Preliminary Report
Hurricane Jose
17 - 25 October, 1999

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a. Synoptic History

This hurricane originated from a tropical wave that moved off the west coast of Africa on 8 October. The wave moved slowly westward across the tropical Atlantic for several days. By 15 October, when the system was located about midway between Africa and the Lesser Antilles, its associated shower activity became better organized. The initial satellite classifications, a T1.0 on the Dvorak scale, were done at 1200 UTC 17 October. The disturbance developed into a tropical depression by 1800 UTC that same day, while located about 700 miles east of the southern Windward Islands. There was well-defined upper-tropospheric outflow over the depression. Moving west-northwestward, the depression strengthened into Tropical Storm Jose on the 18th while centered about 400 miles east of the Windward Islands.

Initially, it appeared that a large mid-tropospheric high over the southwestern north Atlantic would steer the tropical cyclone on a westward to west-northwestward track for several days. However, a mid- to upper-tropospheric trough produced a weakness in the ridge in the vicinity of Puerto Rico. This imparted a more northward component to Jose's motion. After turning toward the northwest, Jose became a hurricane late on the 19th while centered about 150 miles east of the Leeward Islands. As it neared these islands, Jose reached its peak intensity of 85 knots at 1200 UTC 20 October. Turning back to a west-northwest heading, Hurricane Jose struck the northern Leeward Islands , passing over Antigua around midday on the 20th. The eye then moved near St. Barthelemy and St. Martin from 0000 to 0300 UTC on the 21st.

As Jose moved over the northern Leeward Islands, southwesterly vertical shear adversely impacted the tropical cyclone's intensity. Jose weakened to a tropical storm by the time it reached Tortola in the British Virgin Islands, around 1100 UTC on the 21st. A little later on the 21st, the cyclone turned back toward the northwest, as the center passed about 50 miles northeast of the eastern tip of Puerto Rico. With a large mid- to upper-tropospheric trough positioned over the western North Atlantic, recurvature was now imminent. Jose turned northward, then north-northeastward on the 22nd. The storm continued north-northeastward at a faster forward speed on the 23rd, its structure still disrupted by southwesterly shear. Early on the 24th, however, microwave data indicated that the low-level center was becoming more involved with

the deep convection. Satellite intensity estimates indicate that Jose regained hurricane strength by 1200 UTC 24 October. The hurricane passed about 300 miles east of Bermuda around midday on the 24th, and the forward speed increased markedly. The rejuvenation of the tropical cyclone was short-lived. Jose weakened back to a tropical storm around 0000 UTC 25 October. It continued to accelerate into the North Atlantic, losing tropical characteristics by 1200 UTC on the 25th. Later that day, the system merged with a larger mid-latitude low and associated front.

b. Meteorological Statistics

Table 1 lists the best track positions and intensities of Jose at six-hourly intervals. Figure 1 is a display of this track.

Figures 2 and 3 depict the curves of minimum central sea-level pressure and maximum one-minute average "surface" (10 meters above ground level) wind speed, respectively, as a function of time. Also plotted are the observations on which the curves are based, consisting of aircraft reconnaissance and dropsonde data from the U.S. Air Force Reserves (the Hurricane Hunters) and NOAA, surface synoptic data, as well as Dvorak-technique estimates from the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB), and the U.S. Air Force Weather Agency (AFWA) using satellite imagery. In Fig. 2, the aircraft flight level wind measurements have been adjusted for elevation (90% of 700 mb wind speeds, 80% of 850 mb speeds, and 85% of 1500 ft speeds), and dropsonde wind measurements above the surface are adjusted to the 10 meter level using a mean hurricane eyewall profile determined by previous dropsonde measurements.

Jose's peak intensity of 85 knots is based on: 1) 10 meter winds of that speed measured by a Global Positioning System dropsonde, and 2) 90% of 700 mb flight level winds of 92 knots.

