

PRELIMINARY REPORT  
HURRICANE GLORIA  
16 - 27 September 1985

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Gloria affected the northeastern United States from North Carolina through Maine. Sustained wind speeds of hurricane force were observed at Cape Hatteras, North Carolina; Bridgeport, Connecticut; and Blue Hill and Scituate, Massachusetts. Storm surge tides ranged from four to seven feet above predicted astronomical tide.

Track and warnings

Table 1 lists best track estimates of center position, minimum sea level pressure, maximum sustained (one-minute average) surface wind and stage of development. Fig. 1 shows a map of this track.

The track begins near the Cape Verde Islands on 16 September, when a low-level circulation was observed from the European METEOSAT satellite. Based strictly on satellite data, Gloria is estimated to have remained near minimal storm strength for several days while traveling toward the west to west-northwest at 15 to 20 knots across the tropical Atlantic Ocean.

Aircraft reconnaissance began on the 21st, when the storm was centered about 400 n.m. east of the Lesser Antilles and moving west at 14 knots. Figs. 2 and 3 show time-curves of minimum sea level pressure and maximum sustained surface wind estimates along with selected plots of reconnaissance and surface data.

A hurricane watch was issued for the northern Leeward Islands midday on the 21st. On the next day, a reconnaissance aircraft measured a 68-knot wind speed at 1500 ft, at a location 25 n.m. north of the center of the hurricane. Gloria was upgraded to a hurricane and hurricane warnings were issued for the watch area. Table 2 lists all hurricane watch and warning actions taken during Gloria. The hurricane changed its direction of motion from due west to west-northwest, midday on the 22nd, and passed to the north of the Leeward Islands.

On the 24th, a hurricane warning was issued by the Bahamian Government for portions of the Bahamas. By this time, the hurricane's central pressure had fallen below 950 mb and reconnaissance winds at the 850 mb level were exceeding 90 knots. Gloria then made a turn to a northwest heading, allowing it to miss the Bahamas.

At 25/0120 GMT, the central pressure was estimated at 919 mb, based on extrapolation of an aircraft 700-mb height measurement. At 25/0510 GMT, the same aircraft measured a wind speed of 126 knots at 700 mb, 10 n.m. east of the center. Based on this data, the maximum sustained surface wind speed is estimated at 125 knots. During this time, Gloria was centered at 25 degrees north latitude, with a classical stadium-type wall cloud surrounding the eye, and it is assumed that there was little difference between the wind at the surface and at 700 mb.

A hurricane watch was issued on the afternoon of the 25th from South Carolina to Virginia, when Gloria was centered 400 n.m. east of Miami, Florida. Gloria gradually turned northward and began to weaken. On the morning of the 26th, the watch was changed to a warning and by that afternoon, the warnings were extended northward to Massachusetts.

The center passed over the Outer Banks of North Carolina early on the 27th and weakened while accelerating north northeastward. Its center passed just offshore of Virginia, Maryland, Delaware and New Jersey, so that the strongest winds remained over the water and these states experienced the weaker side of the hurricane. The center came ashore over western Long Island, about ten hours after the North Carolina landfall, and Gloria became extratropical over Maine at 28/0000 GMT.

As an extratropical storm, Gloria moved across eastern Canada and back over the open waters of the far North Atlantic and gradually intensified over a period of several days. The storm produced unusual weather over portions of western Europe. For example, 4 October was the warmest October day during this century in Basel, Switzerland.

The hurricane was monitored by U.S. Air Force and NOAA reconnaissance aircraft from 21-27 September. There were 54 center penetrations, which averages out to one center fix every 2.7 hours for the six-day period. In addition, NOAA conducted a synoptic-scale Omega dropwindsonde experiment on the 23rd and 24th, while Gloria was centered about 200 n.m. north of Puerto Rico.

#### Landfall observations

The center of the hurricane crossed the U.S. coast at Hatteras Island, North Carolina and Long Island, New York. Table 3 lists selected surface observations taken during the period of landfall.

