

Preliminary Report
Hurricane Madeline
16 - 20 October 1998

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16 November 1998

a. Synoptic History

Madeline can be traced back to a tropical wave that emerged from the west coast of Africa on 25 September. The wave produced intermittent clusters of convection as it moved across the Atlantic and Caribbean Sea. Cloudiness associated with the wave crossed over Central America on 5 and 6 October. Convection increased in the vicinity of the Gulf of Tehuantepec on 9 October, and Dvorak classifications began on this day. Satellite classifications temporarily ceased on 11 October, although disorganized cloudiness persisted off the southwest coast of Mexico. Classifications resumed on 15 October and the "best track" indicates that a tropical depression formed from the disturbance near 0000 UTC 16 October while centered about 200 n mi west-southwest of Manzanillo, Mexico (Fig. 1 and Table 1).

Under diffluent conditions aloft, the deep convection became more concentrated and satellite estimates suggest that the depression strengthened into Tropical Storm Madeline at 1200 UTC 16 October while centered about 150 n mi southwest of Cabo Corrientes, Mexico. Banding features became more pronounced and Madeline became a hurricane at 1800 UTC 17 October while centered about 85 n mi west-southwest of Cabo Corrientes. Upper-level outflow remained well-established, and it is estimated that the maximum winds in Madeline reached 75 knots from 1200 UTC 18 October to 0000 UTC 19 October. Satellite pictures showed a hint of an eye on the 18th, and the last report from a reconnaissance aircraft reported that the minimum central pressure was continuing to drop late that day. The best track estimates that the lowest pressure of 979 mb occurred at 0000 UTC 19 October.

Upper-level shear increased during the 19th, and the cloud pattern began looking somewhat ragged. Madeline weakened to a tropical storm by 1200 UTC 19 October, and to a tropical depression twelve hours later, at which time only a swirl of low clouds was left of it midway between the southern tip of Baja California and the

mainland of Mexico. The center of the tropical cyclone never crossed the coast, although rainbands moved over portions of southwestern Mexico.

Steering currents surrounding the tropical cyclone were relatively weak throughout its lifetime. In the early stages, Madeline was located near the western edge of an east-west oriented mid-level ridge which resulted in a general northward motion of the cyclone. On the 17th and 18th, a mid-level trough approaching from the west appears to be the reason for a slow northeastward motion. The trough did not move the tropical cyclone far before shearing occurred, however, and the lower-level steering eventually turned the weakening Madeline toward the northwest.

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 4.5 (77 knots) from TAFB, SAB and AFGWC.

In addition to the satellite estimates, observations were received from U.S. Air Force "Hurricane Hunter" aircraft. The lowest minimum central pressure reported was 980 mb at 2153 UTC 18 October during the second of two missions into the hurricane. The maximum wind measured was 76 knots from a flight level of 10,000 feet at 2028 UTC on the 18th. A near-surface wind of 73 knots was reported by one of the GPS dropwindsondes near this time.

c. Casualty and Damage Statistics

There were no reports of casualties or damages from Madeline received at the NHC.

d. Forecast and Warning Critique

The NHC average official track forecast errors for Madeline (excluding the tropical depression stage) were 38 (12 cases), 81 (10 cases), 137 (8 cases), 186 (6 cases) and 313 n mi (2 cases), respectively, for the 12-, 24-, 36-, 48- and 72-hour forecast periods. Although the sample size is small, these errors were larger than the 1988-1997 average errors except at 12 hours for which the errors are comparable. The NHC average official track forecast errors were similar to or lower than the averages from most of the operationally available track prediction models through 48 hours. The exception was the UKMI guidance which was 48 n mi lower than the official forecast at 48 hours for a homogeneous sample of five. No meaningful comparisons can be made at 72 hours due to the small number of forecasts made for that time period. The relatively large errors from the official track forecasts as well as the track guidance are not unusual for a northward moving tropical cyclone in the eastern North Pacific. The need for improvement in track forecasts for a hurricane like Madeline near land and in an area of heavy marine traffic is obvious.

The NHC official intensity forecasts showed a negative bias (i.e., intensity was underestimated) while Madeline was strengthening and a distinct positive bias (i.e., intensity was overestimated) while Madeline was weakening. For example, the 48-hour intensity forecast issued about two days before maximum intensity was reached was 40 knots too low. On the other hand, the 12- and 24-hour intensity forecasts issued near the time of maximum intensity were 40 knots too high. These larger than usual short-period intensity forecasts were the result of the inability to forecast rapid weakening.

Table 2 summarizes the watches and warnings issued for Madeline.

Table 1. Best track, Hurricane Madeline, 16 - 20 October 1998.