Table 2 lists selected surface observations for Jose. The highest measured wind speed from a surface reporting station was 70 knots with a gust to 89 knots at Antigua. Sustained winds of hurricane force (65 knots) were also measured at St. Maarten. The highest wind measurement from the Virgin Islands was 52 knots (sustained) with a gust to 60 knots at St. John. Higher wind speeds likely occurred over portions of the British Virgin Islands. In Puerto Rico, winds were mostly below tropical storm force, however there was an unofficial measurement (from a portable anemometer) of sustained winds of 30 to 39 knots with a gust to 48 knots from Costa Azul Beach in Luquillo.

Very heavy rains fell well after the passage of the center over the northern Leeward Islands, in association with feeder bands well east or southeast of the center.

Rainfall totals were as high as 12 to 15 inches over portions of the islands.

A ship with call sign *9HII6*, located at 31.6°N 59.5°W, reported winds of 130°/85 knots on 24 October 1200 UTC. Further investigation of this observation revealed that the wind speed was erroneously reported to be about double its true value.

Storm surge observations are not available.

No tornadoes were reported in association with Jose.

c. Casualty and Damage Statistics

Two deaths are known to have been caused by Jose, one in Antigua and one in St. Maarten. Damage in Antigua was characterized as "minor". In St. Maarten, the heavy rains caused extensive flooding and mud slides which damaged roads and homes, especially in low-lying areas. United States (Puerto Rico and the U.S. Virgin Islands) damage totals are minimal, and apparently did not exceed 5 million dollars.

d. Forecast and Warning Critique

Table 3 lists the average track errors for Jose for various forecast models and the official forecast. In the mean, the official forecasts were comparable to the most recent ten-year averages through 36 hours, but considerably worse at 48 and 72 hours. It can be seen that normally reliable models such as the GFDL and the UKMI also had quite large average errors at the latter two time periods. It should be noted that due to computer problems at the National Center for Environmental Prediction's (NCEP's) Central Operations, the GFDL model was run in a lower resolution (two-nested grids) than normal. These problems also caused some potentially valuable dropsonde data in the environment of Jose from the NOAA G-IV jet aircraft to be excluded from the NCEP global analysis.

In most cases, the official forecasts had a leftward bias. During the first couple of days of Jose's existence, the sharp recurvature to the north of Puerto Rico was not anticipated. In the latter part of Jose's lifetime, the official forecasts were generally too fast, taking the cyclone much too far north into the Atlantic.

Generally, the intensity of Jose was overpredicted in the official forecasts. Wind speed forecast errors were as large as 40 to 50 knots (too high) in 24 to 48 hours. It was not anticipated that southwesterly shearing would cause weakening. The SHIPS model also overpredicted the strength of Jose, although the errors tended to be a bit less than the official forecasts. It should be noted that, again due to computer problems, the SHIPS guidance was not available for about one third of the forecasts.

Table 4 lists the various watches and warning issued for Jose. Hurricane warnings were issued more than 24 hours in advance of the time of closest approach of the center to Antigua and St. Maarten, but only about 12 hours in advance for St. Barthelemy and St. Martin. Hurricane warnings for the Virgin Islands and Puerto Rico proved to be unneccessary, due to deficiencies in the track and intensity forecasts.