The NWS office at Buxton, North Carolina reported a minimum pressure of 947.5 mb at 27/0536 GMT (Table 3) and an aircraft reported an extrapolation from 700 mb of 942 mb at 27/0542 GMT (Fig. 2), at a

location about 10 n.m. north of Buxton. The maximum sustained wind speed at Cape Point near Buxton was 64 knots, out of the east-southeast, at which time the center was located approximately 40 n.m. to the south.

An automated station at Diamond Shoal Light, 14 n.m. east-southeast of Cape Hatteras, reported 85 knots, sustained, at 27/0500 GMT with a peak gust of 104 knots. A radiosonde was released at Cape Hatteras at 0600 GMT, very close to the time of the eye passage. This is a rare event and the sounding shows a warm, moist vertical profile in the lower atmosphere, similar to the few other such observations.

Sustained wind speeds generally remained below hurricane force to the west of the center as it accelerated toward Long Island and New England. However, a report of 80 knots, sustained, was received from the Chesapeake Bay Bridge and Tunnel at South Island, Virginia.

The center moved ashore on western Long Island, between JFK airport and Islip. A 64-knot wind was reported from Bridgeport, Connecticut and there were 70-knot sustained winds in the Boston area, 60 n.m. east of the center. However, these winds were measured at elevations well above sea level.

Storm surge tides ranged from four to seven feet above predicted astronomical tide levels over much of the coast from North Carolina through Massachusetts. Coastal flooding was somewhat minimized by the arrival of peak surge during low tide at many locations. Also, both wind and surge forecasts were higher than observed, because of the rapid weakening of the hurricane on the 27th.

#### Deaths and damages

There were eleven deaths attributed to Gloria; one in North Carolina, six in Connecticut, two in Rhode Island and two in New Hampshire.

Wind damage was greater on the east side of the hurricane and resulted in downed trees causing extended power outages for hundreds of thousands of people in the northeast U.S. To the west of the center, from Virginia through New Jersey, the strongest winds were from the west to northwest...after the center had passed. Beach erosion and coastal flooding were severe along portions of the North Carolina Outer Banks. Considerable flooding also occurred in Pamlico Sound after the center passed. Significant beach erosion was reported from Maryland, Delaware, New Jersey, Connecticut and Rhode Island.

The American Insurance Association has estimated insured property damage in 13 states at \$340,000,000 dollars. FEMA estimates are not yet available. Ratios between total damage estimates and insured property damage have ranged from two to five for previous hurricanes. This suggests that the total Gloria damage could reach one billion dollars.

Table 1.  
Preliminary best track  
Hurricane Gloria  
16 - 27 September 1985

date/time (GMT)	position		pressure (mb)	wind speed (kt)	stage
	lat.	lon.			
16/1200	13.3	23.6	1009	25	tropical depression
1800	13.8	24.8	1008	25	"
17/0000	14.1	25.9	1008	30	"
0600	14.3	27.1	1008	30	"
1200	14.6	28.3	1007	35	tropical storm
1800	14.7	29.6	1007	35	"
18/0000	14.9	31.7	1006	35	"
0600	15.0	33.8	1006	35	"
1200	15.1	35.9	1006	35	"
1800	15.4	38.1	1006	30	tropical depression
19/0000	15.8	39.5	1006	30	"
0600	16.2	40.9	1006	30	"
1200	16.6	42.2	1006	30	"
1800	17.0	43.8	1006	30	"
20/0000	17.2	45.1	1005	35	tropical storm
0600	17.4	46.7	1004	40	"
1200	17.5	48.1	1003	45	"
1800	17.6	49.8	1002	45	"
21/0000	17.7	51.2	1001	50	"
0600	17.7	52.8	1001	55	"
1200	17.7	54.2	1000	60	"
1800	17.7	55.3	1000	65	hurricane
22/0000	17.8	56.3	1000	65	"
0600	17.8	57.1	996	70	"
1200	17.8	58.2	992	70	"
1800	18.4	59.0	990	65	"
23/0000	19.0	60.2	990	65	"
0600	19.7	61.5	989	65	"
1200	20.4	62.9	987	65	"
1800	21.0	64.2	980	75	"
24/0000	21.5	65.5	956	95	"
0600	21.9	66.8	952	100	"
1200	22.5	67.9	950	100	"
1800	23.2	69.0	935	105	"
25/0000	24.2	70.0	920	120	"
0600	25.1	70.9	920	125	"
1200	26.1	72.0	926	115	"
1800	26.9	73.0	933	95	"

