

Tropical Cyclone Report
Hurricane Maria
1-10 September 2005

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Maria was briefly a major hurricane, but it remained well out at sea.

a. Synoptic History

On 27 August, the axis of a large and strong tropical wave crossed the coast of Africa and moved into the far eastern tropical Atlantic. Cloudiness and showers associated with the wave soon became organized and by 28 August two areas of concentrated deep convection, each showing signs of circulation, were evident within the wave. One of the areas moved northwestward to a location just west of the Cape Verde Islands, and subsequently became disorganized. The other area, which was broader, moved westward for a day or so and then turned northwestward. This system developed a well-defined low-level circulation on 31 August. However, an adjacent upper-tropospheric cyclone produced strong south-southwesterly shear that prevented the formation of persistent deep convection near or over the center. By 1200 UTC 1 September, convection became persistent enough near the center to designate that a tropical depression had formed about 910 n mi east of the northernmost Leeward 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.

A cell of the subtropical ridge was situated to the northeast of the tropical cyclone. This was the primary steering feature, and it drove the system on a west-northwestward to northwestward track for several days. The nearby upper-level low continued to exert a shearing influence, and this hindered significant intensification for about a day. As the effects of the upper-level low lessened, the depression was able to strengthen into a tropical storm by around 1200 UTC 2 September. However, the environment was still not very conducive for strengthening, and the storm intensified at a rather slow pace for a couple of days. While continuing to move well out at sea around the western periphery of the subtropical high, Maria eventually became a hurricane at about 0600 UTC 4 September. Upper-level winds became more favorable for strengthening on 4-5 September. Maria developed a well-defined eye on 5 September and reached its peak intensity, estimated to be near 100 kt, around 0000 UTC 6 September. The hurricane was centered about 415 n mi east of Bermuda at this time and had begun its recurvature around the subtropical anticyclone. It has often been observed that Atlantic tropical cyclones reach their peak intensity around the time of recurvature.

Maria was a major hurricane very briefly; in fact, a weakening trend was already underway at 0600 UTC 6 September. The hurricane turned toward the northeast that day and there was a gradual increase in forward speed over the next couple of days, due to deep-layer

southwesterly flow on the northwest side of the subtropical high. The slow weakening trend was halted on UTC 7 September, when Maria appeared to combine with an upper-level trough and re-intensified slightly to about 75 kt. By 8 September, slow weakening was again underway, and the cyclone diminished to tropical storm strength by about 0000 UTC 9 September. Although Maria stubbornly hung on to tropical characteristics as it moved into the mid-latitudes, it was eventually transformed into an extratropical storm around 1200 UTC 10 September while accelerating north-northeastward. In response to strong baroclinic forcing, the storm intensified and acquired hurricane-force winds over the north Atlantic on 11 September. It began weakening again on 12 September and passed near Iceland on 13 September. Finally, as the system approached Norway, it merged with another strong extratropical cyclone.

b. Meteorological Statistics

Observations in Maria (Figs. 2 and 3) include satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB) and the U. S. Air Force Weather Agency (AFWA). Microwave satellite imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM), the NASA QuikSCAT, and Defense Meteorological Satellite Program (DMSP) satellites were also useful in tracking Maria. QuikSCAT wind speed data were particularly useful on 7 September and provided the main basis for designating Maria as a hurricane even though most Dvorak intensity estimates indicated that it had weakened to a tropical storm.

