

PRELIMINARY REPORT  
HURRICANE JOAN  
10-23 OCTOBER 1988  
BY  
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INTRODUCTION

The 1988 hurricane season was unusual in a variety of ways and Joan, the last hurricane of the season, made its contribution. It's extremely rare that a tropical storm or hurricane hugs the north coast of South America passing directly over Curacao in the Netherland Antilles and over the Guajira Peninsula of Colombia. Previously in this century only a June tropical storm in 1933 did so, although the tracks of Edith 1971 and the depression track of Irene 1971 were only a little to the north of that area. Usually, close proximity to land inhibits development of tropical cyclones, but Joan reached hurricane strength just 30 n mi north of the coast of Colombia. Moreover, Joan was only the second hurricane to strike the southeast coast of Nicaragua south of Bluefields since 1911...and by far the strongest. No other hurricane of record reached category 4 strength south of 12N.

SYNOPTIC HISTORY

Joan formed in an ITCZ disturbance that moved off the northwest coast of Africa south of latitude 10N on 5 October 1988. The low-latitude cloud cluster remained poorly organized until 9 October when satellite pictures indicated the presence of a banding pattern with the convection detaching from the ITCZ. By 1800 UTC, 10 October, the system had reached tropical depression status based on satellite classifications.

Tropical Depression Seventeen continued developing and based on satellite imagery it is estimated that it reached tropical storm status near 0600 UTC, 11 October, with a Dvorak current intensity of 2.5. Twelve hours later ship SNJG had 40-knot sustained winds essentially verifying the satellite classification maximum sustained wind estimate of 45 knots at that time.

Tropical Storm Joan continued moving westward for the next two days. Reconnaissance aircraft reports at 1114 UTC, 13 October, verified that the system had weakened somewhat while approaching the Windward Islands. There was little change in the strength of Joan while passing directly over the island of Grenada but reconnaissance reports and satellite pictures verified gradual strengthening as the system continued westward under the influence of a pronounced ridge of high pressure to the north. Joan hugged the Caribbean coast of Venezuela with the center passing over Curacao and the Paraguana Peninsula of Venezuela, as well as the Guajira Peninsula of Colombia. Joan reached hurricane strength just west of the Guajira Peninsula and only 30 n mi north of the coast of Colombia. It is unusual for tropical systems to strengthen that close to the coast. Perhaps the close proximity of the 18,648-foot Sierra Nevada de Santa Marta Mountains to the south help to focus the low-level inflow.

Hurricane Joan continued strengthening while moving westward under the persistent ridging to the north. The hurricane weakened while making a tight cyclonic loop 130 n mi north of Panama City, Panama on 20 October but resumed strengthening upon emerging from the loop. It is not known whether the proximity of trailing Tropical Depression Eighteen north of the Guajira Peninsula contributed to the weakening and/or looping process. Moreover, weakening may have resulted from upwelling associated with the nearly stalled hurricane. In any event, Tropical Depression Eighteen gradually dissipated while Joan was experiencing rapid strengthening just prior to its arrival at the coast of Nicaragua. The last pressure reported by reconnaissance aircraft prior to landfall was 936 mb at 0055 UTC, 22 October, which was determined via a dropsonde on the edge of the 15-20 n mi diameter eye. Based on differences between satellite/reconnaissance estimations of pressure during the previous several hours and the objective Dvorak T-Number of 6.5, it is estimated that the lowest pressure probably was 932 mb just prior to landfall at Bluefields, Nicaragua. The highest measured wind at the 850 mb flight level was 124 knots. Based on that it is estimated that the highest sustained wind speed at the time of minimum pressure was near 125 knots.

Joan remained well-organized as it continued moving westward across the lowlands of Nicaragua, across the northern portion of Lake Nicaragua, over Managua, and off the Pacific coast south of Leon, Nicaragua. While there were no official surface observations near the center as the tropical cyclone crossed Nicaragua, based on satellite pictures it is estimated that Joan weakened to a minimal tropical storm before emerging over the Pacific Ocean on 23 October.

