Tropical Cyclone Report
Hurricane Gustav
8 - 12 September 2002

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Hurricane Gustav was a category 2 hurricane of subtropical origin. The cyclone passed near the Outer Banks of North Carolina as a tropical storm, then passed over the eastern end of Nova Scotia and western Newfoundland as a category 1 hurricane.

## a. Synoptic History

An area of showers developed between the Bahamas and Bermuda on 6 September in association with a developing upper-level trough and a weak surface trough. The upper-level trough amplified over the next two days in response to upstream ridging enhanced by Tropical Storm Fay over the Gulf of Mexico. As this occurred, convection increased in both coverage and intensity and the surface trough became better defined. A broad surface low formed in the system late on 7 September. By 1200 UTC 8 September, the cyclone had developed sufficient organized convection to qualify as a subtropical depression about 440 n mi south-southeast of Cape Hatteras, North Carolina. Later that day, an Air Force Reserve Hurricane Hunter aircraft investigated the cyclone and found it had become Subtropical Storm Gustav. 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.

Gustav moved erratically west-northwestward on 9 September as it slowly strengthened. On that day, the cyclone had a large area of light winds near the center with multiple low-level cloud swirls, and aircraft and satellite position fixes often differed by 30-50 n mi. Gustav turned north early on 10 September as convection became better organized near the center. Based on this and the development of a band of strong winds closer to the center, it is estimated that the cyclone transformed into a tropical storm around 1200 UTC. Maximum sustained winds reached 55 kt while the center passed between Cape Hatteras and Diamond Shoals, North Carolina about 2100 UTC that day. It should be noted that while the circulation center stayed offshore (not a "landfall"), the radius of maximum winds (RMW) passed over portions of the Outer Banks and thus counts as a "strike" for this area.

Gustav turned northeastward when it reached the Hatteras area, then accelerated northeastward on 11 September in southwesterly flow caused by baroclinic cyclogenesis over the New England states and southeastern Canada. In a complex process similar to that seen in Hurricane Michael in 2000, the tropical cyclone intensified as it gradually began to merge with or absorb the non-tropical low. Gustav became the 2002 season's first hurricane just before1200 UTC and reached a maximum intensity of 85 kt near 1800 UTC. After that, the cyclone began to weaken. Gustav made landfall over the southern part of Cape Breton, Nova Scotia near 0430 UTC 12 September as

an 80-kt hurricane. Satellite, surface, and radar data indicated the cyclone was becoming extratropical as it made a second landfall over southwestern Newfoundland near 0900 UTC. Gustav lost all tropical characteristics by 1200 UTC as it continued northeastward while decelerating across Newfoundland. The remnant extratropical low moved into the Labrador Sea, where it turned northwestward late on 13 September and dissipated on 15 September.

b. Meteorological Statistics

Observations in Gustav (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), as well as flight-level and dropwindsonde observations from flights of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command. Additionally, there were many observations from ships, buoys, and land stations.

The maximum winds reported in Gustav were flight-level winds of 104 kt from both Air Force Reserve (at 850 mb) and NOAA (at 700 mb) hurricane hunters around 1900-2000 UTC 11 September. Using standard flight-level to surface reduction for eyewall conditions, the NOAA report would yield a surface wind estimate of 90-95 kt (Fig. 2). However, neither aircraft reported an eye or eyewall, so a more conservative reduction for convective bands would yield a surface wind estimate of 85-90 kt. This is in better agreement with the 80-85 kt estimated surface wind from the Air Force aircraft and with an 83 kt surface wind measured by the Stepped Frequency Microwave Radiometer instrument on the NOAA aircraft. The minimum aircraft-reported pressure on a formal fix was 969 mb at 1701 UTC 11 September. However, a dropsonde released later that day near the flight-level wind maximum southeast of the center reported a surface pressure of 964 mb. This suggests that the rapid northeastward motion displaced the wind center of the cyclone to the northwest of the pressure center.

Gustav affected many ships and buoys between North Carolina and Nova Scotia, with selected observations given in Table 2. The most notable observations were from the ship **Tellus** (call sign WRYG), which reported 88 kt and 90 kt winds at 1500 and 1600 UTC 11 September. While these winds are not totally inconsistent with the strength of Gustav at the time, the ship was far enough from the center that the speeds appear somewhat suspect. The oil rig WCY533 near Sable Island reported 74 kt winds and a 965.0 mb pressure at 0300 UTC 12 September. Other noteworthy ship and buoy reports include a 55 kt wind reported by the **Columbus Canterbury** (call sign ELUB8) near the North Carolina coast at 1900 UTC 10 September and a 964.3 mb pressure from Canadian buoy 44142 at 2300 UTC 11 September.

