Preliminary Report
Hurricane Howard
20 - 30 August 1998

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Hurricane Howard is estimated to have been the strongest hurricane of the 1998 eastern North Pacific hurricane season. The hurricane remained over water its entire lifetime without any direct effects to land.

a. Synoptic History

Howard can be traced back to a tropical wave that emerged from the west coast of Africa on 7 August. The wave spawned intermittent clusters of convection as it moved across the Atlantic at low latitudes, and then remained rather nondescript during its passage over the Caribbean Sea and the northern portions of South America. Cloudiness and convection increased off the Pacific coast of Central America on 17 August.

The first satellite classifications were received on 18 August. Animation of satellite imagery indicated a broad low-level cyclonic circulation with intermittent bursts of deep convection on the 18th and 19th. The deepest convection became more persistent near the circulation center, and the "best track" indicates that a tropical depression formed from the disturbance near 0600 UTC 20 August while centered about 300 n mi south of Puerto Angel, Mexico (Fig. 1 and Table 1). The tropical cyclone moved generally west-northwestward near 10 knots in response to deep-layer-mean steering.

Banding features became more pronounced and the depression strengthened into Tropical Storm Howard at 0000 UTC 21 August while centered about 375 n mi south of Acapulco, Mexico. The center of the tropical cyclone became more centrally embedded within deep convection and Howard became a hurricane at 1800 UTC 21 August while centered about 450 n mi south-southeast of Manzanillo, Mexico. The upper-level outflow became better established, and Howard continued to intensify as evidenced by the appearance of an eye in satellite imagery on 22 August. Rapid strengthening occurred and Howard became a category three hurricane on the

Saffir/Simpson Hurricane Scale by 1200 UTC on this date. It is estimated that Howard reached its peak intensity of 130 knot one-minute surface winds and 932 mb minimum central pressure near 0000 UTC 23 August while centered about 525 n mi south-southeast of the southern tip of Baja California. Howard's intensity neared the top end of category four, with a small-diameter eye embedded within a very cold central dense overcast. Although the eye gradually became larger and some intensity fluctuations occurred, Howard appears to have remained a major hurricane (category three or higher) for four days.

Howard moved over cooler water and weakened to a tropical storm by 0000 UTC 28 August while centered about 950 n mi west-southwest of the southern tip of Baja California. The cyclone weakened to a tropical depression at 1200 UTC 29 August while centered about 1200 n mi west-southwest of the southern tip of Baja California and is considered to have dissipated on 30 August--although a low-level cloud swirl persisted for a few more days.

b. Meteorological Statistics

Figures 2 and 3 show the curves of minimum central pressure and maximum one-minute wind speed, respectively, versus time, along with the observations on which they are based. As usual for an eastern Pacific tropical cyclone, satellites provided the primary source of observational data. Dvorak technique location and intensity estimates from the satellite data were produced by the Air Force Weather Agency (AFGWC in figures), the NOAA Synoptic Analysis Branch (SAB) and the NOAA Tropical Analysis and Forecast Branch (TAFB). The highest official Dvorak T number was 6.5 (127 knots) from TAFB and SAB. However, the highest objective Dvorak T number using an experimental program developed by the University of Wisconsin was 7.0 (140 knots) between 1345 UTC 22 August and 0300 UTC 23 August. The highest 12-hour weighted-average objective Dvorak T number peaked at 7.0 near 0000 UTC 23 and is the basis for estimating the peak intensity at this time. The maximum wind in the best track is between the official and experimental estimates.

c. Casualty and Damage Statistics

There were no reports of casualties or damage from Howard received at the NHC.

d. Forecast and Warning Critique

The NHC average official track forecast errors for Howard (excluding the tropical depression stage) were 34 (32 cases), 68 (30 cases), 95 (28 cases), 125 (26 cases) and 199 n mi (22 cases), respectively, for the 12-, 24-, 36-, 48- and 72-hour forecast periods. These were all similar to the 1988-1997 average errors of 39, 71, 105, 137 and 195 n mi for the same time periods. The NHC average official track forecast errors were similar to the averages from the operationally available track prediction models through 48 hours. Surprisingly, the AVNI, GFDI, UKMI, CLIP, BAMD, BAMM and BAMS guidance models all had average track forecast errors somewhat less (21 to 62 n mi) than the average official forecasts at 72 hours.

The NHC official intensity forecasts showed a distinct negative bias (i.e., intensity was underestimated) while Howard was strengthening and a distinct positive bias (i.e., intensity was overestimated) while Howard was weakening. The largest intensity forecast error occurred 36 hours prior to peak intensity and was 50 knots too low.

Watches and warnings were neither issued nor necessary for Howard.

Table 1. Best track, Hurricane Howard, 20 - 30 August, 1998.

