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NOAA TECHNICAL MEMORANDUM NWSTM PR-36



1990 TROPICAL CYCLONES - CENTRAL NORTH PACIFIC

Honolulu, HI
April 1991

**U.S. DEPARTMENT OF
COMMERCE**

National Oceanic and
Atmospheric Administration

National Weather
Service

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National Weather Service, Pacific Region Subseries

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1990 TROPICAL CYCLONES - CENTRAL NORTH PACIFIC

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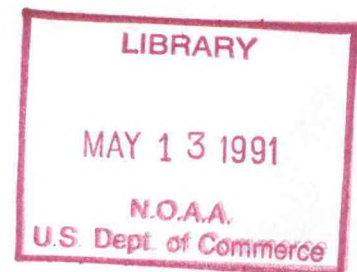


TABLE OF CONTENTS

1990 TROPICAL CYCLONES - Central Pacific

1. Central North Pacific Tropical Cyclone Data, 1990	1
2. Tropical Storm AKA	2
3. Tropical Storm AKA - Actual vs Best Track Error	3
4. Fig. 1 - Tropical Storm AKA - Best Track Plot	4
5. Fig. 2 - GOES-C Visual Imagery of T.S. AKA at 0001 UTC 8 August 1990.	5
6. Fig. 3 - GOES-C Visual Imagery of T.S. AKA at 0001 UTC 10 August 1990.	6
7. Tropical Storm AKA - 24 Hour Forecast Verification	7
8. Tropical Storm AKA - 36 Hour Forecast Verification	8
9. Tropical Storm AKA - 48 Hour Forecast Verification	9
10. Tropical Storm AKA - 72 Hour Forecast Verification	10
11. Tropical Depression TWO-C	11
12. Fig. 4 - T.D. TWO-C and Tropical Storm POLO Best Track Plot	12
13. Fig. 5 - GOES-C Visual Imagery of T.D. TWO-C at 1701 UTC 10 August 1990	13
14. Hurricane MARIE	14-15
15. Fig. 6 - GOES C Visual Imagery of Hurricane MARIE at 2301 UTC 13 September 1990	16
16. Fig. 7 - GOES C Visual Imagery of Hurricane MARIE at 0001 UTC 15 September 1990	17
17. Fig. 8 - GOES C Visual Imagery of Hurricane MARIE at 0031 UTC 15 September 1990	18
18. Hurricane MARIE - Actual vs Best Track Error	19
19. Fig. 9 - Hurricane MARIE - Best Track Plot	20
20. Fig. 10 - GOES-C Visual Imagery of Tropical Depression MARIE at 2331 UTC 19 September 1990	21

	<u>PAGE</u>
Hurricane MARIE - 24 Hour Forecast Verification	22
Hurricane MARIE - 36 Hour Forecast Verification	23
Hurricane MARIE - 48 Hour Forecast Verification	24
Hurricane MARIE - 72 Hour Forecast Verification	25
Tropical Storm POLO	26
Fig. 11 - GOES-C Visual Imagery of Tropical Depression POLO at 1831 UTC 1 October 1990	27
1990 Forecast Verification Summary	28

CENTRAL NORTH PACIFIC TROPICAL CYCLONE DATA SUMMARY, 1989*

<u>Name</u>	<u>Dates</u>	<u>Highest Classification in Central Pacific</u>	<u>Max Winds</u>	<u>Min SLP</u>	<u>Hours Observed per Class</u>
AKA	7-13 Aug	Tropical Storm	E55 (SFSS)	N/A	132(TS), 6(TD)
TWO-C	10-13 Aug	Tropical Depression	E30 (SFSS)	N/A	54(TD)
MARIE	14-21 Sep	Hurricane	E100(SFSS)	N/A**	72(H), 36(TS), 9(TD)
POLO	1-2 Oct	Tropical Storm	E30 (SFSS)	N/A	6(TS), 12(TD)

Key

H - Hurricane

TS - Tropical Storm

TD - Tropical Depression

Example: 36(H), 84(TS), 12(TD)

Total hours per class: H 36 hrs

TS 84 hrs

TD 12 hrs

NOTES:

* Data pertain only to period when tropical cyclone was in the central Pacific.

** RECCE flown after system reached its peak.

TROPICAL STORM AKA
AUGUST 7-13, 1990

Tropical Storm AKA was the first cyclone of the 1990 season to develop in the central North Pacific. Forecasters at the Central Pacific Hurricane Center (CPHC) in Honolulu had been following a disturbed area southeast of Hawaii for several days with the aid of satellite imagery. The disturbed area became increasingly organized and by August 6 in the area of 10N 145W began to show the early stages of development into a tropical cyclone. The CPHC issued its first advisory on Tropical Depression ONE-C at 072100 UTC, positioning the new system near 11N 150W (Fig. 1). ONE-C quickly gained strength and was upgraded to a tropical storm and named AKA at 08/0300 UTC (Fig. 2). The new tropical storm continued to move westward a path which took it well south of the Hawaiian Islands. Closest point of approach to South Point, Hawaii was 500 miles due south at 09/0000 UTC with maximum sustained winds of 45 knots near the center.

AKA reached its peak intensity of 55 knots near 11N 165W early on the 10th (Fig. 3). AKA's track, up to now, was well south of the average climatological path taken by previous storms in the area. The storm began to move along a more west northwesterly track that took it about 225 miles south of Johnston Island at 11/0900 UTC. AKA did little to affect the weather on Johnston Island except for a slight strengthening of the trade winds into the 25 to 30 knot range.

AKA crossed the international dateline near 15N 180 and the CPHC passed the warning responsibility to the Joint Typhoon Warning Center (JTWC) on Guam at 13/1500 UTC. AKA continued on a west northwest track and passed south of Wake Island as a dissipating tropical depression at 15/1200 UTC. The JTWC issued its last bulletin on the moribund AKA at 15/1500 UTC.

TROPICAL STORM AKA
Central Pacific - AUGUST 7-13, 1991

<u>DTG</u> <u>(Z)</u>	<u>BEST TRACK</u> <u>N/W</u>	<u>ACTUAL TRACK</u> <u>N/W</u>	<u>ERROR</u> <u>NM</u>	<u>ESTIMATED</u> <u>MAX WIND</u> <u>(KT)</u>
07/18	10.5 150.0	10.5 150.0	0	30
08/00	10.6 151.5	10.6 151.5	0	35
06	10.8 152.8	10.8 152.8	0	35
12	11.1 154.1	10.9 154.0	14	35
18	11.4 155.2	10.9 153.5	105	35
09/00	11.8 156.2	11.7 156.2	6	35
06	12.0 157.3	11.8 157.1	17	40
12	11.9 158.5	12.0 158.5	6	45
18	11.6 160.1	11.8 160.8	43	50
10/00	11.3 161.7	11.3 161.7	0	50
06	11.1 163.1	11.1 163.0	6	50
12	11.3 164.5	11.3 164.5	0	55
18	11.6 166.4	11.5 165.5	53	55
11/00	12.4 168.0	12.5 168.0	6	45
06	12.8 169.1	12.8 169.2	6	45
12	13.1 170.2	13.1 170.2	0	35
18	13.4 171.3	13.3 171.2	8	35
12/00	13.8 172.5	13.4 172.2	30	35
06	14.1 173.6	14.0 173.5	9	35
12	14.3 174.8	14.3 174.5	18	40
18	14.6 176.0	14.5 176.0	6	45
13/00	14.9 177.8	14.8 177.8	6	45
06	15.0 179.4	15.0 178.5	52	45
12	15.0 179.0E	15.0 179.0E	0	40

-----CROSSED INTERNATIONAL DATELINE INTO WESTERN PACIFIC-----

18	15.0 177.5E	15.0 177.5E	0	40
14/00	15.1 175.6E	15.1 175.6E	0	35
06	15.4 173.9E	15.4 173.9E	0	35
12	15.9 172.2E	15.5 172.2E	24	35
18	16.3 171.0E	16.5 170.9E	13	35
15/00	16.6 169.8E	16.6 170.0E	12	35
06	16.7 168.7E	16.7 168.9E	12	30
12	16.8 167.7E	16.8 167.7E	0	25

