

Tropical Cyclone Report
Tropical Storm Henriette
4-8 September 2001

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Henriette was a tropical storm most noteworthy for the manner of its demise - a circumnavigation of, and ultimate absorption by Hurricane Gil.

a. Synoptic History

A Hovmöller (longitude vs. time) diagram of satellite images indicates that Henriette's precursor was a tropical wave that crossed Central America on 28-29 August. In a monsoon-like environment characterized by large-scale low-level cyclonic turning, the wave began showing signs of development a couple hundred miles south of Acapulco, Mexico on 1 September, and by 2 September, convection had become organized enough to warrant Dvorak classifications. A QuikSCAT pass suggests that a closed circulation may have been present by about 1200 UTC 3 September; however, visible satellite images showed that the circulation was exposed northeast of the poorly organized deep convection due to strong easterly or northeasterly shear. Little change in organization occurred during the next 24 hours as the system moved west-northwest a few hundred miles south of Mexico.

Early morning visible satellite images on 4 September revealed a partially exposed but well defined low-level circulation. While deep convection was confined to the southwestern half of the circulation, the convection was close enough to the center for Dvorak satellite intensity estimates to increase to 25-30 kt, and the system became Tropical Depression Nine-E at 1200 UTC 4 September, about 300 n mi west-southwest of Manzanillo, Mexico, and also about 765 n mi east of Tropical Depression Eight-E (which was to become Hurricane Gil).

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 mid-level ridge to the north of the depression took the system initially on a west-northwesterly track at about 14 kt. Early on 5 September, as the depression's heading turned to the west, the separation between the circulation center and the deep convection lessened and Dvorak satellite intensity estimates increased to 35 kt. A QuikSCAT pass at 1347 UTC showed a surge of southwesterly winds of 40-45 kt as far as 250 n mi south of the center. On the basis of the Dvorak estimates and the QuikSCAT data, it is estimated that the depression became Tropical Storm Henriette at 0600 UTC 5 September, about 350 n mi south-southwest of Cabo San Lucas, Mexico. At this time, Tropical Storm Gil was located about 690 n mi to the west of Henriette.

Henriette slowly became better organized on 6 September. The convective pattern became more symmetric and the intensity increased to 50 kt. Meanwhile, Henriette turned to the northwest

and accelerated to a forward speed of 15-17 kt as it began to feel the influence of Hurricane Gil, then located 465 n mi to the southwest. Upper-level easterly flow, which was still evident over the cyclone early on the 6th, lessened and a more favorable outflow pattern began to develop. Convective banding near the center became better defined, and Henriette reached its peak intensity of 55 kt at 0000 UTC 7 September.

At the time of peak intensity, water temperatures under Henriette were about 25°C but were rapidly-decreasing as the cyclone moved northwestward. Within a few hours, the convective cloud tops warmed significantly. As the convection collapsed, Henriette began to weaken and turned west-northwestward around the periphery of Hurricane Gil. At this point Gil, which had been moving westward, turned sharply north-northwestward, and the distance between the two cyclones began to decrease rapidly. By 0000 UTC 8 September, Henriette was over 22°C water, devoid of deep convection, and moving westward at 20 kt about 330 n mi north of Hurricane Gil. Henriette turned to the southwest at a speed of about 22 kt, and by 1200 UTC 8 September had weakened to a tropical depression. Well entrained into the circulation of Gil, Henriette dissipated as a tropical cyclone when it lost its own closed low-level circulation, as evidenced by low-cloud trajectories, shortly after 1200 UTC on the 8th. At the time of dissipation, Henriette was located about 210 n mi west of Tropical Storm Gil.

A low-cloud swirl, associated with the remnant vorticity of Henriette, could be tracked for over 24 h after the tropical cyclone formally dissipated. The swirl completed a cyclonic loop of Gil, and could be tracked until about 1600 UTC 9 September, when it was about 185 n mi north-northeast of Gil. The tracks of both cyclones are shown in Fig. 4, and a satellite image of the two systems is shown in Fig. 5. In the 52 h period beginning at 1200 UTC 7 September, and ending when Henriette had been completely absorbed, the pair executed a complete mutual revolution. It is also apparent that the centroid of the two systems was moving on a generally west-northwesterly track. The closest approach appears to have occurred within an hour or two of 0600 UTC 9 September, when the two vorticity centers were separated by about 90 n mi.

b. Meteorological Statistics

Observations in Henriette (Figs. 2 and 3) included 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). The highest Dvorak intensity estimate for Henriette was 55 kt, and this value is the peak intensity assigned to the tropical storm.