Gustav brought tropical-storm winds to portions of the North Carolina coast and eastern Nova Scotia. In North Carolina, the Coastal Marine Automated Network station at Diamond Shoals reported 52 kt sustained winds with a gust to 61 kt at 1400 UTC 10 September and a 984.8 mb pressure at 2000 UTC. The Cape Hatteras Coast Guard station reported a gust of 68 kt at 2130 UTC. In Nova Scotia, Sable Island reported 48 kt sustained winds with a gust to 66 kt at 0414 UTC 12 September, while Hart Island reported a pressure of 961.4 mb at 0345 UTC. Tropical-storm winds were also reported on Prince Edward Island as the wind field of Gustav expanded during

extratropical transition.

Storm surge flooding of 5-6 ft above normal tide levels occurred along the inland side of the Outer Banks in Hyde and Dare counties. This occurred during a period of strong northwesterly winds following the passage of the center of Gustav. Storm tides of 3-4 ft above normal were reported in Cedar Island and along the Neuse River. Tides were 1-2 ft above normal elsewhere along the coasts of North Carolina and southeastern Virginia. A 4-5 ft storm surge occurred at Charlottetown, Prince Edward Island. Above normal tides were also reported along the coasts of northern and eastern Nova Scotia and eastern New Brunswick.

Storm total rainfalls were 2-5 in over portions of the Outer Banks, Nova Scotia, and Prince Edward Island. This included a 4.90 in total at Ocracoke, North Carolina and a 4.25 in total at Lyon's Brook, Nova Scotia. One tornado occurred during Gustav near Ocracoke.

c. Casualty and Damage Statistics

Gustav directly caused one death - a swimmer at Myrtle Beach, South Carolina who suffered injuries from high surf and died two days later. Forty people had to be rescued from storm surge in Hatteras at the height of the storm.

Damages from Gustav were minor. Damages to property and vehicles in North Carolina is estimated at about $100,000. In Canada, the worst damage occurred on Prince Edward Island, where whole trees were toppled and local flooding occurred. In Nova Scotia, some docks were damaged and trees were blown down.

d. Forecast and Warning Critique

Average official track errors (with the number of cases in parentheses) for Gustav were 50 (13), 70 (11), 66 (9), 112 (7), and 239 (3) n mi for the 12, 24, 36, 48, and 72 h forecasts, respectively. These errors are lower than the average official track errors for the 10-yr period 1992-2001 (43, 81, 115, 148, and 222 n mi, respectively) for 24, 36, and 48h, and higher than the 10-yr average at 12 and 72 h. (Table 4).

Several of the numerical guidance models performed well during Gustav. The National Weather Service Global Forecasting System model (AVNO) had overall best performance, with average track forecast errors of less than 60 n mi through 48 h and a 110 n mi error at 72 h.

Average official intensity errors were 5, 7, 9, 12, and 22 kt for the 12, 24, 36, 48, and 72 h forecasts, respectively. For comparison, the average official intensity errors over the 10-yr period 1992-2001 are 7, 11, 14, 16, and 19 kt, respectively. The largest intensity forecast errors occurred during Gustav's northeastward acceleration, when the intensities were underforecast.

Table 5 lists the U. S. watches and warnings associated with Gustav. A tropical storm watch was issued for portions of the North Carolina coast at 2100 UTC 8 September, while a tropical storm

warning was issued for much of the watch area at 0300 UTC 9 September. This was 48 and 42 h, respectively, before the closest approach of the center to the Cape Hatteras area. In addition to the warnings in table 5, the Canadian Hurricane Center in Halifax, Nova Scotia issued warnings for wind rain and storm surge for large portions of New Brunswick, Nova Scotia, Newfoundland, and Prince Edward Island.

*Acknowledgments*

Much of the U. S. data in this report was contributed by the National Weather Service forecast offices in Wilmington, North Carolina, Morehead City, North Carolina, and Wakefield, Virginia. Peter Bowyer of the Canadian Hurricane Center and Chris Fogarty of Dalhouse University contributed much of the Canadian data.

