

Preliminary Report
Hurricane Mitch
22 October - 05 November 1998

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Mitch is responsible for over nine thousand deaths predominately from rain-induced flooding in portions of Central America, mainly in Honduras and Nicaragua. This makes Mitch one of the deadliest Atlantic tropical cyclones in history, ranking only below the 1780 "Great Hurricane" in the Lesser Antilles, and comparable to the Galveston hurricane of 1900, and Hurricane Fifi of 1974, which primarily affected Honduras.

The 905 mb minimum central pressure and estimated maximum sustained wind speed of 155 knots over the western Caribbean make Mitch the strongest October hurricane (records began in 1886). Mitch moved across the Yucatan Peninsula and southern Florida as a tropical storm.

a. Synoptic History

The origins of Mitch can be traced back to a tropical wave that moved across the southern portion of west Africa on 8/9 October. Rawinsonde data from Abidjan, Cote D' Ivorie, located about 980 n mi southeast of Dakar, suggests that the wave had passed through the region around 8 October. The wave crossed the west coast of Africa, generally south of 15 North, on 10 October. The wave progressed across the tropical Atlantic for the next seven days with west-southwesterly upper-level winds preventing significant development.

After moving through the eastern Caribbean Sea on the 18th and 19th, satellite pictures showed an organizing cloud pattern over the south-central Caribbean Sea on the 20th. Shower and thunderstorm activity continued to become better organized in the southwest Caribbean Sea early on the 21st. Subsequently, a U.S. Air Force Reserve (USAFR) reconnaissance aircraft was dispatched to investigate the disturbance that afternoon and found winds of 39 knots at the 1500-foot flight level, and a central pressure of 1001 mb. On this basis, the system became a tropical depression at 0000 UTC 22 October, about 360 n mi south of Kingston, Jamaica – see Figs. 1a and 1b, and Table 1 for the "best track". The depression moved slowly westward and strengthened to a tropical storm later that day, about 225 n mi east-southeast of San Andres Island, while moving in a cyclonic loop. By the 23rd, the intensification of Mitch was disrupted by westerly vertical wind shear associated with an upper-level low north-northwest of the tropical cyclone. Later on the 23th, the upper low weakened, the shear diminished, and Mitch began to strengthen while moving slowly northward.

Mitch became a hurricane at 0600 UTC 24 October while located about 255 n mi south-southwest of Kingston, Jamaica. Later that day, as it turned toward the west, Mitch began a period of rapid intensification. During a 24 hour period beginning on the afternoon of the 24th, its central pressure dropped 52 mb, to 924 mb. With a symmetric, well-established upper-tropospheric outflow pattern evident on satellite imagery, the hurricane continued to strengthen. On the afternoon of the 26th, the central pressure reached a minimum of 905 mb, while the cyclone was centered about 50 n mi southeast of Swan Island. This pressure is the fourth lowest ever measured in an Atlantic hurricane, tied with Hurricane Camille in 1969. This is also the lowest pressure ever observed in an October hurricane in the Atlantic basin. Prior to Mitch, the strongest measured hurricane in the northwest Caribbean was Hurricane Hattie in 1961 with a central pressure of 924 mb. At its peak on the 26th, Mitch's maximum sustained 1-minute surface winds were estimated to be 155 knots, a category five hurricane on the Saffir/Simpson Hurricane Scale.

After passing over Swan Island on 27 October, Mitch began to gradually weaken while moving slowly westward. It then turned southwestward and southward toward the Bay Islands off the coast of Honduras. The center passed very near the island of Guanaja as a category five hurricane, although it is unlikely that winds of that strength were experienced on the island. Mitch slowly weakened as its circulation interacted with the land mass of Honduras. From mid-day on the 27th, to early on the 29th, the central pressure rose 59 mb. The center of the hurricane meandered near the north coast of Honduras from late on the 27th through the 28th, before making landfall during the morning of the 29th about 70 n mi east of la Ceiba with estimated surface winds of 70 knots and a minimum central pressure of 987 mb.

After making landfall, Mitch moved slowly southward, then southwestward and westward, over Honduras, weakening to a tropical storm by 1800 UTC 29 October, and to a tropical depression by 1800 UTC 31 October.

The overall motion was slow, less than 4 knots, for a week. This resulted in a tremendous amount of rainfall, estimated at up to 35 inches, primarily over Honduras and Nicaragua -- see Table 2. The heavy rainfall resulted in flash floods and mudslides that killed thousands of people. It is noted that a large east-west mountain range, with peaks approaching 10,000 feet, covers this part of Central America and this terrain likely contributed to the large rainfall totals. Some heavy rains also occurred in other portions of Central America.

Although Mitch's surface circulation center dissipated near the Guatemala/Mexico border on 1 November, the remnant circulation aloft continued to produce locally heavy rainfall over portions of Central America and eastern Mexico for the next couple of days.

By the afternoon of 2 November, meteorologists at the Tropical Prediction Center/National Hurricane Center (NHC) Tropical Analysis and Forecast Branch (TAFB), and the Satellite Analysis Branch (SAB) of the National Environmental Satellite, Data, and Information Service began to follow a cloud-system center,

the remnants of Mitch, in satellite imagery over the Bay of Campeche. Shower and thunderstorm activity began to increase later on the 2nd. On 3 November, a low-level circulation became evident in the eastern Bay of Campeche. A USAFR aircraft sent to investigate the system later that afternoon found 45 knot winds at 1500 feet and a minimum central pressure of 997 mb. Thus, advisories were re-initiated on Tropical Storm Mitch located about 130 n mi southwest of Merida, Mexico. Mitch moved northeastward and weakened to a depression early on the 4th after it made landfall over the northwestern Yucatan peninsula. The center re-emerged over the south-central Gulf of Mexico by mid-morning on the 4th, and Mitch regained tropical storm strength. The storm began to accelerate northeastward as it became involved with a frontal zone moving through the eastern Gulf of Mexico. Mitch made landfall on the morning of 5 November in southwest Florida near Naples, with estimated maximum sustained winds of 55 knots. Mitch continued to move rapidly northeastward and by mid-afternoon of the 5th, moved offshore of southeastern Florida and became extratropical. The extratropical cyclone accelerated northeastward across the North Atlantic Ocean from the 6th through the 9th.

b. Meteorological Statistics

The best-track intensities in Table 1 were obtained from the data in Figures 2 and 3 which depict the curves of minimum central sea-level pressure and maximum sustained one-minute average "surface" (10 meters above ground level) wind speed, respectively, as a function of time. The data these curves are based on, also plotted in the figures, include USAFR and NOAA aircraft reconnaissance data, Dvorak-based intensity estimates from TAFB, SAB, and the U.S. Air Force Weather Agency (AFGWC in figures).