Table 1. Best track, Hurricane Jose, 17-25 October, 1999

Date/Time (UTC)	Position		Pressure (mb)	Wind Speed (kt)	Stage
	Lat. (°N)	Lon. (°W)			
17 / 1800	9.8	50.8	1006	25	tropical depression
18 / 0000	10.3	51.8	1005	30	"
18 / 0600	10.9	52.8	1004	35	tropical storm
18 / 1200	11.5	53.9	1003	40	"
18 / 1800	12.2	55.1	1002	40	"
19 / 0000	12.9	56.1	1000	45	"
19 / 0600	13.5	57.1	994	55	"
19 / 1200	14.1	58.1	994	60	"
19 / 1800	14.9	58.9	992	65	hurricane
20 / 0000	15.7	59.5	987	70	"
20 / 0600	16.3	60.2	979	80	"
20 / 1200	16.8	61.1	980	85	"
20 / 1800	17.2	62.0	983	80	"
21 / 0000	17.6	62.7	990	75	"
21 / 0600	18.1	63.8	992	65	"
21 / 1200	18.5	64.8	996	60	tropical storm
21 / 1800	19.0	65.3	994	55	"
22 / 0000	19.4	65.8	993	50	"
22 / 0600	19.9	66.1	992	50	"
22 / 1200	20.5	65.9	992	50	"
22 / 1800	21.1	65.6	993	50	"
23 / 0000	22.0	65.2	994	50	"
23 / 0600	23.0	64.8	995	50	"
23 / 1200	24.0	64.3	995	55	"

Date/Time (UTC)	Position		Pressure (mb)	Wind Speed (kt)	Stage
	Lat. (°N)	Lon. (°W)			
23 / 1800	25.2	63.8	995	55	"
24 / 0000	26.6	63.1	995	55	"
24 / 0600	28.0	62.2	990	60	"
24 / 1200	29.7	61.1	987	65	hurricane
24 / 1800	32.2	59.8	987	65	"
25 / 0000	34.9	58.1	990	60	tropical storm
25 / 0600	37.9	55.8	994	55	"
25 / 1200	40.0	51.8	996	50	extratropical
25 / 1800					absorbed by larger extratropical low
20 / 1200	16.8	61.1	980	85	maximum intensity
20 / 0600	16.3	60.2	979	80	minimum pressure
20 / 1600	17.1	61.7	982	80	landfall at Antigua
21 / 1105	18.4	64.6	996	60	landfall at Tortola

Table 2. Hurricane Jose, selected surface observations, October, 1999.

Location	Press. (mb)	Date/ time (UTC)	Sustained wind (kt)[a]	Peak gust (kt)	Date /time (UTC)[b]	Storm surge (ft)[c]	Storm tide (ft)[d]	Total rain (in)
Leeward Islands								
Antigua	982.0	20/1600	70	89	20/1523			7.64
Desirade			50	65	20/0800			
St. Barthelemy	996.0	21/0000	54	78	21/0000			
Sint Maarten (Juliana Airport)	992.0	21/0214	65	87	21/0116			11.03
Sint Maarten (Point Blanche)								13.75
U.S. Virgin Islands								
St. Croix ASOS	999.7		27	32	21/1255			1.05
St. John (NWS sensor F420C)			52	60	21/1657			
St. Thomas ASOS								0.90
St. Thomas Mount Zion								2.93
St. Thomas National Park Svc								1.62
Puerto Rico								
Aguas Buenas								5.43
Carolina (SJU) ASOS	1001.7	21/1902	20	26	21/1005			1.30
Carolina								2.97
Ceiba (TJNR) ASOS	1001.0	21/1854	25	32	21/1216			1.14
Cupey Rio Piedras								3.96
Gurabo Abajo								3.87
Hatillo								3.65
Jagueyes Abajo								3.69
Manati-Orocovis								2.42
Naranjito								3.47
Orocovis								4.19
Rio Fajardo								3.28
Rio Grande								4.15
Rio Grande near El Verde								4.34
Rio Icacos Naguabo								6.18
Rio Piedras								4.05

[a]ASOS are 2-minute averages, Desirade and St. Barthelemy are 10-minute averages, all others are 1-minute averages.
[b]Date/time is for sustained wind when both sustained and gust are listed.
[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).

Table 3.