Joan was renamed Miriam upon entering the eastern Pacific Ocean basin and hugged the coast of El Salvador and the Pacific coast of Guatemala before turning southwestward under shearing conditions and initially dissipating 300 n mi south of Acapulco, Mexico on 28 October. Miriam did regenerate again to a tropical depression but did not reach tropical storm status. It finally dissipated on 2 November 1988. (See Figs. 1-3 and Tables 1 and 4 for "best track" information on Joan.)

#### METEOROLOGICAL STATISTICS

Very scanty meteorological information is available from the areas affected by Joan. Heavy rainfalls of 5-10 inches (up to 15 inches in mountainous areas) and mud slides were responsible for most of the damage and deaths in Venezuela, Colombia, Panama, and Costa Rica. Maximum observed winds and storm surges at Bluefields, Nicaragua are not available at this writing.

#### CAUSALTY AND DAMAGE STATISTICS

Joan slammed into Bluefields, Nicaragua, a city of 46,000, with explosive impact. Based on newspaper articles and reports from the Nicaraguan Embassy in Washington, D.C., a large percentage of the city's 6,000 houses were blown apart or lost roofs, and most of the main buildings were destroyed. Throughout Nicaragua and the offshore islands, there were 148 people killed, 184 persons seriously injured, 100 missing and 187,000 homeless. About 23,000 homes were destroyed and 9,000 others damaged. Approximately 15,700 cattle, 20,000 pigs, and 456,000 chickens perished. Raging floodwaters tore out 30 bridges and left 36 others seriously damaged. Some 404 miles of road sections were washed out. Nearly 70,000 were evacuated from Managua. Evacuations in Bluefields were met with resistance.

In Costa Rica, the Rio Corredores burst through a dike at Ciudad Neily. Twenty rivers overflowed and 75 towns were flooded ranging from hamlets to Quetos, a Pacific coast city of 15,000. A total of 28 people were killed, 75 were injured, 18 missing, and 7,500 were homeless. About 55,000 Costa Ricans were evacuated.

Four people were killed in Panama, 25 in Colombia, and 11 in Venezuela. Some 27,000 were left homeless in Colombia.

The Nicaraguan Embassy in Washington, D.C., estimated the damage in Nicaragua to be 840 million dollars. Damage estimates are not available from the other affected countries but the total damage produced by Hurricane Joan likely approached 1.5 billion dollars.

#### FORECAST AND WARNING CRITIQUE

Prior to Joan reaching hurricane strength, the NHC83 model tried to turn the storm toward the northwest at the end of the forecast periods; whereas after reaching hurricane strength, the model performed well. The Quasi-Lagrangian Model did poorly. Although it is difficult to predict extreme events, persistence worked well on the track forecasts due to the persistent ridging to the north, and in the intensity forecasts due to persistently favorable outflow patterns aloft.

The multitude of probability tables that were issued in Joan were likely of little use when the system was paralleling the north coast of South America. However, highest probabilities correctly focused on San Andres and then Bluefields which, if used, would have been further evidence to support evacuations in Nicaragua. Even as the hurricane was approaching landfall at Bluefields, there was disbelief among the local residents and a reluctance to evacuate. (See Tables 2-3 for warnings and probabilities issued for Joan.)

