five percent reduction in the diameter of the mid-level eye occurred during the 12-h time period between the two images while Katia was undergoing rapid intensification. A moat region surrounding the eye, which was the precursor to a complete eyewall replacement cycle and start of a rapid weakening phase, was just forming in the 2341 UTC image. Images courtesy of the U.S. Navy Fleet Numerical Meteorology and Oceanography Center, Monterey, CA.

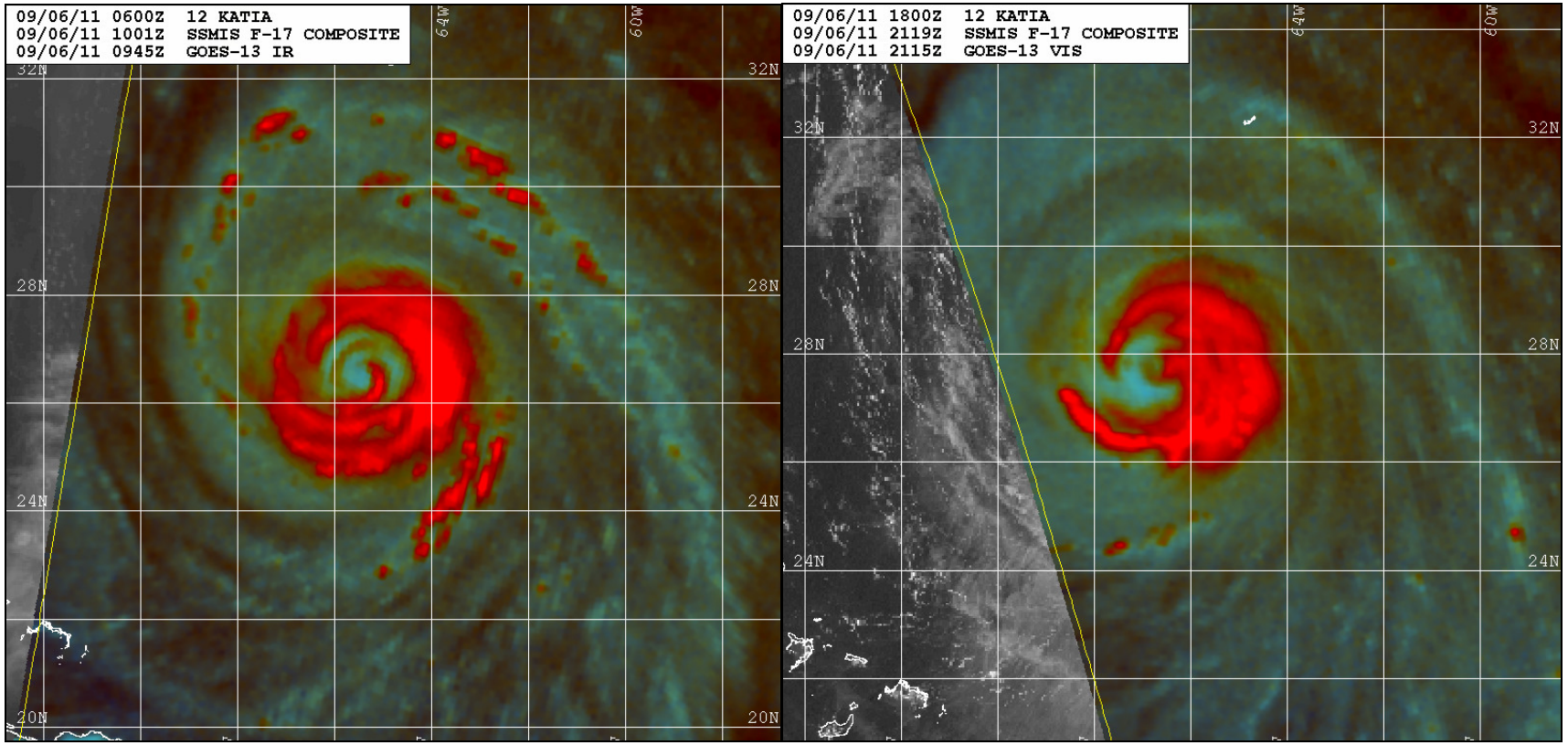

Figure 6. SSMI/S 91 GHz microwave images on 6 September at 1001 UTC (left) and 2119 UTC (right) depicting the eyewall replacement cycle and rapid weakening phase that began shortly after Katia had achieved its peak intensity. The left panel shows the narrow inner eyewall surrounded by the much thicker outer eyewall; the right panel shows almost complete dissipation of the remnant inner eyewall along with some erosion of the outer eyewall in the western quadrant. Images courtesy of the U.S. Navy Fleet Numerical Meteorology and Oceanography Center, Monterey, CA.

