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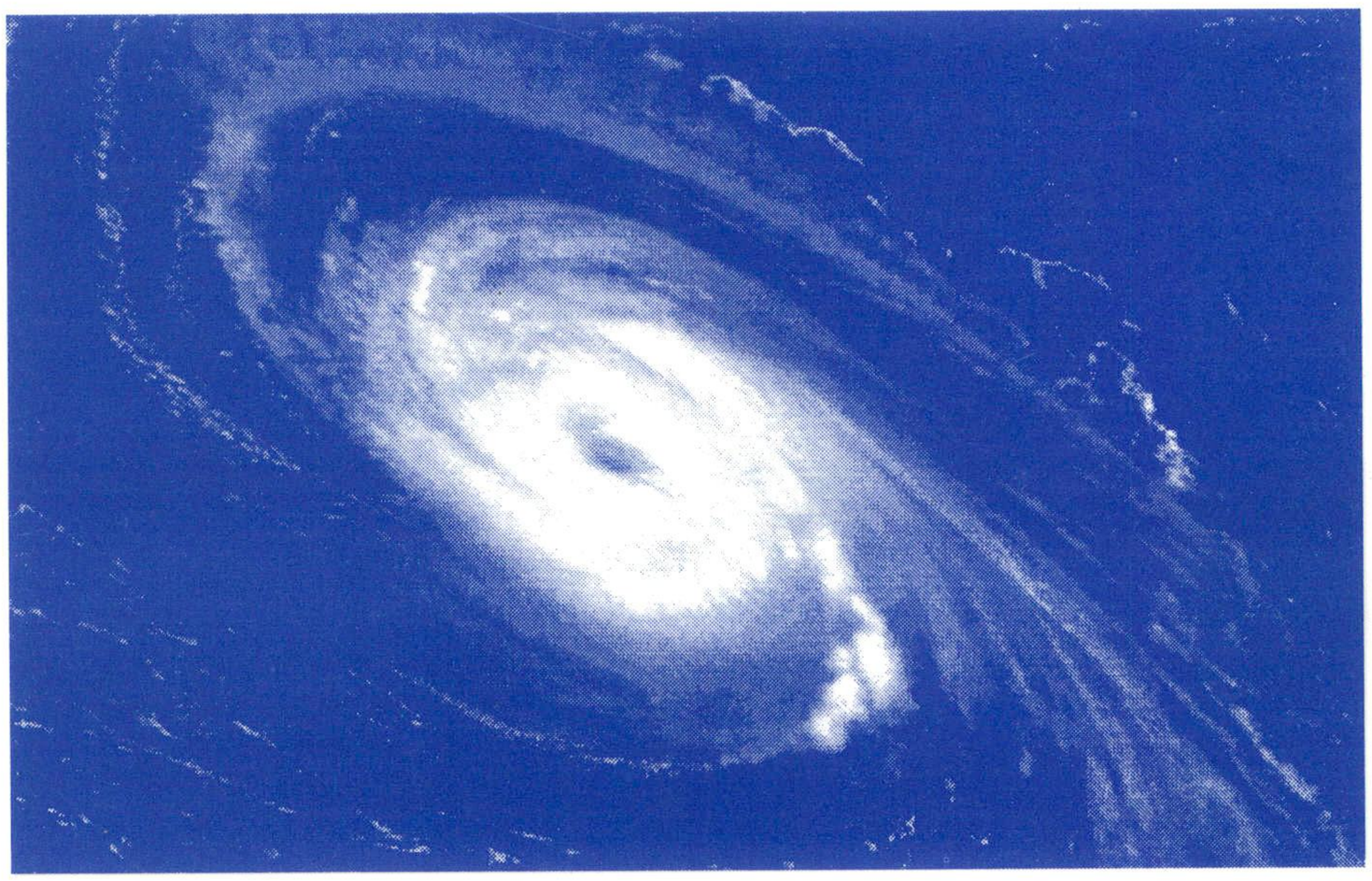
OFFICE OF THE FEDERAL COORDINATOR FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

National Hurricane Operations Plan

FCM-P12-1994



Hurricane Emily - Aug 30, 1993

Washington, DC
May 1994

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CHANGE AND REVIEW LOG

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FOREWORD

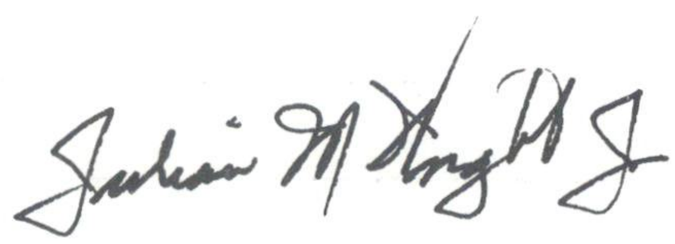
This publication is the 32nd edition of the National Hurricane Operations Plan (NHOP). It is a compilation of the procedures and agreements reached at the 48th Interdepartmental Hurricane Conference (IHC), which was held in Miami, Florida, February 15-18, 1994. Details of the conference can be found in the minutes published by this office.

The conference is sponsored annually by the Working Group for Hurricane and Winter Storms Operations, Committee for Basic Services of the Interdepartmental Committee for Meteorological Services and Supporting Research. It brings together the cognizant Federal agencies to reach agreement on items of mutual interest and concern related to hurricane forecasting and warning services.

All of the chapters in this edition have minor updates or changes. More substantial changes were made to the text, figures and tables in Chapters 5, 6, and 7, which describe aircraft reconnaissance, satellite surveillance, and surface radar reporting to include information on the WSR-88D radar.