Preliminary forecast evaluation of Hurricane Jose
Heterogeneous sample

(Errors in nautical miles for tropical storm
and hurricane stages with number
of forecasts in parenthesis)

Technique	**Period (hours)**				
	12	**24**	**36**	**48**	**72**
CLIP	53 (27)	117 (25)	186 (23)	263 (21)	391 (17)
GFDI	44 (15)	102 (14)	215 (12)	331 (11)	578 (8)
GFDL*	36 (13)	48 (12)	104 (11)	185 (10)	426 (8)
LBAR	37 (22)	51 (20)	71 (18)	100 (16)	183 (13)
AVNI	52 (19)	93 (18)	132 (17)	197 (15)	278 (9)
BAMD	39 (27)	66 (25)	109 (23)	176 (21)	397 (17)
BAMM	48 (26)	80 (24)	117 (22)	156 (20)	273 (17)
BAMS	64 (26)	111 (24)	150 (22)	178 (20)	202 (16)
A98E	43 (26)	85 (24)	119 (22)	149 (20)	226 (16)
NGPI	133 (10)	198 (10)	218 (10)	216 (8)	238 (8)
UKMI	55 (24)	106 (22)	179 (20)	282 (18)	431 (14)
NHC OFFICIAL	39 (27)	72 (25)	139 (23)	235 (21)	384 (17)
NHC OFFICIAL 1989-1998 10-year average	48 (2005)	89 (1790)	128 (1595)	164 (1410)	242 (1107)

* GFDL output not available until after forecast issuance.

Table 4. Watch and warning summary, Hurricane Jose, October, 1999.

Date/time (UTC)	Action	Location
18/0900	Hurricane watch issued	Barbados
18/1200	Tropical storm watch issued	Trinidad and Tobago
18/2100	Hurricane watch issued	Grenadines, St. Vincent, St. Lucia, and Dominica
18/2100	Tropical storm warning issued	Barbados
18/2100	Tropical storm watch issued	Grenada
18/2100	Tropical storm watch discontinued	Trinidad and Tobago
19/0000	Hurricane watch issued	Martinique, Guadeloupe, Antigua, Barbuda, Montserrat, St. Kitts, Nevis, and Anguilla
19/0300	Hurricane watch issued	St. Eustatius, Saba, St. Maarten, St. Martin, and St. Barthelemy
19/0600	Hurricane watch changed to tropical storm watch	St. Vincent and the Grenadines
19/0600	Hurricane watch discontinued	Barbados
19/0900	Hurricane warning issued	Dominica, Martinique, and Guadeloupe
19/0900	Tropical storm watch discontinued	Grenada
19/1500	Hurricane warning issued	Dominica, Montserrat, Antigua, Barbuda, Nevis, St. Kitts, St. Eustatius, Saba, St. Maarten, and Anguilla
19/1500	Hurricane watch issued	British and U.S. Virgin Islands, and Puerto Rico
19/1500	Tropical storm warning issued	St. Lucia
19/1500	Tropical storm watch discontinued	St. Vincent and the Grenadines

Date/time (UTC)	Action	Location
19/2100	Hurricane warning issued	British and U.S. Virgin Islands, and Puerto Rico
19/2100	Hurricane watch discontinued	St. Lucia
20/0000	Hurricane warning issued	Guadeloupe
20/0300	Tropical storm warning discontinued	St. Lucia and Barbados
20/1200	Hurricane warning issued	Desirade, St. Martin, and St. Barthelemy
20/1200	Hurricane warning discontinued	Guadeloupe
20/1500	Hurricane warning discontinued	Dominica
20/2100	Hurricane warning discontinued	Antigua and Desirade
21/0900	Hurricane warning changed to tropical storm warning	U.S. Virgin Islands and Puerto Rico
21/0900	Hurricane warning discontinued	St. Maarten, St. Eustatius, and Saba
21/1500	Hurricane warning discontinued	Montserrat, Barbuda, Nevis, St. Kitts, Anguilla,St. Martin, and St. Barthelemy
21/1500	Hurricane warning changed to tropical storm warning	British Virgin Islands
21/2100	Tropical storm warning discontinued	British and U.S. Virgin Islands, and Puerto Rico