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Draft 12/16/88

Final 1/18/89

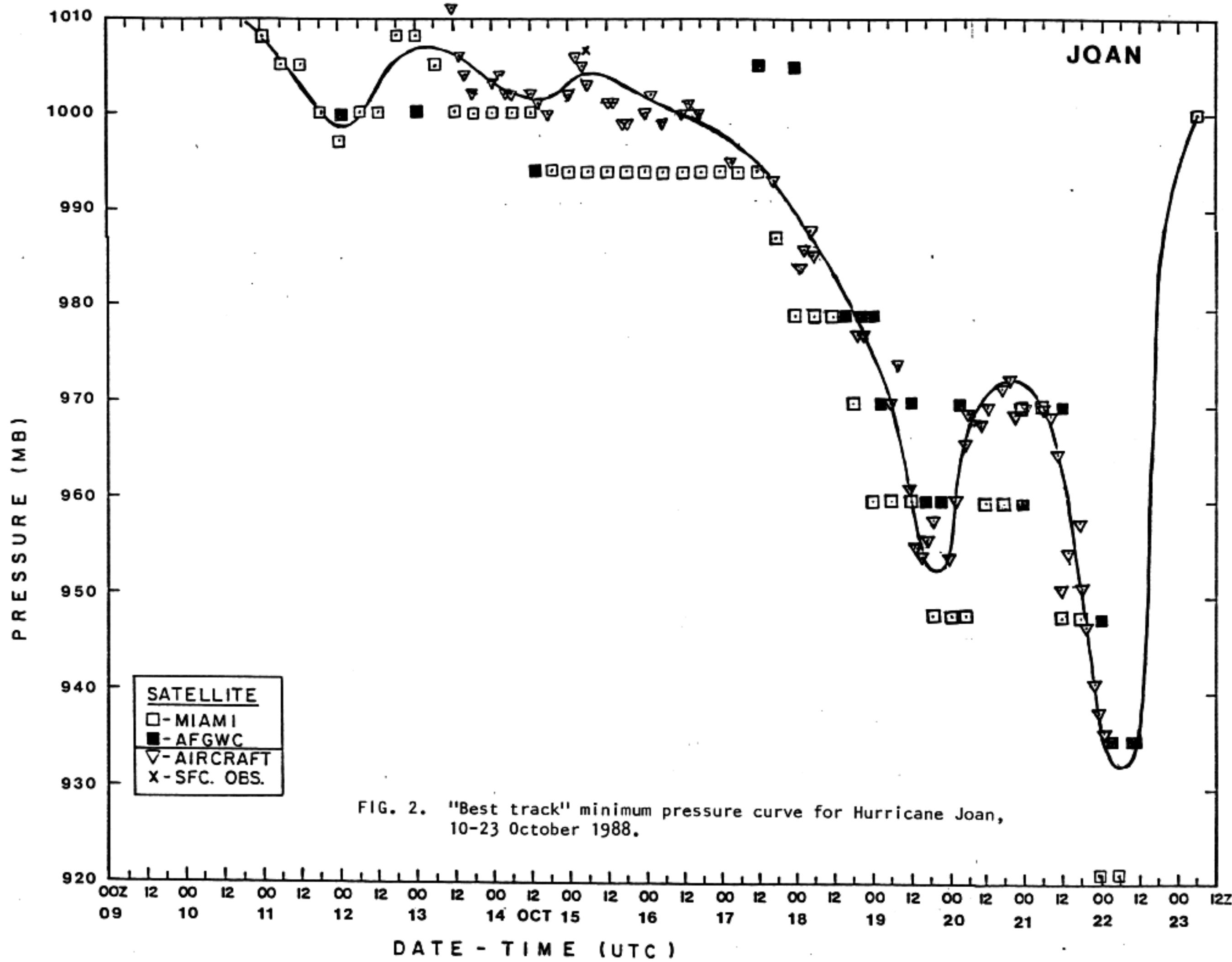


FIG. 2. "Best track" minimum pressure curve for Hurricane Joan, 10-23 October 1988.