Table 1. Best track for Hurricane Gustav, 8 - 12 September 2002.

| Date/Time (UTC) | Latitude (°N) | Longitude (°W) | Pressure (mb) | Wind Speed (kt) | Stage |
|---|---|---|---|---|---|
| 08/ 1200 | 29.0 | 71.0 | 1009 | 30 | subtropical depression |
| 08 / 1800 | 30.2 | 71.1 | 1007 | 35 | subtropical storm |
| 09 / 0000 | 30.5 | 72.3 | 1004 | 40 | " |
| 09 / 0600 | 31.2 | 72.6 | 1003 | 40 | " |
| 09 / 1200 | 31.6 | 73.6 | 1002 | 40 | " |
| 09 / 1800 | 31.9 | 74.5 | 1002 | 40 | " |
| 10 / 0000 | 32.1 | 75.5 | 996 | 45 | " |
| 10 / 0600 | 33.0 | 75.5 | 990 | 50 | " |
| 10 / 1200 | 33.7 | 75.4 | 987 | 50 | tropical storm |
| 10 / 1800 | 35.0 | 75.4 | 985 | 55 | " |
| 11 / 0000 | 35.5 | 74.7 | 983 | 55 | " |
| 11 / 0600 | 36.8 | 73.0 | 977 | 60 | " |
| 11 / 1200 | 38.0 | 70.8 | 971 | 70 | hurricane |
| 11 / 1800 | 40.3 | 66.8 | 964 | 85 | " |
| 12 / 0000 | 43.1 | 62.8 | 962 | 80 | " |
| 12 / 0600 | 46.5 | 59.6 | 960 | 75 | " |
| 12 / 1200 | 48.6 | 57.7 | 965 | 60 | extratropical |
| 12 / 1800 | 50.1 | 55.5 | 967 | 60 | " |
| 13 / 0000 | 51.0 | 54.0 | 968 | 55 | " |
| 13 / 0600 | 52.5 | 52.5 | 968 | 50 | " |
| 13 / 1200 | 54.5 | 51.4 | 972 | 45 | " |
| 13 / 1800 | 56.0 | 49.5 | 976 | 45 | " |
| 14 / 0000 | 57.0 | 51.5 | 982 | 40 | " |
| 14 / 0600 | 58.0 | 52.5 | 984 | 35 | " |
| 14 / 1200 | 59.5 | 53.5 | 989 | 30 | " |

| Date/Time (UTC) | Latitude (°N) | Longitude (°W) | Pressure (mb) | Wind Speed (kt) | Stage |
|---|---|---|---|---|---|
| 14 / 1800 | 61.0 | 54.0 | 992 | 30 | " |
| 15 / 0000 | 62.5 | 54.5 | 998 | 20 | " |
| 15 / 0600 | | | | | dissipated |
| 12 / 0400 | 45.3 | 60.8 | 960 | 80 | minimum pressure |
| 12 / 0430 | 45.6 | 60.4 | 960 | 80 | Landfall near Kelpy Cove, Cape Breton Island, Nova Scotia |
| 12 / 0900 | 47.6 | 58.6 | 963 | 65 | Landfall near Rose-Blanche-Harbour le Cou, Newfoundland |

Table 2. Selected ship and drifting buoy reports with winds of at least 34 kt for Hurricane Gustav, 8 -12 September 2002.

| Date/Time (UTC) | Ship name or call sign | Latitude (°N) | Longitude (°W) | Wind dir/speed (kt) | Pressure (mb) |
|---|---|---|---|---|---|
| 08 / 1620 | Buoy 41652 | 30.0 | 68.8 | 150 / 43 | 1012.9 |
| 09 / 0300 | Buoy 41537 | 27.4 | 70.8 | 210 / 41 | 1015.4 |
| 09 / 0620 | Buoy 41652 | 30.0 | 68.4 | 170 / 52 | 1014.6 |
| 09 / 0800 | Buoy 41537 | 27.5 | 70.8 | 180 / 56 | 1014.6 |
| 09 / 1500 | **P&O Nedlloyd Sydney** | 34.0 | 76.2 | 010 / 45 | 1010.5 |
| 09 / 1800 | **P&O Nedlloyd Sydney** | 34.6 | 75.2 | 030 / 37 | 1007.5 |
| 10 / 1800 | **Star Inventana** | 32.6 | 72.3 | 250 / 35 | 1012.4 |
| 10 / 1800 | **Charles Island** | 33.9 | 72.8 | 140 / 35 | 1003.0 |
| 10 / 1900 | **Columbus Canterbury** | 35.5 | 75.0 | 090 / 55 | N/A |
| 11 / 0000 | **Charles Island** | 33.0 | 74.1 | 250 / 40 | 1001.5 |
| 11 / 0600 | WAAH | 35.8 | 72.5 | 220 / 52 | 988.5 |
| 11 / 1500 | **Nedlloyd Holland** | 37.8 | 66.9 | 210 / 54 | 990.5 |
| 11 / 1500 | **Tellus** | 38.0 | 68.1 | 150 / 88 | 978.0 |
| 11 / 1600 | **Tellus** | 38.0 | 68.2 | 240 / 90 | 982.3 |
| 11 / 1800 | **Swan** | 35.0 | 71.5 | 240 / 39 | 1003.7 |
| 12 / 0000 | **P&O Nedlloyd Jakarta** | 37.2 | 59.8 | 220 / 47 | 1005.0 |
| 12 / 0000 | **Majestic Maersk** | 40.7 | 61.6 | 220 / 40 | 988.0 |
| 12 / 0300 | WCY533 | 44.0 | 60.3 | 190 / 74 | 965.0 |
| 12 / 0600 | **Choyang Zenith** | 37.0 | 59.9 | 230 / 41 | 1004.5 |
| 12 / 0600 | YJRX2 | 44.2 | 59.6 | 240 / 55 | 978.7 |
| 12 / 1200 | **Albatros** | 44.1 | 63.8 | 320 / 48 | 993.2 |
| 12 / 1200 | **Algofax** | 46.6 | 59.5 | 290 / 43 | 976.0 |
| 12 / 1200 | 3FPK7 | 46.6 | 48.0 | 210 / 38 | 995.6 |
| 12 / 1500 | HP6038 | 46.4 | 48.4 | 190 / 40 | 994.7 |
| 12 / 1800 | **Kometik** | 43.4 | 53.9 | 230 / 55 | 992.0 |
| 12 / 1800 | **Atlantic Concert** | 46.3 | 50.2 | 160 / 36 | 990.9 |
| 12 / 2100 | Buoy 44602 | 44.5 | 52.8 | 250 / 39 | N/A |
| 13 / 0300 | HP6038 | 46.4 | 48.4 | 230 / 45 | 999.5 |
| 13 / 0600 | **Atlantic Concert** | 45.6 | 53.4 | 260 / 50 | 1004.2 |
| 13 / 0900 | 3FPK7 | 46.6 | 48.0 | 250 / 39 | 1005.7 |
| 13 / 1200 | **Canmar Success** | 49.7 | 45.7 | 200 / 42 | 1002.5 |
| 13 / 1800 | **Canmar Success** | 50.0 | 47.4 | 210 / 45 | 1005.8 |