Only three ship reports of winds of tropical storm force associated with Maria were received. These are listed in Table 2.

c. Casualty and Damage Statistics

There were no reports of damages or casualties during the tropical cyclone stages of Maria. However, the post-Maria merger with another extratropical low was a powerful cyclone, and it triggered a landslide in Norway that killed one person.

d. Forecast and Warning Critique

Average official track errors (with the number of cases in parentheses) for Maria were 33 (34), 56 (32), 74 (30), 85 (28), 120 (24), 156 (20), and 218 (16) n mi for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. These errors are lower than the average official track errors for the 10-yr period 1995-2004¹ of 42, 75, 107, 138, 202, 236, and 310 n mi, respectively. Table 3 shows a comparison of the mean track errors for selected numerical guidance with those of the official forecasts. The GUNA consensus and Florida State University Superensemble (FSSE) had lower errors than the official forecast (OFCL) at most forecast times. At 72 h and beyond, however, those two numerical techniques had significantly fewer cases than the official (i.e., were frequently unavailable). It should also be noted that the mean official error was slightly higher than CLP5 (Five-day Climatology and Persistence) at 120 h -- indicating no skill, on average, for the official forecasts at five days.

¹ Errors given for the 96 and 120 h periods are averages over the four-year period 2001-4.

Average official intensity errors were 6, 6, 8, 8, 12, 13, and 9 kt for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. For comparison, the average official intensity errors over the 10-yr period 1995-2004 are 6, 10, 12, 15, 18, 20, and 22 kt, respectively. The official intensity forecasts were substantially better than average at two through five days. A number of official forecasts were premature (as much as 48-54 h too early) in predicting Maria's extratropical transition.

For as long as four days in advance of its formation, the National Hurricane Center's Tropical Weather Outlooks anticipated the formation of a tropical depression from the wave that eventually spawned Maria. However, these outlooks first focused on the disturbed weather area that moved northwestward toward the Cape Verde Islands and failed to develop. By 29 August, the Outlooks correctly began to identify a second, larger area of weather within the wave as a candidate for tropical cyclone formation.

Watches and/or warnings were not required for any land areas.

Table 1. Best track for Hurricane Maria, 1-10 September 2005.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
01 / 1200	18.8	45.5	1008	30	tropical depression
01 / 1800	19.3	46.2	1008	30	"
02 / 0000	19.9	47.2	1008	30	"
02 / 0600	20.5	48.3	1008	30	"
02 / 1200	21.1	49.4	1006	35	tropical storm
02 / 1800	21.5	50.2	1003	40	"
03 / 0000	22.0	51.0	1001	45	"
03 / 0600	23.0	52.0	1000	45	"
03 / 1200	24.4	53.1	997	50	"
03 / 1800	25.5	54.0	994	55	"
04 / 0000	26.5	54.6	990	60	"
04 / 0600	27.5	55.1	987	65	hurricane
04 / 1200	28.6	55.5	987	65	"
04 / 1800	29.6	56.0	980	75	"
05 / 0000	30.2	56.5	980	75	"
05 / 0600	30.9	56.8	977	80	"
05 / 1200	31.5	56.8	975	85	"
05 / 1800	32.1	56.7	970	90	"
06 / 0000	32.6	56.6	962	100	"
06 / 0600	33.0	56.5	970	90	"
06 / 1200	33.5	56.0	975	80	"
06 / 1800	33.9	55.4	980	75	"
07 / 0000	34.4	54.6	987	65	"
07 / 0600	34.8	53.3	983	70	"
07 / 1200	35.6	51.8	980	75	"
07 / 1800	36.5	50.8	980	75	"
08 / 0000	37.2	49.9	982	70	"
08 / 0600	37.9	49.0	985	65	"
08 / 1200	38.7	48.0	985	65	"
08 / 1800	39.1	47.2	985	65	"
09 / 0000	39.4	46.4	987	60	tropical storm
09 / 0600	39.8	44.9	987	55	"
09 / 1200	40.4	43.4	988	55	"
09 / 1800	41.1	42.1	988	50	"
10 / 0000	41.9	40.6	988	50	"
10 / 0600	42.9	39.2	988	50	"
10 / 1200	44.5	37.7	980	50	extratropical
10 / 1800	46.0	36.3	975	55	"
11 / 0000	48.0	35.0	975	60	"
11 / 0600	50.0	34.0	974	60	"