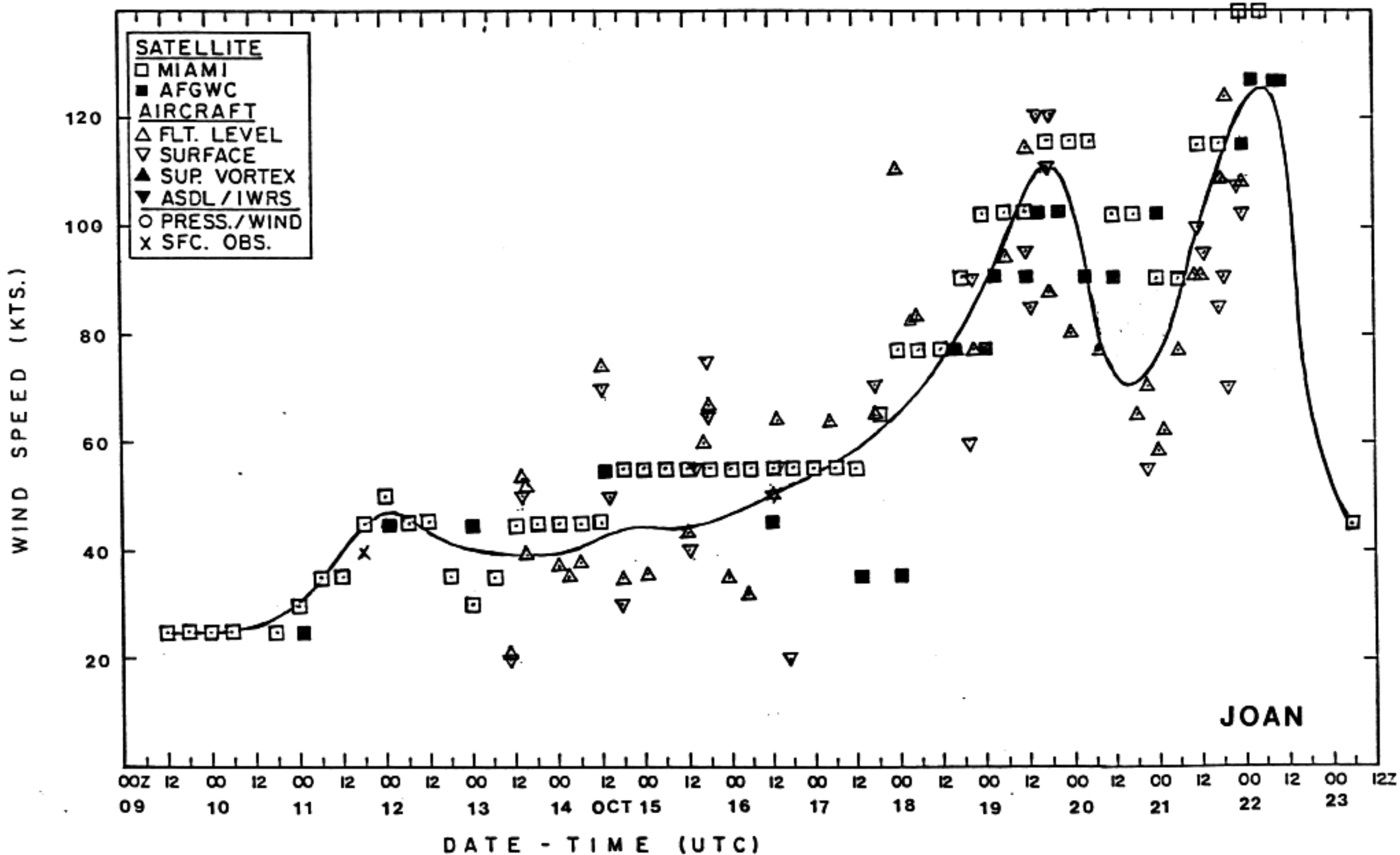