A QuikSCAT overpass on 5 September showing 40-45 kt winds well away from the center was the basis for the operational upgrade of Henriette to a tropical storm. A QuikSCAT pass near 0300 UTC 8 September suggested that Henriette no longer had a closed circulation, so it is possible that the cyclone may have dissipated earlier than indicated in the best track.

There were no ship reports of winds of tropical storm force associated with Henriette.

c. Casualty and Damage Statistics

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

d. Forecast and Warning Critique

Track forecasts for Henriette were quite good, given the complicated synoptic environment. Average official track errors (with the number of cases in parentheses) for Henriette were 32 (11), 63 (9), 87 (7), 128 (5), and 253 (1) n mi for the 12, 24, 36, 48, and 72 h forecasts, respectively. These errors are comparable to the average official track errors for the 10-yr period 1991-2000 (Table 2), despite the fact that CLIPER errors for Henriette were much larger than the long-term CLIPER errors. Barotropic models were good performers, while the global multilayer models, particularly the NOGAPS and UKMET, did not handle the interaction between Henriette and Gil as well.

Henriette's intensity was also well-forecast. Average official intensity errors were 6, 8, 10, 11, and 0 kt for the 12, 24, 36, 48, and 72 h forecasts, respectively. For comparison, the average official intensity errors over the 10-yr period 1991-2000 are 7, 12, 16, 19, and 21 kt, respectively.

There were no watches and warnings associated with Henriette.

Table 1. Best track for Tropical Storm Henriette, 4-8 September 2001.

| Date/Time (UTC) | Latitude (°N) | Longitude (°W) | Pressure (mb) | Wind Speed (kt) | Stage |
|-----------------|---------------|----------------|---------------|-----------------|--|
| 04 / 1200 | 16.9 | 108.8 | 1006 | 25 | tropical depression |
| 04 / 1800 | 17.5 | 110.1 | 1006 | 25 | " |
| 05 / 0000 | 17.8 | 111.5 | 1006 | 30 | " |
| 05 / 0600 | 17.9 | 112.9 | 1005 | 35 | tropical storm |
| 05 / 1200 | 17.8 | 114.3 | 1005 | 40 | " |
| 05 / 1800 | 17.7 | 115.7 | 1003 | 40 | " |
| 06 / 0000 | 17.7 | 117.1 | 1000 | 45 | " |
| 06 / 0600 | 18.2 | 118.5 | 997 | 50 | " |
| 06 / 1200 | 18.8 | 119.9 | 997 | 50 | " |
| 06 / 1800 | 19.6 | 121.5 | 997 | 50 | " |
| 07 / 0000 | 20.5 | 122.9 | 994 | 55 | " |
| 07 / 0600 | 21.3 | 124.5 | 997 | 50 | " |
| 07 / 1200 | 22.1 | 126.0 | 1000 | 45 | " |
| 07 / 1800 | 22.6 | 127.7 | 1000 | 45 | " |
| 08 / 0000 | 22.9 | 129.8 | 1002 | 40 | " |
| 08 / 0600 | 22.6 | 132.2 | 1004 | 35 | " |
| 08 / 1200 | 21.6 | 134.3 | 1010 | 30 | tropical depression |
| 08 / 1800 | | | | | dissipated within circulation of Hurricane Gil |
| 07 / 0000 | 20.5 | 122.9 | 994 | 55 | minimum pressure |