Date/Time (UTC)	Position		Pressure (mb)	Wind Speed (kt)	Stage
	Lat. (°N)	Lon. (°W)			
16/0000	17.8	107.6	1006	25	tropical depression
0600	18.4	107.8	1004	30	"
1200	18.9	108.0	1003	40	tropical storm
1800	19.3	108.1	1000	55	"
17/0000	19.5	108.2	997	55	"
0600	19.6	108.0	994	60	"
1200	19.7	107.6	992	60	"
1800	19.9	107.2	990	65	hurricane
18/0000	20.1	106.9	988	70	"
0600	20.3	106.7	986	70	"
1200	20.6	106.6	985	75	"
1800	20.9	106.5	983	75	"
19/0000	21.2	106.6	979	75	"
0600	21.6	106.7	980	70	"
1200	22.2	106.9	987	55	tropical storm
1800	23.0	107.6	994	35	"
20/0000	23.7	108.5	1004	25	tropical depression
0600					dissipated
19/0000	21.2	106.6	979	75	minimum pressure

Table 2. Watch and warning summary, Hurricane Madeline, October 1998.

Date/time (UTC)	Action	Location
16/1500	tropical storm warning issued	Baja California from La Paz southward
16/1500	hurricane watch issued	Baja California from La Paz southward
17/0900	hurricane watch issued	Mazatlan to Los Mochis, Mexico
17/1500	hurricane warning issued	Melaque to Mazatlan, Mexico including the Islas Marias
17/1500	tropical storm warning discontinued	Baja California from La Paz southward
19/0300	hurricane warning discontinued	Melaque to just southeast of Cabo Corrientes
19/0300	hurricane warning extended northwestward	Mazatlan to El Dorado, Mexico
19/1500	hurricane warning discontinued	Cabo Corrientes to San Blas, Mexico
19/1800	hurricane warning downgraded to tropical storm warning	north of San Blas to El Dorado, Mexico including the Islas Marias
19/1800	hurricane watch downgraded to tropical storm watch	northwest of El Dorado to Los Mochis, Mexico
19/1800	hurricane watch downgraded to tropical storm watch	Baja California from La Paz southward
20/0000	all remaining tropical storm watches and warnings discontinued	

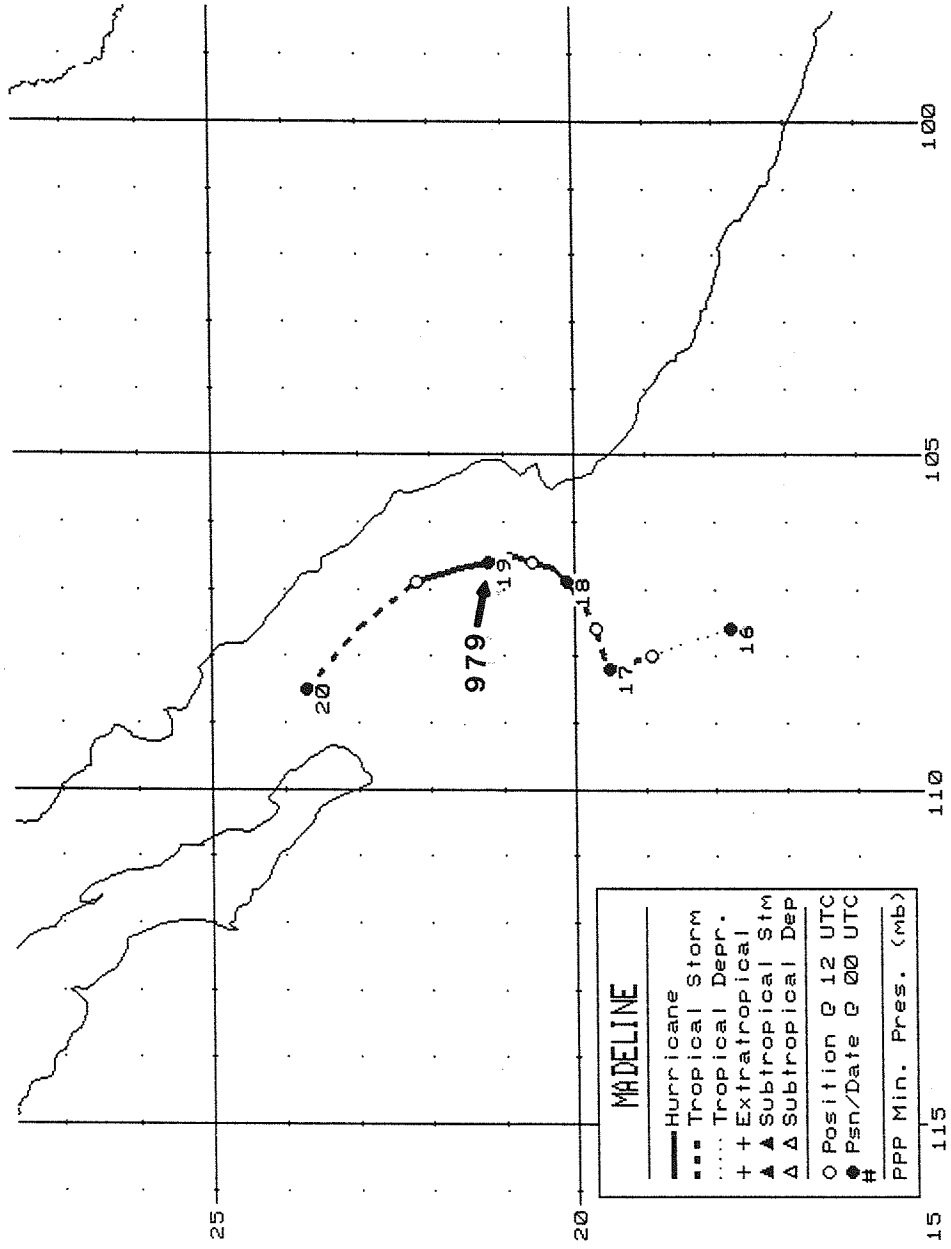


Figure 1. Best track positions for Hurricane Madeline, 16 - 20 October 1998.