Table 1. (continued)  
Preliminary best track  
Hurricane Gloria  
16 - 27 September 1985

date/time (GMT)	position		pressure (mb)	wind speed (kt)	stage
	lat.	lon.			
26/0000	27.8	74.0	940	85	"
0600	28.9	75.0	944	80	"
1200	30.0	75.5	946	80	"
1800	31.4	76.2	944	85	"
27/0000	33.2	76.0	942	90	"
0600	35.5	75.5	942	90	"
1200	38.4	74.5	951	85	"
1800	41.9	72.8	964	75	"
28/0000	45.5	70.0	986	50	extratropical

minimum sea level pressure estimated from reconnaissance data:  
25/0120 919

landfall: southern Hatteras Island  
27/0530 35.2 75.6 942 90

landfall: western Long Island  
27/1600 40.6 73.3 961 75

date/time (GMT)	position		pressure (mb)	wind speed (kt)	stage
	lat.	lon.			
28/0000	45.5	70.0	986	50	extratropical
0600	48.1	67.8			"
1200	49.5	64.5			"
1800	50.8	61.2			"
29/0000	51.5	57.5	990		"
0600	52.1	53.8			"
1200	52.4	50.0			"
1800	52.5	47.5			"
30/0000	52.5	45.0			"
0600	52.5	42.5			"
1200	52.5	40.0			"
1800	52.9	37.9			"
October					
01/0000	53.3	35.9			"
0600	53.8	34.0			"
1200	54.5	32.0			"
1800	55.5	30.0			"
02/0000	56.6	29.0	960		"

