

a. Synoptic history

Chris was first detected as a tropical wave near the west coast of Africa on 15 August. It became a tropical depression on the 21st in the tropical Atlantic midway between Africa and the Lesser Antilles when a low level cloud circulation was identified on satellite imagery.

Chris' track is shown in Figure 1 and Table 1 lists the best track statistics. The track is a smooth parabola in the shape of the periphery of the Atlantic subtropical surface high pressure ridge. Chris remained a depression for seven days as it moved from the tropical Atlantic across portions of the Lesser and Greater Antilles and over the Bahamas. It became a tropical storm for only twelve hours, during which time it moved inland near Savannah, Georgia.

Figures 2 and 3 show the wind and pressure curves for this storm as a function of time, along with the various data from which the curves were constructed. Satellite analyses indicated that a tropical cyclone was being tracked from the 21st until landfall on the 28th. However, 13 separate investigative reconnaissance flights on the 23rd through the 27th were unable to find a well-defined low level circulation during this time. Also, even though many of the satellite intensity estimates were for tropical storm status, surface and reconnaissance observations clearly showed that surface wind speeds were below 35 knots.

Finally, on the 28th, reconnaissance aircraft located a low level circulation center at 0600 UTC just east of Melbourne, Florida and a ship located about 50 n.m. northeast of the center reported 40-knot sustained winds and the system was upgraded to Tropical Storm Chris on this basis. At 1000 UTC, a tropical storm watch was issued from Edisto Beach, South Carolina to Cape Hatteras, North Carolina and tropical storm warnings were issued at 1200 UTC from Savannah, Georgia to Cape Hatteras.

The system had been moving at about twelve knots for the several days prior to becoming a tropical storm. However, when it came abeam of Florida, its motion for the next 24 hours averaged 18 knots and for the period from 0600 to 1200 UTC on the 28th, its speed of motion was 27 knots. Perhaps this apparent rapid acceleration was due to the reformation of the circulation center.

b. Meteorological statistics

The center of Chris made landfall at 1500 UTC on the 28th near Savannah. Table 2 lists selected surface observations in the warning area. The highest observed sustained wind speed was 37 knots at the Savannah Light Tower with an anemometer elevation of 70 feet. Storm surge tides ranged up to 1.5 feet above normal astronomical tide levels. Rainfall storm totals near the coast were less than three inches.

c. Casualty and damage statistics

Chris weakened to a depression over South Carolina and then merged with a front. The surface low pressure system was tracked across the northeastern U.S. and over to Nova Scotia on the 30th. Inland rainfall amounts ranged from three to five inches in a swath from South Carolina through Pennsylvania and into Vermont. Strong thunderstorms also accompanied the low center. One death and one injury resulted from a tornado that destroyed a number of mobile homes in Clarendon County, South Carolina. Otherwise, in general, wind damage was minor. The total U.S. dollar damage for this storm is estimated at one-half million dollars. While near Puerto Rico on the 24th, the depression dumped 4.5 inches of rain on the island and three deaths were attributed to the weather.

d. Forecast and warning critique

Forecast verification statistics are limited since Chris was a tropical storm for only twelve hours. The very short tropical storm warning lead time was unavoidable since Chris became a storm only nine hours prior to landfall. Table 3 lists the 72-hour landfall probabilities that were issued by the National Hurricane Center during the time that Chris was still a depression. Table 4 lists the probabilities that were issued while Chris was a tropical storm.

MBL 10/12/88

Table 1.