Although the 1993 hurricane season had less than the normal number of hurricanes, there were four significant storms that affected the U.S., Mexico, other Central American countries, and the Caribbean coast of South America. Hurricane Emily brushed the North Carolina Outer Banks of the U.S. East Coast. Tropical Storm Bret and Hurricane Gert both caused significant damage and loss of life along the Gulf of Mexico and Caribbean Sea coastal regions of Central and South America. Hurricane Calvin was the largest and most destructive hurricane of the eastern Pacific. It killed 34 people and caused millions of dollars in damage.

The effectiveness of the multi-agency storm warning support system that has evolved over the years is a tribute to the dedication and cooperation of public, private and government individuals and concerns. It is gratifying to see their extensive review and planning efforts blended into the updated National Hurricane Operations Plan each year.



JULIAN M. WRIGHT, JR.
Federal Coordinator for Meteorological
Services and Supporting Research

NATIONAL HURRICANE OPERATIONS PLAN

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CHAPTER 1

INTRODUCTION

1.1. **General**. The tropical cyclone warning service is an interdepartmental effort to provide the United States and designated international recipients with forecasts, warnings, and assessments concerning tropical and subtropical weather systems. The National Oceanic and Atmospheric Administration of the Department of Commerce is responsible for providing forecasts and warnings for the Atlantic and Eastern and Central Pacific Oceans while the Department of Defense provides the same services for the Western Pacific and Indian Ocean (see Figure 1-1). Interdepartmental cooperation achieves economy and efficiency in the operation of the tropical cyclone warning service. This plan provides the basis for implementing agreements of the Department of Commerce, Department of Defense, and the Department of Transportation reached at the annual Interdepartmental Hurricane Conference. The Interdepartmental Hurricane Conference is sponsored by the Committee for Basic Services of the Interdepartmental Committee for Meteorological Services and Supporting Research to bring together cognizant Federal agencies and achieve agreement on items of mutual concern related to the Atlantic and Eastern Pacific tropical cyclone warning services.

1.2. **Scope**. The procedures and agreements contained herein apply to the Atlantic Ocean, Gulf of Mexico, Caribbean Sea, and North Pacific Ocean east of the 180th meridian. This plan is intended to define the role of the individual agencies participating in the tropical cyclone warning service when more than one agency is involved in the delivery of service in any specific area. When a single agency is involved in any specific area, that agency's procedures should be contained in internal documents and, to the extent possible, be consistent with National Hurricane Operations Plan practices and procedures.