11 / 1200	52.0	32.9	971	65	"
11 / 1800	54.0	32.0	968	65	"
12 / 0000	55.5	31.0	962	65	"
12 / 0600	57.0	29.0	967	65	"
12 / 1200	58.5	26.0	970	65	"
12 / 1800	61.0	23.0	972	60	"
13 / 0000	62.0	21.0	974	55	"
13 / 0600	62.9	19.0	976	50	"
13 / 1200	63.5	16.0	980	45	"
13 / 1800	63.0	10.0	983	45	"
14 / 0000	63.0	0.0	984	45	"
14 / 0600					Merged with extratropical cyclone
06 / 0000	32.6	56.6	962	100	minimum pressure

Table 2. Selected ship reports with winds of at least 34 kt for Hurricane Maria, 1-10 September 2005.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
07 / 1200	PECS	33.8	49.5	200 / 37	1008.3
09 / 0000	HPII	37.5	38.3	180 / 36	1015.0
10 / 0500	WRYX	48.1	36.9	090 / 37	1010.0

Table 3. Preliminary forecast evaluation (heterogeneous sample) for Hurricane Maria, 1-10 September 2005. Forecast errors (n mi) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type. Verification includes the depression stage, but does not include the extratropical stage, if any.

Forecast Technique	Forecast Period (h)						
	12	24	36	48	72	96	120
CLP5	46 (34)	86 (32)	119 (30)	146 (28)	181 (24)	201 (20)	217 (16)
GFNI	37 (31)	70 (29)	103 (27)	137 (24)	191 (20)	266 (13)	354 (9)
GFDI	35 (34)	54 (32)	76 (30)	101 (27)	162 (22)	223 (14)	219 (10)
GFSI	42 (34)	68 (31)	91 (29)	124 (25)	210 (18)	353 (11)	375 (5)
AEMI	40 (34)	67 (32)	92 (30)	131 (28)	199 (18)	314 (14)	365 (9)
NGPI	35 (33)	60 (31)	85 (29)	113 (27)	178 (23)	226 (18)	339 (14)
UKMI	43 (33)	70 (31)	88 (29)	87 (27)	100 (23)	170 (19)	332 (15)
A98E	42 (34)	62 (32)	101 (30)	166 (28)	264 (24)	402 (20)	538 (16)
A9UK	49 (16)	68 (16)	92 (15)	132 (14)	220 (12)		
BAMD	38 (33)	72 (31)	104 (29)	128 (27)	212 (23)	354 (19)	579 (15)
BAMM	35 (33)	54 (31)	73 (29)	107 (27)	182 (23)	286 (19)	392 (15)
BAMS	50 (33)	84 (31)	117 (29)	161 (27)	260 (23)	380 (19)	473 (15)
CONU	32 (34)	54 (32)	74 (30)	91 (28)	122 (24)	153 (18)	263 (14)
GUNA	32 (32)	53 (29)	71 (27)	73 (22)	116 (16)	162 (10)	208 (4)
FSSE	31 (29)	50 (27)	67 (22)	81 (21)	105 (17)	155 (11)	160 (7)
OFCL	33 (34)	56 (32)	74 (30)	85 (28)	120 (24)	156 (20)	218 (16)
NHC Official (1995-2004 mean)	42 (3400)	75 (3116)	107 (2848)	138 (2575)	202 (2117)	236 (649)	310 (535)