Date/Time (UTC)	Position		Pressure (mb)	Wind Speed (kt)	Stage
	Lat. (°N)	Lon. (°W)			
20/0600	10.5	96.5	1008	25	tropical depression
20/1200	10.5	97.6	1007	30	"
1800	10.6	98.7	1006	30	"
21/0000	10.7	99.8	1003	40	tropical storm
0600	10.9	100.7	997	50	"
1200	11.2	101.5	994	55	"
1800	11.6	102.4	987	65	hurricane
22/0000	12.2	103.3	979	75	"
0600	12.8	104.4	970	85	"
1200	13.4	105.6	960	100	"
1800	14.0	106.8	950	110	"
23/0000	14.4	108.0	932	130	"
0600	14.7	109.3	935	125	"
1200	15.0	110.5	939	125	"
1800	15.2	111.6	943	125	"
24/0000	15.5	112.7	948	115	"
0600	15.8	113.7	950	110	"
1200	16.1	114.8	953	110	"
1800	16.4	115.9	950	110	"
25/0000	16.8	117.0	948	115	"
0600	17.1	118.2	948	115	"
1200	17.3	119.3	948	115	"
1800	17.4	120.3	948	115	"
26/0000	17.5	121.2	948	115	"
0600	17.5	122.1	950	110	"
1200	17.5	122.8	960	100	"
1800	17.5	123.4	970	90	"
27/0000	17.7	123.9	975	85	"
0600	18.0	124.4	979	80	"
1200	18.4	125.0	983	70	"
1800	18.9	125.7	987	65	"
28/0000	19.5	126.4	991	60	tropical storm
0600	20.1	127.2	994	55	"
1200	20.5	127.9	997	50	"
1800	20.5	128.7	1000	45	"
29/0000	20.4	129.5	1002	40	"
0600	20.2	130.3	1005	35	"
1200	19.7	131.2	1006	30	tropical depression
1800	19.3	132.4	1008	25	"
30/0000	18.8	133.5	1009	25	"
0600					dissipated

23/0000	14.4	108.0	932	130	minimum pressure

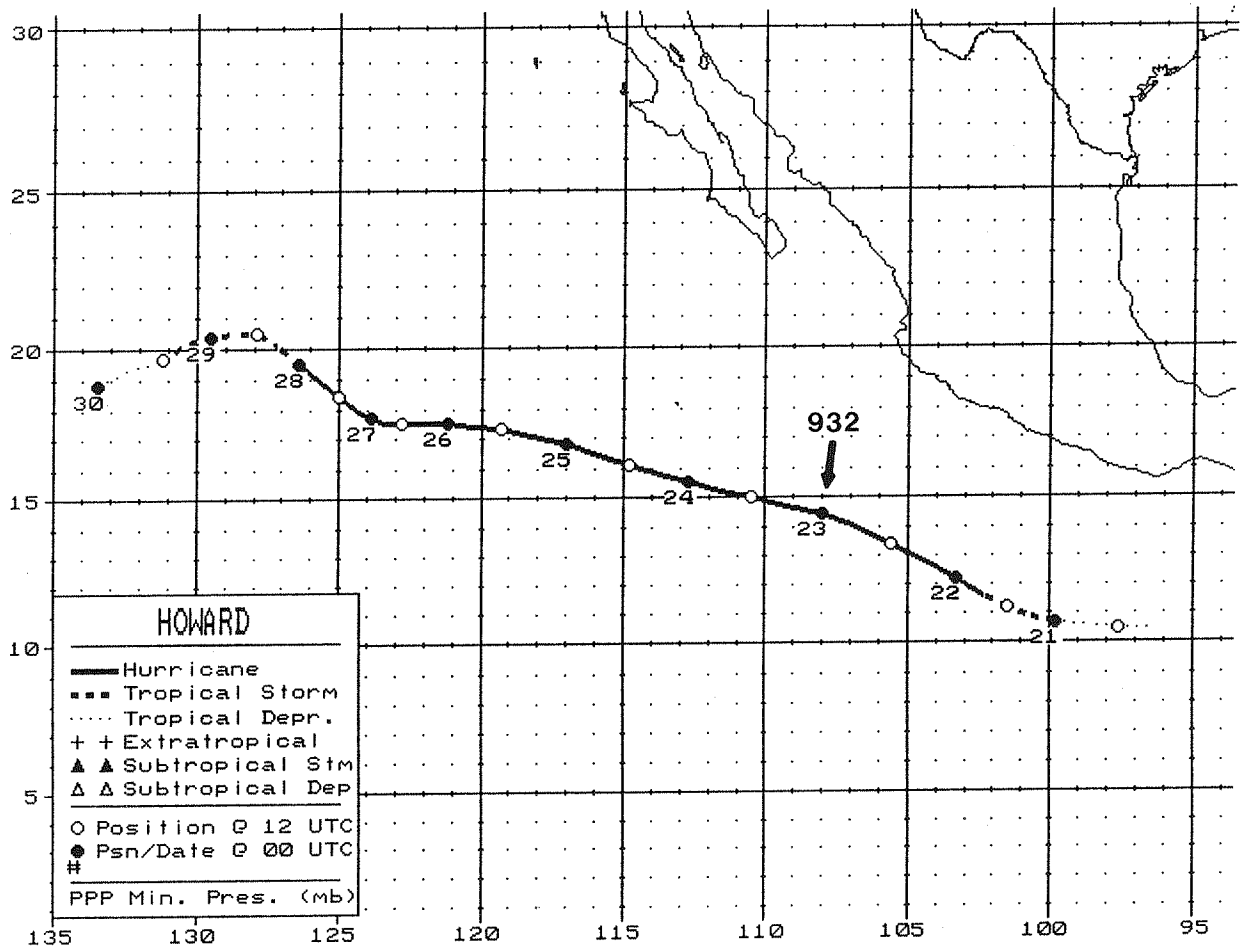

Figure 1. Best track positions for Hurricane Howard, 20 - 30 August 1998.