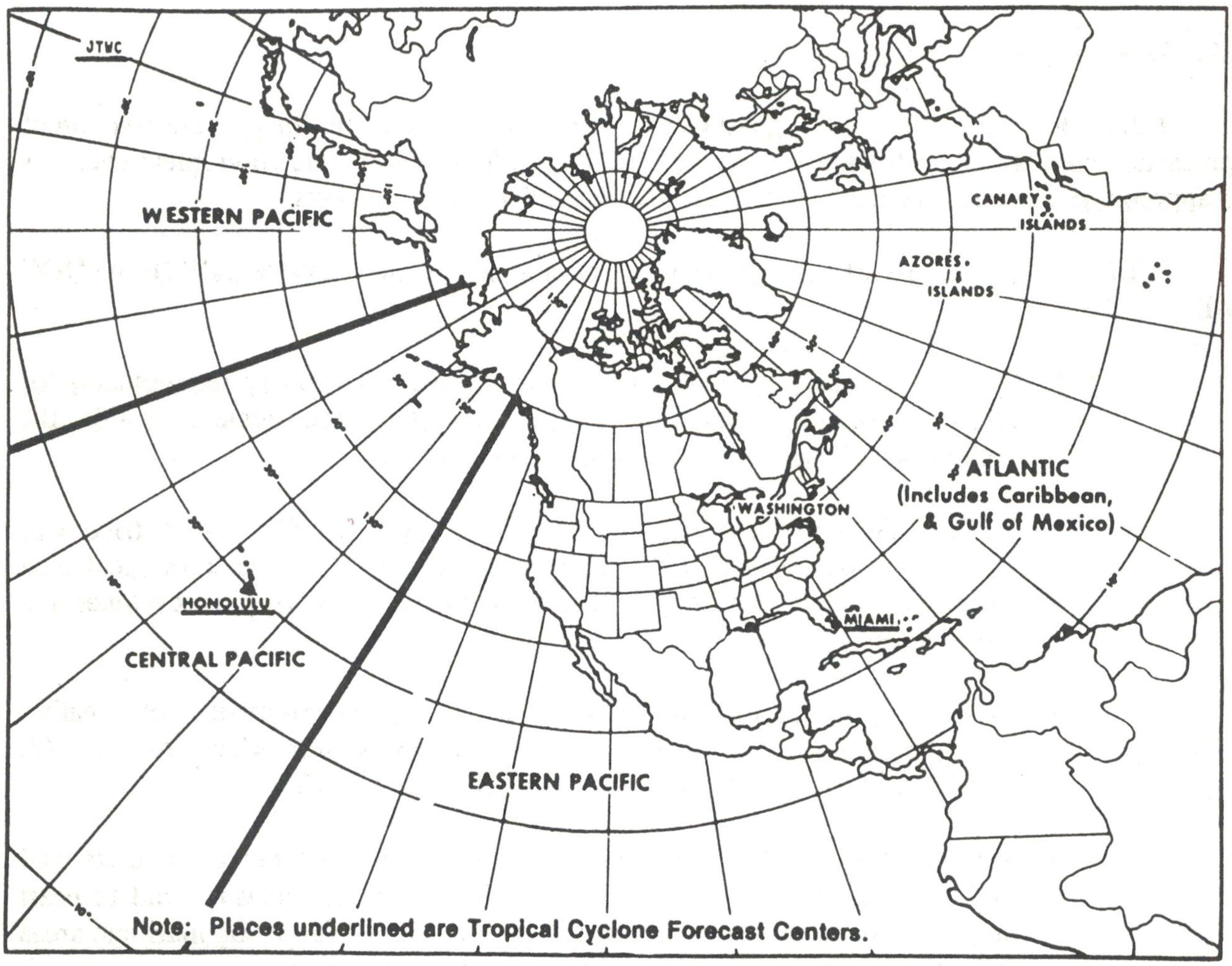

Figure 1-1. Tropical cyclone forecast centers' areas of responsibility

CHAPTER 2

RESPONSIBILITIES OF COOPERATING FEDERAL AGENCIES

2.1. General. The Department of Commerce (DOC), through the National Oceanic and Atmospheric Administration (NOAA), is charged with the overall responsibility to implement a responsive, effective national tropical cyclone warning service. Many local, state, and Federal agencies play a vital role in this system--their cooperative efforts help ensure that necessary preparedness actions are undertaken to minimize loss of life and destruction of property. The joint participation by the Department of Defense (DOD) and the Department of Transportation (DOT) with the DOC brings to bear those limited and expensive Federal resources considered essential for storm detection and accurate forecasting. This cooperative effort has proven to be a cost effective, highly responsive endeavor to meet national requirements for tropical cyclone warning information.

2.2. DOC Responsibilities.

2.2.1. Forecast and Warning Services. The DOC will provide timely dissemination of forecasts, warnings, and all significant information regarding tropical and subtropical cyclones to appropriate agencies, general public, and marine and aviation interests.

2.2.2. Support to DOD. Through NOAA's National Weather Service (NWS), the DOC will

- consult, as necessary, with DOD regarding their day-to-day requirements for cyclone assessments and attempt to meet these requirements within the capabilities of the tropical cyclone warning service.

- prepare, through the National Hurricane Center (NHC), and distribute to DOD, the coordinated DOC reconnaissance and other meteorological data requirements to be provided by DOD on tropical or subtropical cyclones and disturbances.

- provide facilities, administrative support, and dissemination of weather observation data for Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) as agreed to by DOC and DOD.

- provide DOD with basic meteorological information, warnings, forecasts, and associated prognostic reasoning concerning location, intensity, and forecast movement of tropical and subtropical cyclones in the following maritime areas and adjacent states and possessions of the United States:

- Atlantic Ocean (north of the equator including the Caribbean Sea and Gulf of Mexico)--advisories are the responsibility of the Director, NHC, Miami, FL. The NHC will consult with the Naval Atlantic Meteorology and Oceanography Center (NAVLANTMETOCCEN), Norfolk, VA, prior to issuing initial and final advisories and prior to issuing any advisory that indicates a significant change in forecast of intensity or track from the previous advisory. Exchange of information is encouraged on subsequent warnings when significant changes are made or otherwise required.

- Eastern Pacific Ocean (north of the equator and east of 140°W)--advisories are the responsibility of the Director, NHC, Miami, FL. The NHC will consult with the Naval Pacific Meteorology and Oceanography Center (NAVPACMETOCCEN), Pearl Harbor, HI, prior to issuing initial and final advisories and prior to issuing any advisory that indicates a significant change in forecast of intensity or track from the previous advisory. Exchange of information is encouraged on subsequent warnings when significant changes are made or otherwise required.

- Central Pacific Ocean (north of the equator between 140°W and 180°)--advisories are the responsibility of the Director, Central Pacific Hurricane Center (CPHC), Honolulu, HI. The CPHC will consult with the NAVPACMETOCCEN and the 15th Weather Squadron, Hickam AFB, HI, prior to issuing initial and final advisories and prior to issuing any advisory that indicates a significant change in forecast of intensity or track from the previous advisory. Exchange of information is encouraged on subsequent warnings when significant changes are made or otherwise required.

2.2.3. Post-Analysis of Tropical Cyclones. The DOC, through NWS, will conduct an annual post-analysis for all tropical cyclones in the Atlantic and the Pacific regions east of 180° and prepare an annual hurricane report for issue to interested agencies.

2.2.4. Environmental Satellite Systems. The National Environmental Satellite, Data, and Information Service will operate DOC environmental satellite systems capable of providing coverage of meteorological conditions in the tropics during the tropical cyclone season (see Figure 2-1) and monitor and interpret DOC satellite imagery. The DOC will obtain, as necessary, National Aeronautics and Space Administration (NASA) research and development satellite data and DOD operational satellite data for NWS operational use and to comply with NHC and CPHC satellite data requirements.