Table 2. Preliminary forecast evaluation (heterogeneous sample) for Tropical Storm Henriette, 4-8 September 2001. 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 |
| CLIP | 53 (11) | 111 (9) | 174 (7) | 238 (5) | 329 (1) |
| GFDI | 72 (10) | 132 (8) | 210 (6) | 344 (3) | |
| LBAR | 50 (11) | 79 (9) | 84 (7) | 69 (5) | 243 (1) |
| AVNI | 58 (10) | 93 (8) | 138 (6) | 127 (3) | |
| BAMD | 50 (11) | 83 (9) | 94 (7) | 95 (5) | 238 (1) |
| BAMM | 51(11) | 81 (9) | 93 (7) | 85 (5) | 87 (1) |
| BAMS | 52 (11) | 80 (9) | 93 (7) | 86 (5) | 73 (1) |
| NGPI | 105 (11) | 210 (9) | 339 (7) | 483 (5) | |
| UKMI | 67 (4) | 200 (4) | 537 (4) | 482 (2) | 952 (1) |
| GUNS | 70 (3) | 115 (3) | 242 (3) | 358 (1) | |
| NHC Official | 32 (11) | 63 (9) | 87 (7) | 128 (5) | 253 (1) |
| NHC Official (1991-2000 mean) | 37 (2273) | 68 (2034) | 99 (1802) | 128 (1584) | 185 (1203) |

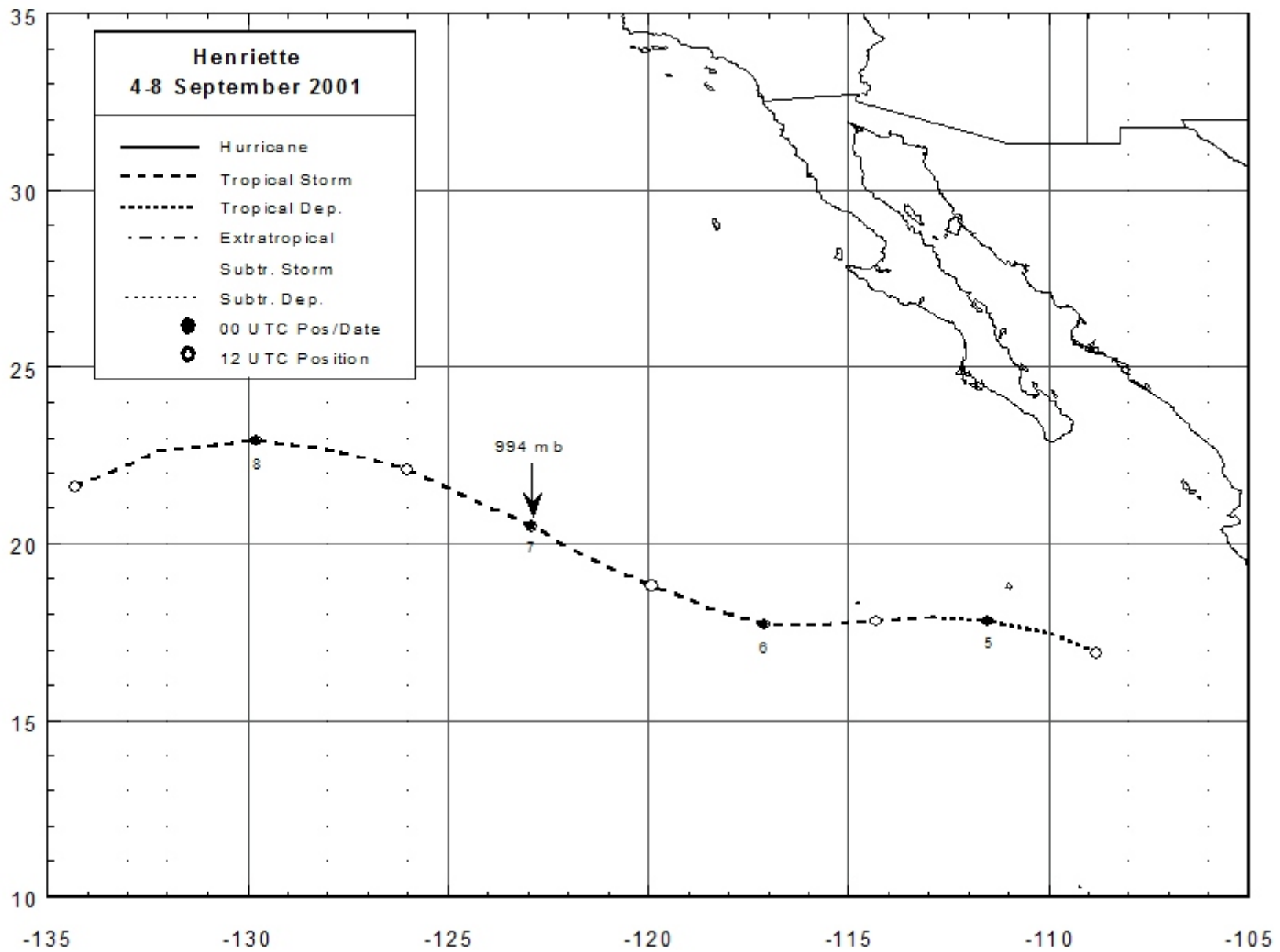


Figure 1. Best track positions for Tropical Storm Henriette, 4-8 September 2001.