# NORTH ATLANTIC HURRICANE TRACKING CHART

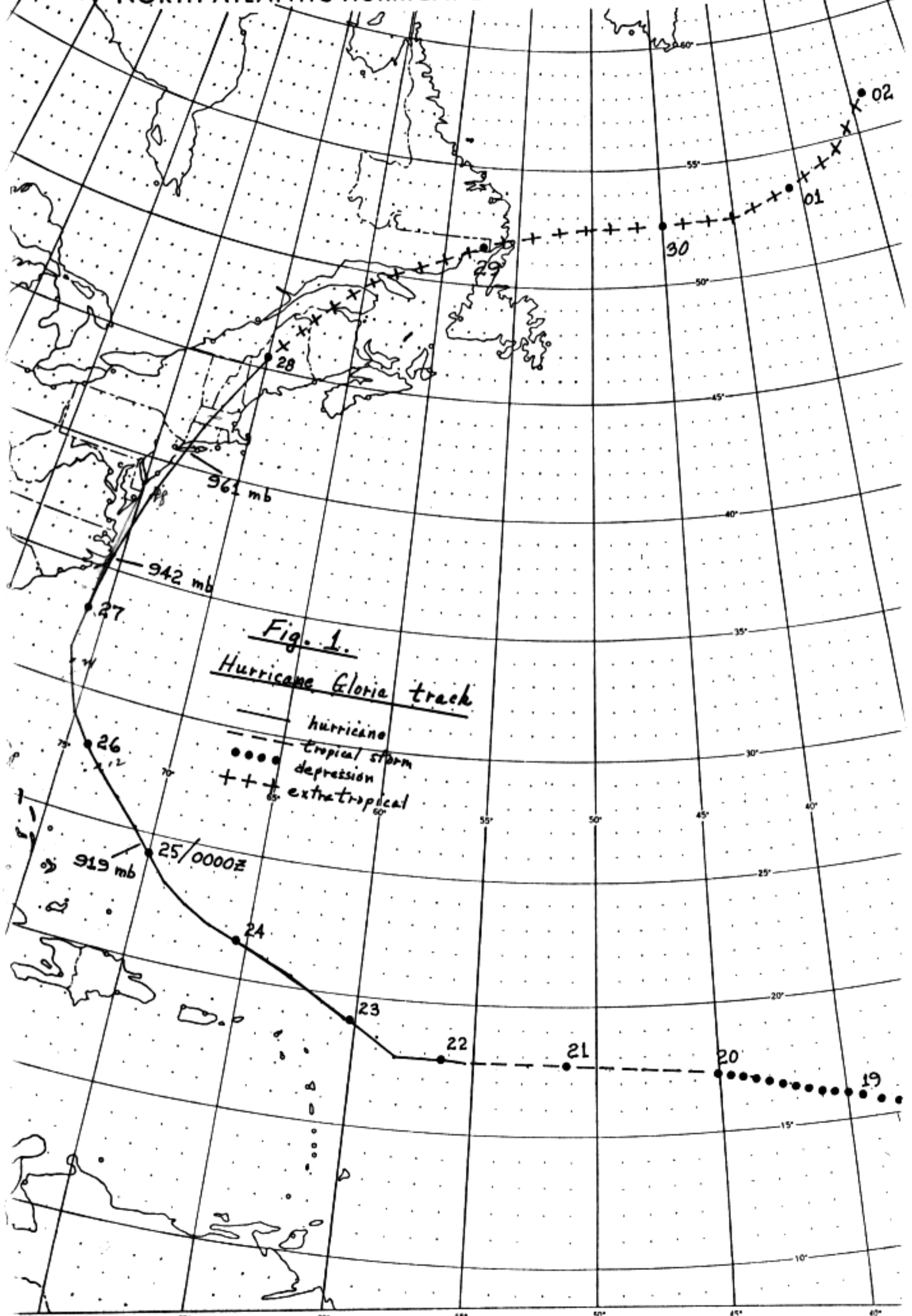


Fig. 1.  
Hurricane Gloria track

- hurricane
- - - tropical storm
- depression
- + + + extratropical

Table 2.  
 Summary of hurricane warnings  
 Hurricane Gloria  
 September 1985

date/time (GMT)	action	location
21/1600	hurricane watch	Northern Leeward Islands from Antigua through the Virgin Islands.
22/1300	hurricane warning	Northern Leeward Islands from Antigua through the Virgin Islands.
23/1000	discontinue all warnings	
24/1600	hurricane warning hurricane watch	eastern and central Bahamas. northwest Bahamas.
25/0100	discontinue warnings	southeast Bahamas.
25/1600	discontinue warnings hurricane watch	Bahamas. N.C. Outer Banks from Cape Lookout to the Va. border.
25/1900	hurricane watch	Edisto Beach, S.C. to Cape Henry, Va.
26/1000	hurricane warning	Cape Romain, S.C. to Cape Henry.
26/1900	hurricane watch	north of Cape Henry to Plymouth, Mass.
26/2030	hurricane warning hurricane watch	Edisto Beach to Plymouth. Plymouth to Eastport, Maine.
26/2200	discontinue warnings	south of Little River Inlet, N.C.
27/0400	hurricane warnings	Little River Inlet to Merrimack River, Mass.
27/1000	discontinue warnings	south of Cape Lookout
27/1400	hurricane warnings discontinue warnings	Chincoteague, Va. to Eastport, Maine. south of Chincoteague.
27/1600	storm warnings	western New Brunswick and Nova Scotia.
27/1800	discontinue warnings	south of Manasquan, N.J.
27/2000	discontinue warnings	south and west of Watch Hill, R.I.
27/2200	discontinue warnings	west of Castle Hill, R.I.
28/0000	discontinue all hurricane warnings.	