Most of the aerial reconnaissance flights into Mitch were by the USAFR "Hurricane Hunters". The Hurricane Hunters flew 19 missions, and made 41 center fixes while NOAA aircraft performed 2 missions contributing 9 center fixes. The highest 700-mb flight-level wind report was 168 knots at 1900 UTC 26 October by the USAFR. This wind speed was observed 14 n mi northeast of the center near the time of a 905 mb GPS dropsonde-measured pressure. A dropsonde in the northeast eyewall showed winds to near 160 knots at 900 mb, but lower speeds below that altitude. The highest satellite-based intensity estimate, obtained by both objective and subjective methods, was 155 knots on the 26th and the 27th.

Table 2 lists rainfall observations from Honduras, with a maximum of 35.89 inches from Choluteca. Even higher values may have gone unobserved. Table 3 lists selected surface observations from Florida, where the highest observed sustained wind speed was 52 knots, at an elevation of 43.9 meters, from the Fowey Rock C-MAN station just offshore of Miami. Significant ship reports are listed in Table 4.

Five tornadoes were spawned by Mitch in South Florida: two in the Florida Keys, one each in Broward, Palm Beach, and Collier Counties. The most significant of these (F2 intensity) occurred in the upper Florida Keys, Islamorada to North Key Largo.

c. Casualty and Damage Statistics

The estimated death toll from Mitch currently stands at 9,086. Fact Sheet #21 from the U.S. Agency for International Development, as of December 1998, compiled the following death totals: Honduras, 5677; Nicaragua, 2,863; Guatemala, 258; El Salvador; 239; Mexico, 9 and 7 in Costa Rica. The death toll also includes 31 fatalities associated with the schooner *Fantome*. In addition, another 9191 persons were listed as missing. The exact death toll will probably never be known. However, this was one of the deadliest Atlantic tropical cyclones in history, ranking below only the 1780 "Great Hurricane" in the lesser Antilles, and comparable to the Galveston hurricane of 1900, and Hurricane Fifi of 1974, the latter also striking Honduras.

Mitch also claimed two lives in Monroe County, Florida. Both deaths were drowning-related incidents resulting from a fishing boat capsizing.

It has been estimated that there was a 50 percent loss to Honduras' agricultural crops. At least 70,000 houses were damaged and more than 92 bridges were damaged or destroyed. There was severe damage to the infrastructure of Honduras and entire communities were isolated from outside assistance. To a lesser extent, damage was similar in Nicaragua, where a large mudslide inundated ten communities situated at the base of La Casitas Volcano. Guatemala and El Salvador also suffered from flash floods which destroyed thousands of homes, along with bridges and roads.

The Florida tornadoes injured 65 people and damaged or destroyed 645 homes.

Insured property damage supplied by the Florida insurance Council puts the insured damage estimate for Florida at \$20 million. These estimates exclude storm surge damage. To determine the total *estimated* damage, a ratio of 2:1 is applied to the insured property damage; this is based on comparisons done in historical hurricanes. Thus, the U.S. total estimated damage from Mitch is \$40 million.

d. Forecast and Warning Critique

Table 5 lists the various watches and warnings issued. Hurricane warnings were issued for Jamaica, Honduras, Guatemala, Belize, and the Caribbean coast of the Yucatan Peninsula, Mexico. A tropical storm warning was issued for the Cayman Islands, the Gulf of Mexico coast of the Yucatan Peninsula, Cuba, and South Florida and the Florida Keys. As the effects of Mitch on Nicaragua were confined to rainfall flooding, there were no hurricane warnings there.

The average official track forecast errors for Mitch were 39, 80, 125, 167, and 237 n mi for the 12-, 24-, 36-, 48-, and 72-hr forecast periods, respectively - see Table 7. The number of forecasts ranged from 41 at the 12-hr period to 28 at the 72-hr period. The average track errors are quite similar to the average official forecast for the previous ten years. The official forecasts

are plotted in Fig. 4(a) and this shows that there was a persistent northwest bias to these forecasts. The official track forecast was for a slow mostly northwestward motion for the many days that the hurricane was in the northwestern Caribbean, as suggested by the models. Mitch actually moved westward and then southward and the forecast turn toward the northwest did not take place until the hurricane had moved over Honduras and Nicaragua. Some of the most reliable guidance models also had this track bias, as shown in Fig. 4(b) which shows the GFDL model track forecasts. In retrospect, the slow southward, then southwestward, motion which began early on the 27th, was likely due to a weak mid-level anticyclone over the western Gulf of Mexico. However, the absence of rawinsonde data from Mexico and Central America likely hindered the track prediction models and forecasters from resolving this feature during the event.

The average absolute official wind speed forecast errors were 8, 15, 27, 30, and 39 kt at 12, 24, 36, 48, and 72 h, respectively. These are somewhat larger than the previous ten-year averages. There was an under-forecast of 80 knots for the 72-hr forecast verifying at 0000 UTC on the 27th, at the time of the estimated peak surface wind of 155 knots. Overall, the official intensity forecasts indicated a general strengthening trend between the 24th and the 26th.