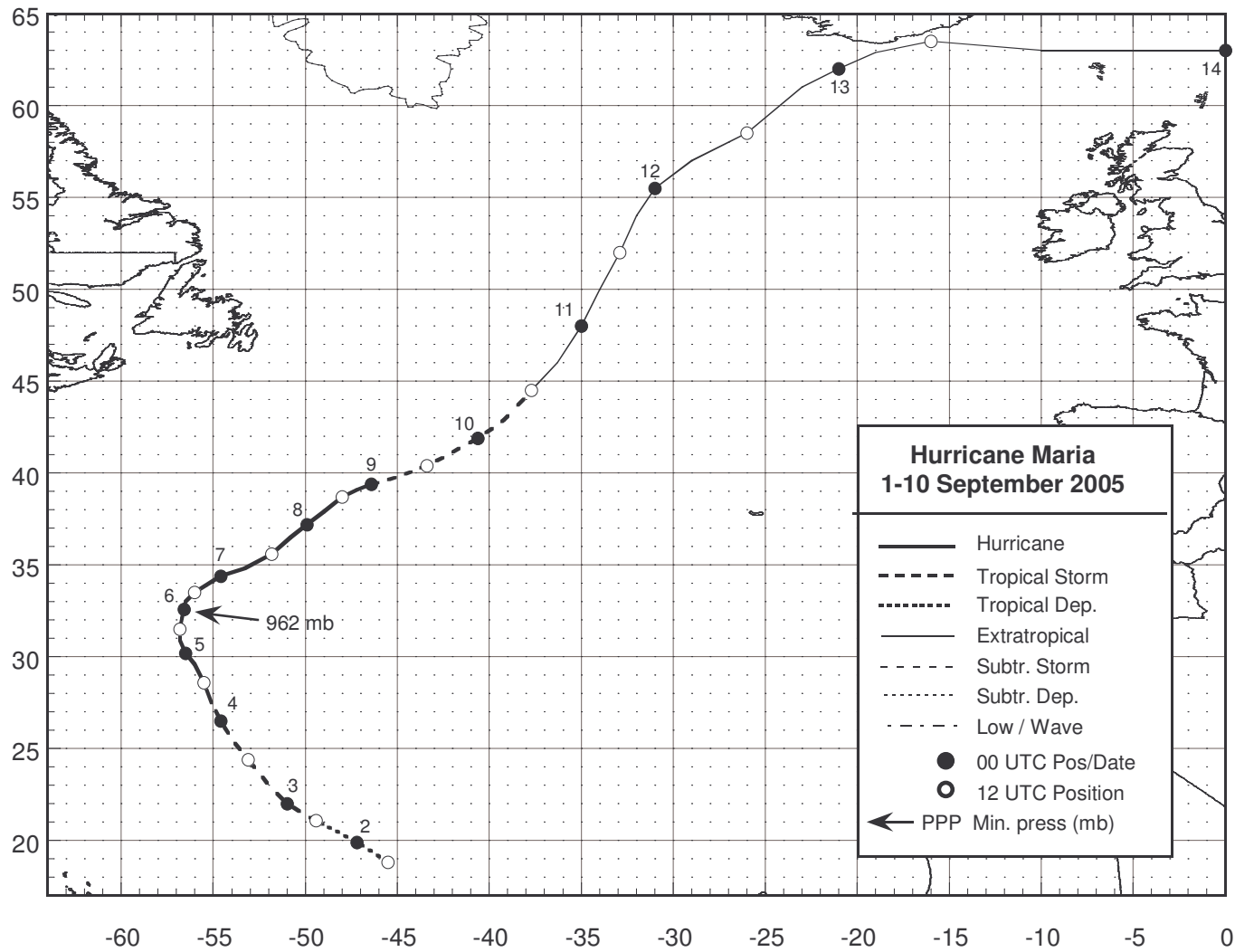


Figure 1. Best track positions for Hurricane Maria, 1-10 September 2005. Track during the extratropical stage is based partially on analyses from the NOAA Ocean Prediction Center.