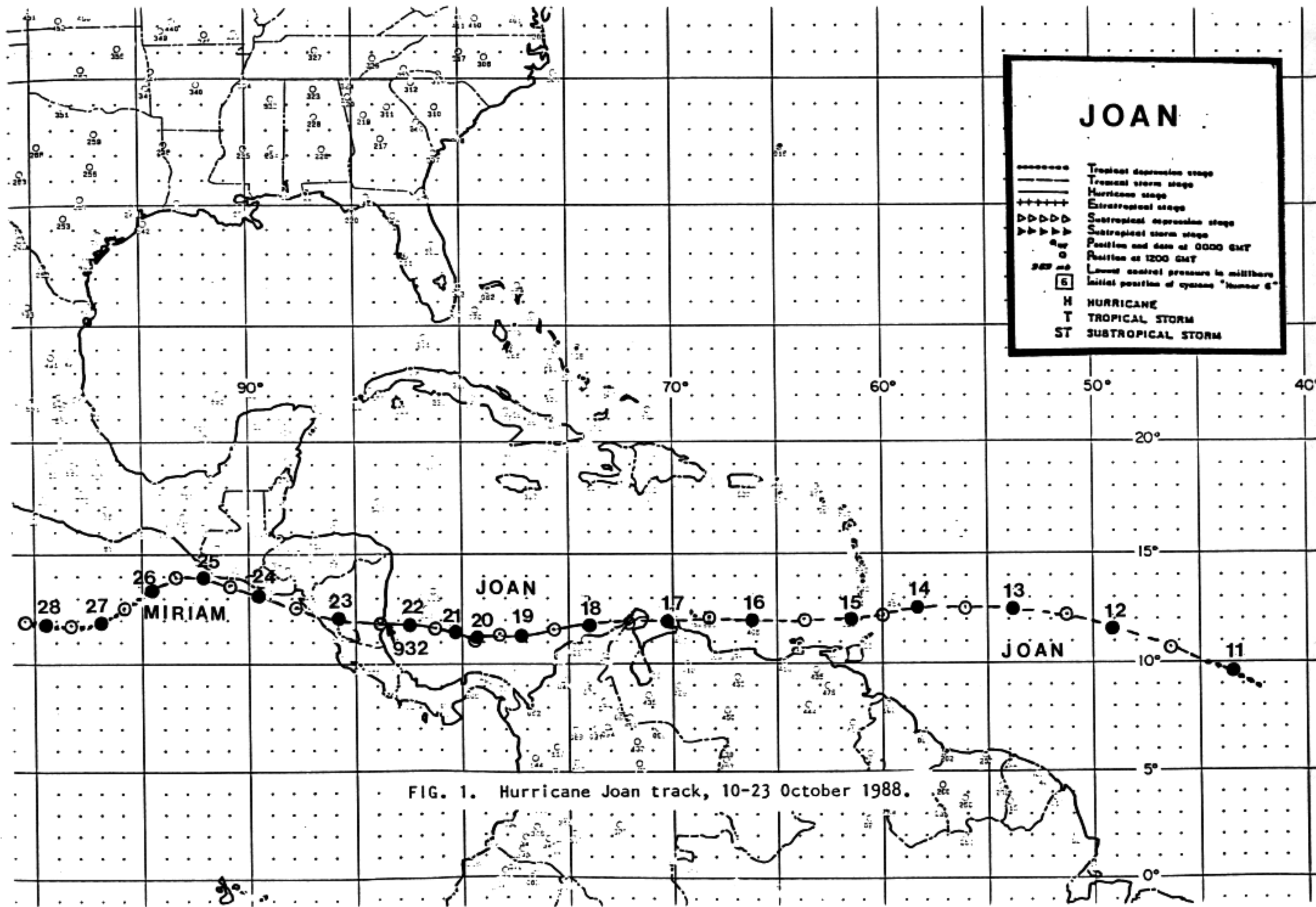