Acknowledgments:

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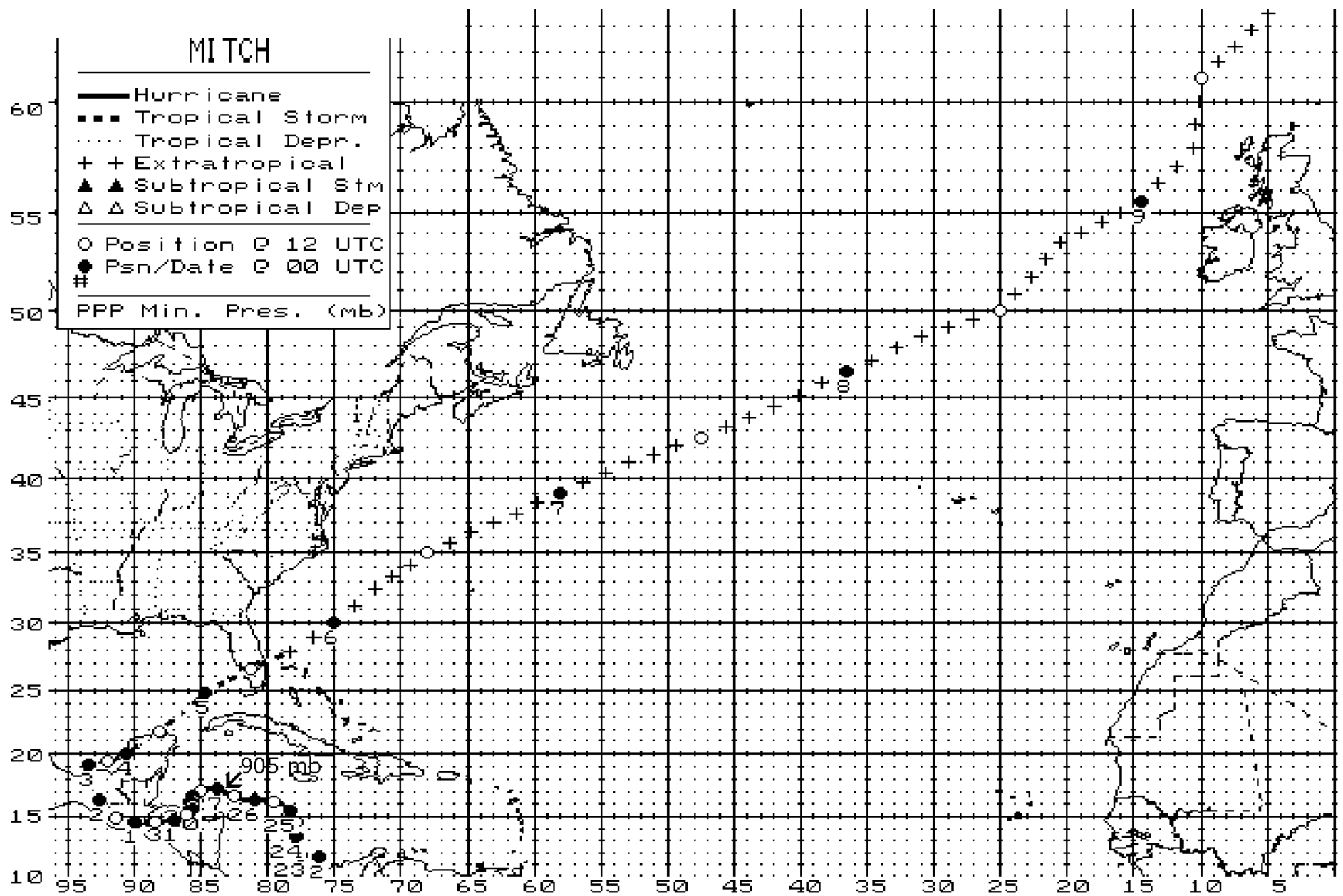


Figure 1a. Best Track of Hurricane Mitch, 22 October - 9 November 1998.

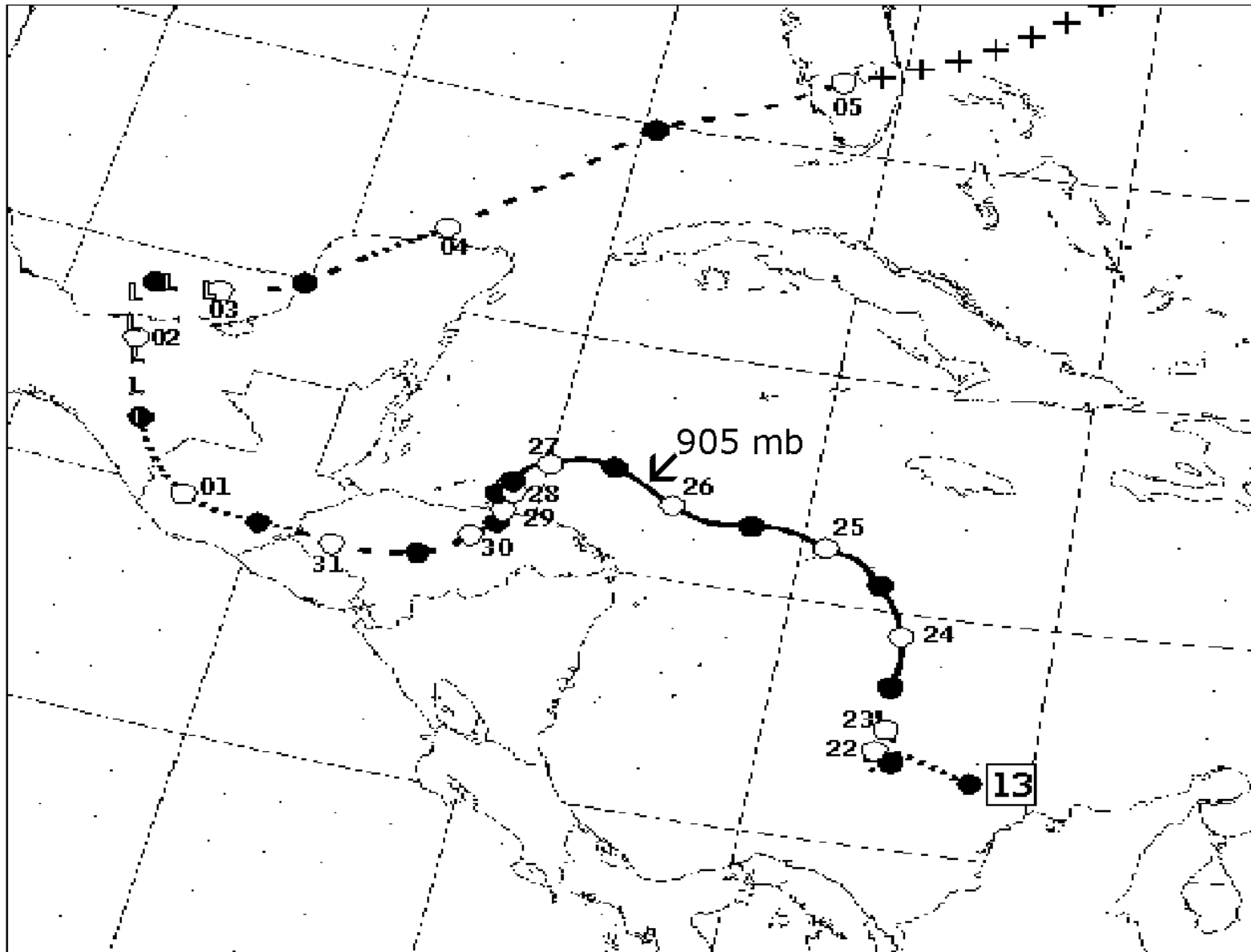


Figure 1b. Best Track of Hurricane Mitch, 22 October - 5 November 1998. All symbols are as shown in Figure 1a, with "L" indicating the period when the system was below tropical depression status.