AVERAGE ERROR 13.9 NM

Fig. 1

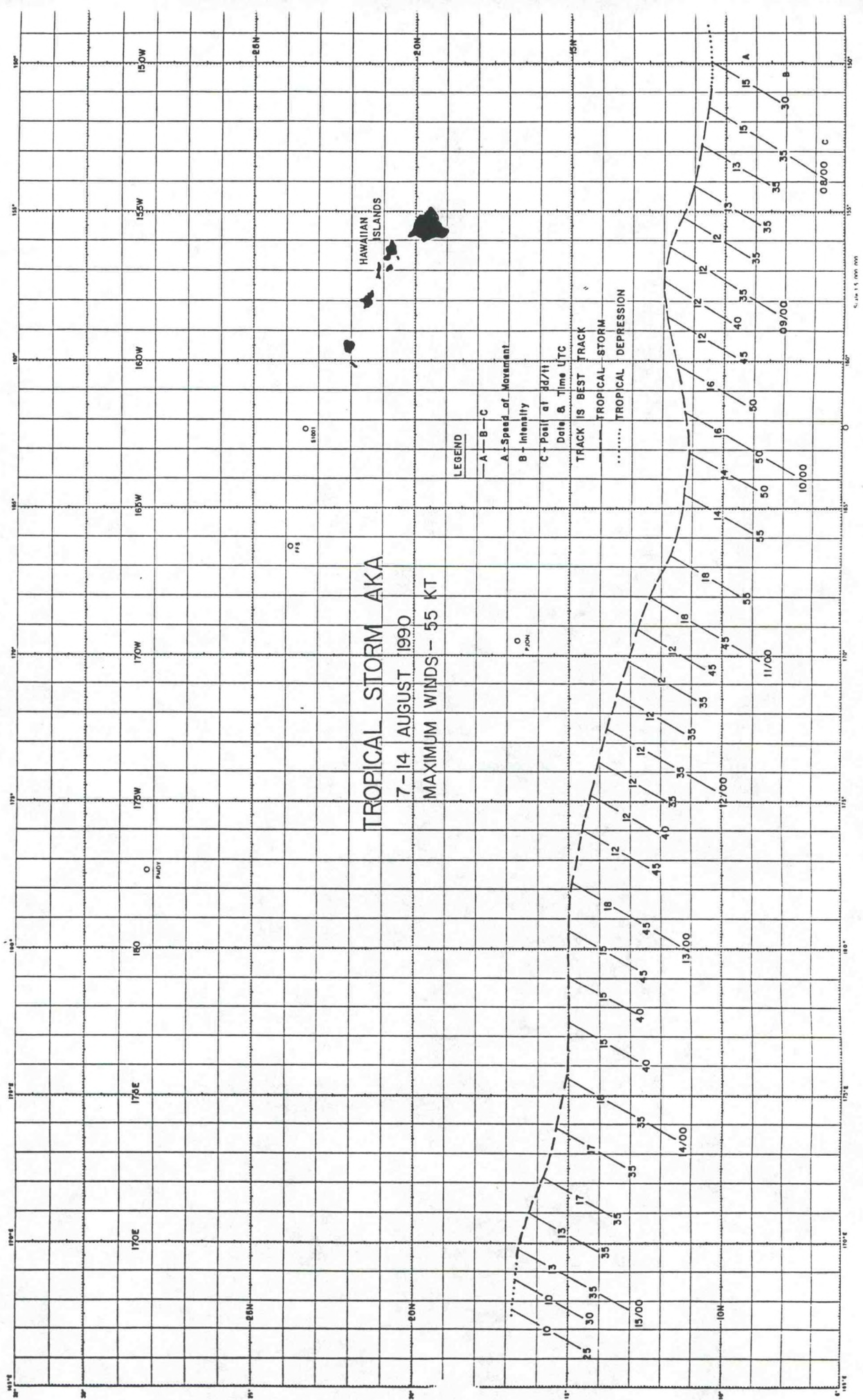
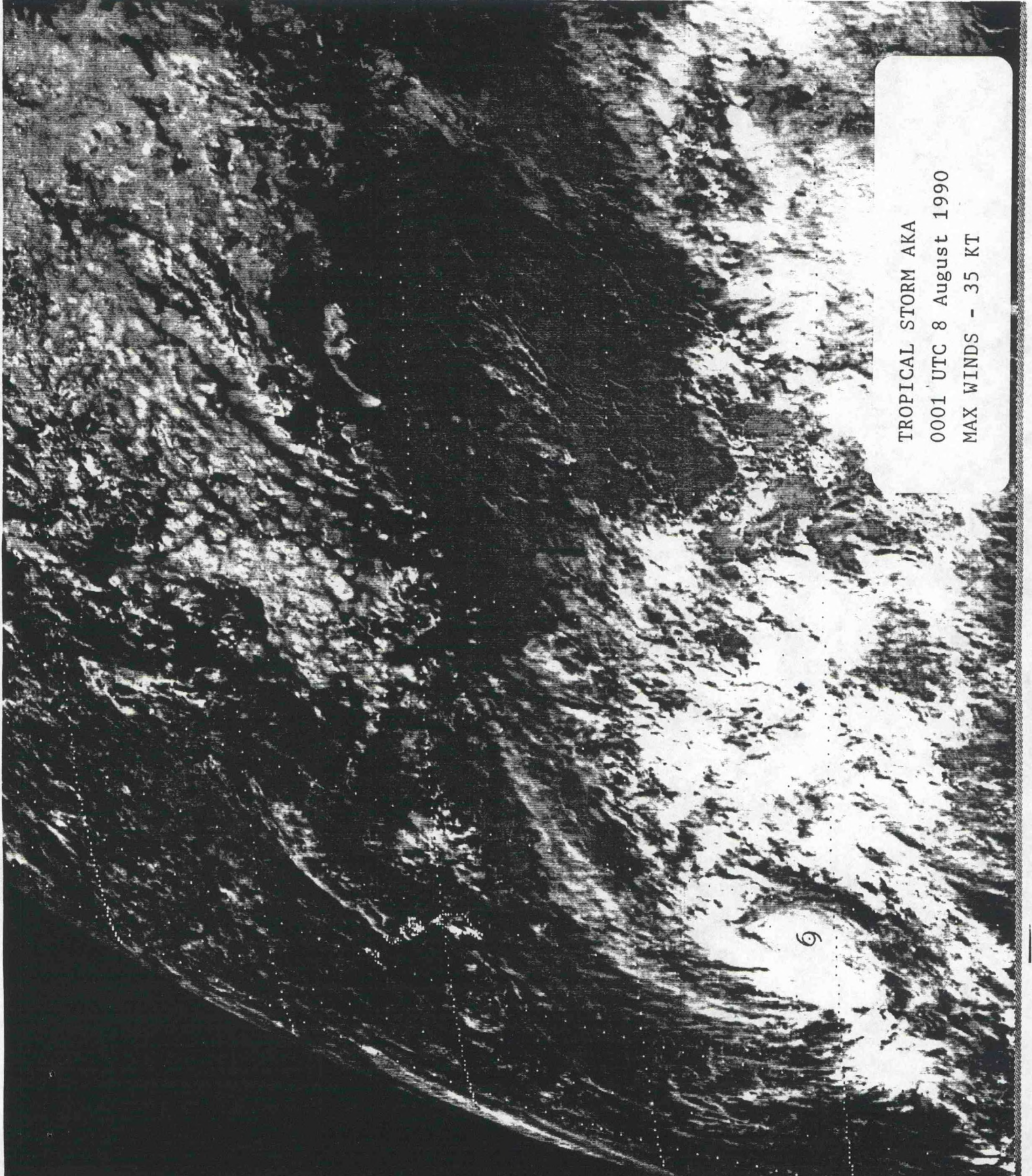
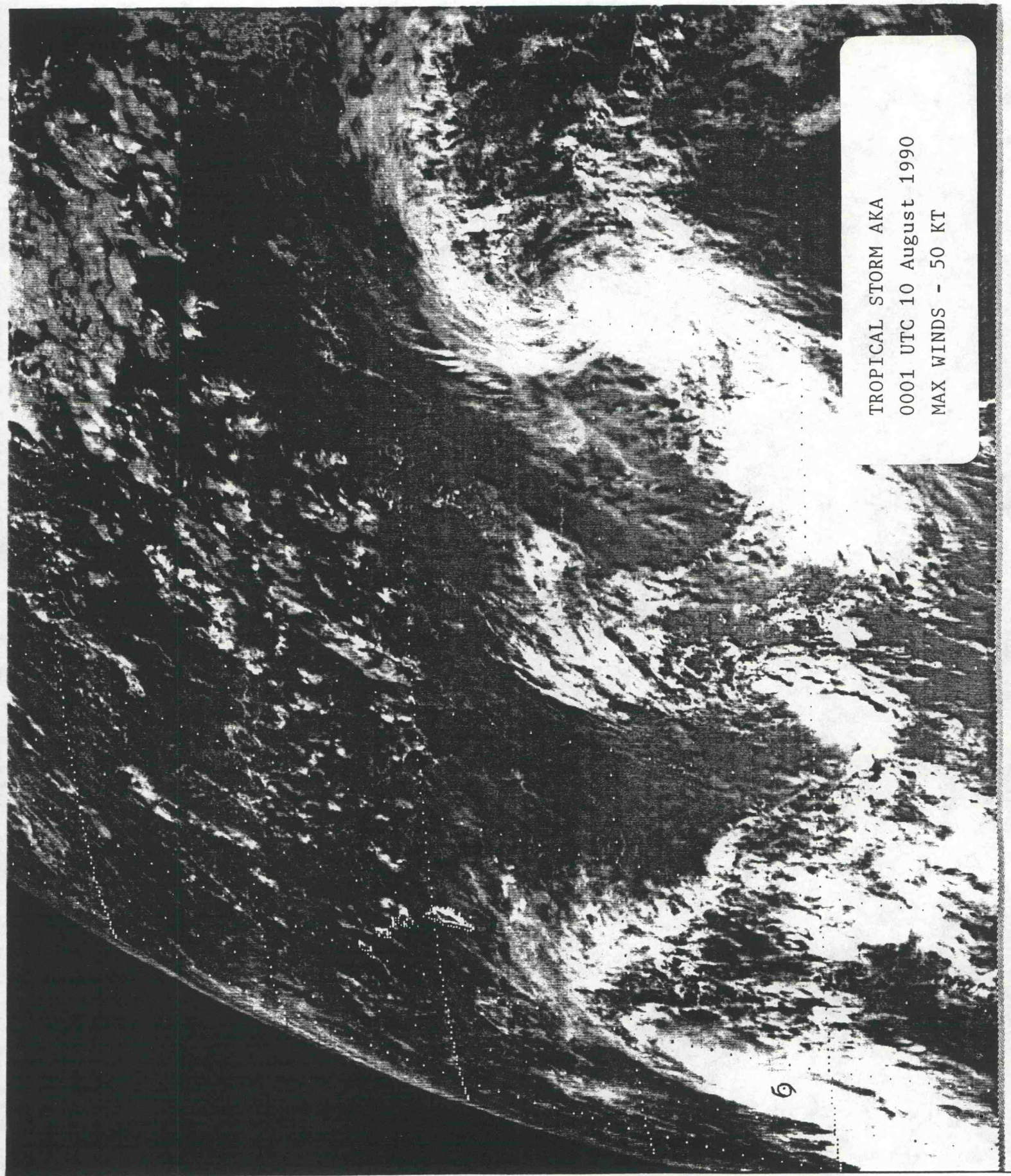