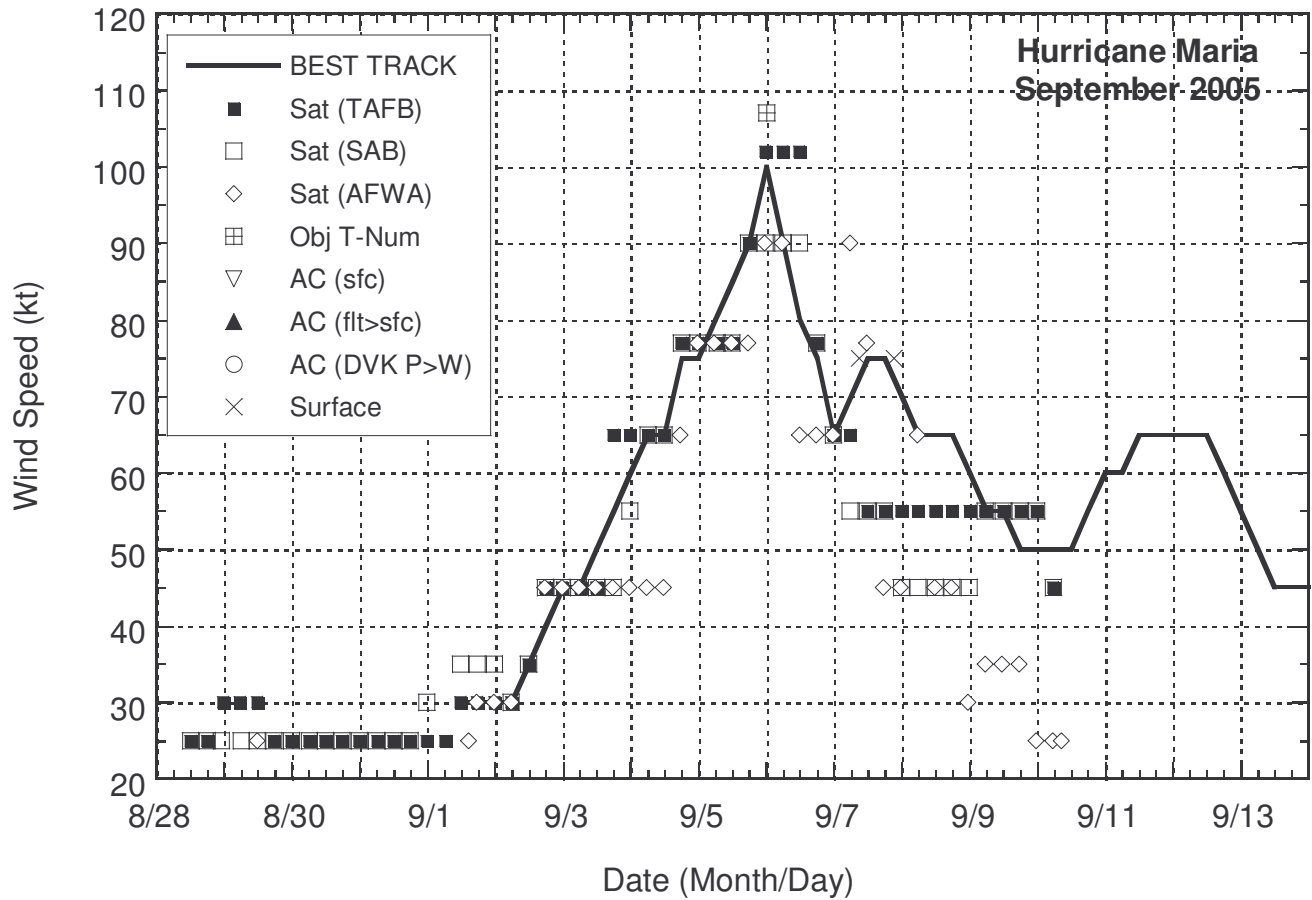


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Maria, 1-10 September 2005. Objective Dvorak estimates represent linear averages over a three-hour period centered on the nominal observation time. Estimates during the extratropical stage are based partially on analyses from the NOAA Ocean Prediction Center.