Preliminary best track, Tropical Storm Chris, 21-30 August 1988

date/time (UTC)	position		pressure (mb)	wind speed (knots)	stage
	lat.	lon.			
21/1200	14.9	43.3	1009	25	tropical depression
1800	14.6	45.7	1009	25	"
22/0000	14.6	47.8	1009	25	"
0600	14.7	49.9	1009	25	"
1200	14.8	51.9	1009	30	"
1800	15.1	54.0	1009	30	"
23/0000	15.3	55.7	1009	30	"
0600	15.6	57.5	1009	30	"
1200	16.0	59.2	1009	30	"
1800	16.3	61.0	1009	30	"
24/0000	16.7	62.4	1009	30	"
0600	16.9	63.8	1009	30	"
1200	17.2	65.2	1009	30	"
1800	17.5	66.7	1009	30	"
25/0000	17.8	67.8	1009	30	"
0600	18.2	68.8	1009	30	"
1200	18.5	69.8	1008	30	"
1800	19.1	70.9	1008	30	"
26/0000	19.8	72.1	1008	30	"
0600	20.5	73.2	1008	30	"
1200	21.5	74.2	1008	30	"
1800	22.5	75.4	1008	30	"
27/0000	23.3	76.2	1008	30	"
0600	24.1	77.2	1008	30	"
1200	24.9	78.1	1008	30	"
1800	25.8	79.0	1008	30	"
28/0000	26.8	79.7	1008	30	"
0600	28.2	80.0	1008	40	tropical storm
1200	30.8	80.8	1005	45	"
1800	32.8	81.1	1006	35	"
29/0000	34.1	81.1	1008	25	tropical depression
0600	35.8	80.6	1009	20	extratropical
1200	37.5	79.5	1009	20	"
1800	39.2	77.6	1010	20	"
30/0000	41.2	73.6	1008	20	"
0600	43.5	69.9	1008	20	"
1200	45.0	65.0	1008	25	"
1800	46.5	60.0	1008	25	"
Landfall					
28/1500	32.0	80.9	1005	40	tropical storm
Maximum intensity					
28/1200	30.8	80.8	1005	45	tropical storm

Table 2. Tropical Storm Chris selected observations, August 1988

Location	Minimum sea level pressure(mb)		Maximum surface wind speed(kt)			Storm surge(ft)	Rain (in)
	Pressure	Date/time (UTC)	1-minute average	Peak Gust	Date/time (UTC) ¹	Tide height above normal	Storm total
Georgia							
Fort Pulaski						+1.5	
Savannah Light Tower (SVLSl 70 ft ele.)			37	43	28/1500		
Savannah(SAV)	1009.6	28/1554	15		28/1351		
Tybee MARS			30		28/1545		
South Carolina							
Beaufort(NBC)	1008.7	28/1610	23	33	28/1155		1.95
Charleston(CHS)	1013.9	28/1800	29	35	28/1257		2.66
Charleston City						+0.5	0.69
Myrtle Beach(MYR)			19	35	28/1455	+1.0	1.63
North Carolina							
Cape Hatteras(HAT)	1019.9	29/0850	14	22	29/1650		
Oak Island			20	28	28/1745		
Wilmington(ILM)	1017.7	29/0850	14	23	28/1450		0.01
Wrightsville Beach			20		28/1745		

¹Time of 1-minute wind, except when only a gust is given.

Table 3. 72-hour probability, in per cent, of center of Tropical Depression Seven passing within 65 miles of listed locations.