Table 3. Selected surface observations for Hurricane Gustav, 8-12 September 2002.

| 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) | | | |
| **North Carolina** | | | | | | | | |
| Alligator River Bridge | | | 10/2100 | | 56 | | | |
| Beaufort (KMRH)[f] | 10/1900 | 999.7 | 10/2033 | 32 | 39 | | | 1.95 |
| Cape Hatteras CG | | | 10/2130 | | 68 | | | |
| Cape Hatteras Fishing Pier | 10/2112 | 985.3 | 10/2112 | 37 | 55 | | | |
| Cedar Island | | | 10/2130 | | 48 | | | |
| Duck (NOS) | 10/2324 | 995.0 | 10/2248 | 44 | 55 | | | |
| Elizabeth City (KECG) | 10/2145 | 999.0 | 10/2054 | 26 | 38 | | | 0.61 |
| Frisco (KSHE) | 10/1700 | 987.5 | 11/0100 | 25 | 36 | | | 4.72 |
| Manteo (KMQI)[f] | 10/2100 | 993.5 | 10/2300 | 35 | 47 | | | 2.27 |
| Nags Head | | | 10/2000 | | 53 | | | |
| Ocracoke | | | 10/2030 | | 64 | | | 4.90 |
| | | | | | | | | |
| **Nova Scotia** | | | | | | | | |
| Ashdale | | | | | | | | 4.13 |
| Hallifax | | | | | | | | 3.70 |
| Hart Island (CWRN) | 12/0345 | 961.4 | | | | | | |
| Liverpool | | | | | | | | 4.02 |
| Lyon's Brook | | | | | | | | 4.25 |
| Middleboro | | | | | | | | 3.94 |
| Sable Island (CWSA)[f] | 12/0300 | 969.2 | 12/0414 | 48 | 66 | | | |
| St. Paul's Island (CWEF)[f] | 12/0500 | 961.6 | 12/0742 | | 66 | | | |
| | | | | | | | | |
| **Prince Edward Island** | | | | | | | | |
| Charlottetown | | | 12/0245 | 35 | 52 | 4-5 | | 2.76 |
| | | | | | | | | |
| **Buoys and C-MAN** | | | | | | | | |
| Buoy 41001 | 11/0600 | 997.5 | 11/0310 | 36[e] | 46 | | | |
| Buoy 41002 | 10/0500 | 996.7 | 10/1500 | 29 | 35 | | | |
| Buoy 44004 | 11/1300 | 977.5 | 10/1420 | 44[e] | 62 | | | |
| Buoy 44008 | 11/1700 | 983.1 | 11/1600 | 29 | 35 | | | |
| Buoy 44011 | 11/1900 | 972.4 | 11/2000 | 44 | 61 | | | |
| Buoy 44014 | 11/0400 | 991.3 | 11/0500 | 35 | 44 | | | |
| Buoy 44137 | 12/0000 | 983.6 | 12/0500 | 47 | | | | |
| Buoy 44139 | 12/0500 | 982.8 | 12/0600 | 41 | | | | |