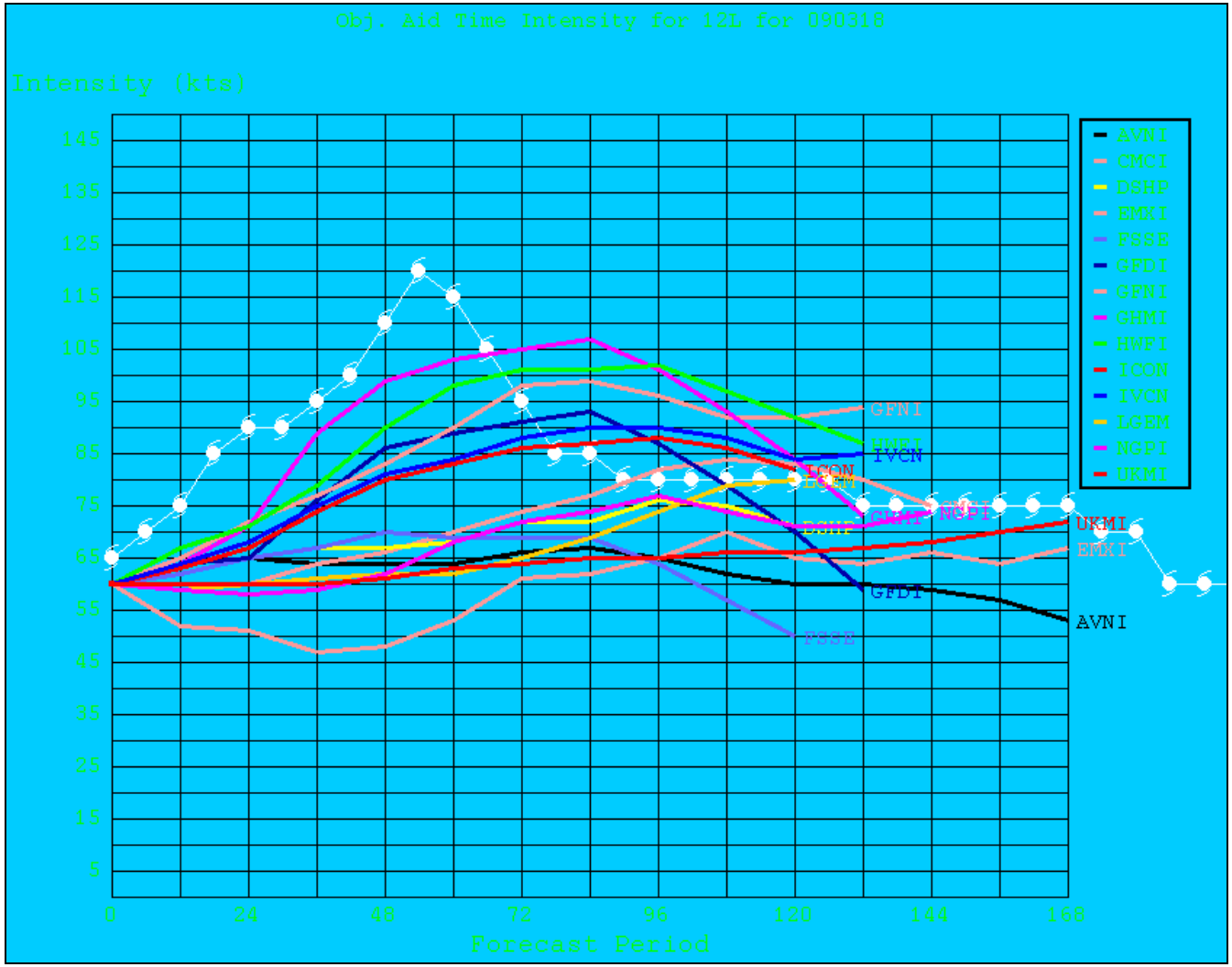

Figure 7. Katia intensity forecast model guidance at 1800 UTC 3 September when the cyclone was a 65-kt hurricane and was 24 h away from beginning a rapid intensification phase. None of the model guidance captured the overall intensification trend, including Katia's peak intensity, and was actually forecasting intensification during the period that Katia was rapidly weakening on 6 September. The best performing model for this forecast cycle was the GFDL model (GHMI) and the worst performing model was the ECMWF (EMXI), with the latter model actually predicting weakening rather strengthening during the ensuing 72-h period.