ADVISORY ISSUANCE TIME:	23/1030PM	24/6AM	24/NOON	24/6PM	24/1030PM
PROBABILITY END TIME:	<u>26/8PM</u>	<u>27/2AM</u>	<u>27/8AM</u>	<u>27/2PM</u>	<u>27/8PM</u>
SKPG 125N 717W	2	3	X	X	X
TAPA 171N 618W	4	X	X	X	X
TKPK 173N 627W	66	X	X	X	X
TNCM 181N 631W	17	X	X	X	X
TISX 177N 648W	69	4	X	X	X
TIST 183N 650W	47	X	X	X	X
TJPS 180N 666W	53	25	52	12	20
MDSD 185N 697W	29	27	42	45	73
MDCB 176N 714W	24	34	58	43	58
MTPP 186N 724W	21	22	36	30	48
MTCA 183N 738W	18	21	37	24	37
MKJP 179N 768W	13	16	23	17	19
MKJS 185N 779W	12	14	18	15	17
MWCG 193N 814W	9	10	11	10	12
MUGM 200N 751W	14	14	17	16	22
MUCM 214N 779W	11	10	11	11	13
MUCF 221N 805W	8	8	8	8	10
MUSN 216N 826W	6	7	7	7	8
MUHA 230N 824W	5	5	6	6	7
MUAN 219N 850W	4	5	5	5	6
MMCZ 205N 869W	3	4	5	4	5
MZBZ 175N 883W	2	4	5	4	4
MGPB 157N 886W	2	4	4	4	3
MHNJ 165N 859W	4	6	7	6	6
MNPC 141N 834W	4	7	7	6	5
MNBL 120N 839W	2	4	4	4	3
SKSP 126N 817W	3	5	6	5	4
MRLM 100N 831W	X	2	2	2	X
TJSJ 184N 661W	45	6	12	X	X
MDPP 198N 707W	19	13	10	18	26
MBJT 215N 712W	12	7	6	9	8
MYMM 224N 730W	11	7	7	8	9
MYSM 241N 745W	8	5	5	6	7
MYEG 235N 758W	9	7	7	7	9
MYAK 241N 776W	7	6	4	6	8
MYNN 251N 775W	6	4	2	5	6
MYGF 266N 787W	3	2	2	3	4
MMMD 210N 897W	X	2	2	2	2
ST CROIX VI	69	4	X	X	X
ST THOMAS VI	47	X	X	X	X
SAN JUAN PR	45	6	12	X	X
PONCE PR	53	25	52	12	20
MARATHON FL	4	4	4	4	6
MIAMI FL	3	3	3	3	5
W PALM BEACH FL	3	2	2	2	3
FT PIERCE FL	2	X	X	2	3
COCOA BEACH FL	X	X	X	X	2
KEY WEST FL	4	4	4	X	6
MARCO ISLAND FL	3	2	3	3	4
FT MYERS FL	2	2	2	2	3
VENICE FL	X	X	X	X	2
TAMPA FL	X	X	X	X	2

X MEANS LESS THAN 2 PER CENT

Table 3. 72-hour probability, in per cent, of center of Tropical
(cont.) Depression Seven passing within 65 miles of listed locations.

ADVISORY ISSUANCE TIME:	25/6AM	25/NOON	15/6PM	25/1030PM	26/6AM
PROBABILITY END TIME:	<u>28/2AM</u>	<u>28/8AM</u>	<u>28/2PM</u>	<u>28/8PM</u>	<u>29/2AM</u>
MDSO 185N 697W	98	23	X	X	X
MDCB 176N 714W	48	27	X	X	X
MTPP 186N 724W	54	65	42	22	x
MICA 183N 738W	31	35	9	15	X
MKJP 179N 768W	13	13	5	6	2
MKJS 185N 779W	13	14	8	12	4
MWOG 193N 814W	10	10	9	12	8
MUGM 200N 751W	29	38	39	72	X
MUCM 214N 779W	16	19	22	39	37
MUCF 221N 805W	12	14	15	21	19
MUSN 216N 826W	10	11	12	15	13
MUHA 230N 824W	9	11	13	16	15
MUAN 219N 850W	7	8	9	11	10
MMCZ 205N 869W	5	5	6	8	6
MZBZ 175N 883W	3	3	2	3	2
MGPB 157N 886W	2	2	X	X	X
MHNJ 165N 859W	3	3	2	3	2
MDPP 198N 707W	53	70	9	X	X
MBJT 215N 712W	14	10	5	X	X
MYMM 224N 730W	15	15	22	4	4
MYSM 241N 745W	13	13	15	8	10
MYEG 235N 758W	15	16	22	14	23
MYAK 241N 776W	13	14	19	16	24
MYNN 251N 775W	11	12	16	13	16
MYGF 266N 787W	8	9	12	11	13
MMMD 210N 897W	2	3	4	5	4
MARATHON FL	9	11	14	15	16
MIAMI FL	8	10	13	13	15
W PALM BEACH FL	7	9	12	11	13
FT PIERCE FL	6	7	10	10	12
COCOA BEACH FL	5	6	9	9	10
DAYTONA BEACH FL	3	4	7	7	9
JACKSONVILLE FL	2	3	5	5	6
SAVANNAH GA	X	3	3	3	4
CHARLESTON SC	X	X	3	2	3
MYRTLE BEACH SC	X	X	2	2	3
WILMINGTON NC	X	X	2	X	2
KEY WEST FL	9	10	13	15	15
MARCO ISLAND FL	7	9	12	12	13
FT MYERS FL	6	8	11	11	12
VENICE FL	5	6	10	10	11
TAMPA FL	4	5	8	9	10
CEDAR KEY FL	3	4	7	7	8
ST MARKS FL	X	2	4	4	6
APALACHICOLA FL	X	2	5	5	6
PANAMA CITY FL	X	2	4	4	5
PENSACOLA FL	X	X	3	3	3
MOBILE AL	X	X	2	2	3
GULFPORT MS	X	X	2	2	2
BURAS LA	X	X	X	2	3
NEW ORLEANS LA	X	X	X	2	2
GULF 29N 85W	2	3	5	6	7
GULF 29N 87N	X	2	4	4	5
GULF 28N 89W	X	X	3	2	4
GULF 28N 91W	X	X	2	2	3