| 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) | | | |
| Buoy 44142 | 11/2300 | 964.3 | 12/0000 | 44 | 60 | | | |
| Buoy 44145[f] | 12/0900 | 994.8 | 13/0000 | 52 | | | | |
| Bupy 44251 | 12/1000 | 984.7 | 13/0000 | 37 | | | | |
| Buoy 44255 | 12/0800 | 968.1 | 13/0700 | 37 | | | | |
| Cape Lookout (CKLN7) | 10/1700 | 996.9 | 10/2010 | 31[e] | 40 | | | |
| Diamond Shoals (DSLN7) | 10/2000 | 984.8 | 10/1400 | 52 | 61 | | | |
| Duck (DUCN7) | 11/0000 | 997.7 | 10/2250 | 46[e] | 57 | | | |
| Frying Pan Shoals (FPSN7) | 10/1000 | 1002.1 | 10/0100 | 44 | 52 | | | |

[a] Date/time is for sustained wind when both sustained and gust are listed.
[b] Except as noted, sustained wind averaging periods for C-MAN and land-based ASOS reports are 2 min; buoy averaging periods are 8 min.
[c] Storm surge is water height above normal astronomical tide level.
[d] Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level).
[e] 10-min average
[f] Incomplete record

Table 4. Preliminary forecast evaluation (heterogeneous sample) for Hurricane Gustav, 8 - 12 September 2002. Forecast errors for tropical storm and hurricane stages (n mi) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type.

| Forecast Technique | Forecast Period (h) | | | | |
|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 |
| CLP5 | 88 (13) | 202 (11) | 301 ( 9) | 421 ( 7) | 421 ( 3) |
| GFNI | 68 (12) | 106 (10) | 188 ( 8) | 338 ( 6) | 822 ( 2) |
| GFDN* | 62 ( 7) | 103 ( 6) | 141 ( 5) | 229 ( 4) | 725 ( 2) |
| GFDI | 74 (13) | 82 (11) | 121 ( 9) | 167 ( 7) | 422 ( 3) |
| GFDL* | 53 (13) | 88 (11) | 104 ( 9) | 161 ( 7) | 348 ( 3) |
| AFW1* | 57 ( 6) | 104 ( 5) | 136 ( 4) | 213 ( 3) | 404 ( 1) |
| COAI | 65 (11) | 94 ( 9) | 163 ( 7) | 293 ( 5) | 887 ( 1) |
| COAL* | 68 ( 6) | 84 ( 5) | 116 ( 4) | 215 ( 3) | 729 ( 1) |
| LBAR | 60 (13) | 121 (11) | 203 ( 9) | 309 ( 7) | 411 ( 3) |
| A98E | 67 (13) | 91 (11) | 79 ( 9) | 168 ( 7) | **147** ( 3) |
| A9UK | 70 ( 6) | **68** ( 5) | 84 ( 4) | 200 ( 3) | **104** ( 1) |
| BAMD | 50 (13) | 75 (11) | 99 ( 9) | 126 ( 7) | **197** ( 3) |
| BAMM | 55 (13) | 90 (11) | 121 ( 9) | 146 ( 7) | 263 ( 3) |
| BAMS | 69 (13) | 113 (11) | 157 ( 9) | 183 ( 7) | 372 ( 3) |
| AVNI | **42** (13) | **46** (11) | **55** ( 9) | **65** ( 7) | **134** ( 3) |
| AVNO* | **29** (13) | **32** (11) | **42** ( 9) | **58** ( 7) | **110** ( 2) |
| AEMI | 53 ( 9) | **61** ( 7) | 78 ( 6) | **92** ( 4) | **232** ( 2) |
| AEMN* | **32** ( 6) | **45** ( 5) | **43** ( 4) | **63** ( 3) | **187** ( 1) |
| NGPI | 81 (13) | **66** (11) | 109 ( 9) | 155 ( 7) | 307 ( 3) |
| NGPS* | **40** (13) | **61** (11) | 78 ( 9) | 124 ( 7) | 402 ( 3) |
| UKMI | 51 (12) | **61** (10) | **65** ( 8) | **80** ( 6) | **115** ( 3) |
| UKM* | 68 ( 6) | **58** ( 5) | 74 ( 4) | **100** ( 3) | **98** ( 1) |
| GUNS | 63 (12) | **65** (10) | 78 ( 8) | **95** ( 6) | **138** ( 3) |
| GUNA | 55 (12) | **58** (10) | 67 ( 8) | **80** ( 6) | **133** ( 3) |
| OFCL | 50 (13) | 70 (11) | 66 ( 9) | 112 ( 7) | 239 ( 3) |
| NHC Official (1992-2001 mean) | 43 (2199) | 81 (1965) | 115 (1759) | 148 (1580) | 222 (1272) |

* Output from these models was unavailable at time of forecast issuance.