FIG. 3. "Best track" maximum wind speed curve for Hurricane Joan, 10-23 October 1988.



## JOAN

	Tropical depression stage
	Tropical storm stage
	Hurricane stage
	Extratropical stage
	Subtropical depression stage
	Subtropical storm stage
	Position and date at 0000 GMT
	Position at 1200 GMT
	Lowest central pressure in millibars
	Initial position of system "Number 6"
	HURRICANE
	TROPICAL STORM
	SUBTROPICAL STORM

FIG. 1. Hurricane Joan track, 10-23 October 1988.

TABLE 1. Preliminary best track, Hurricane Joan, 10-23 October 1988.

date/time (UTC)	position		pressure (mb)	wind speed (knots)	stage
	lat.	lon.			
10/1800	08.9	42.2	1010	25	Tropical Depression
11/0000	09.5	43.6	1008	30	"
0600	10.1	45.0	1005	35	Tropical Storm
1200	10.7	46.4	1003	40	"
1800	11.2	47.9	1000	45	"
12/0000	11.5	49.0	999	50	"
0600	11.8	50.1	1000	45	"
1200	12.1	51.3	1003	45	"
1800	12.3	52.5	1006	40	"
13/0000	12.4	53.8	1007	40	"
0600	12.5	54.9	1007	40	"
1200	12.6	56.0	1006	40	"
1800	12.7	57.1	1005	40	"
14/0000	12.6	58.3	1003	40	"
0600	12.4	59.4	1002	40	"
1200	12.2	60.0	1001	45	"
1800	12.0	60.8	1001	45	"
15/0000	12.1	61.5	1003	45	"
0600	12.1	62.8	1004	45	"
1200	12.0	63.8	1004	45	"
1800	11.9	64.9	1003	45	"
16/0000	12.0	66.1	1002	45	"
0600	12.0	67.2	1001	50	"
1200	11.9	68.2	1000	50	"
1800	12.0	69.2	999	50	"
17/0000	12.0	70.2	998	55	"
0600	12.0	71.2	997	55	"
1200	11.9	72.1	995	60	"
1800	11.8	73.0	993	60	"
18/0000	11.8	74.0	990	65	Hurricane
0600	11.7	75.0	987	70	"
1200	11.5	75.8	984	75	"
1800	11.3	76.5	980	80	"
19/0000	11.2	77.2	976	90	"
0600	11.3	77.8	970	95	"
1200	11.4	78.3	960	105	"
1800	11.3	78.9	953	110	"
20/0000	11.3	79.3	956	105	"
0600	11.1	79.8	967	85	"
1200	11.1	79.5	971	70	"
1800	11.3	79.9	973	70	"
21/0000	11.5	80.3	972	75	"
0600	11.5	80.7	970	90	"
1200	11.6	81.2	964	100	"
1800	11.8	81.8	952	110	"
22/0000	11.9	82.5	937	120	"
0600	11.9	83.2	932	125	"
1200	11.9	83.9	936	120	"
1800	12.0	85.0	983	70	"
23/0000	12.1	85.9	993	55	Tropical Storm
0600	12.2	86.8	1000	45	"
Landfall:					
15/0100	12.1	61.8	1003	45	Grenada
17/0600	12.0	71.2	997	55	Guajira Peninsula
22/1000	11.9	83.7	932	125	Bluefields

TABLE 2. Warnings issued for Joan, October 1988.

<u>LOCATION</u>	<u>WARNING</u>	<u>ISSUED (UTC)</u>	<u>DISCONTINUED (UTC)</u>
Barbados	Tropical Storm Warning	13/1600	14/1900
Dominica, St. Lucia, St. Vincent & Grenadines	Tropical Storm Watch	13/1600	14/0100 except 14/1900 Dominica
Martinique	Tropical Storm Watch	13/1600	14/2200
Grenada & Dependencies	Tropical Storm Watch	13/2200	14/0100
St. Lucia, St. Vincent & Grenadines	Tropical Storm Warning	14/0100	15/1000
Grenada & Dependencies	Tropical Storm Warning	14/0100	15/1600
Trinidad, Tobago	Tropical Storm Warning	14/1600	14/2200
La Blanquilla, Orchila, Los Roques	Tropical Storm Watch	14/2200	15/0100
Los Testigos, Margarita, La Tortuga, Islas de Aves	Tropical Storm Watch	14/2200	15/1600
La Blanquilla, Orchila, Los Roques	Tropical Storm Warning	15/0100	
Margarita, Los Tortuga, Islas de Aves	Tropical Storm Warning	15/1600	
La Blanquilla, Margarita, La Tortugas	Tropical Storm Warning		16/0400
Orchila	Tropical Storm Warning		16/1000
Los Roques, Isla de Aves	Tropical Storm Warning		16/1600
Peninsula de Paraguana	Tropical Storm Warning	16/1600	17/1000
Peninsula de la Guajira	Tropical Storm Warning	16/1600	17/2200
Isla Los Monjes	Tropical Storm Warning	16/2200	17/2200
Punta San Blas to Boca Del Toro, Panama	Hurricane Watch	18/1600	19/1600
San Andres, Providencia, Albuquerque	Hurricane Watch	18/1600	19/1600
East Coast of Costa Rica Including Offshore Islands	Hurricane Watch	19/0700	22/0100