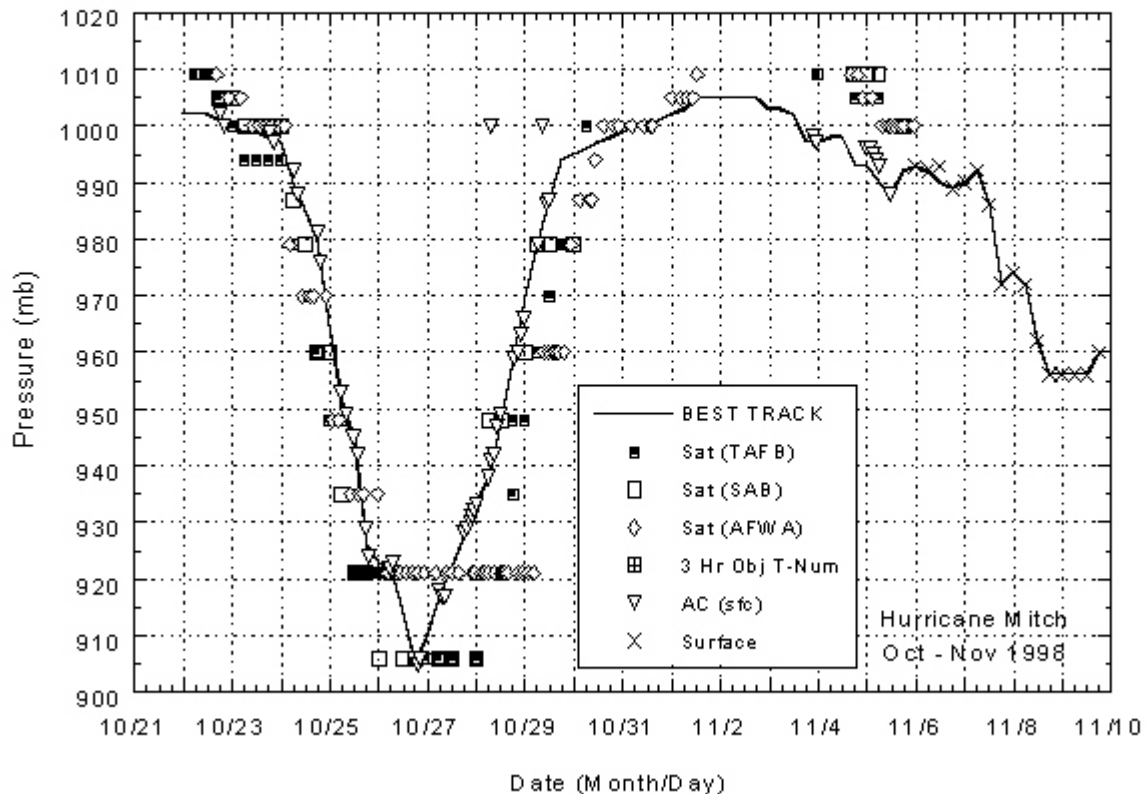


Figure 2. Best track minimum central pressure curve and central pressure observations for Hurricane Mitch.