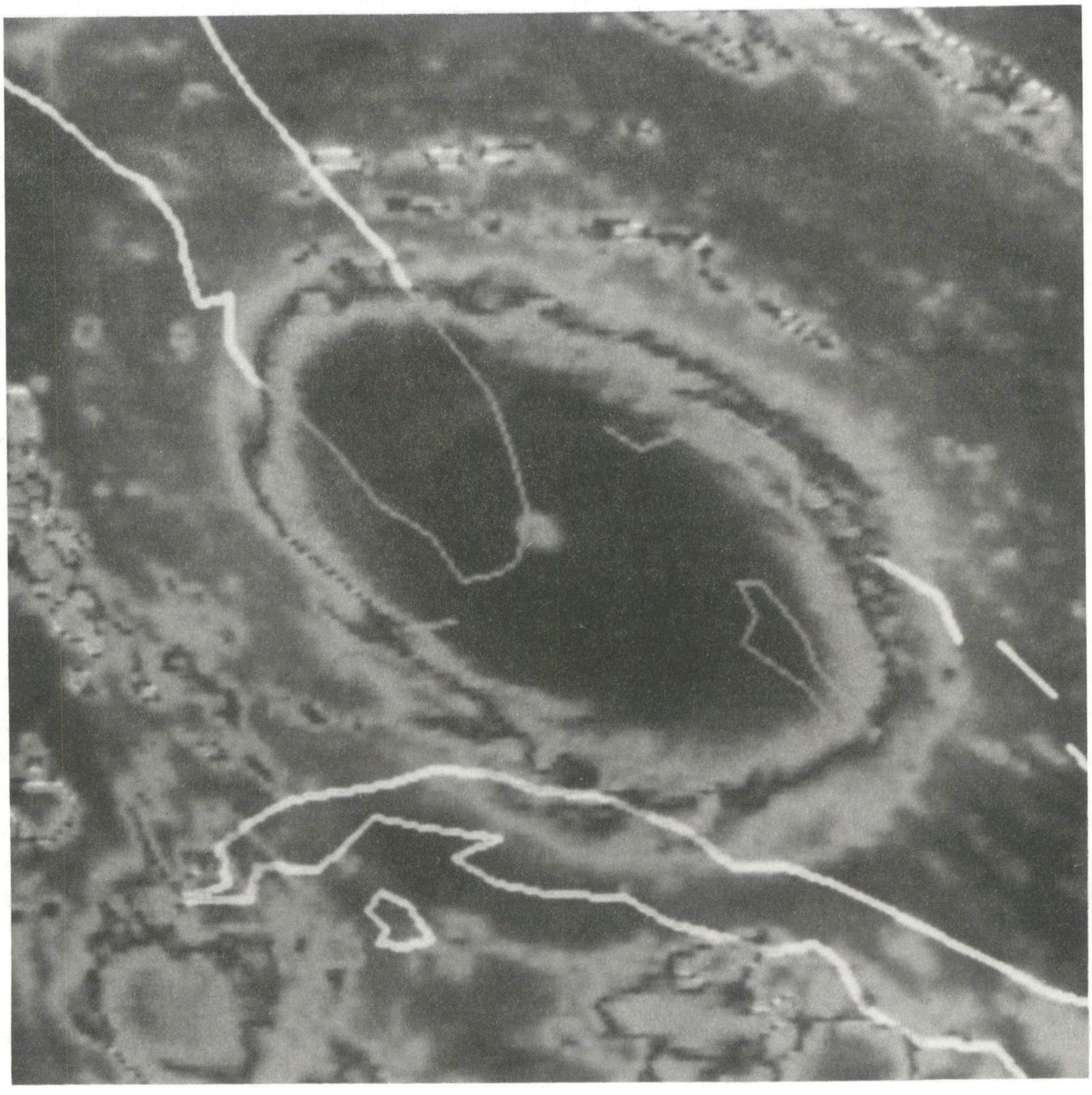

Figure 2-1. Hurricane Andrew, August 24, 1992

2.2.5. Data Buoy Systems. Through the National Data Buoy Center (NDBC), the DOC will develop, deploy, and operate environmental data buoy systems and automated coastal stations to support the data requirements of NHC and CPHC.

2.2.6. Weather Reconnaissance. Through the Office of NOAA Corps Operations (NOAA Corps), DOC will provide weather reconnaissance flights as specified in Chapter 5, unless relieved of these responsibilities by the Administrator of NOAA.

2.3. <u>DOD Responsibilities</u>. The DOD will

- provide NWS with timely dissemination of significant information received regarding tropical and subtropical cyclones.

- provide NHC and CPHC current DOD requirements for tropical and subtropical cyclone advisories.

- meet DOC requirements for aircraft reconnaissance and other special observations as agreed to by DOD and DOC (see Appendix C).

- provide at NHC a 24-hr aircraft operation interface--Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH).

- designate CARCAH as the liaison to NHC and the military point of contact for NHC to request special DOD observations in support of this plan; i.e., Defense Meteorological Satellite Program (DMSP) fixes, additional upper air observations, etc.

- provide access to North American Aerospace Defense Command long-range radar sites (see Chapter 7).

- provide weather reconnaissance data monitor services to evaluate and disseminate reconnaissance reports.

- provide, on an emergency backup basis, through Air Force Global Weather Central, Offutt AFB, NE and 15th Weather Squadron, Hickam AFB, HI, surveillance support with fixes and/or intensity, and gale wind radius estimates to all United States tropical cyclone warning agencies through analysis of satellite imagery obtained primarily from the DMSP system.

2.4. DOT Responsibilities.

2.4.1. Information Dissemination. The DOT will provide NWS with timely dissemination of significant information received regarding tropical and subtropical cyclones.

2.4.2. Flight Assistance. Through the Federal Aviation Administration, the DOT will provide air traffic control, communications and flight assistance services.

2.4.3. U. S. Coast Guard. The DOT will provide the following through the U.S. Coast Guard:

- personnel, vessel, and communication support to the NDBC for development, deployment, and operation of moored environmental data buoy systems.
- surface observations to NWS from its coastal facilities and vessels.
- communications circuits for relay of weather observations to NWS in selected areas.
- coastal broadcast facilities at selected locations for tropical storm or hurricane forecasts and warnings.