Fig. 2



TROPICAL STORM AKA
0001 UTC 8 August 1990
MAX WINDS - 35 KT

Fig. 3



TROPICAL STORM AKA
0001 UTC 10 August 1990
MAX WINDS - 50 KT

TROPICAL STORM: AKA

FROM: 07/1800 TO: 15/1200 UTC AUGUST 1980

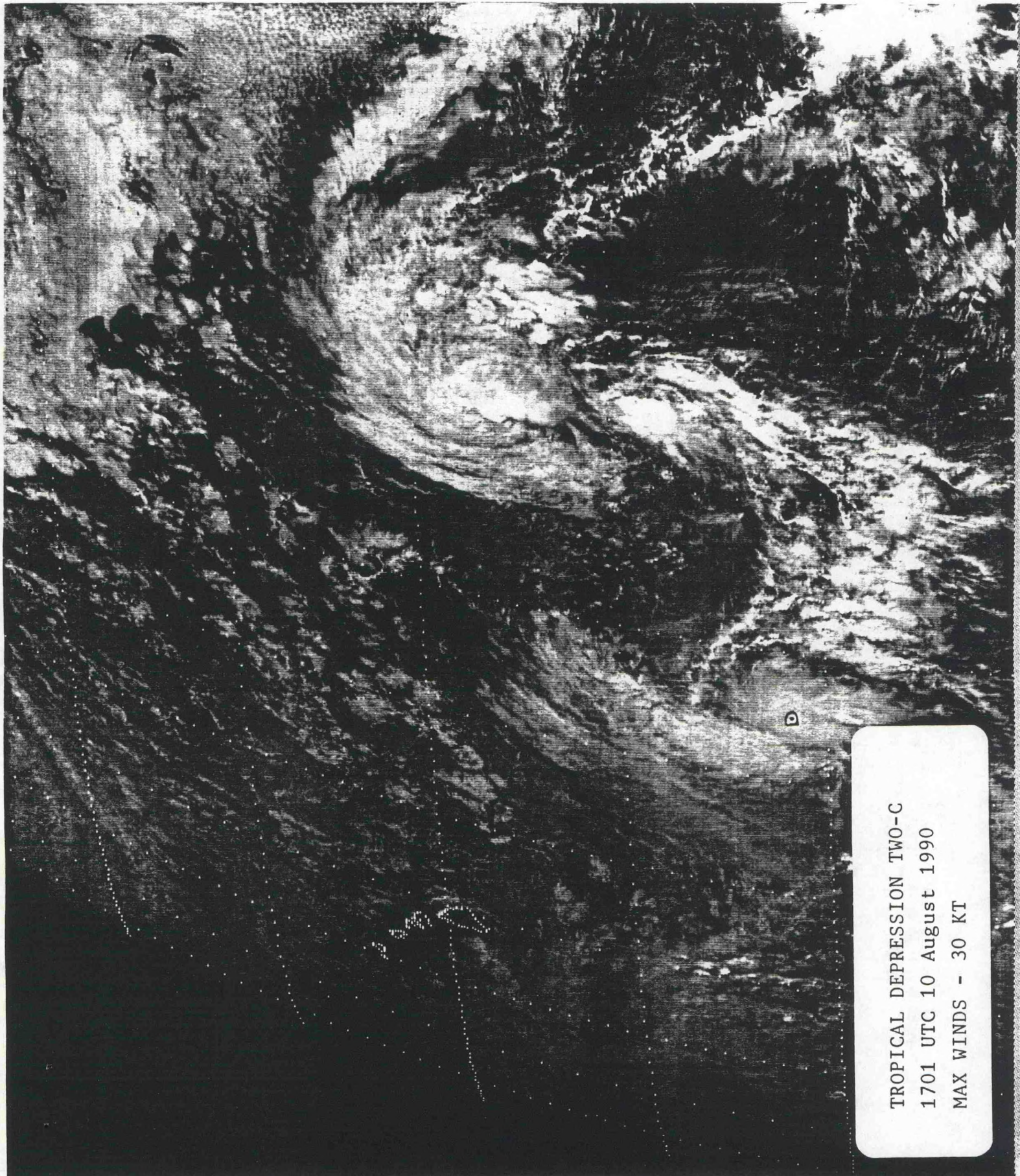
DTG UTC	BEST TRACK			24 HOUR FORECAST POSITION												AVERAGE ERROR IN NM =>															
	LAT NORTH	LONG WEST	OTCH	CPHC LAT NORTH	LONG WEST	EPSS87 LAT NORTH	LONG WEST	EPAN85 LAT NORTH	LONG WEST	EPCL84 LAT NORTH	LONG WEST	EPIC81 LAT NORTH	LONG WEST	QLM LAT NORTH	LONG WEST	HPAC LAT NORTH	LONG WEST	OTCH LAT NORTH	LONG WEST	CPHC	EPSS87	EPAN85	EPCL84	EPIC81	QLM	HPAC	OTCH	#N/A!	#N/A!		
0718	10.5	150.0		10.0	154.1	10.6	154.1	10.1	154.2	9.9	153.9	11.0	156.0	10.9	156.1					108											
0800	10.6	151.5		10.6	155.8	11.1	156.0	10.9	156.2	10.7	156.0	11.0	157.2	10.7	156.0					76	81										
0805	10.8	152.8		11.2	157.2	11.3	157.3	11.5	157.4	11.1	157.2	11.2	158.4	11.2	158.4					48	44										
0812	11.1	154.1		11.4	158.2	11.5	158.4	11.7	158.6	11.4	158.5	11.6	159.6	11.4	158.5					35	24										
0818	11.4	155.2		11.7	160.4	12.0	160.4	12.2	160.4	12.0	160.4	12.2	160.8	12.0	160.6					217	207										
0906	11.8	158.5		12.3	160.5	12.3	160.4	12.7	160.9	12.3	160.4	12.7	160.8	12.0	160.6					110	97										
0912	11.9	160.1		12.9	161.0	12.4	161.0	13.1	160.9	12.3	161.0	12.2	161.0	12.0	160.6					164	147										
0918	11.3	161.7		13.0	162.8	12.6	162.7	13.1	162.7	12.3	162.7	12.2	164.1	12.8	162.2					143	132										
1000	11.1	163.1		13.1	165.7	12.7	165.5	13.1	165.7	12.3	165.5	9.3	166.4	11.2	166.3					99	88										
1012	11.7	166.8		13.1	165.7	12.7	165.5	13.1	165.7	12.3	165.5	11.4	167.9	11.4	167.9					105	109										
1018	12.4	166.0		13.1	165.7	12.7	165.5	13.1	165.7	12.3	165.5	11.4	167.9	11.4	167.9					90	85										
1106	12.6	169.2		12.3	167.5	11.5	167.9	11.4	167.9	10.9	168.0	12.2	170.0	11.6	169.6					172	175										
1112	13.1	170.2		12.0	169.7	12.0	169.6	12.0	169.6	11.5	169.7	13.8	173.9	14.0	173.9					109	109										
1118	13.5	171.4		12.4	169.6	12.4	169.7	12.4	169.7	12.2	169.7	13.8	173.9	14.0	173.9					72	75										
1200	13.8	172.5		14.5	171.8	13.7	171.7	14.9	173.1	13.8	172.9	14.0	174.7	14.0	174.7					125	151										
1208	14.0	173.5		14.9	172.7	14.0	172.2	15.2	174.2	14.0	174.3	14.0	174.7	14.0	174.7					59	41										
1212	14.3	174.8		13.3	174.7	14.0	174.2	15.2	174.2	14.0	174.3	14.0	174.7	14.0	174.7					72	41										
1218	14.6	176.0		13.3	175.7	13.9	175.7	13.7	175.8	13.1	175.6	13.9	176.6	13.9	176.6					60	65										
1300	14.9	177.8		13.8	176.8	14.2	176.1	14.5	175.9	13.7	175.6	13.9	176.6	13.9	176.6					80	46										
1306	15.0	179.4		15.0	179.4	14.7	177.7	15.0	178.9	14.4	177.7	15.4	179.3	15.4	179.3					89	109										
1312	15.0	179.0		14.8	179.5	15.1	178.5	15.2	179.7	15.0	178.4	15.4	179.3	15.4	179.3					83	102										
1318	15.0	177.5		14.9	179.5	15.1	178.5	15.2	179.7	15.0	178.4	15.4	179.3	15.4	179.3					117	145										
1400	15.1	175.8		15.4	176.7	15.8	176.4	15.8	176.4	15.3	176.5	15.9	177.4	15.9	177.4					116	113										
1406	15.4	173.9		15.7	176.7	15.8	176.4	15.8	176.4	15.3	176.5	15.9	177.4	15.9	177.4					126	164										
1412	15.9	172.2		15.1	172.9	15.5	173.1	15.2	173.3	14.7	173.1	15.9	177.4	15.9	177.4					139	56										
1418	16.3	171.0																			62										
1500	16.6	169.8																													
1506	16.7	168.8																													
1512	16.8	167.7																													