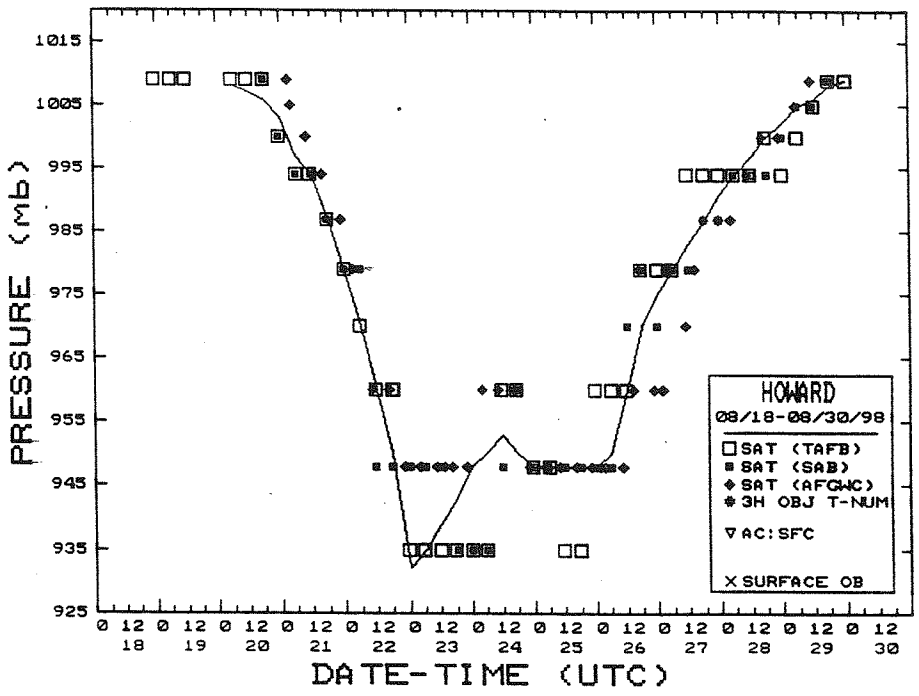

Figure 2. Best track minimum central pressure curve for Hurricane Howard.

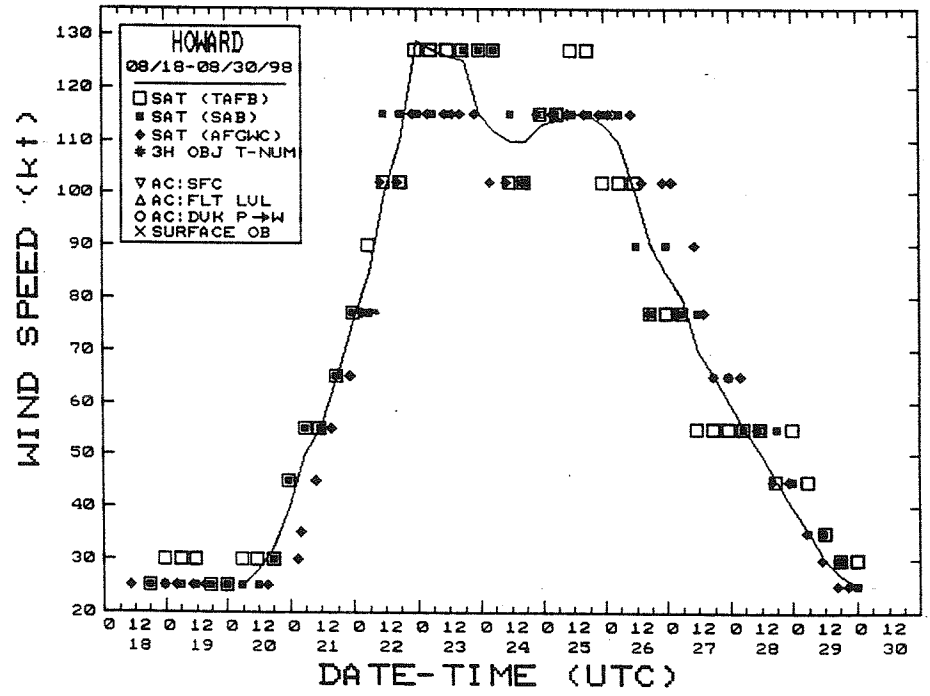

Figure 3. Best track maximum sustained wind speed curve for Hurricane Howard.