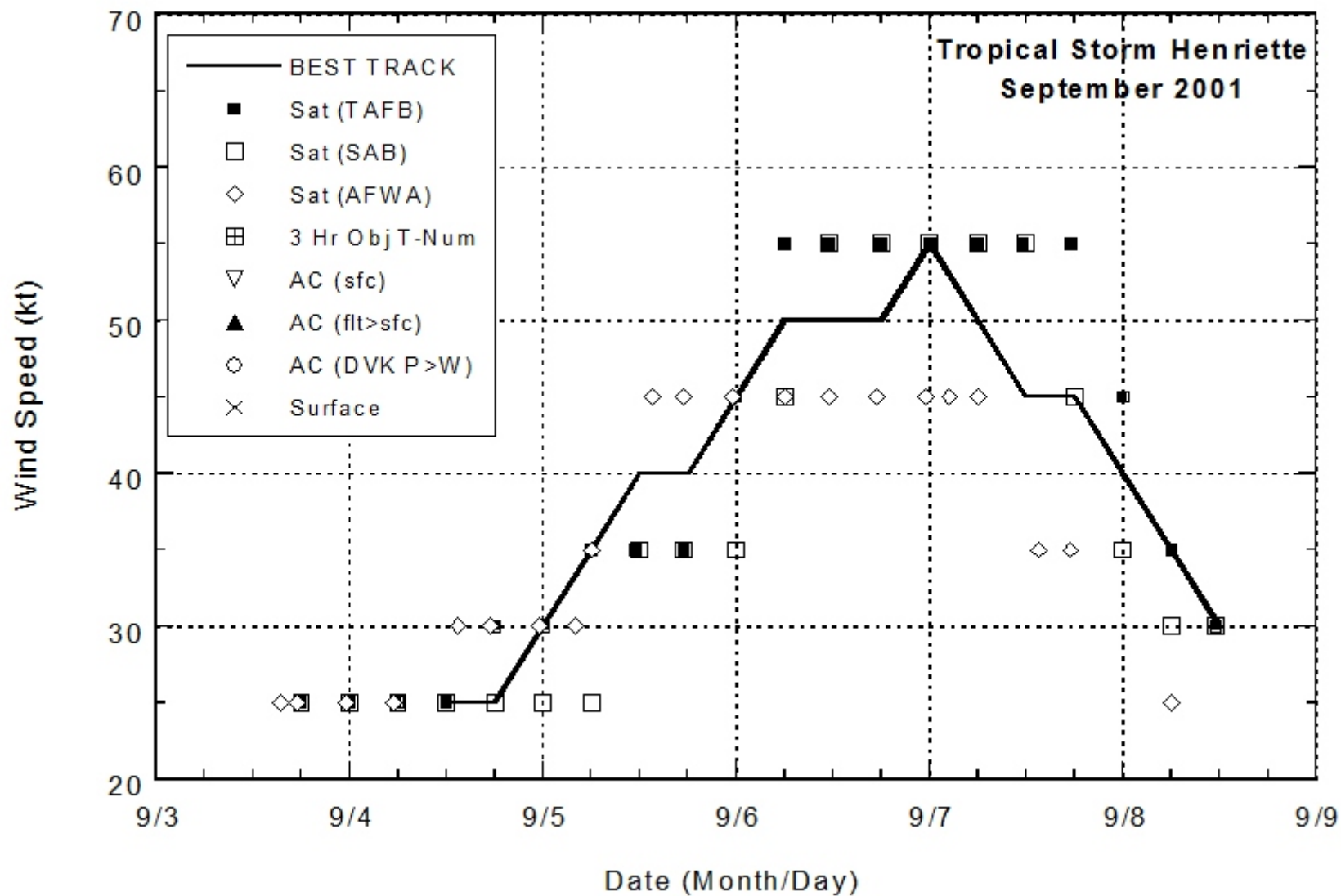


Figure 2. Best track maximum sustained surface wind speed curve for Tropical Storm Henriette, 4-8 September 2001, and the observations on which the best track curve is based.