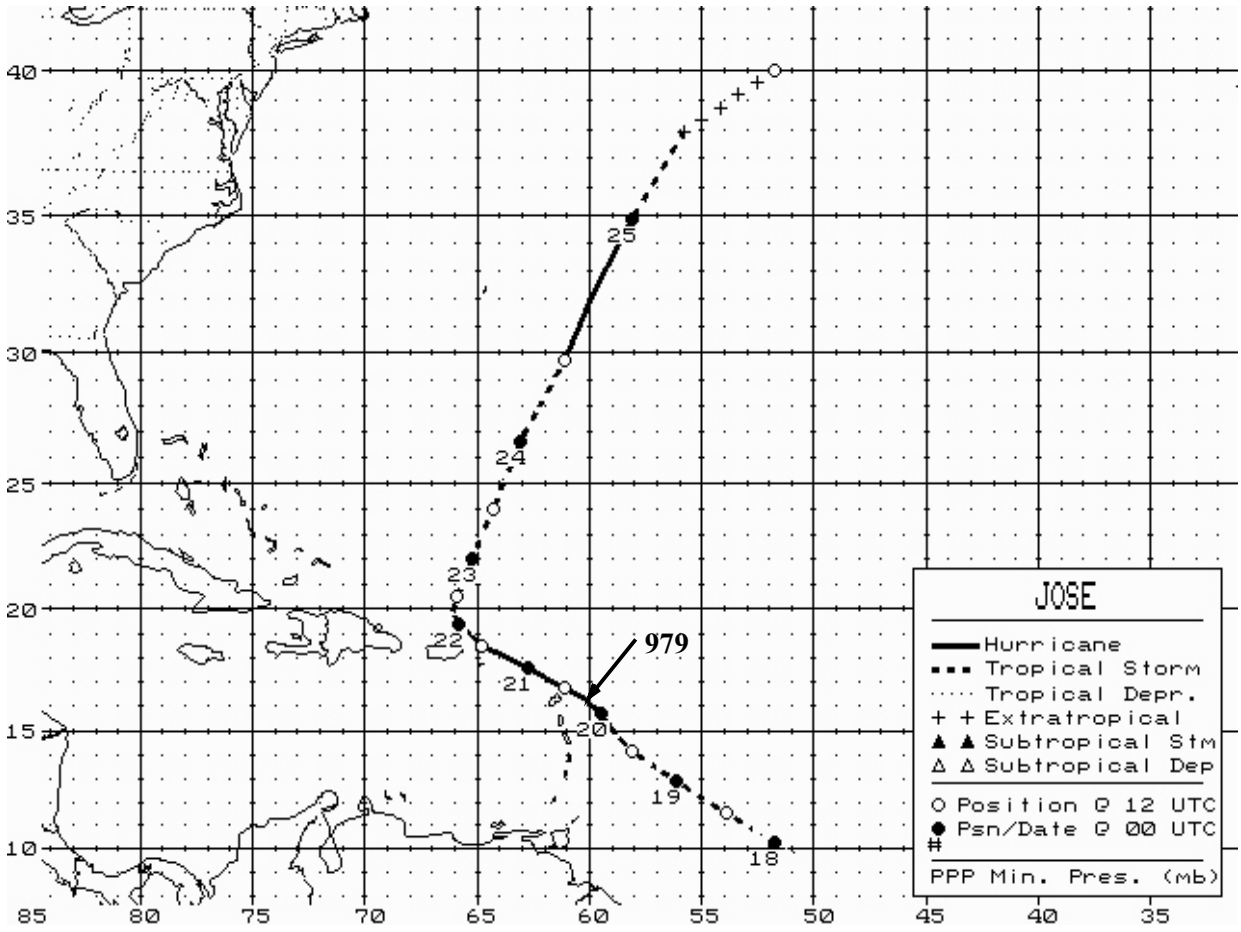

Fig. 1. Best track positions for Hurricane Jose, 17-25 October, 1999.