2.5. Annual Liaison with Other Nations. The DOD, DOC, and DOT will cooperate in arranging an annual trip to the Caribbean and the Gulf of Mexico area to carry out a continuing and effective liaison of the warning service with the directors of meteorological services, air traffic control agencies, and disaster preparedness agencies of nations in those areas.

2.6. Air Traffic Control/Flight Operations Coordination. The operations officers of the principal flying units, the Assistant Manager, Operations, Air Traffic Control System Command Center, Central Flow Control Facility, Washington, D.C., and the assistant managers for traffic management or assistant manager for military operations, as appropriate, at key Air Route Traffic Control Centers (ARTCC) will maintain a close working relationship on a continuing basis to ensure mission success under actual tropical storm conditions. This will involve visits to each other's facilities, familiarization flights, and telephone and teletype communications to improve the understanding of each other's requirements and capabilities.

2.6.1. Gulf of Mexico Weather Reconnaissance. The 53rd Weather Reconnaissance Squadron and NOAA Corps' Aircraft Operations Center operations officers will maintain a close working relationship with the Air Traffic Control System Command Center, Central Flow Control Facility, the ARTCCs, and the Fleet Aerial Control and Surveillance Facility (FACSFAC) for the coordination of weather reconnaissance flights in the Gulf of Mexico and over the Caribbean Sea in particular, and in the United States in general. The operations officers will

- request the assistance of the appropriate ARTCC/FACSFAC in support of the National Hurricane Operations Plan.

- provide the current operations officer's name and telephone number to the appropriate ARTCC and FACSFAC.

- publish the unit's telephone numbers [Federal Telephone System (FTS)/Defense Switched Network (DSN)/Commercial] and teletype address code for Service B (Appendix H).

2.6.2. Air Traffic Control Assistance. The Air Traffic Control System Command Center, appropriate ARTCCs, and FACSFAC will maintain a close working relationship with the weather reconnaissance units and provide airspace and air traffic control assistance to the extent possible. Those organizations will

- provide the current names and telephone numbers of points of contact to the flying units.

- publish telephone numbers (FTS/DSN/Commercial) and teletype code for Service B (Appendix H).

CHAPTER 3

GENERAL OPERATIONS AND PROCEDURES OF THE NATIONAL WEATHER SERVICE HURRICANE CENTERS

3.1. General. This chapter describes the products, procedures, and communications headers used by the National Hurricane Center (NHC) and the Central Pacific Hurricane Center (CPHC).

3.2. Products.

3.2.1. Tropical Weather Outlook (TWO). Tropical weather outlooks are issued by the NHC and CPHC during their respective hurricane seasons. The NHC writes TWOs in both the Atlantic and Eastern Pacific. They are transmitted at 0530, 1130, 1730, and 2230 Eastern Local Time in the Atlantic and at 0400, 1000, 1600, and 2200 UTC in the Eastern Pacific. In the Central Pacific, TWOs are transmitted by the CPHC at 1000 and 2200 UTC. The outlook briefly describes significant areas of disturbed weather and their potential for tropical cyclone development out to 48 hr. A tropical weather summary of Atlantic and Eastern Pacific tropical cyclone activity will be prepared and issued at the end of each month during the hurricane season.

3.2.2. Tropical Cyclone Discussion.

3.2.2.1. Atlantic and Eastern Pacific. The NHC will issue a tropical cyclone discussion on Atlantic tropical cyclones at 0330, 0930, 1530, and 2130 UTC, and on Eastern Pacific tropical cyclones at 0230, 0830, 1430, and 2030 UTC. Discussions will be disseminated for intergovernmental use only and will contain preliminary prognostic positions and maximum wind speed forecasts up to 72 hr; will describe objective techniques, synoptic features, and climatology used; and will provide reasons for track changes.

3.2.2.2. Central Pacific. The CPHC will issue a tropical cyclone discussion twice daily not later than 0330 and 1530 UTC. The discussions will describe objective techniques, synoptic features, and climatology used and will provide reasons for track changes.

3.2.3. Public Advisories. Public advisories are issued by the NHC for all tropical cyclones in the Atlantic. In the Eastern Pacific, public advisories are issued by NHC for tropical cyclones that are expected to affect land within 48 hr. In the Central Pacific, public advisories are issued by CPHC for all tropical cyclones within the area of responsibility. Scheduled public advisories are issued at the same time scheduled marine advisories are issued. However, when NHC is issuing advisories every 3 hours in the Atlantic, the 0400 UTC public advisory will be issued at 0230 UTC to ensure that the latest information is available for the heavily-watched evening local news shows. Watch and warning break points are listed in Table 3-1.

[NOTE: Public advisories use statute miles for distance and miles per hour for speed. Nautical miles and knots may be added at the discretion of the centers.]