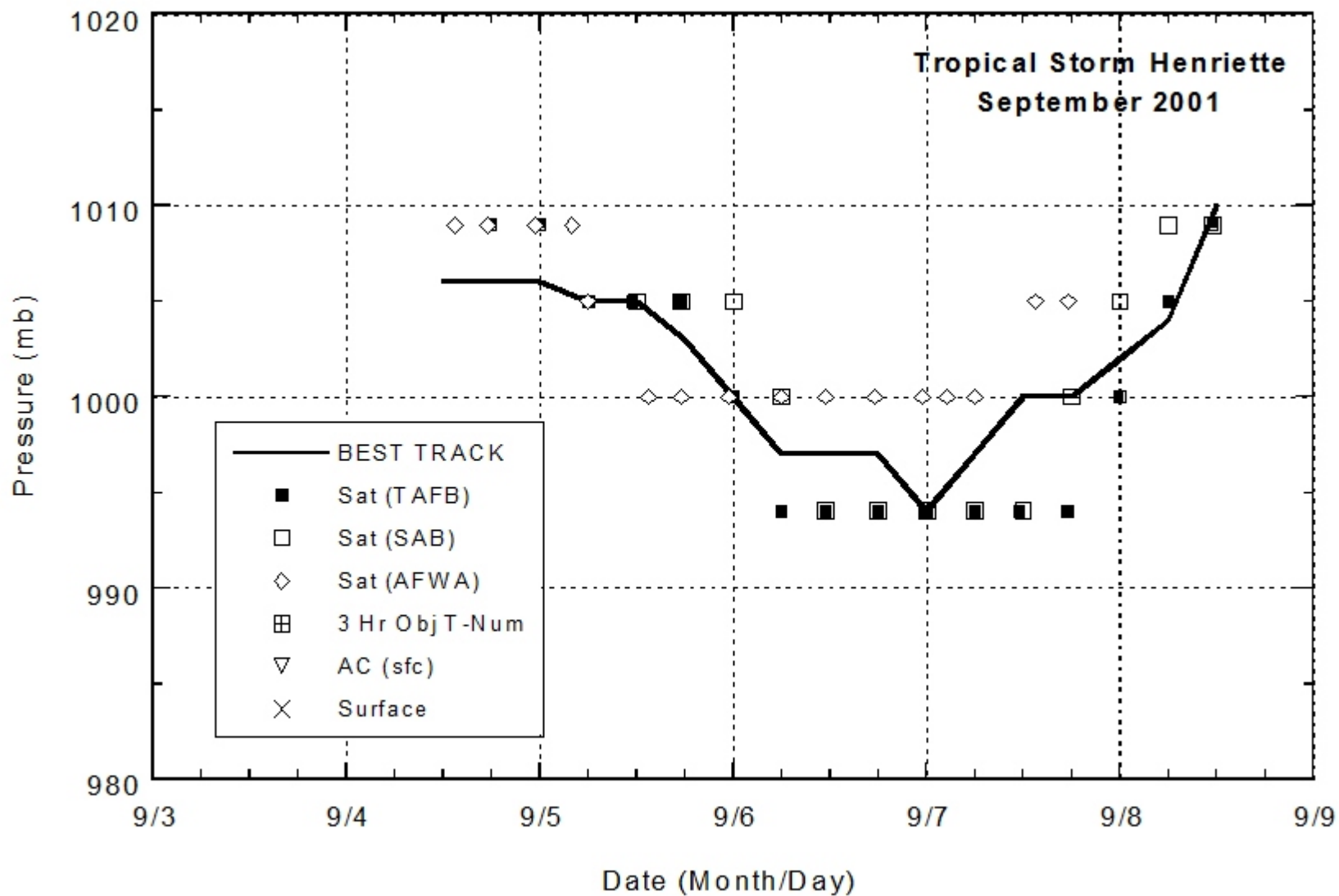


Figure 3. Best track minimum central pressure curve for Tropical Storm Henriette, 4-8 September 2001, and the observations on which the best track curve is based.