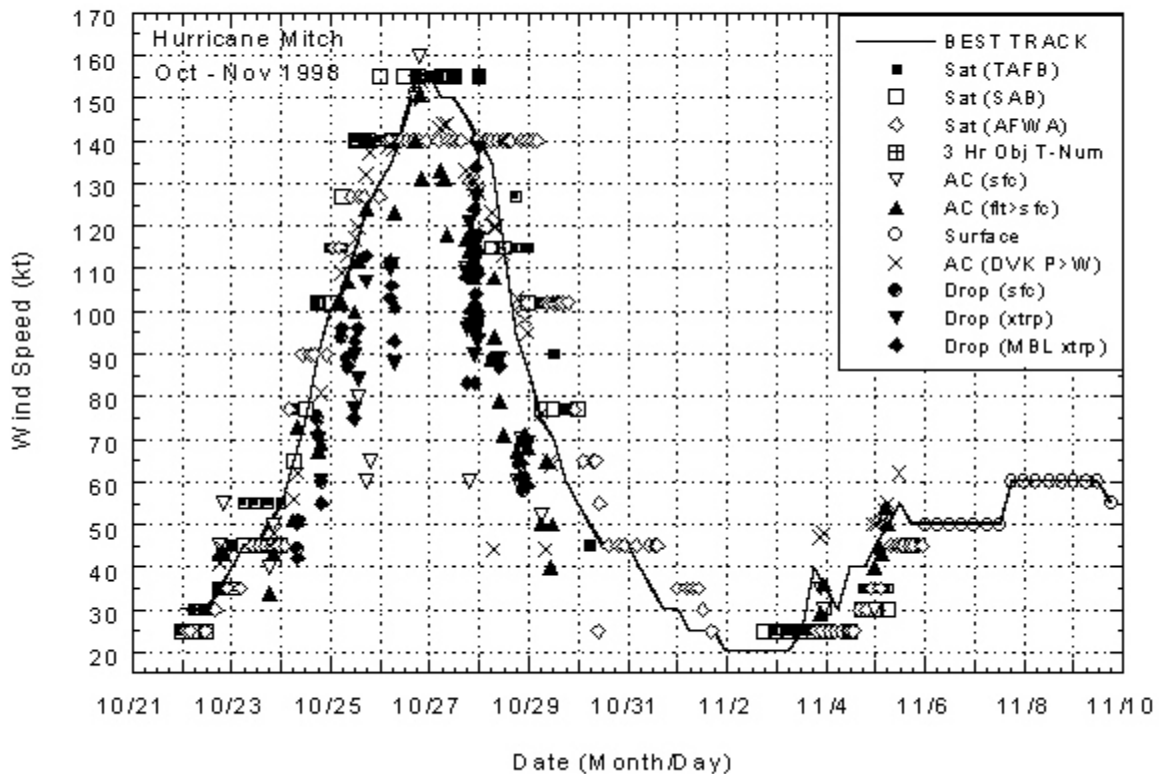


Figure 3. Best track maximum sustained wind speed curve for Hurricane Mitch, with all available intensity estimates and wind observations. *In situ* observations have been adjusted for elevation (90% of 700 mb wind speeds, 80% of 850 mb speeds, and 85% of 1500 ft speeds).

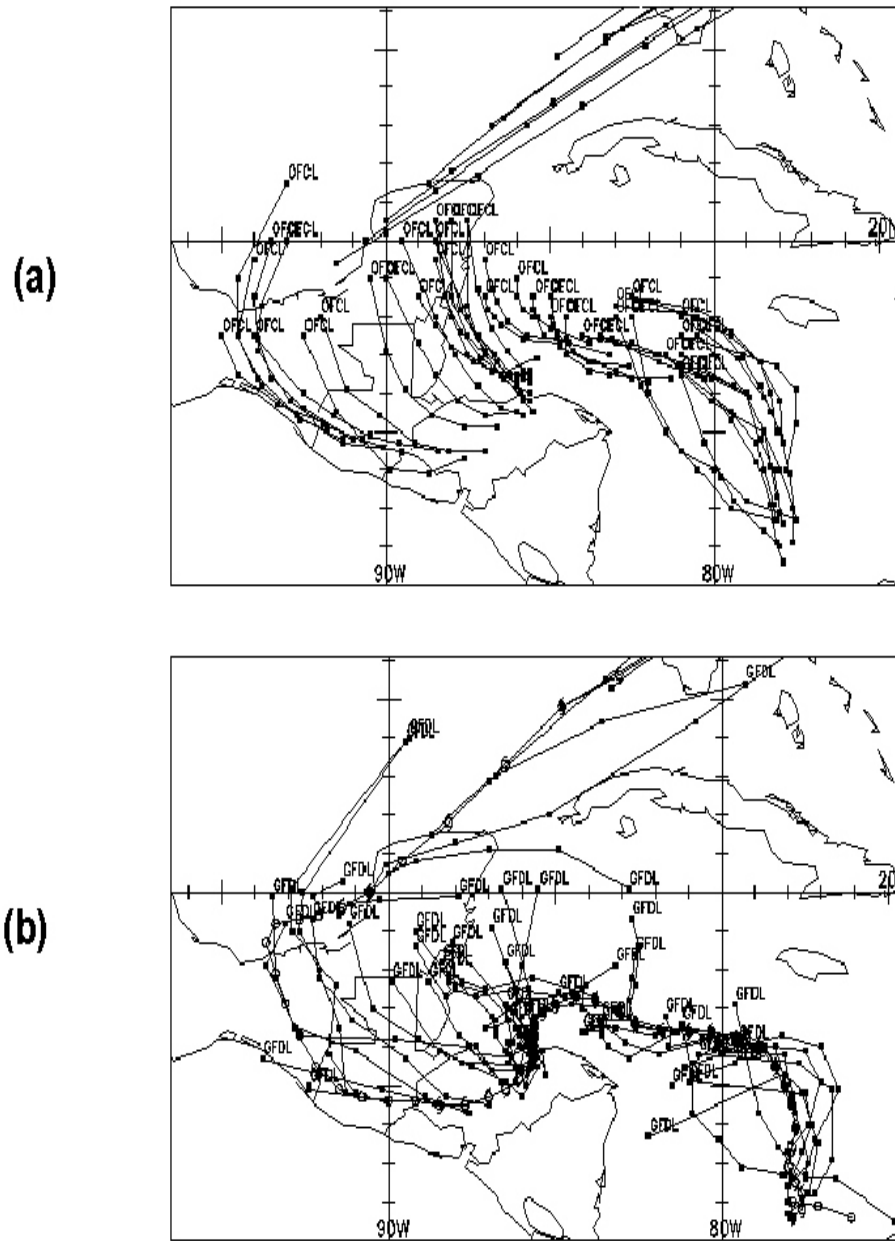


Fig. 4. Track forecasts for hurricane Mitch, (a) Official, (b) GFDL model.

Table 1.
Preliminary Best Track - Hurricane Mitch, 22 October - 09 November 1998.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
22/0000	11.6	76.1	1002	30	Tropical Depression
0600	11.9	77.1	1002	30	" "
1200	12.0	77.9	1002	30	" "
1800	11.6	77.9	1001	35	Tropical Storm
23/0000	11.8	77.6	1000	40	" "
0600	12.2	77.6	999	45	" "
1200	12.5	77.8	999	45	" "
1800	12.9	78.0	998	50	" "
24/0000	13.4	77.9	997	55	" "
0600	13.9	77.8	990	65	Hurricane
1200	14.5	77.9	985	75	" "
1800	15.0	78.1	980	90	" "
25/0000	15.5	78.4	965	100	" "
0600	16.0	78.9	951	105	" "
1200	16.2	79.6	945	115	" "
1800	16.4	80.3	926	125	" "
26/0000	16.4	81.0	923	130	" "
0600	16.4	81.8	922	135	" "
1200	16.6	82.6	914	145	" "
1800	16.9	83.1	905	155	" "
27/0000	17.2	83.8	910	155	" "
0600	17.3	84.4	917	150	" "
1200	17.1	85.0	922	150	" "
1800	16.9	85.4	928	145	" "
28/0000	16.6	85.6	933	140	" "
0600	16.3	85.6	938	130	" "
1200	16.3	85.6	948	115	" "
1800	16.3	85.7	959	95	" "
29/0000	16.2	85.8	970	85	" "
0600	16.1	85.8	979	75	" "
1200	15.9	85.7	987	70	" "
1800	15.8	85.6	994	60	Tropical Storm
30/0000	15.6	85.7	995	55	" "
0600	15.4	85.9	996	50	" "