TABLE 2. Warnings issued for Joan, October 1988.  
(contd)

<u>LOCATION</u>	<u>WARNING</u>	<u>ISSUED (UTC)</u>	<u>DISCONTINUED (UTC)</u>
San Andres, Providencia, Alburquerque	Hurricane Warning	19/1600	22/1000
East Coast of Nicaragua Including Offshore Islands	Hurricane Watch	19/1600	21/1600
East Coast of Nicaragua Including Offshore Islands	Hurricane Warning	21/1600	22/1600
Costa Rica	Flash Flood & Mud Slide Warning	21/1600	
Nicaragua	Flash Flood & Mud Slide Warning	21/1600	
Western Panama	Flash Flood & Mud Slide Warning	21/1600	22/1300
Eastern Half of Honduras	Flash Flood & Mud Slide Warning	21/2200	
Western Half of Honduras	Flash Flood & Mud Slide Warning	22/1600	



TABLE 3. Chances of the center of Hurricane Joan passing within 65 miles of listed locations by date and time (AST or EDT...both same) indicated; probabilities in percent.

ADVISORY DATE/TIME	13/6PM	13/9PM	13/MID	14/6AM	14/NOON	14/6PM	14/9PM	14/MID
PROBABILITY TIME	16/2PM	16/2PM	16/8PM	17/2AM	17/8AM	17/2PM	17/2PM	17/8PM
SKPG	12.5N 71.7W	9	9	10	10	11	12	12
TNCC	12.2N 69.0W	12	12	13	13	15	17	16
SVMG	11.0N 64.0W	13	13	16	16	28	39	29
TPPP	10.6W 61.4W	8	8	11	10	24	—	—
TTPT	11.2N 60.8W	16	16	23	24	49	—	—
TGPY	12.0N 61.8W	26	26	40	42	72	94	—
TBPB	13.1N 59.5W	71	71	91	97	78	—	—
TVSV	13.1N 61.2W	45	45	65	72	73	71	—
TLPL	13.8N 61.0W	48	48	57	58	41	—	—
TFFF	14.6N 61.0W	39	39	35	32	10	—	—
TDPR	15.3N 61.4W	27	27	19	18	8	6	—
TFFR	16.3N 61.5W	16	16	11	10	7	5	—
TAPA	17.1N 61.8W	12	12	9	9	6	5	—
TKPK	17.3N 62.7W	12	12	10	10	7	6	7
TNCM	18.1N 63.1W	10	10	8	9	7	6	6
TISX	17.7N 64.8W	12	12	11	11	9	9	8
TIST	18.3N 65.0W	10	10	9	10	8	8	8
TJPS	18.0N 66.6W	11	11	10	11	9	9	9
TJSJ	18.4N 66.1W	10	10	9	10	8	8	8
MDSO	18.5W 69.7W	8	8	8	9	8	8	7
MDCB	17.6N 71.4W	8	8	8	9	8	9	8
MTPP	18.6N 72.4W	6	6	6	7	6	7	6
MDPP	19.8N 70.7W	5	5	5	6	5	6	5
MICA	18.3N 73.8W	5	5	5	6	5	6	5
MBJT	21.5N 71.2W	3	3	3	4	3	3	3
MKJP	17.9N 76.8W	3	3	3	4	3	4	3
MKJS	18.5N 77.9W	—	—	2	2	2	2	2
MUGM	20.0N 75.1W	—	—	2	3	3	3	3
MPCO	9.3N 79.9W	—	—	2	2	2	—	2
SKSP	12.6N 81.7W	—	—	—	—	—	—	2
MUCM	21.4N 77.9W	—	—	—	—	—	—	—
MNPC	14.1N 83.4W	—	—	—	—	—	—	—
MNBL	12.0N 83.9W	—	—	—	—	—	—	—
MRLM	10.0N 83.1W	—	—	—	—	—	—	—
MWCG	19.3N 81.4W	—	—	—	—	—	—	—
MHNJ	16.5N 85.9W	—	—	—	—	—	—	—
MZBZ	17.5N 88.3W	—	—	—	—	—	—	—
MGPB	15.7N 88.6W	—	—	—	—	—	—	—
MMCZ	20.5N 86.9W	—	—	—	—	—	—	—