Table 5. Watch and warning summary for Hurricane Gustav. The table does not include the various watches and warning issued for Canada by Environment Canada.

| Date/Time (UTC) | Action | Location |
|---|---|---|
| 08/2100 | Tropical Storm Watch | Cape Fear, NC northward to the NC/VA border including the Pamlico and Ablemarle Sounds |
| 09/0300 | Tropical Storm Warning | Cape Fear, NC to Currituck Beach Light, NC including the Pamlico and Ablemarle Sounds |
| 09/0300 | Tropical Storm Watch | NC/VA border to Parramore Island, VA and southern Chesapeake Bay south of New Point Comfort, VA |
| 10/0300 | Tropical Storm Warning | Currituck Beach Light, NC to Parramore Island, VA and southern Chesapeake Bay south of New Point Comfort, VA |
| 10/1800 | Tropical Storm Warning discontinued | west of Surf City, NC |
| 10/2100 | Tropical Storm Warning discontinued | west of Bogue Inlet, NC |
| 11/0300 | Tropical Storm Warning discontinued | south of Ocracoke Inlet, NC including the Pamlico and Ablemarle Sounds and southern Chesapeake Bay south of New Point Comfort, VA |
| 11/0900 | Tropical Storm Warning discontinued | remainder of NC/VA coasts |