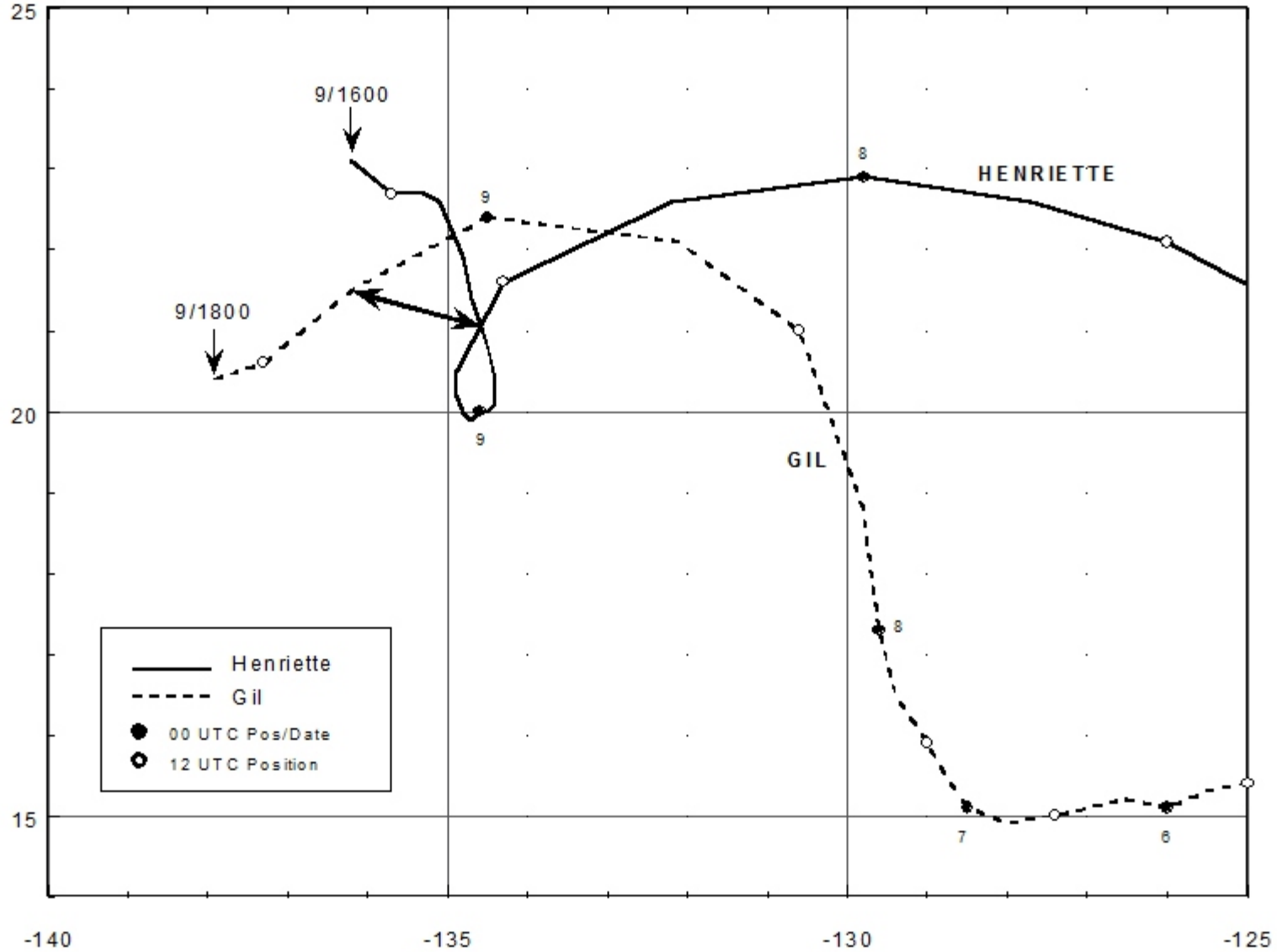
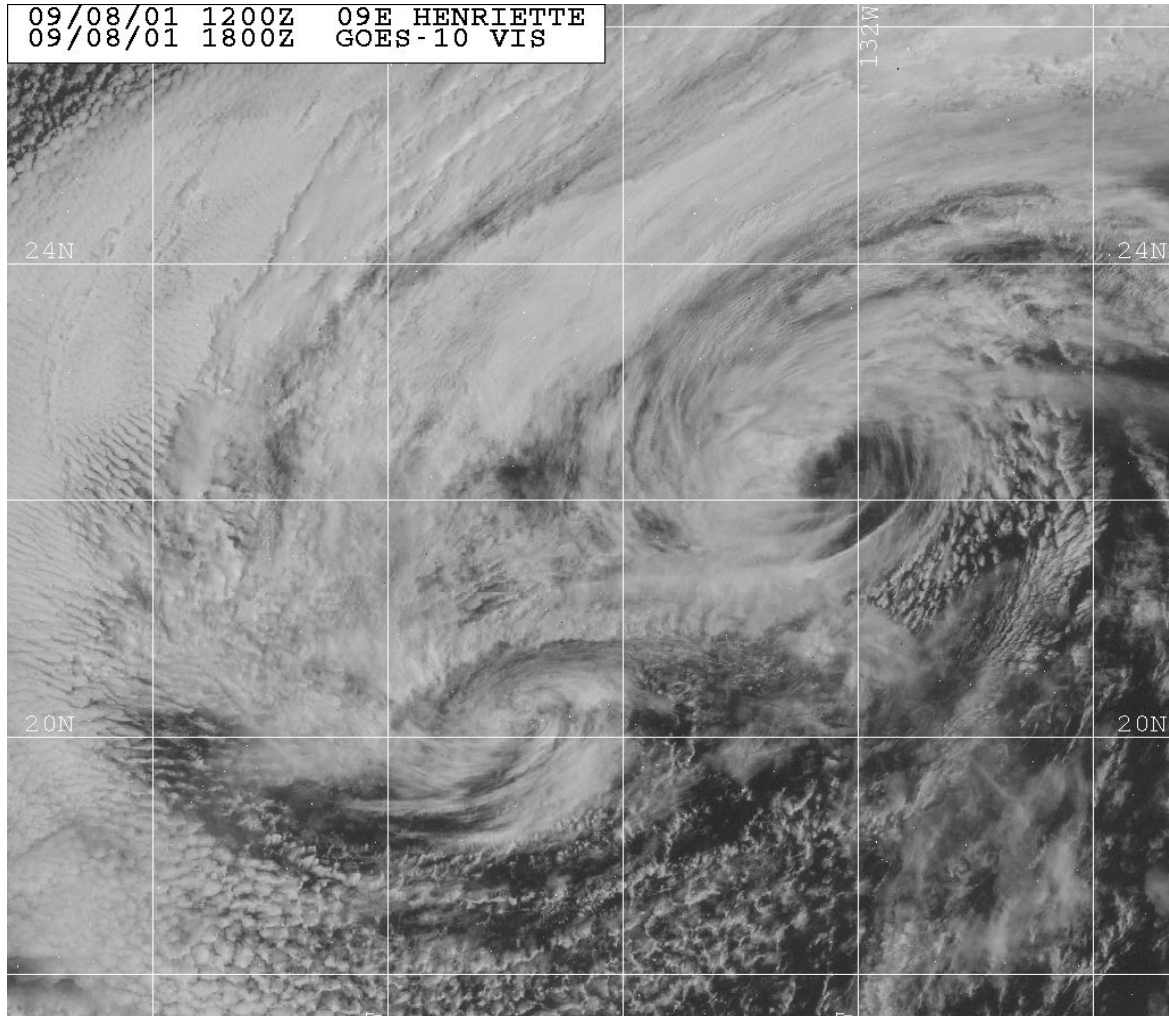


Figure 4. Tracks of Tropical Storm Henriette and its remnants (solid line) and Hurricane Gil (dashed line) for the period 6-9 September 2001. The track of Henriette follows the low-level vorticity center after dissipation. The double-headed arrow indicates the center positions at their closest approach, roughly 0600 UTC on the 9th.



Naval Research Laboratory http://www.nrlmry.navy.mil/sat_products.html
 <-- Visible (Sun elevation at center is 46 degrees) -->

Figure 5. Visible satellite image of Tropical Storm Gil and the remnant cloud swirl of Tropical Storm Henriette, at 1800 UTC 8 September 2001. Henriette is located to the southwest of Gil. Image courtesy of the Naval Research Laboratory.