TABLE 3. Chances of the center of Hurricane Joan passing within 65 miles of (contd) listed locations by date and time (AST or EDT...both same) indicated; probabilities in percent.

ADVISORY	DATE/TIME	20/MID	21/6AM	21/NOON	21/6PM	21/MID
PROBABILITY	TIME	23/8PM	24/2AM	24/8AM	24/2PM	24/8PM
SKPG	12.5N 71.7W	—	—	—	—	—
TNCC	12.2N 69.0W	—	—	—	—	—
SVMG	11.0N 64.0W	—	—	—	—	—
TTPP	10.6W 61.4W	—	—	—	—	—
TTPT	11.2N 60.8W	—	—	—	—	—
TGPY	12.0N 61.8W	—	—	—	—	—
TBPB	13.1N 59.5W	—	—	—	—	—
TVSV	13.1N 61.2W	—	—	—	—	—
TLPL	13.8N 61.0W	—	—	—	—	—
TFFF	14.6N 61.0W	—	—	—	—	—
TDPR	15.3N 61.4W	—	—	—	—	—
TFFR	16.3N 61.5W	—	—	—	—	—
TAPA	17.1N 61.8W	—	—	—	—	—
TKPK	17.3N 62.7W	—	—	—	—	—
TNCM	18.1N 63.1W	—	—	—	—	—
TISX	17.7N 64.8W	—	—	—	—	—
TIST	18.3N 65.0W	—	—	—	—	—
TJPS	18.0N 66.6W	—	—	—	—	—
TJSJ	18.4N 66.1W	—	—	—	—	—
MDSD	18.5W 69.7W	—	—	—	—	—
MDCB	17.6N 71.4W	—	—	—	—	—
MTPP	18.6N 72.4W	—	—	—	—	—
MDPP	19.8N 70.7W	—	—	—	—	—
MTCA	18.3N 73.8W	—	—	—	—	—
MBJT	21.5N 71.2W	—	—	—	—	—
MKJP	17.9N 76.8W	—	—	—	—	—
MKJS	18.5N 77.9W	—	—	—	—	—
MUGM	20.0N 75.1W	—	—	—	—	—
MPCO	9.3N 79.9W	9	—	—	—	—
SKSP	12.6N 81.7W	45	63	68	79	—
MUCM	21.4N 77.9W	—	—	—	—	—
MNPC	14.1N 83.4W	18	21	20	21	18
MNBL	12.0N 83.9W	22	36	38	46	78
MRLM	10.0N 83.1W	18	19	20	18	12
MWCG	19.3N 81.4W	4	4	4	—	—
MHNJ	16.5N 85.9W	9	11	11	11	11
MZBZ	17.5N 88.3W	6	7	8	8	9
MGPB	15.7N 88.6W	8	11	11	11	13
MMCZ	20.5N 86.9W	2	3	3	3	—

TABLE 4. Ship reports associated with Hurricane Joan.

<u>SHIP</u>	<u>DATE</u>	<u>UTC</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>WIND (KT)</u>	<u>PRESSURE (MB)</u>
SNJG	11 October	1800	12.2N	48.3W	130/40	1009.4
ELHT	20 October	1200	10.2N	78.8W	230/35	1005.0
SHIP	20 October	1200	10.2N	77.5W	170/35	1006.1