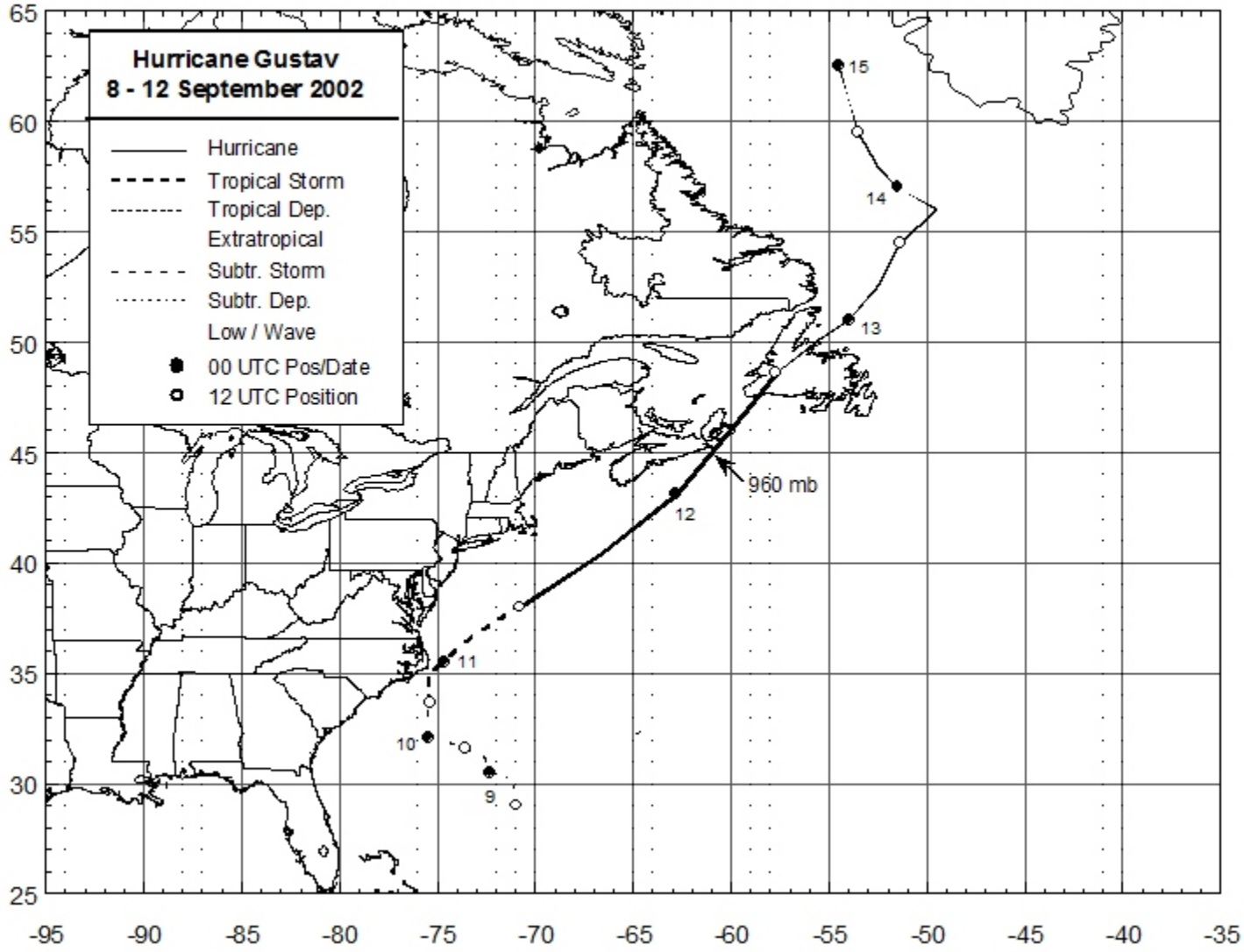


Figure 1. Best track positions for Hurricane Gustav, 8 - 12 September 2002. Track during the extratropical stage is based on analyses from the NOAA Marine Prediction Center.

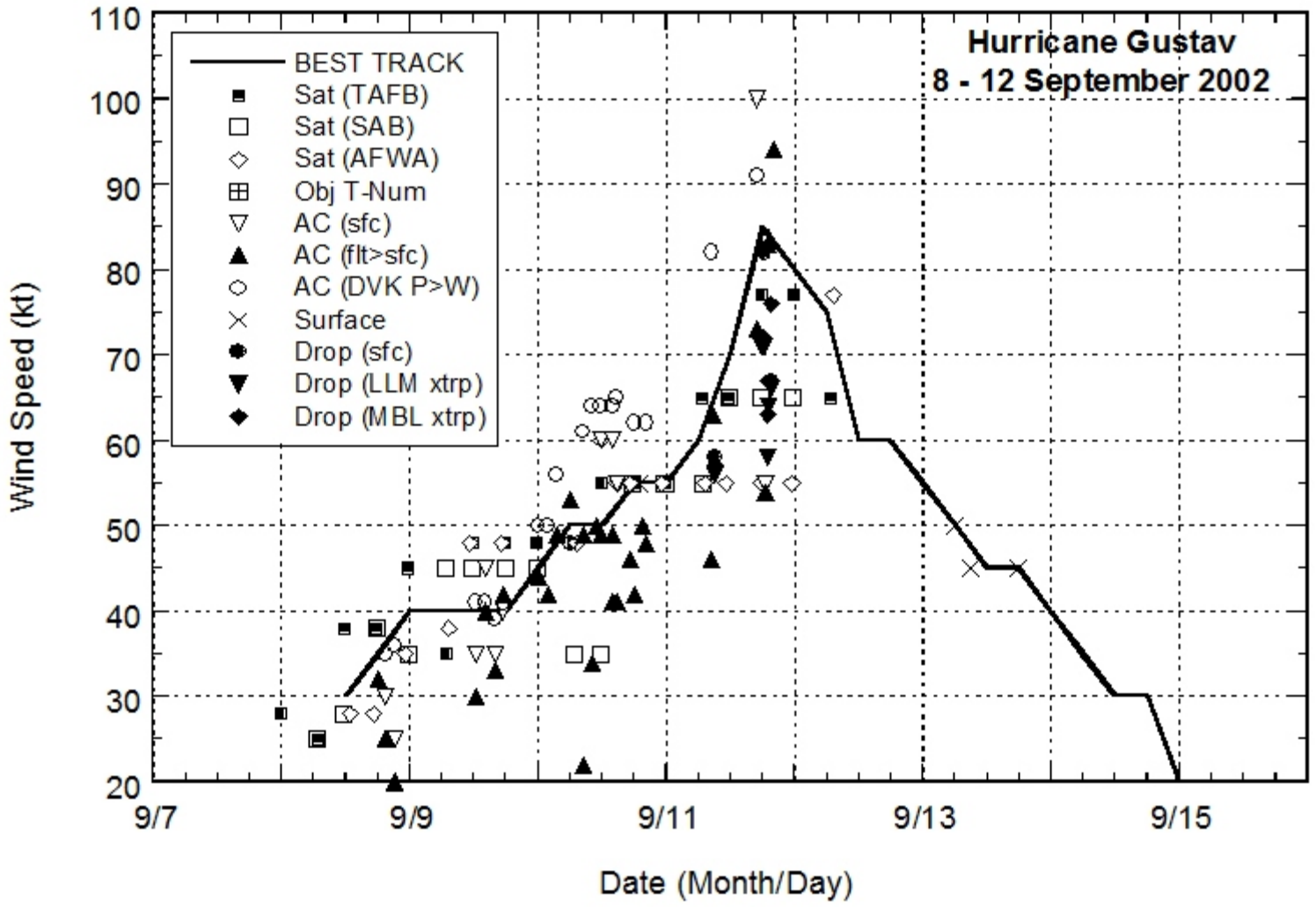


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Gustav, 8 - 12 September 2002. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% reduction factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM), and from the sounding boundary layer mean (MBL). Estimates during the extratropical stage are based on analyses from the NOAA Marine Prediction Center and the Canadian Hurricane Center.