Table 3. (continued)  
Hurricane Gloria selected surface observations, September 1985.  
All times are GMT. Wind speed is one-minute average. Rain amounts  
are storm totals. Tide values are height above normal astronomical  
tide predictions, unless indicated.

location	pressure (mb)	date/ time	wind (kt)	date/ time	rain (inches)	tide (ft)	date/ time
<b>New York</b>							
Battery Park						7.0	27/1706
Central Park	972.9	27/1605			3.48		
Islip	968.5	27/1535					
Willets Point						4.3	27/1636
<b>Connecticut</b>							
Bridgeport(250' el.)	965.1		64		0.62		
East Lyme						4-5	
Groton						5	
Hartford	971.4	27/1810	37	27/1850	1.17		
Stamford						4.4	27/1713
<b>Rhode Island</b>							
Providence	986.0	27/1910	45	27/1850		1-2	
<b>Massachusetts</b>							
Becket					4.01		
Blue Hill			71	27/1852			
Logan Airport			53	27/2008			
Brant Point			45	27/1900			
Cape Ann			52	27/2115			
Cape Cod Canal			40	27/2000			
Chatham(CG)			58	27/2030			
Chatham WSMO			63	27/1833			
Chester					6.00		
Colran					3.82		
Knightville Dam					5.95		
Littleville Lake					6.02		
Menemsha			45	27/2000			
Merrimack River			35	27/1730			
New Bedford						5.8	27/1915
Provincetown			50	27/2000			
Scituate(120' el.)			70	27/1930			
Woods Hole						4	27/1800
Worcester	981.5	27/2000					
<b>New Hampshire</b>							
Concord	986.5	27/1930			0.67		
<b>Maine</b>							
Cape Neddick			50	27/2300			
Goat Island			50	27/2200			
Manana Island			55	27/2300			
Portland	987.8	27/2208	46	27/2148	0.41	1.0	28/0400

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Hurricane Gloria selected surface observations, September 1985.  
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are storm totals. Tide values are height above normal astronomical  
tide predictions, unless indicated.

location	pressure (mb)	date/ time	wind (kt)	date/ time	rain (inches)	tide (ft)	date/ time
<b>South Carolina</b>							
Beaufort	1002.5	26/2055			trace		
Charleston Harbor						1.2	27/0000
Charleston airport	1004.1	26/2250	20	26/1816	trace		
Charleston city			19	26/1925			
Edisto Beach			14	26/1930			
Folly Beach			17	26/1830			
Hilton Head Island			12	26/2030			
Myrtle Beach	1004.0	27/0055	18	27/0130	trace	0.6	26/2230
Springmaid pier			21	27/0130			
<b>North Carolina</b>							
Cape Hatteras(Buxton)	947.5	27/0536	64	27/0402	2.10		
Cape Lookout			47	27/0700			
Cherry Point	985.3	27/0353	31	27/0335	7.00		
Diamond Shoal Light			85	27/0500			
Frying Pan Shoals			51	26/2300			
Jacksonville	990.3	27/0456	27	27/0256	3.36		
Neuse River						6 (est.)	
New Bern	987.8	27/0400			7.09		
Raleigh	999.5	27/0650	19	27/0623	0.03		
Wilmington	995.3	27/0252	23	26/2353	1.46		
Wrightsville Beach						4 (est.)	
<b>Virginia</b>							
Norfolk	981.4	27/0830	40	27/0750	5.65		
NGU			58	27/0950			
Richmond	993.7	27/0945	24	27/0950	4.02		
Sewells Point						4.1	27/0800
South Island			80			4.9MSL	27/0930
Virginia Beach	977.7	27/0849					
Wallops Island	975.6	27/1050					
<b>Maryland</b>							
BWI Airport	993.5	27/1307	25	27/1652	6.04		
Crisfield	985.4	27/1200					
Ocean City	972.6	27/1200					
<b>Delaware</b>							
Dover	982.8	27/1255					
Indian River Inlet						3.5	
Wilmington	986.1	27/1301	32	27/1454	3.75		
<b>New Jersey</b>							
Atlantic City			35	27/1600	1.78		
Atlantic City airport	971.2	27/1358	42	27/1633	1.83		
Lakehurst	971				3.74		
McGuire AFB					4.13		
Port Republic	983.2						
Ventnor City Pier						5.7	27/1320
Newark	974.9						