() = EAST LONGITUDE

TROPICAL DEPRESSION TWO-C
AUGUST 10-13, 1990

Tropical Depression TWO-C was the second and only other tropical cyclone to be classified in the central North Pacific during the 1990 season. A disturbance near 11N 142.5W (Fig. 4) was labeled TWO-C at 10/1800 UTC on August 10 when visual satellite imagery (Fig. 5) showed that the disturbance had become much better organized overnight. TWO-C moved in a west northwest direction for the next 18 hours and then changed to a south of west track near 11.7N 144.8W about 11/1800 UTC. It continued toward the west southwest until 12/0600 UTC and then turned toward the west. Hurricane reconnaissance aircraft flew a low level investigative mission on TWO-C during the daylight hours on the 12th and could find no identifiable circulation. Accordingly, the CPHC issued its last advisory on the dissipated TWO-C at 13/0300 UTC...about 600 miles south southeast of Hilo, Hawaii.

Fig. 5



TROPICAL DEPRESSION TWO-C
1701 UTC 10 August 1990
MAX WINDS - 30 KT

HURRICANE MARIE
SEPTEMBER 14-21 1990

Early during the month of September, the monsoonal trough stretched from the Philippines all the way across the Pacific to the Central American coast. MARIE had its beginnings as a disturbance embedded in the trough about the 6th of September. The National Hurricane Center in Miami labeled the infant system Tropical Depression SIXTEEN-E at 2100 UTC on 7 September 1990 as it moved toward the west at 9 knots. SIXTEEN-E showed rapid development and was upgraded to a tropical storm and named MARIE at 08/2100 UTC and to a hurricane at 09/0300 UTC near 14.1N 128.7W while moving toward the west northwest at 10 knots.

MARIE continued to intensify and peaked between 11/0000 UTC and 11/1200 UTC near 14.7N 133.0W with maximum sustained winds estimated at 125 knots.

Hurricane MARIE crossed into the central North Pacific from the Eastern Pacific near 17N 140W at 14/0600 UTC. Figures 6, 7, and 8 show Marie with a well defined eye just prior to and after crossing into the central North Pacific. Maximum sustained winds at this time were estimated to be 100 knots using satellite imagery and Dvorak's Tropical Cyclone Analysis Technique. MARIE remained a steady state hurricane for another 48 hours through 16/1200 UTC after resuming a course toward the west northwest. During this time frame, MARIE was being drawn northward by a trough racing eastward in the mid-latitudes to its north and began to weaken (Fig. 9).

A tropical storm watch was issued for the Big Island of Hawaii at 17/0300 UTC when MARIE was 340 miles to the east southeast of Hilo. The forecast track, at this time, took the storm to south of the Big Island. In addition to the tropical storm watch, a high surf advisory was issued for the southeast shores of the Big Island.