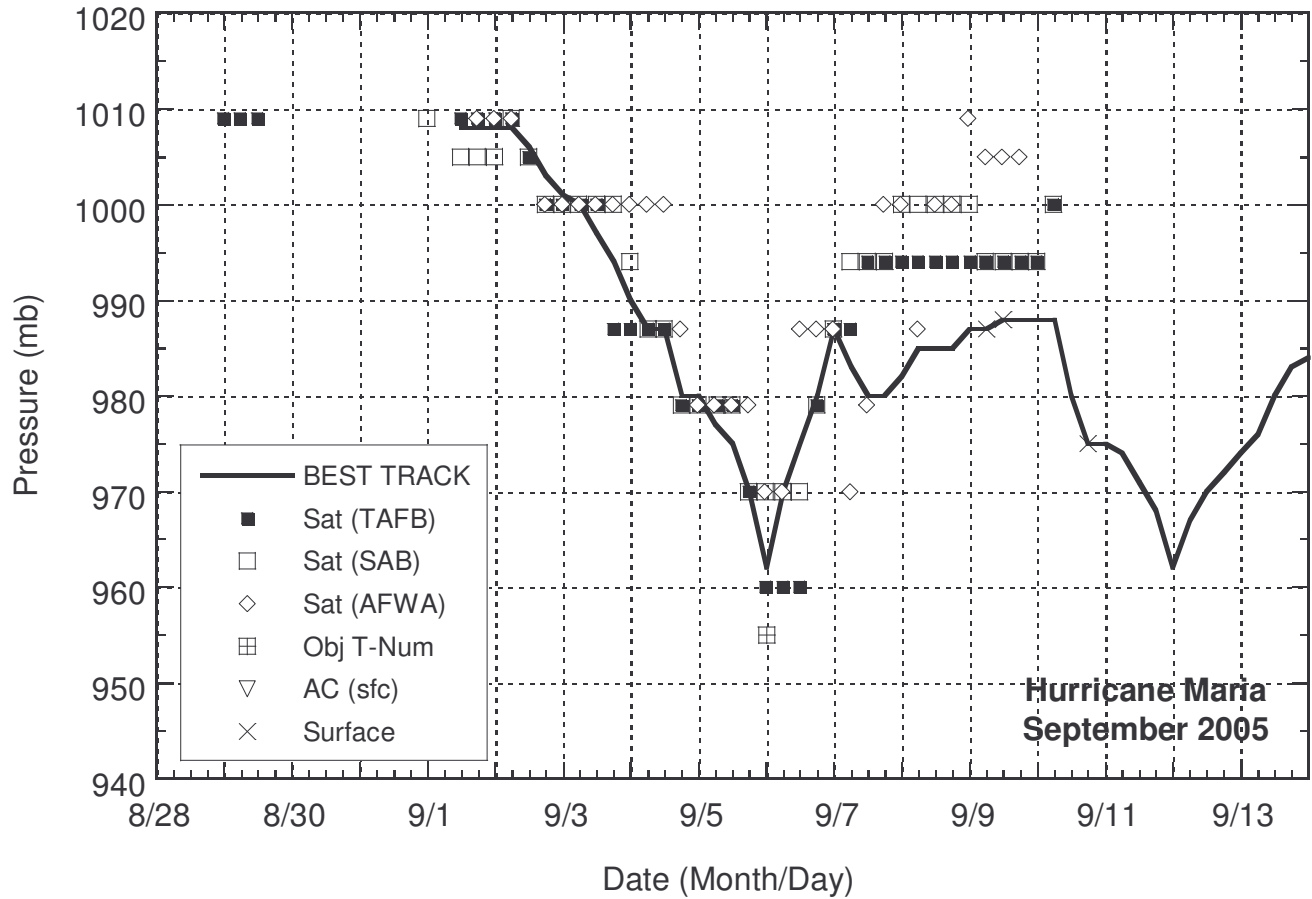


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Maria, 1-10 September 2005. Objective Dvorak estimates represent linear averages over a three-hour period centered on the nominal observation time. Estimates during the extratropical stage are based partially on analyses from the NOAA Ocean Prediction Center.