Table 1 (continued).
Preliminary Best Track - Hurricane Mitch, 22 October - 05 November 1998.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
30/1200	15.2	86.1	997	45	Tropical Storm
1800	14.9	86.5	998	45	" "
31/0000	14.7	87.0	999	45	" "
0600	14.5	87.7	1000	40	" "
1200	14.5	88.5	1000	35	" "
1800	14.6	89.2	1001	30	Tropical Depression
01/0000	14.6	90.0	1002	30	" "
0600	14.7	90.8	1003	25	" "
1200	14.9	91.5	1005	25	" "
1800	15.5	92.2	1005	25	Tropical Depression
02/0000	16.3	92.7	1005	20	Low
0600	17.1	93.1	1005	20	Low
1200	17.9	93.4	1005	20	Low
1800	18.7	93.7	1005	20	Low
03/0000	19.2	93.4	1003	20	Low
0600	19.3	92.7	1003	20	Low
1200	19.4	92.1	1002	25	Low
1800	19.6	91.4	997	40	Tropical Storm
04/0000	20.0	90.6	997	35	" "
0600	20.8	89.6	998	30	Tropical Depression
1200	21.8	88.2	998	40	Tropical Storm
1800	23.3	86.5	993	40	" "
05/0000	24.8	84.8	993	45	" "
0600	25.6	83.1	990	50	" "
1200	26.6	81.3	987	55	" "
1800	27.5	78.3	992	50	Extratropical
06/0000	30.0	75.0	993	50	" "
0600	32.5	72.0	992	50	" "
1200	35.0	68.0	990	50	" "
1800	37.0	63.0	989	50	" "
07/0000	39.0	58.0	990	50	" "
0600	41.0	53.0	992	50	" "
1200	42.5	47.5	986	50	" "

Table 1 (continued).
Preliminary Best Track - Hurricane Mitch, 22 October - 05 November 1998.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
07/1800	44.5	42.0	972	60	" "
08/0000	46.5	36.5	974	60	" "
0600	48.5	31.0	972	60	" "
1200	50.0	25.0	962	60	" "
1800	53.5	20.5	956	60	" "
09/0000	55.5	14.5	956	60	" "
0600	58.0	10.5	956	60	" "
1200	61.0	10.0	956	60	Extratropical
1800	63.5	5.0	960	55	" "
26/1800	16.9	83.1	905	155	Minimum Pressure
L A N D F A L L S					
29/1200	15.9	85.7	987	70	HONDURAS 72 n mi E of La Ceiba
04/0200	20.1	90.5	998	35	MEXICO 15 n mi NNE of Campeche
05/1100	26.2	81.9	989	55	USA 5 n mi W of Naples, Florida

Table 2.

Hurricane Mitch selected Honduras rainfall totals,
25-31 October 1998.

L o c a t i o n	Rainfall Total (in)	Maximum 1-Day Total	Date
Choluteca	35.89	18.37	10/31
La Ceiba	34.52	11.19	10/27
Balfate	26.43	10.24	10/26
Tela	22.26	6.73	10/28
Yoro	20.49	9.28	10/28
Orica	17.89	4.35	10/30
Santa Lucia	15.18	5.48	10/30
Sabana Grande	14.53	7.33	10/30
Lepaguare	13.19	3.55	10/26
Amapala	12.38	10.24	10/31
Colonia 21 De Octubre	11.85	6.31	10/31
Santa Barbara	11.81	3.96	10/30
Unah (Tegucigalpa)	11.58	5.09	10/30
Moroceli	10.65	7.48	10/31
Roatan	10.65	3.68	10/27
La Mesa	10.55*	5.87	10/28
Catacamas	10.13	3.95	10/30
Gracias	10.05	3.23	10/25

* - No data available 10/30-31; a higher amount could have occurred.

Table 3.
Hurricane Mitch selected surface observations, November 1998.

LOCATION	Press. (mb)	Date/Time (UTC)	Sust. Wind (kts) ^a	Peak gust (kts)	Date/Time (UTC) ^b	Storm Surge (ft) ^c	Storm Tide (ft) ^d	Total rain (in)
Florida								
Key West Airport	995.7	05/0853	35	48	05/0653			2.11
Boca Chica NAS	996.6	05/0855	25	38	05/0855			
Marathon	997.2	05/1053	18	30	05/1104			
Homestead								3.12
Homestead AFB	995.9	05/1158	20	35	05/1229			
Tamiami Airport	995.1	05/1153	20	33	05/1153			3.58
Miami Int. Airport	994.1	05/1356	20	38	05/1042			5.88
Opa Locka Airport	993.9	05/1353	28	38	05/1153			
Hollywood								3.29
Ft. Lauderdale								6.62
Ft. Lauderdale Beach								3.88
Ft. Lauderdale Int.	993.8	05/1353	29	36	05/1120			
Ft. Lauderdale Exec.	993.8	05/1353	25	34	05/1830			
Pompano Beach Airport	993.7	05/1353	28	39	05/0408			
West Palm Beach								6.70
West Palm Beach	994.7	05/1153	25	34	05/1658			
Naples								1.42
Naples Airport	991.2	05/1115	18	27	05/1246			
Miami Beach			26	40	05/1248			3.15
Flamingo			33	39	05/0948			
Virginia Key	995.0	05/1352	26	37	05/1252			
Lower Keys							2-4 ^e	
Collier County							<1 ^e	
Miami-Dade County							<1 ^e	
Broward County							1-2 ^e	
Vero Beach	996.6	05/1321	25	42	05/13219			4.14
Vero Beach FAA tower								5.45
Cape Canaveral(KTTS)	1000.7	05/1358	22	39	05/1705	3 ^e		
Patrick AFB(KCOF)	999.0	05/1355	27	37	05/1735			
Melbourne Airport(KMLB)	998.3	05/1350	20	30	05/1150			4.54
Melbourne NWS								4.95
Titusville(KTIX)	1002.0	05/1358	25	35	05/1758			
Fort Pierce	994.6	05/1255	20	29	05/1400			5.36
Orlando Int.	1001.5	05/1253	23	29	05/1714			1.58
Stuart(KSUA)	995.3	05/1230						
Jupiter/Tequesta	1003.2							7.00
Port Myaca	997.9							6.48
Stuart	995.2							6.10
Fort Pierce	996.2							5.33
Okeechobee	998.9							4.17
St Petersburg (KPIE)	1001.8	05/0953	20	25	05/0953			1.22
St Petersburg(KSPG)	1000.9	05/1053	21	27	05/0945			
St Petersburg Pier			30	35	05/1300			
Tampa Airport(KTPA)	1001.5	05/1056	14	23	05/1156			0.47
MacDill AFB(KMCF)	1001.5	05/1059	12	22	05/1331			1.34
Tampa Old Port			24	29	05/1254			
Ruskin(KTBW)								1.94
Sunshine Skyway			29	34	05/1054			
Winter Haven(KGIF)	1001.2	05/1053	16	23	05/1153			0.84