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Table 3. 72-hour probability, in per cent, of center of Tropical
(cont.) Depression Seven passing within 65 miles of listed locations.

ADVISORY ISSUANCE TIME:	26/NOON	26/6PM	26/1030PM	27/6AM	27/NOON
PROBABILITY END TIME:	<u>29/8AM</u>	<u>29/2PM</u>	<u>29/8PM</u>	<u>30/2AM</u>	<u>30/8AM</u>
MWCG 193N 814W	5	3	X	X	X
MUGM 200N 751W	5	X	X	X	X
MUCM 214N 779W	39	23	X	X	X
MUCF 221N 805W	21	15	4	X	X
MUSN 216N 826W	13	10	2	X	X
MUHA 230N 824W	17	14	6	X	X
MUAN 219N 850W	10	8	2	X	X
MMCZ 205N 869W	6	4	X	X	X
MZBZ 175N 883W	2	X	X	X	X
MYSM 241N 745W	6	7	2	X	X
MYEG 235N 758W	27	48	90	X	X
MYAK 241N 776W	31	44	86	98	27
MYNN 251N 775W	19	27	59	61	79
MYGF 266N 787W	15	18	34	36	62
MMMD 210N 897W	4	3	X	X	X
MARATHON FL	21	21	19	20	10
MIAMI FL	19	21	34	35	44
W PALM BEACH FL	16	18	30	33	52
FT PIERCE FL	14	16	25	26	43
COCOA BEACH FL	13	14	21	21	36
DAYTONA BEACH FL	11	12	17	18	26
JACKSONVILLE FL	9	10	14	15	18
SAVANNAH GA	6	7	12	13	15
CHARLESTON SC	5	6	11	12	15
MYRTLE BEACH SC	4	5	10	11	14
WILMINGTON NC	3	4	9	10	13
MOREHEAD CITY NC	3	3	8	10	12
CAPE HATTERAS NC	2	3	7	9	11
NORFOLK VA	X	X	5	7	9
OCEAN CITY MD	X	X	3	6	7
ATLANTIC CITY NJ	X	X	2	5	6
NEW YORK CITY NY	X	X	X	X	4
MONTAUK POINT NY	X	X	X	X	4
KEY WEST FL	19	18	14	14	6
MARCO ISLAND FL	18	18	20	21	19
FT MYERS FL	16	17	20	21	22
VENICE FL	14	15	17	18	18
TAMPA FL	13	13	17	17	20
CEDAR KEY FL	11	11	14	15	17
ST MARKS FL	8	9	11	12	12
APALACHICOLA FL	8	9	10	11	9
PANAMA CITY FL	7	8	9	9	8
PENSACOLA FL	5	6	7	6	5
MOBILE AL	4	5	5	5	3
GULFPORT MS	4	4	4	4	3
BURAS LA	4	4	4	3	2
NEW ORLEANS LA	3	3	3	3	9
NEW IBERIA LA	2	2	2	X	X
GULF 29N 85W	9	10	11	X	9
GULF 29N 87W	7	8	7	X	5
GULF 28N 89W	6	6	5	X	2
GULF 28N 91W	4	4	3	X	X

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Table 3. 72-hour probability, in per cent, of center of Tropical
(cont.) Depression Seven passing within 65 miles of listed locations.