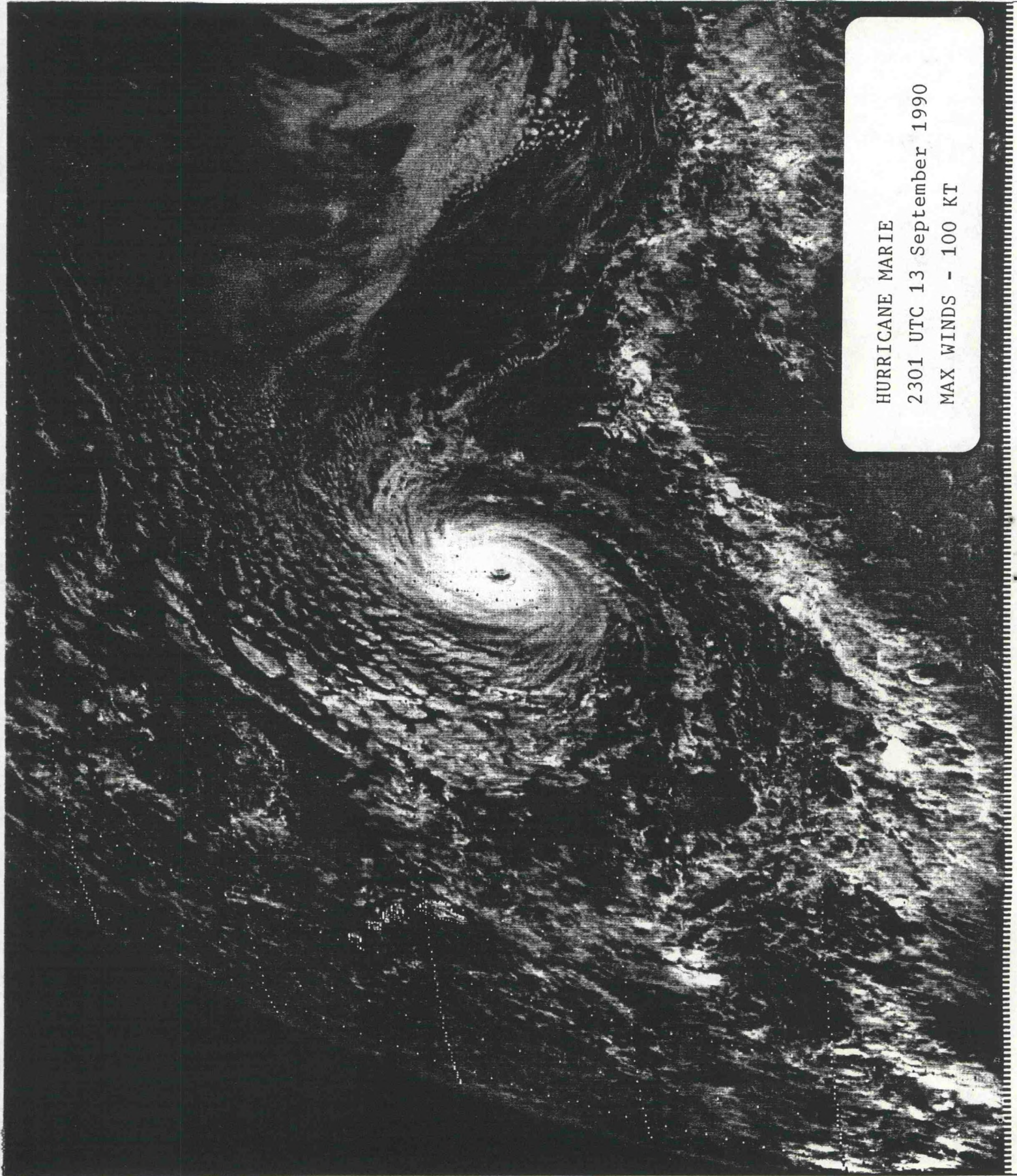
Air Force aerial reconnaissance crews began to make fixes and gather data on MARIE about 17/0400 UTC and found that the cyclone was continuing to weaken. MARIE was downgraded to a tropical storm at 17/0600 UTC, MARIE had moved to within 230 miles of Hilo by 17/1800 UTC and the tropical storm watch was upgraded to a tropical storm warning at 17/2100 UTC. A tropical storm watch was also issued at this time for Maui County. During this same period, an upper level anticyclone moved between the storm and the mid-latitude trough to the north and began to steer MARIE toward the west southwest.

Aerial reconnaissance data continued to show a steady weakening trend as MARIE moved west southwestward and the tropical storm warning for the Big Island was downgraded to a watch at 18/2100 UTC. MARIE was downgraded to a tropical depression at 19/0000 UTC and resulted in the cancellation of the tropical storm watches for

Hawaii and Maui counties and the high surf advisory for the southeast coast of the Big Island. Figure 10 shows MARIE as a weakening tropical depression south of the Hawaiian Islands.

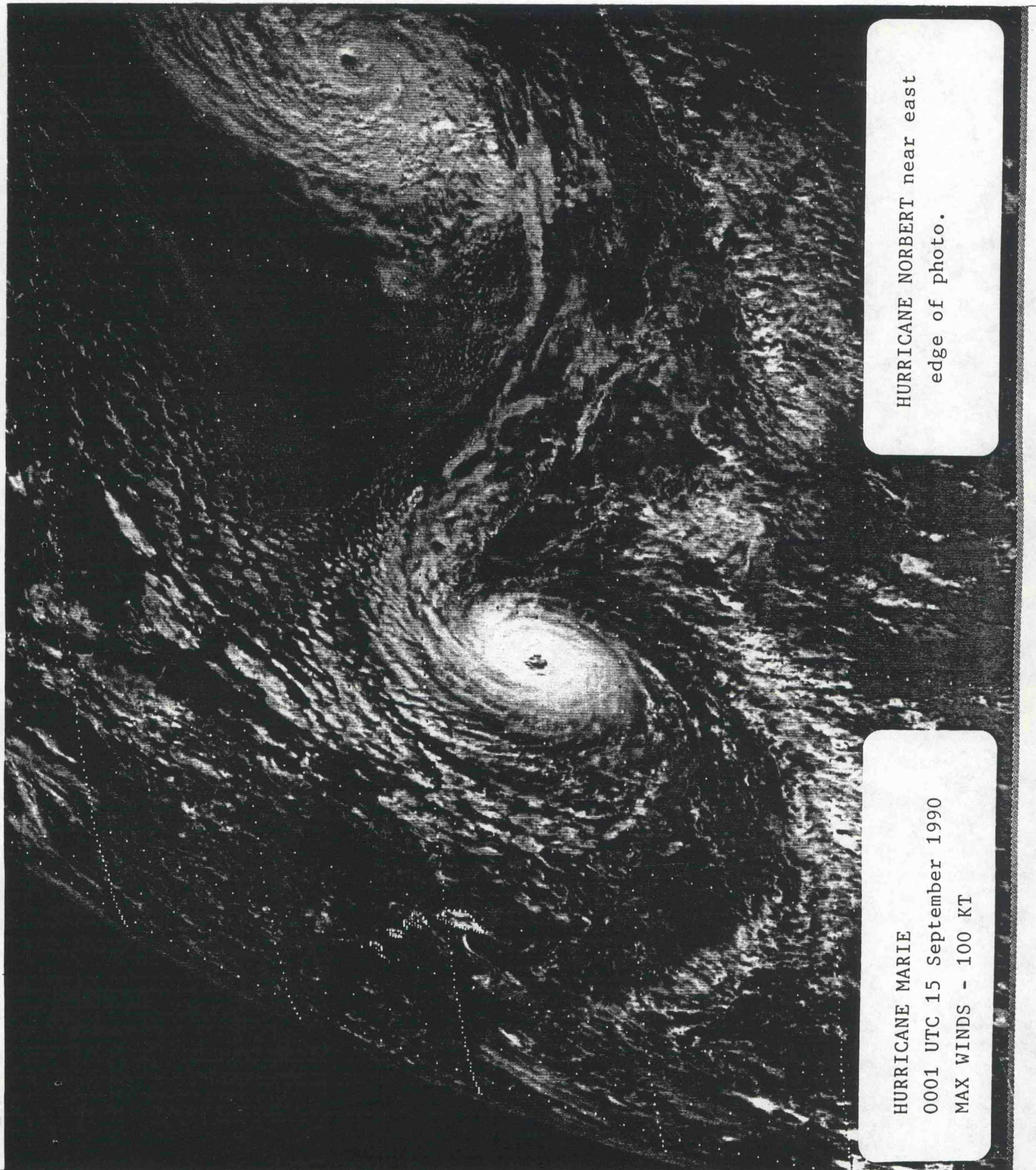
Tropical Depression MARIE continued westward and at 190600 UTC passed within 180 miles of South Point, Hawaii. The depression dissipated near 16.0N 160.2W at 21/0000 UTC.