LOCATION	Press. (mb)	Date/Time (UTC)	Sust. Wind (kts) ^a	Peak gust (kts)	Date/Time (UTC) ^b	Storm Surge (ft) ^c	Storm Tide (ft) ^d	Total rain (in)
Florida								
Lakeland(KLAL)	1001.4	05/1054	13	20	05/1152			1.94
Sarasota Airport(KSRQ)	1000.0	05/1050	15	25	05/1350			1.75
Arcadia								4.76
Punta Gorda(KPGD)	997.3	05/0944	25	33	05/0944			3.88
Fort Myers(KFMY)	994.6	05/1017	21	31	05/1238			6.05
Fort Myers Reg. S.W.	993.6	05/1018	27	33	05/1018			

^a Standard NWS ASOS and C-MAN on-hour averaging periods are 2 min; buoys are 8 min.

^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 NGVD.

^e Estimated.

Table 4.
Hurricane Mitch selected National Buoy Data Center (NDBC) and Ship
observations, 21 September - 05 November 1998.

LOCATION	Press (mb)	Date/ Time (UTC)	Sust. wind (kts) ^a	Peak Gust (kts)	Date/ Time (UTC) ^b	Max Sgnft. Wave Ht. (FT)
CMAN Stations						
Lake Worth, FL (LKWF1)	994.1	05/1300	36	42	05/1200	
Fowey Rocks, FL (FWYF1)	995.9	05/1400	52	63	05/1300	
Molasses Reef, FL (MLRF1)	997.1	05/1200	41	45	05/1100	
Long Key, FL (LONF1)	996.9	05/1100	32	39	05/0900	
Sombrero Key, FL (SMKF1)	997.2	05/1100	41	46	05/0800	
Sand Key, FL (SANF1)	995.9	05/0700	39	43	05/0700	
Dry Tortugas, FL (DRYF1)	993.4	05/0500	41	47	05/0500	
NOAA/NDBC Buoys						
42003 (25.9N / 85.9W)	1001.4	05/0500	37	44	04/2350	14.6
41010 (25.9N / 78.5W)	995.4	05/2000	37	45	05/1800	13.7
Ship Reports of ≥34-Knot Winds						
PYRO (14.4N 77.0W)	1010.2	22/1200	37		22/1200	2.0
ZCBN5 (11.8N 78.3W)	1006.0	23/2100	38		23/2100	2.0
ZCBN5 (12.5N 77.6W)	1005.2	24/0000	37		24/0000	2.0
ZCBN5 (13.4N 77.1W)	1005.3	24/0300	40		24/0300	MM
ZCBN5 (14.2N 76.7W)	1006.1	24/0600	39		24/0600	MM
PEXV (19.7N 81.3W)	1009.1	25/2100	43		25/2100	2.0
PDWT (20.2N 84.3W)	1008.0	27/0000	37		27/0000	3.0
KGDF (21.5N 76.5W)	1012.0	27/0000	35		27/0000	3.0
3FKZ3 (22.1N 73.1W)	1016.0	27/0000	36		27/0000	3.0
PDWT (20.4N 83.9W)	1009.5	27/0300	39		27/0300	7.0
PDWT (20.6N 83.5W)	1009.5	27/0600	39		27/0600	MM
PDWT (20.7N 83.0W)	1009.0	27/0900	45		27/0900	MM
PJAG (9.6N 85.5W)	1011.0	27/1200	39		27/1200	2.0
PDWT (20.8N 82.5W)	1012.0	27/1200	37		27/1200	4.0
ELRU3 (21.1N 85.5W)	1010.0	27/1200	37		27/1200	MM
C6YC (21.3N 83.2W)	1010.0	27/1800	40		27/1800	2.0
C6YC (20.9N 82.6W)	1009.5	27/2100	45		27/2100	3.0

^a Standard NWS C-MAN averaging period is 2 min; buoys are 8 min.

^b Date/time is for sustained wind when both sustained and gust are listed.

^c Buoy failed shortly after this observation; a lower pressure and a higher wind and wave height may have occurred.

MM - missing data.

Table 4 (continued).
Hurricane Mitch selected National Buoy Data Center (NDBC) and Ship
observations, 21 September - 05 November 1998.

LOCATION	Press (mb)	Date/ Time (UTC)	Sust. wind (kts) ^a	Peak Gust (kts)	Date/ Time (UTC) ^b	Max Sgnft. Wave Ht. (FT)
Ship Reports of ≥34-knot Winds						
C6KU7 (18.6N 86.6W)	1005.1	28/1200	40		28/1200	3.0
PJAG (14.4N 77.3W)	1010.0	31/1200	35		31/1200	2.0
C6YE (17.7N 87.2W)	1008.0	31/1200	38		31/1200	3.0
C6HH3 (16.2N 87.6W)	1007.8	31/1500	54		31/1500	MM
WLDF (23.9N 86.9W)	1003.7	04/0600	40		04/0600	4.0
3FKZ3 (20.3N 85.4W)	999.0	04/1200	48		04/1200	MM
WLDF (24.7N 84.9W)	1003.0	04/1200	39		04/1200	2.0
3FKZ3 (20.0N 84.9W)	1000.0	04/1500	48		04/1500	5.0
3FKZ3 (19.5N 82.8W)	1001.0	05/0000	36		05/0000	4.0
ELFT8 (23.2N 86.6W)	998.0	05/0000	38		05/0000	2.0
C6KY3 (22.7N 86.3W)	997.0	05/0300	40		05/0300	3.0
SHIP (25.1N 85.2W)	1000.5	05/0600	36		05/0600	6.0
KXDB (24.9N 80.3W)	996.1	05/1200	45		05/1200	3.0
C6KU7 (25.9N 77.5W)	1000.0	05/1500	35		05/1500	3.0
3EZK9 (25.1N 75.6W)	1001.0	05/1800	37		05/1800	10.0
ELUA5 (26.0N 75.4W)	1000.0	05/1800	38		05/1800	4.0

^a Standard NWS C-MAN averaging period is 2 min; buoys are 8 min.