ADVISORY ISSUANCE TIME:	27/6PM	27/1030PM
PROBABILITY END TIME:	<u>30/2PM</u>	<u>30/8PM</u>
MYNN 251N 775W	23	X
MYGF 266N 787W	72	98
MARATHON FL	4	X
MIAMI FL	60	31
W PALM BEACH FL	72	81
FT PIERCE FL	60	72
COCOA BEACH FL	46	59
DAYTONA BEACH FL	33	41
JACKSONVILLE FL	21	25
SAVANNAH GA	17	21
CHARLESTON SC	17	20
MYRTLE BEACH SC	15	18
WILMINGTON NC	14	17
MOREHEAD CITY NC	14	15
CAPE HATTERAS NC	12	14
NORFOLK VA	10	12
OCEAN CITY MD	8	10
ATLANTIC CITY NJ	7	8
NEW YORK CITY NY	5	6
MONTAUK POINT NY	5	6
PROVIDENCE RI	4	5
NANTUCKET MA	4	5
HYANNIS MA	4	5
BOSTON MA	3	4
PORTLAND ME	2	3
BAR HARBOR ME	2	2
EASTPORT ME	X	2
YARMOUTH NS	X	2
KEY WEST FL	2	X
MARCO ISLAND FL	16	X
FT MYERS FL	21	5
VENICE FL	16	6
TAMPA FL	20	10
CEDAR KEY FL	17	12
ST MARKS FL	11	8
APALACHICOLA FL	8	6
PANAMA CITY FL	6	5
PENSACOLA FL	4	3
MOBILE AL	2	2
GULFPORT MS	2	2
GULF 29N 85W	7	5
GULF 29N 87W	3	2

X MEANS LESS THAN 2 PER CENT

Table 4. 72-hour probability, in per cent, of center of Tropical Storm Chris passing within 65 miles of listed locations.

ADVISORY ISSUANCE TIME:	28/6AM	28/NOON
PROBABILITY END TIME:	<u>01/2AM</u>	<u>01/8AM</u>
JACKSONVILLE FL	39	X
SAVANNAH GA	35	X
CHARLESTON SC	36	X
MYRTLE BEACH SC	29	X
WILMINGTON NC	24	X
MOREHEAD CITY NC	20	X
CAPE HATTERAS NC	18	X
NORFOLK VA	16	44
OCEAN CITY MD	14	47
ATLANTIC CITY NJ	12	3
NEW YORK CITY NY	11	X
MONTAUK POINT NY	10	7
PROVIDENCE RI	9	27
NANTUCKET MA	10	51
HYANNIS MA	9	65
BOSTON MA	9	51
PORTLAND ME	7	23
BAR HARBOR ME	6	17
EASTPORT ME	6	15
ST JOHN NB	5	15
MONCTON NB	4	13
YARMOUTH NS	7	31
HALIFAX NS	5	29
SABLE ISLAND NS	4	18
SYDNEY NS	3	23
EDDY POINT NS	4	29
PTX BASQUES NFLD	2	13
BURGED NFLD	2	15
ILE ST PIERRE	2	26
CAPE RACE NFLD	X	31
HIBERNIA OILFLD	X	27

X MEANS LESS THAN 2 PER CENT

Figure Captions:

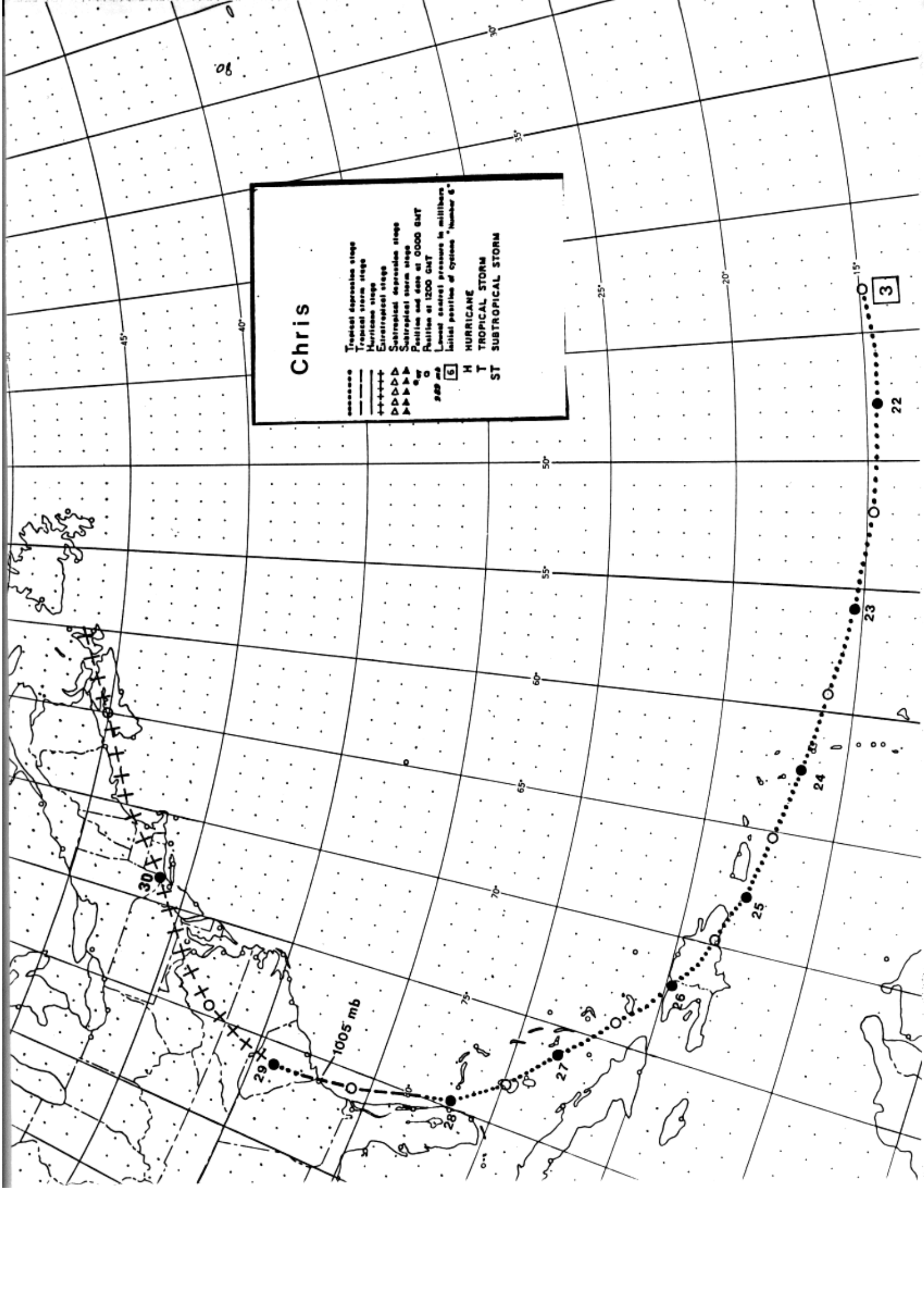
Fig. 1. Best track of Tropical Storm Chris, 21 - 29 August 1988.

Fig. 2. Maximum sustained wind speed versus time for Tropical Storm Chris, 21 -29 August 1988.

Fig. 3. Minimum central surface pressure versus time for Tropical Storm Chris, 21 - 29 August 1988.

Chris

	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 cyclone "number 6"
	HURRICANE
	TROPICAL STORM
	SUBTROPICAL STORM



08

3

22

23

24

25

26

27

28

29

1005 mb

30