Table 3-1. Watch and warning break points

1. Brownsville, TX
2. Port Mansfield, TX
3. Baffin Bay, TX
4. Corpus Christi, TX
5. Port Aransas, TX
6. Port O'Connor, TX
7. Matagorda, TX
8. Freeport, TX
9. High Island, TX
10. Port Arthur, TX
11. Sabine Pass, TX
12. Cameron, LA
13. Morgan City, LA
14. Grand Isle, LA
15. Mouth of Mississippi River, LA
16. Mouth of Pearl River, LA
17. Gulfport, MS
18. Mobile, AL
19. Pensacola, FL
20. Fort Walton Beach, FL
21. Panama City, FL
22. Apalachicola, FL
23. Ochlockonee River, FL
24. St. Marks, FL
25. Aucilla River, FL
26. Steinhatchee River, FL
27. Suwannee River, FL
28. Cedar Key, FL
29. Yankeetown, FL
30. Bay Port, FL
31. Anclote Key, FL
32. Longboat Key, FL
33. Venice, FL
33. Boca Grande, FL
35. Fort Myers Beach, FL
36. Bonita Beach, FL
37. Everglades City, FL
38. Flamingo, FL
39. Seven Mile Bridge, FL
40. Craig Key, FL
41. Key Largo, FL
42. Hallandale, FL
43. Deerfield Beach, FL
44. Boynton Beach, FL
45. Lake Worth, FL
46. Jupiter Inlet, FL
47. Stuart, FL
48. Fort Pierce, FL
49. Vero Beach, FL
50. Sebastian Inlet, FL
51. Cocoa Beach, FL
52. Titusville, FL
53. New Smyrna Beach, FL
54. St. Augustine, Fl
55. Fernandina Beach, FL
56. Brunswick, GA (Atlamaha Sound)
57. Savannah, GA [GA/SC Border and Southern Extent of Coastal Waters Forecast (CWF)]
58. Edisto Beach, SC
59. Cape Romain, SC
60. Little River Inlet, SC (Northern Extent of Columbia CWF and Southern Extent of Raleigh CWF)
61. Cape Fear, NC
62. Topsail Beach, NC
63. Bogue Inlet, NC
64. Cape Lookout, NC
65. Ocracoke Inlet, NC
66. Cape Hatteras, NC
67. Oregon Inlet, NC (The inclusion of Pamlico and Albemarle Sounds should be on a case-by-case basis.)
68. Virginia Beach, VA (Northern Extent of Raleigh CWF and Southern Extent of Washington CWF)
69. Chicoteague, VA
70. Cape Henlopen, DE (Northern Extent of Washington CWF and Southern Extent of Philadelphia CWF)
(The inclusion of Chesapeake Bay and the Tidal Potomac should be on a case-by-case basis.)
71. Manasquan, NJ (Northern Extent of Philadelphia CWF and Southern Extent of New York CWF)
(The inclusion of Delaware Bay should be on a case-by-case basis.)
72. Fire Island Inlet, Long Island, NY
73. Shinnecock Inlet, Long Island, NY
74. Montauk Point, Long Island, NY
75. Port Jefferson Harbor, Long Island, NY
76. New Haven, CT
77. Watch Hill, RI (Northeastern Extent of New York CWF and Southwestern Extent of Boston CWF)
78. Point Judith, RI
79. Woods Hole, MA
80. Chatham, MA
81. Plymouth, MA
82. Gloucester, MA
83. Merrimack River, MA (Northern Extent of Boston CWF and Southern Extent of Portland CWF)
84. Portsmouth, NH
85. Portland, ME
86. Rockland, ME
87. Bar Harbor, ME
88. Eastport, ME

3.2.4. Marine Advisories. Marine advisories are issued by the NHC and the CPHC. See Section 4.3 for content and format of the advisories. Marine advisories will be transmitted to high-seas shipping according to the details found in Worldwide Marine Weather Broadcasts, jointly published by the U.S. Navy and National Weather Service. In both the Atlantic and Pacific, the advisories are scheduled for 0300, 0900, 1500, and 2100 UTC. Pacific advisories should be transmitted 15 min before the effective time.

3.2.5. Probability of Hurricane/Tropical Storm Conditions.

3.2.5.1. When Issued. The probability of hurricane/tropical storm conditions shall be issued in tabular form at the regular scheduled public and marine advisory times and when public advisories are issued. These probabilities will generally be carried for all named storms in the Atlantic Basin [1] forecast to be within 72 hurs of landfall. In addition, NHC may issue probabilities for tropical depressions forecast to become named storms and be a threat to land within 72 hours. When a tropical cyclone is forecast to track parallel to a coastline, maximum values over water points should be included, and the public advisory should state that the highest probabilities are over water. The 72-hour cumulative probabilities of less than 5 percent are not included in the transmitted probability tables.

3.2.5.2. When Computed. The probabilities, which are based on the official forecast track, should be issued when the 72-hour forecast position approaches the coast and should be carried in advisories until the storm makes landfall. The only two conditions in which probability information should not be issued are: (1) the hurricane/tropical storm has made landfall and is not expected to re-emerge over water and/or (2) the computed probability values are not significant. NHC may discontinue issuance of probabilities earlier if other factors arise, such as difficulties with evacuation orders, etc. At the discretion of the hurricane forecaster, probabilities need not be listed for sites where the tropical storm or hurricane would likely be over land or less than tropical storm strength at the time of affecting the site. NHC may include a brief explanation of probabilities in the advisory.

These probabilities should be computed shortly after synoptic times for the 0-24, 24-36, 36-48, and 48-72 hours. A total probability for the next 72 hours should be shown in the last column and should represent a total of all forecast periods. The probability of the storm striking a coastal location within 48 hours may be determined by adding the 0-24, 24-36, and 36-48 hour probabilities. If the probability for a location is less than 1 percent, an "X" will be indicated in the table. If probabilities are not to be issued, a statement will be included in both the public and marine advisory. Refer to Probability of Hurricane/Tropical Storm Conditions: A User's Manual for further information.