^b Date/time is for sustained wind when both sustained and gust are listed.

^c Buoy failed shortly after this observation; a lower pressure and a higher wind and wave height may have occurred.

MM - missing data

Table 5.
Watch and warning summary, Hurricane Mitch, 22 October-05 November 1998.

Date/Time (UTC)	Action	Location
24/1500	Hurricane Watch Issued	Jamaica
24/2100	Hurricane Warning Issued	Jamaica
24/2100	Hurricane Watch Issued	Eastern Cuba from Camaguey to Guantanamo
25/1200	Hurricane Watch Issued	Cayman Is.
25/2100	Hurricane Warning Discontinued	Jamaica
26/0000	Hurricane Watch Discontinued	Eastern Cuba from Camaguey to Guantanamo
26/0300	Hurricane Warning Issued	Honduras from Limon eastward to the Nicaragua border...and Swan Island.
26/2100	Hurricane Warning Issued	Honduras from Limon to the Guatemala border
27/0000	Hurricane Watch Issued	Belize
27/0430	Hurricane Watch Issued	East coast of the Yucatan peninsula from Cabo Catoche southward
27/0900	Hurricane Warning Issued	East coast of the Yucatan peninsula from Cabo Catoche southward and the coast of Guatemala
27/1200	Hurricane Warning Issued	Belize
27/1800	Hurricane Watch Discontinued, Tropical Storm Warning changed to Tropical Storm Watch	Cayman Is.
29/0300	Tropical Storm Watch Discontinued	Cayman Is.
29/2100	Hurricane Warning changed to Tropical Storm Warning	Caribbean coast of Honduras, Guatemala, Belize, and the Yucatan peninsula from Cabo Catoche southward including offshore islands
29/2100	Hurricane Watch Issued	Belize
30/1500	Hurricane Watch Discontinued	Belize
31/1500	Tropical Storm Warning Discontinued	Caribbean coast of Honduras, Guatemala, Belize, and the Yucatan peninsula from Cabo Catoche southward including offshore islands.
03/2100	Tropical Storm Warning Issued	West coast of Yucatan peninsula from Progreso southward to Carmen
04/0900	Tropical Storm Warning Discontinued	West coast of Yucatan peninsula from Progreso southward to Carmen

Table 5 (continued).

Watch and warning summary, Hurricane Mitch 22 October - 5 November 1998.

Date/Time (UTC)	Action	Location
04/1500	Tropical Storm Warning Issued	Florida Keys, Florida peninsula southward from Tarpon Springs on the west coast and southward from New Smyrna Beach on the east coast.
04/1800	Tropical Storm Warning Issued	Western Cuba from the province of Matanzas westward including the Isle of Youth
05/1500	Tropical Storm Warning Discontinued	Florida Keys west of Craig Key, and Florida west coast from west of Flamingo to Tarpon Springs
05/1800	Tropical Storm Warning Discontinued	Western Cuba from the province of Matanzas westward including the Isle of Youth
05/2100	Tropical Storm Warning Discontinued	Florida Keys east of Craig Key, and Florida east coast southward from New Smyrna Beach

Table 6.

Deaths estimates associated with Hurricane Mitch. Death figures based on Fact Sheet #21 from the U.S. Agency for International Development.

LOCATION	DEATHS*
<i>Honduras</i>	5677
<i>Nicaragua</i>	2863
<i>Guatemala</i>	258
<i>El Salvador</i>	239
<i>Mexico</i>	9
<i>Costa Rica</i>	7
<i>United States</i>	2
<i>Offshore - Crew from Ship Fantome</i>	31
Storm Total	9086

* - These are the best estimates received to-date; subject to revision at a later time.

Table 7.

Preliminary track forecast evaluation of Hurricane Mitch - heterogeneous sample. Errors in nautical miles for tropical storm and hurricane stages with number of forecasts in parenthesis. Bold italicized numbers represent average errors which were smaller than the Official forecast error.

Forecast Technique	Period (hours)				
	12	24	36	48	72
CLIP	49 (41)	115 (40)	208 (38)	323 (36)	604 (32)
GFDI	44 (39)	96 (38)	146 (35)	181 (31)	230 (26)
GFDL**	39 (38)	71 (36)	116 (34)	140 (30)	228 (26)
LBAR	42 (41)	88 (40)	138 (38)	179 (33)	246 (25)
AVNI	59 (41)	113 (40)	166 (38)	217 (36)	300 (32)
AVNO**	57 (39)	103 (38)	153 (36)	198 (34)	277 (30)
BAMD	51 (41)	104 (40)	162 (38)	219 (36)	345 (32)
BAMM	60 (41)	106 (40)	157 (38)	202 (36)	297 (32)
BAMS	83 (41)	156 (40)	232 (38)	308 (36)	460 (32)
NGPI	46 (40)	67 (38)	98 (32)	134 (28)	170 (24)
NGPS**	47 (21)	70 (20)	98 (17)	130 (15)	191 (13)
UKMI	52 (40)	88 (38)	118 (36)	153 (34)	230 (30)
UKM**	52 (21)	87 (20)	116 (19)	144 (18)	200 (16)
A90E	46 (41)	96 (40)	141 (38)	188 (36)	385 (32)
A98E	46 (41)	95 (40)	140 (38)	197 (36)	424 (32)
A9UK	52 (19)	104 (18)	157 (18)	213 (18)	449 (16)
EMX		61 (9)		122 (7)	150 (6)
NHC Official	39 (41)	80 (40)	125 (38)	167 (35)	237 (28)
NHC Official 10-Year Average (1988-1997)	47 (1838)	88 (1633)	127 (1449)	165 (1284)	248 (1006)

** - Output from these models was unavailable at time of forecast issuance.