Fig. 6



HURRICANE MARIE
2301 UTC 13 September 1990
MAX WINDS - 100 KT

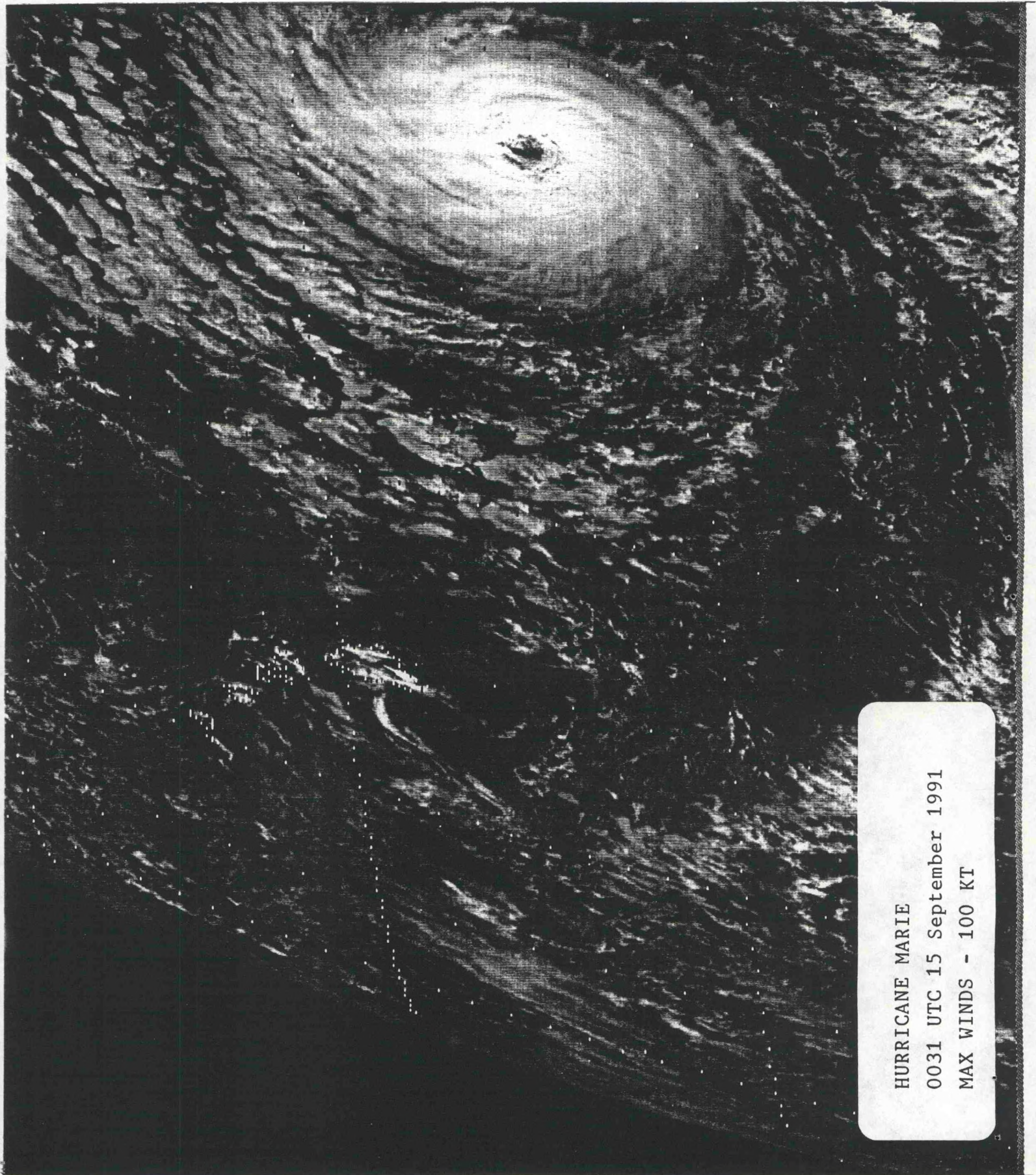
Fig. 7



HURRICANE NORBERT near east
edge of photo.

HURRICANE MARIE
0001 UTC 15 September 1990
MAX WINDS - 100 KT

Fig. 8



HURRICANE MARIE
0031 UTC 15 September 1991
MAX WINDS - 100 KT

HURRICANE MARIE
Central Pacific - September 14-21, 1990

DTG (Z)	BEST TRACK N/W	ACTUAL TRACK N/W	ERROR NM	ESTIMATED MAX WIND (KT)
14/06	17.4 139.6	17.4 139.6	0	100
12	17.5 140.1	17.4 140.1	6	100
18	17.4 140.8	17.4 140.8	0	100
15/00	17.3 141.8	17.3 141.7	6	100
06	17.0 142.8	17.0 142.8	0	100
12	16.7 143.6	16.7 143.6	0	100
18	16.6 144.6	16.6 144.6	0	100
16/00	16.6 145.7	16.6 145.7	0	100
06	16.7 146.8	16.8 146.8	6	100
12	16.9 147.7	17.1 147.8	13	100
18	17.2 148.5	17.2 148.5	0	80
17/00	17.6 149.5	17.6 149.5	0	70
06	17.9 150.3	17.9 150.4	6	60
12	18.2 151.0	18.2 151.0	0	50
18	18.0 151.5	18.1 151.9	24	50
18/00	17.8 151.9	18.0 151.9	12	60
06	17.3 152.5	17.5 152.7	17	60
12	16.8 153.1	16.8 153.1	0	55
18	16.4 153.7	16.4 153.7	0	40
19/00	16.2 154.5	16.3 154.2	18	30
06	16.0 155.2	16.0 155.2	0	30
12	15.9 155.8	15.8 155.8	6	30
18	15.8 156.4	15.8 156.4	0	30
20/00	15.8 157.0	15.8 156.8	12	30
06	15.8 157.8	15.8 157.8	0	30
12	15.8 158.6	15.8 158.8	12	30
18	15.9 159.5	15.8 159.1	24	30
21/00	16.0 160.2	16.0 160.2	0	25