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[1] Atlantic Basin includes the Atlantic, Caribbean and Gulf of Mexico

3.2.5.3. Locations. When appropriate, specific probabilities will be computed for the following locations:

Brownsville, TX	
West Palm Beach, FL	
Corpus Christi, TX	Fort Pierce, FL
Port O'Connor, TX	Cocoa Beach, FL
Galveston, TX	Daytona Beach, FL
Port Arthur, TX	Jacksonville, FL
New Iberia, LA	Savannah, GA
New Orleans, LA	Myrtle Beach, SC
Buras, LA	
Charleston, SC	
Gulfport, MS	Wilmington, NC
Mobile, AL	
Cape Hatteras, NC	
Pensacola, FL	Ocean City, MD
Panama City, FL	Atlantic City, NJ
Apalachicola, FL	Norfolk, VA
St. Marks, FL	New York City, NY
Cedar Key, FL	Montauk Point, NY
Tampa, FL	Providence, RI
Venice, FL	Nantucket, MA
Fort Myers, FL	Hyannis, MA
Marco Island, FL	Boston, MA
Key West, FL	Portland, ME
Marathon, FL	Bar Harbor, ME
Miami, FL	Eastport, ME
29°N85°W	28°N93°W
29°N87°W	27°N96°W
28°N95°W	28°N91°W
28°N89°W	25°N97°W

Probabilities are not issued for the West Coast or Hawaii

3.2.6. Tropical Cyclone Updates. Tropical cyclone updates are brief statements in lieu of or preceding special advisories to inform of significant changes in a tropical cyclone or the posting or cancelling of watches and warnings.

3.2.7. Atlantic and Gulf of Mexico Tropical Cyclone Position Estimates. The NHC may also issue hourly tropical cyclone position estimates when the tropical cyclone is under effective surveillance and within 200 nmi of land-based radar. These estimates, when issued, will be prepared a short time before each hour except at hours when advisories are issued.

Position estimates disseminated to the public, DOD, and other Federal agencies will provide geographical positions in latitude and longitude and also by distance and direction from a well-known point.

3.2.8. Special Tropical Disturbance Statement. Special tropical disturbance statements may be issued to furnish information on strong formative, non-depression systems.

3.2.9. Storm Summaries. Storm summaries are written by the National Meteorological Center (NMC) after subtropical and tropical cyclones have moved inland and public advisories have been discontinued. Storm summaries will continue to be numbered in sequence with public advisories on named storms. Also, these summaries will reference the former storm's name and be issued as long as the remnants of the storm remain a serious flooding threat. Storm summaries will be transmitted at 0500, 1100, 1700, and 2300 UTC.

3.2.10. Satellite Interpretation Message. These are issued four times a day by the NHC and the NMC in Washington to describe synoptic features and significant weather areas. Federal Aviation Administration contractions are used.

3.2.11. Tropical Weather Discussion. These are issued four times a day by the NHC. They describe significant features from the latest surface analysis and significant weather areas for the Gulf of Mexico, the Caribbean, and between the equator and 32°N in both the Atlantic and Eastern Pacific east of 140°W. Plain language is used.

3.2.12. Tropical Disturbance Rainfall Estimates. As required, the NHC /CPHC issues satellite based rainfall estimates, as calculated by the NMC Heavy Precipitation Unit (HPU), for tropical disturbances and tropical cyclones within 36 hr of expected landfall for the Caribbean, the Bahamas and both coasts of Mexico.

3.3. Designation of Tropical and Subtropical Cyclones.

3.3.1. Numbering of Tropical and Subtropical Depressions.

3.3.1.1. Atlantic, Caribbean, and Gulf of Mexico. Depression numbers, ONE, TWO, THREE, will be assigned by the NHC after advising the Naval Atlantic Meteorology and Oceanography Center (NAVLANTMETOCCEN) Norfolk.

3.3.1.2. Pacific East of 140°W. Depression numbers, with the suffix E, e.g., ONE-E, TWO-E, THREE-E, will be assigned by the NHC after advising the Naval Pacific Meteorology and Oceanography Center (NAVPACMETOCCEN), Pearl Harbor. The assigned identifier shall be retained even if the depression passes into another warning area.

3.3.1.3. Pacific West of 140°W and East of 180°. Depression numbers, with suffix C, e.g., ONE-C, TWO-C, THREE-C, will be assigned by the Central Pacific Hurricane Center (CPHC) after advising the NAVPACMETOCCEN, Pearl Harbor.

3.3.1.4. Subtropical Depressions. The numbering of subtropical cyclones shall follow the same procedure as above except a separate consecutive numbering sequence beginning with "ONE" shall be used for subtropical depressions and continues in effect if the system strengthens into a subtropical storm.

3.3.2. Naming of Tropical and Subtropical Storms and Hurricanes.

3.3.2.1. Atlantic and Eastern Pacific. Once the depression has reached tropical storm strength, it shall be named and the depression number will be dropped. If a subtropical cyclone becomes a tropical storm or hurricane, it receives the next available name in the tropical storm naming sequence. A different set of names will be used each year. After a set is used, it will drop to the end of the list to be used again in 6 years. Names of significant hurricanes will be retired and replaced. Lists of Atlantic and Eastern Pacific names are provided in Tables 3-2 and 3-3, respectively.

3.3.2.2. Central Pacific. When a tropical depression intensifies into a tropical storm or hurricane between 140°W and 180°, the depression number will be discontinued and replaced by an appropriate name. The CPHC will select the name from the list of Central Pacific names in Table 3-4. All of the names listed in each column, beginning with column 1, will be used before going on to the next column.