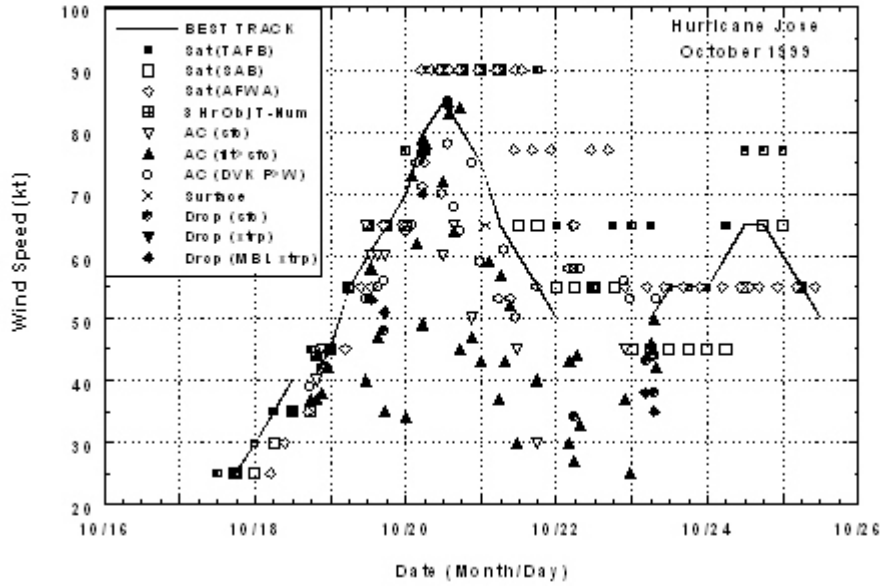

Fig. 2. Best track maximum sustained wind speed curve for Hurricane Jose, showing all available intensity estimates and wind observations, adjusted for elevation (90% of 700 mb flight level wind speeds, 80% of 850 mb speeds, and 85% of 1500 ft speeds. Dropsonde wind speeds are adjusted to the surface using a mean eyewall profile determined by previous dropsonde measurements. MBL denotes mean boundary layer).

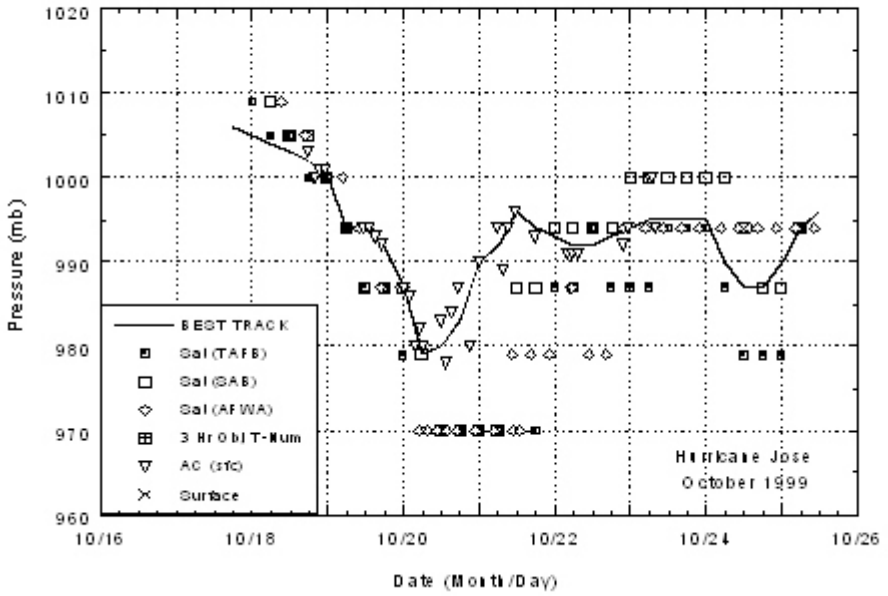

Fig. 3. Best track minimum central pressure curve and central pressure observations or estimates for Hurricane Jose.