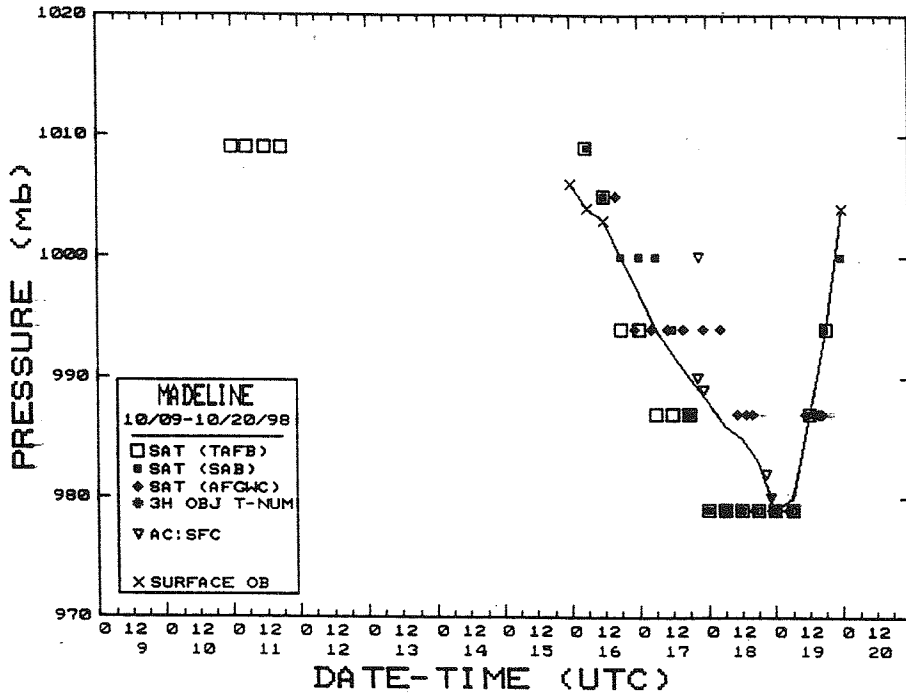


Figure 2. Best track minimum central pressure curve for Hurricane Madeline.

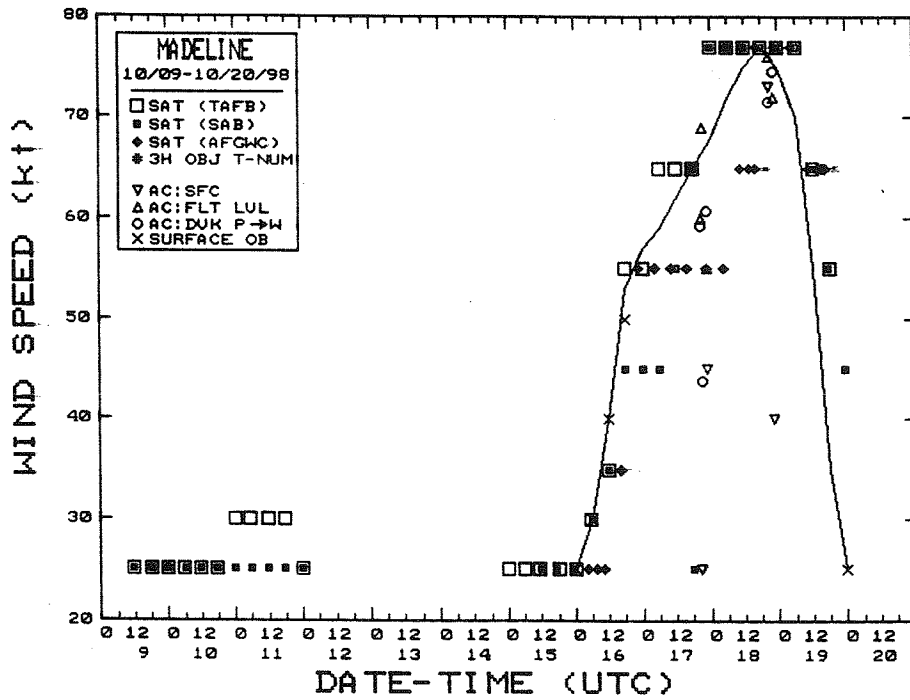


Figure 3. Best track maximum sustained wind speed curve for Hurricane Madeline.