AVERAGE ERROR 5.8 NM

Fig. 9

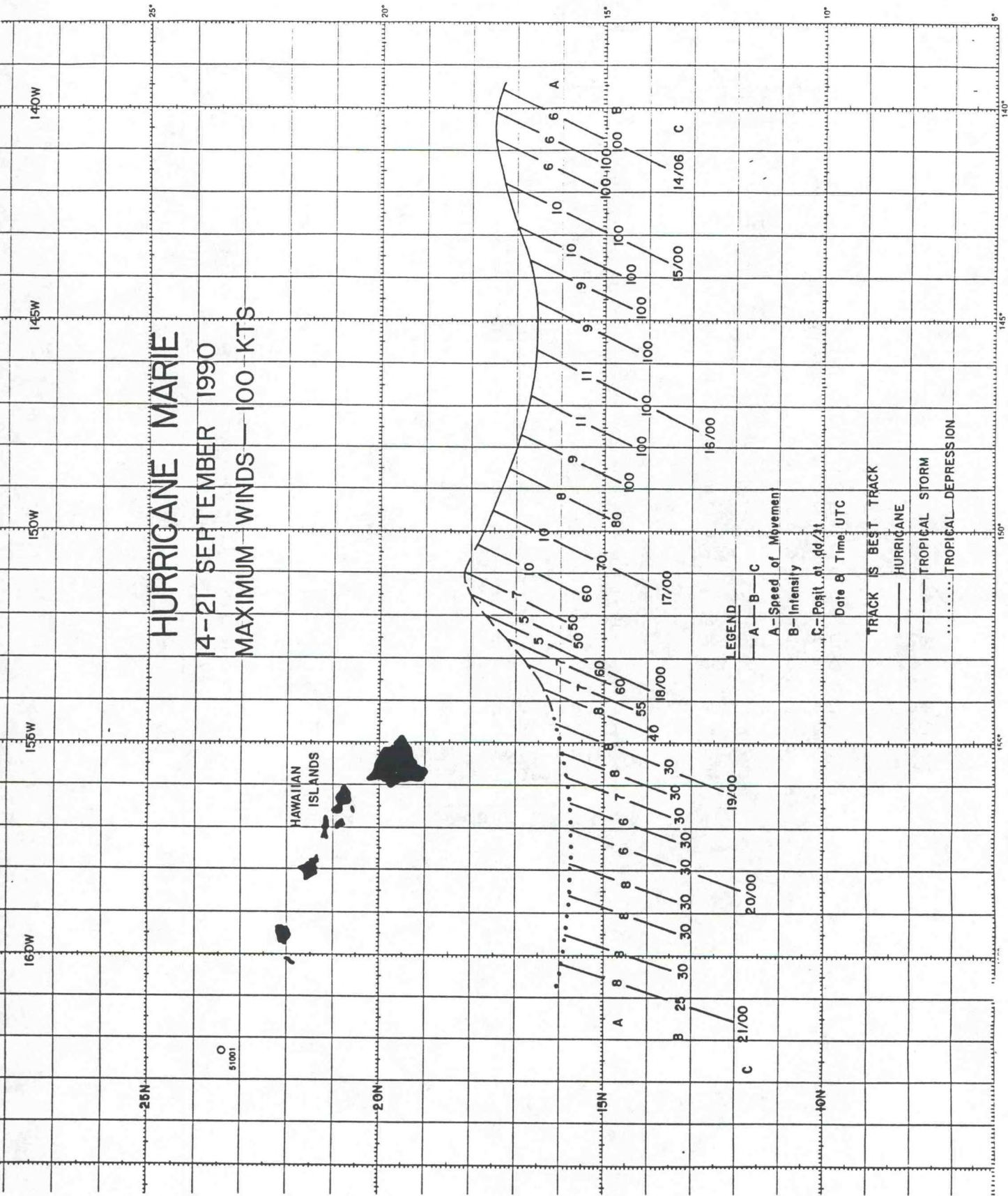
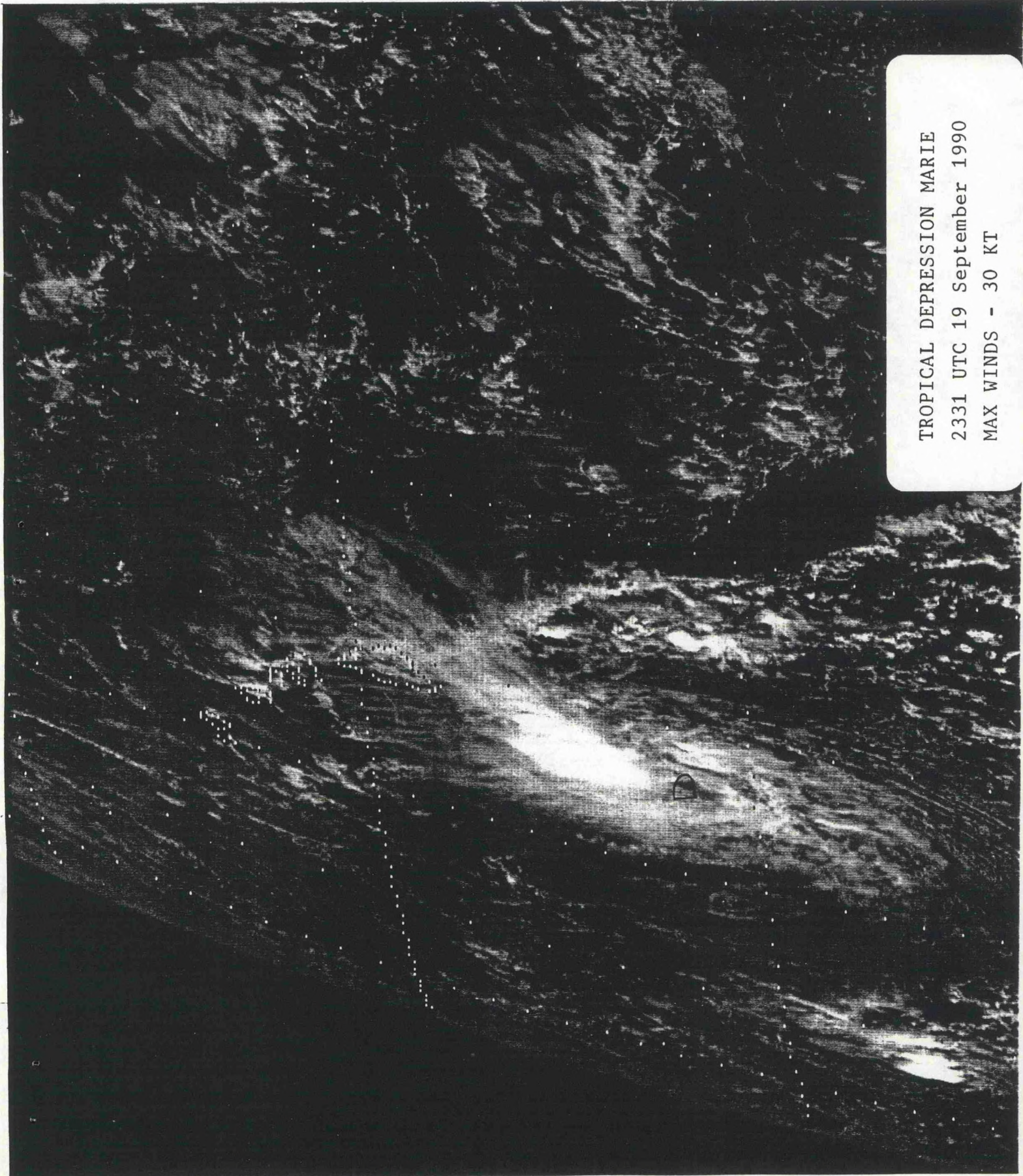