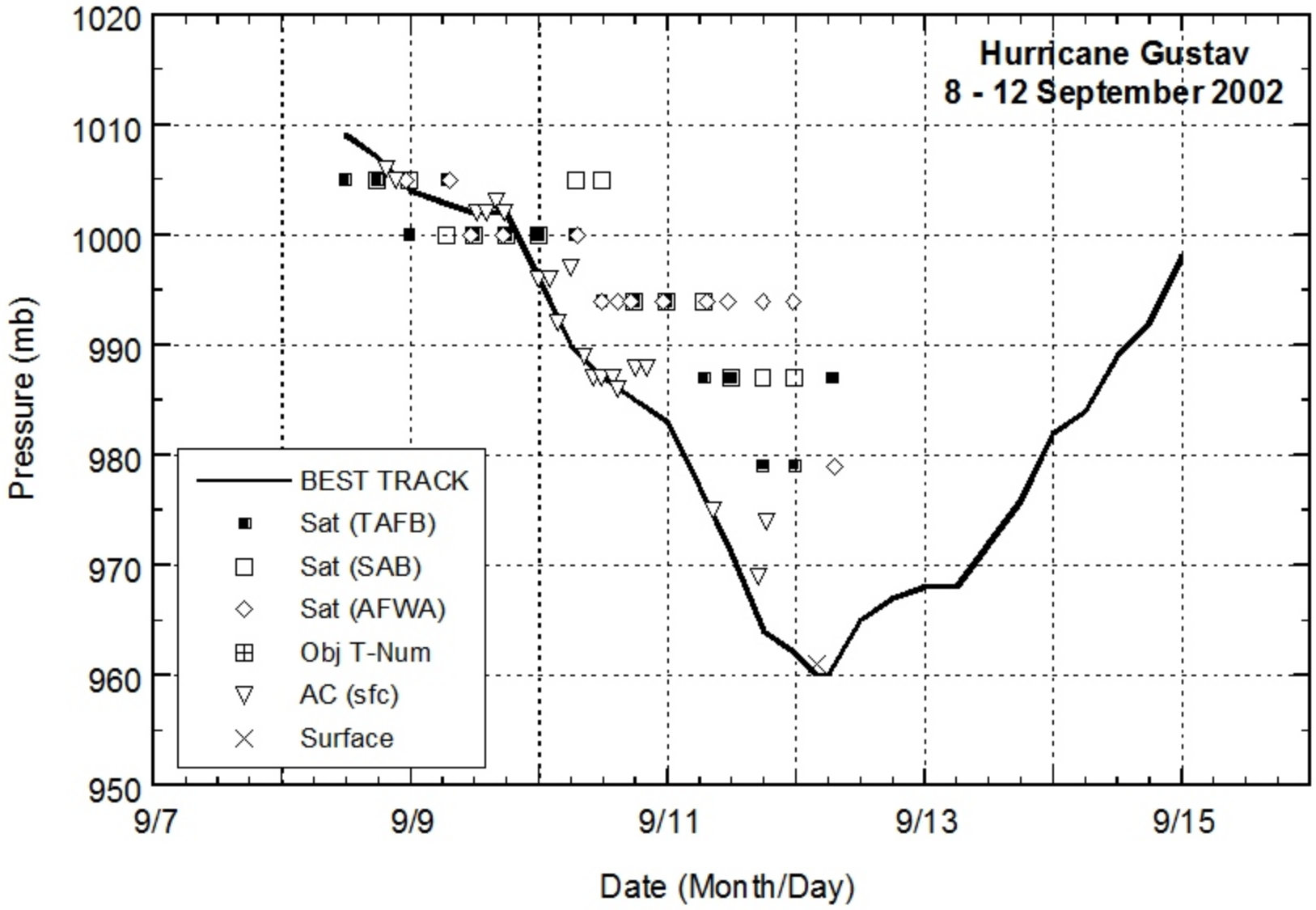


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Gustav, 8 - 12 September 2002.

Estimates during the extratropical stage are based on analyses from the NOAA Marine Prediction Center and the Canadian Hurricane Center.