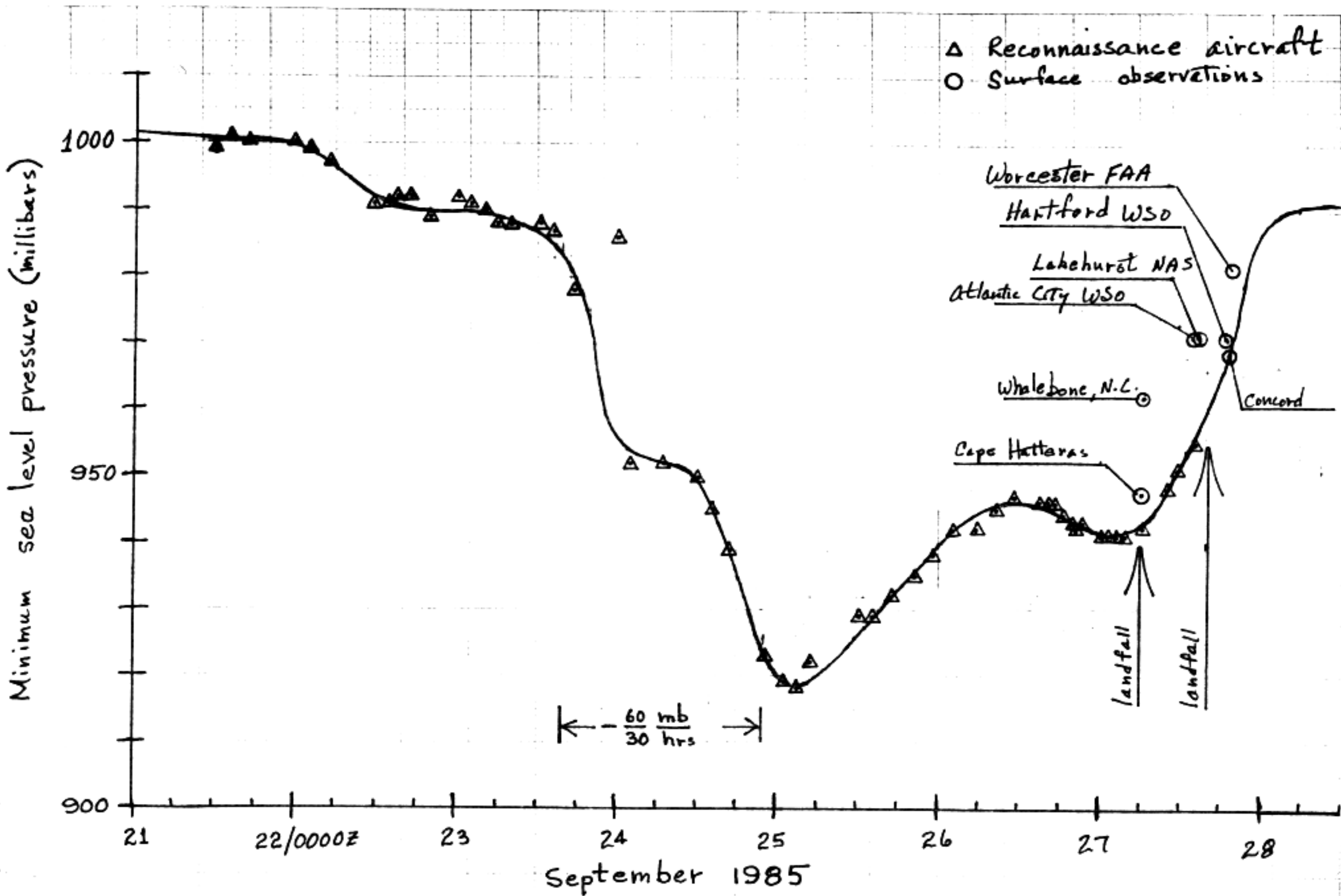
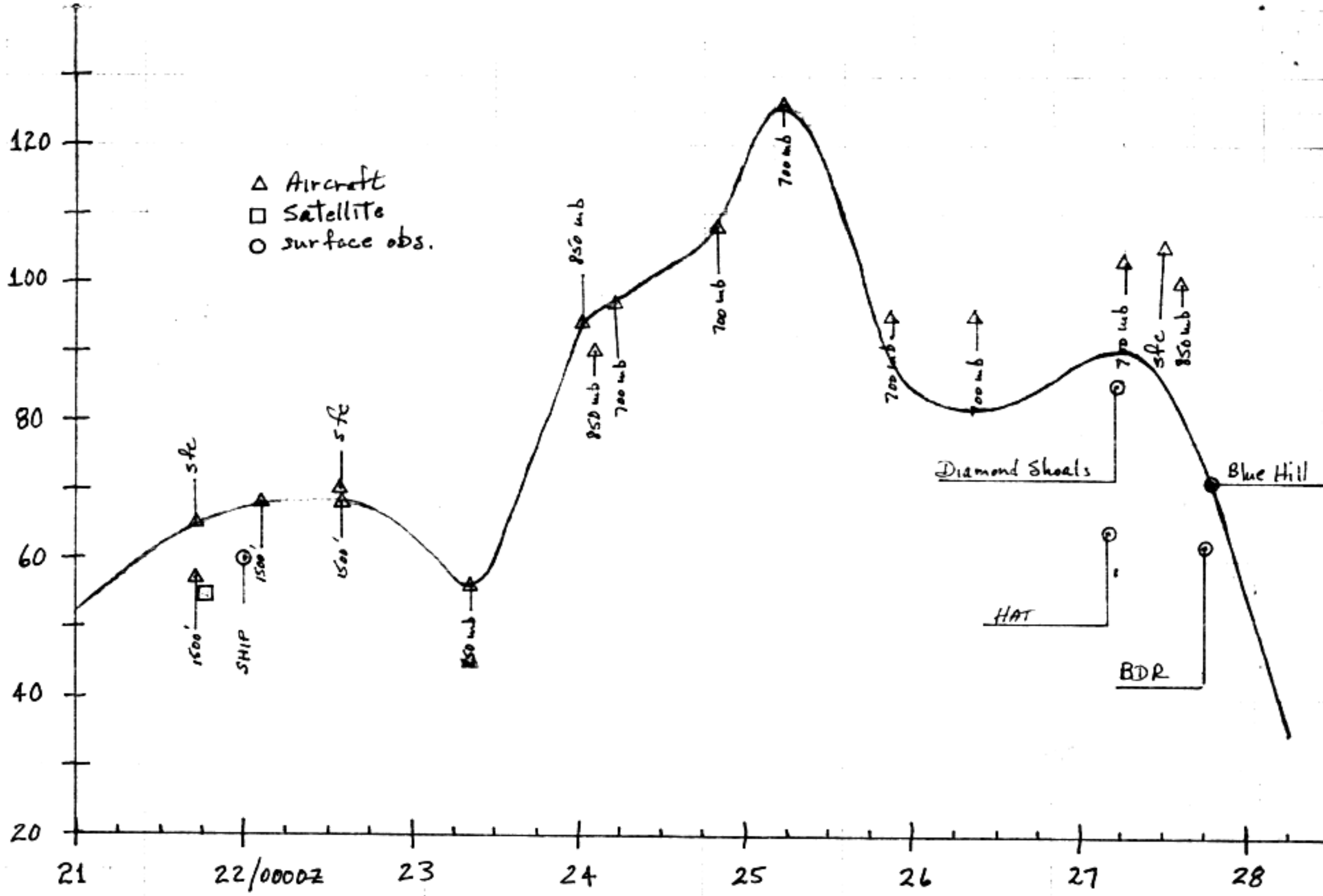


Fig. 2. Sea level Pressure curve.

Maximum sustained surface wind speed (knots)



September 1985

Fig. 3. Maximum sustained surface wind speed curve.