Fig. 10



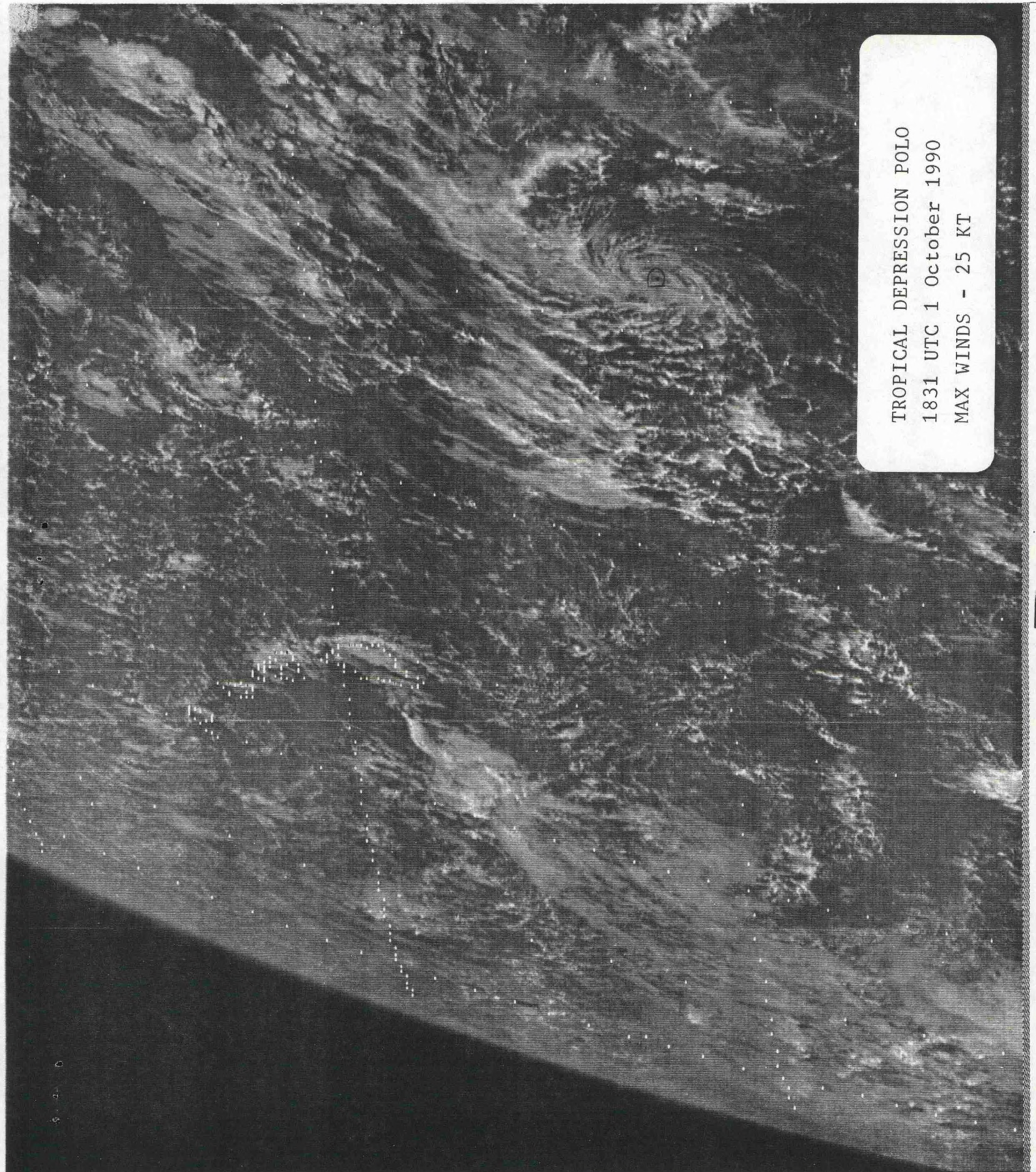
HURRICANE: **MARIE**

DTG	BEST TRACK			72 HOUR FORECAST POSITION												FROM: 14/0600			TO: 21/0000			UTC			SEPTEMBER 1990				
	LAT	LONG	DTG	CPHC	EPSSZ	EPANBS	EPCLB4	EPHCBI	QLM	HPAC	OTCH	CPHC	EPSSZ	EPANBS	EPCLB4	EPHCBI	QLM	HPAC	OTCH	CPHC	EPSSZ	EPANBS	EPCLB4	EPHCBI	QLM	HPAC	OTCH		
1406	17.4	139.6		19.6	146.2	19.9	148.1	20.0	146.4	19.3	144.5	19.3	144.5	23.2	149.2	24.4	148.2	253	173	254	338								
1412	17.5	140.1		19.8	147.0	20.6	147.1	20.6	147.1	19.9	146.7	19.9	146.7	23.2	149.2	24.4	148.2	245	152	263	263								
1418	17.4	140.8		19.5	148.5	19.6	148.3	19.6	148.3	19.3	146.9	19.3	146.9	21.3	148.8	24.4	151.0	192	186	205	271						404		
1500	17.3	141.8		19.1	150.2	19.1	149.4	19.1	149.4	18.9	150.4	18.9	150.4	21.3	148.8	23.8	152.1	124	134	161	199						384		
1506	17.0	142.8		19.1	150.2	15.2	151.1	15.2	151.1	15.6	153.3	15.6	153.3	22.8	153.9	23.6	154.6	159	152	175	111						359		
1512	16.7	143.6		13.6	156.7	16.7	156.2	16.7	156.2	17.2	153.9	17.2	153.9	22.8	153.9	22.9	155.9	216	164	204	87						398		
1518	16.6	144.6		17.0	156.9	16.7	156.2	16.7	156.2	17.2	153.9	17.2	153.9	22.8	153.9	22.6	158.0	216	164	204	87						444		
1600	16.6	145.7		17.0	156.9	16.7	156.2	16.7	156.2	17.2	153.9	17.2	153.9	22.8	153.9	22.6	158.0	216	164	204	87								
1606	16.7	146.8		17.0	156.9	16.7	156.2	16.7	156.2	17.2	153.9	17.2	153.9	22.8	153.9	22.6	158.0	216	164	204	87								
1612	16.9	147.7		17.0	156.9	16.7	156.2	16.7	156.2	17.2	153.9	17.2	153.9	22.8	153.9	22.6	158.0	216	164	204	87								
1618	17.2	148.5		17.0	156.9	16.7	156.2	16.7	156.2	17.2	153.9	17.2	153.9	22.8	153.9	22.6	158.0	216	164	204	87								
1700	17.6	149.5		19.6	146.2	19.9	148.1	20.0	146.4	19.3	144.5	19.3	144.5	23.2	149.2	24.4	148.2	253	173	254	338								
1706	17.9	150.3		19.8	147.0	20.6	147.1	20.6	147.1	19.9	146.7	19.9	146.7	23.2	149.2	24.4	148.2	245	152	263	263								
1712	18.2	151.0		19.5	148.5	19.6	148.3	19.6	148.3	19.3	146.9	19.3	146.9	21.3	148.8	24.4	151.0	192	186	205	271						404		
1718	18.0	151.5		19.1	150.2	19.1	149.4	19.1	149.4	18.9	150.4	18.9	150.4	21.3	148.8	23.8	152.1	124	134	161	199						384		
1800	17.8	151.9		19.1	150.2	15.2	151.1	15.2	151.1	15.6	153.3	15.6	153.3	22.8	153.9	23.6	154.6	159	152	175	111						359		
1806	17.3	152.3		13.6	156.7	16.7	156.2	16.7	156.2	17.2	153.9	17.2	153.9	22.8	153.9	22.9	155.9	216	164	204	87						398		
1812	16.8	153.1		17.0	156.9	16.7	156.2	16.7	156.2	17.2	153.9	17.2	153.9	22.8	153.9	22.6	158.0	216	164	204	87						444		
1818	16.4	153.7		17.0	156.9	16.7	156.2	16.7	156.2	17.2	153.9	17.2	153.9	22.8	153.9	22.6	158.0	216	164	204	87								
1900	16.2	154.5		17.8	158.3	17.8	157.2	17.8	157.2	18.6	156.4	18.6	156.4	22.1	155.8	22.4	160.5	235	217	180	179						486		
1906	16.0	155.2		18.2	158.6	18.9	157.4	18.9	157.4	19.1	157.4	19.1	157.4	24.8	156.2	22.4	160.5	189	267	210	223						599		
1912	15.9	155.8		19.2	158.0	20.3	158.4	20.3	158.4	19.8	158.1	19.8	158.1	20.5	155.3	25.1	160.3	233	302	279	267						601		
1918	15.8	156.4		18.7	158.7	19.9	157.8	19.9	157.8	20.3	158.4	20.3	158.4	20.1	156.9	22.7	161.5	217	258	242	236						266		
2000	15.8	157.0		19.0	160.0	20.9	159.0	20.9	159.0	19.7	159.3	19.7	159.3	22.6	158.5	21.4	159.0	256	265	318	267						354		
2006	15.8	157.8		19.5	159.5	22.0	158.4	22.0	158.4	20.4	160.9	20.4	160.9	22.9	160.4	21.8	162.4	241	277	373	302						485		
2012	13.8	158.6		19.4	159.0	23.0	158.1	23.0	158.1	21.0	159.3	21.0	159.3	22.4	161.1	22.8	161.1	217	300	432	314						443		
2018	15.9	159.5		20.0	164.0	21.3	160.2	21.3	160.2	19.7	162.4	19.7	162.4	22.4	161.1	22.7	161.1	353	243	326	280						417		
2100	16.0	160.2		19.8	163.0	18.8	163.1	18.8	163.1	18.5	160.9	18.5	160.9	24.3	161.1	23.6	160.8	277	190	234	155						456		
AVERAGE ERROR IN NM =>																													
																			229	219	258	222						451	

TROPICAL STORM POLO
OCTOBER 1-2, 1990

The Central Pacific Hurricane Center (CPHC) in Honolulu inherited rapidly weakening Tropical Storm POLO from the National Hurricane Center (NHC) in Miami as October began (Fig. 4, pg 12). POLO crossed into the central North Pacific near 16N 140W moving on a northwesterly course at 01/0000 UTC. The NHC turned the warning responsibility for POLO over to the CPHC with its 01/0300 UTC bulletin. Maximum sustained winds at this time was estimated at 50 knots. At this point, southwest winds aloft were pulling the upper portion of POLO toward the northeast while at lower levels, the trade wind flow south of the subtropical high was carrying the weakening low level circulation westward and later to the southwest. The shearing process was too much for POLO and at 01/1200 UTC, it was downgraded to a tropical depression. The CPHC issued its final bulletin at 01/1800 UTC on a dissipating POLO far to the southeast of Hawaii (Fig. 11).

Fig. 11



TROPICAL DEPRESSION POLO
1831 UTC 1 October 1990
MAX WINDS - 25 KT

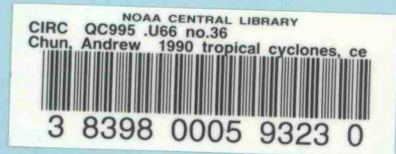
1990 FORECAST VERIFICATION SUMMARY

Forecast Periods
(Average error in nautical miles (NM)/
number of forecasts)

<u>FORECASTER/MODEL</u>	<u>24-HR</u>	<u>36-HR</u>	<u>48-HR</u>	<u>72-HR</u>
CPHC FORECASTER	84/48	124/46	165/44	278/36
EPSS87	83/45	123/43	183/42	290/35
EPAN85	85/44	163/42	240/41	377/31
EPCL84	90/46	132/44	188/44	287/36
EPHC81	75/20	146/19	180/19	236/17
QLM	97/18	148/18	216/17	346/15
HPAC	83/12	N/A	177/10	317/8
OTCM	83/19	N/A	234/17	451/14

The models: EPSS87...a statistical-synoptic model
 EPAN85...a model based on the analog technique
 EPCL84...a model based on persistence and climatology
 EPHC81...a statistical-dynamical model
 QLM.....Quasi-Lagrangian Model
 HPAC.....Half persistence and half climatology
 OTCM.....One-way Interactive Tropical Cyclone Model

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