3.3.2.3. Western Pacific. For the Pacific west of 180°, tropical storms and typhoons are named by the Joint Typhoon Warning Center (JTWC), Guam. The names listed in Table 3-5 are for information only.

3.4. Transfer of Warning Responsibility.

3.4.1. NHC to CPHC. When a tropical or subtropical cyclone approaches 140°W, the coordinated transfer of warning responsibility from the NHC to the CPHC will be made and the appropriate advisory issued.

3.4.2. CPHC to JTWC. When a tropical or subtropical cyclone crosses 180°from east to west, the coordinated transfer of warning responsibility from CPHC to JTWC through NAVPACMETOCCEN, Pearl Harbor, will be made and the appropriate advisory issued.

3.4.3. JTWC to CPHC. When a tropical or subtropical cyclone crosses 180° from west to east, the coordinated transfer of warning responsibility from JTWC to CPHC will be made through NAVPACMETOCCEN, Pearl Harbor. The JTWC will append the statement, "Next advisory by CPHC-HNL" to their last advisory.

Table 3-2. Atlantic tropical cyclone names

1994		1995		1996	
ALBERTO	al-BAIR-to	ALLISON		ARTHUR	
BERYL	BURL	BARRY		BERTHA	BUR-tha
CHRIS		CHANTAL	shan-TAL	CESAR	say-ZAR
DEBBY		DEAN		DOLLY	
ERNESTO	er-NES-to	ERIN	AIR-in	EDOUARD	eh-DWARD
FLORENCE		FELIX	FEEL-ix	FRAN	
GORDON		GABRIELLE	gay-bree-EL	GUSTAV	GOO-stahv
HELENE	he-LEEN	HUMBERTO	oom-BAIR-toe	HORTENSE	HOR-tense
ISAAC	EYE-sak	IRIS	EYE-ris	ISIDORE	IS-i-door
JOYCE		JERRY		JOSEPHINE	JO-ze-feen
KEITH		KAREN		KYLE	KILE
LESLIE		LUIS	loo-EES	LILI	LIL-ee
MICHAEL	MIKE-el	MARILYN		MARCO	
NADINE	nay-DEEN	NOEL		NANA	NAN-uh
OSCAR		OPAL		OMAR	
PATTY		PABLO	PA-blow	PALOMA	pa-LOW-ma
RAFAEL	ra-fe-EL	ROXANNE	rocks-ANN	RENE	re-NAY
SANDY		SEBASTIEN	say-BAS-tyan	SALLY	
TONY		TANYA	TAHN-ya	TEDDY	
VALERIE		VAN		VICKY	
WILLIAM		WENDY		WILFRED	

1997		1998		1999	
ANA		ALEX		ARLENE	
BILL		BONNIE		BRET	
CLAUDETTE	claw-DET	CHARLEY		CINDY	
DANNY		DANIELLE	dan-YELL	DENNIS	
ERIKA	ERR-re-ka	EARL		EMILY	
FABIAN	FAY-bee-in	FRANCES		FLOYD	
GRACE		GEORGES	ZHORZH	GERT	
HENRI	ahn-REE	HERMINE	her-MEEN	HARVEY	
ISABELL	IS-a-bel	IVAN	I-van	IRENE	
JUAN	WAN	JEANNE	JEEN	JOSE	ho-ZAY
KATE		KARL		KATRINA	ka-TREE-na
LARRY		LISA	LEE-sa	LENNY	
MINDY		MITCH		MARIA	ma-REEH-ah
NICHOLAS	NIK-o-las	NICOLE	ni-COLE	NATE	
ODETTE	o-DET	OTTO		OPHELIA	oh-FEEL-ya
PETER		PAULA		PHILIPPE	fe-LEEP
ROSE		RICHARD	RICH-erd	RITA	
SAM		SHARY	SHA-ree	STAN	
TERESA	te-REE-sa	TOMAS	to-MAS	TAMMY	
VICTOR	VIC-ter	VIRGINIE	vir-JIN-ee	VINCE	
WANDA		WALTER		WILMA	

Table 3-3. Eastern Pacific tropical cyclone names

1994		1995		1996	
ALETTA	ah LET ah	ADOLPH		ALMA	AL mah
BUD		BARBARA		BORIS	
CARLOTTA		COSME	COS may	CRISTINA	
DANIEL		DALILA	da LEE luh	DOUGLAS	
EMILIA	ee MIL ya	ERICK		ELIDA	ELL ee dah
FABIO	FAH bee o	FLOSSIE		FAUSTO	FOW sto
GILMA	GIL mah	GIL		GENEVIEVE	
HECTOR		HENRIETTE	hen ree ETT	HERNAN	her NAHN
ILEANA	ay AH nah	ISMAEL	eee mah EL	ISELLE	ee SELL
JOHN		JULIETTE		JULIO	HOO lee o
KRISTY		KIKO	KEE ko	KENNA	
LANE		LORENA	low RAY na	LOWELL	
MIRIAM		MANUEL	mahn WELL	MARIE	
NORMAN		NARDA		NORBERT	
OLIVIA		OCTAVE	AHK tave	ODILE	oh DEAL
PAUL		PRISILLA		POLO	
ROSA		RAYMOND		RACHEL	
SERGIO	SIR gee oh	SONIA	SONE yah	SIMON	
TARA		TICO	TEE koh	TRUDY	
VICENTE	vee CEN tay	VELMA		VANCE	
WILLA		WALLIS		WINNIE	
XAVIER	ZAY vier	XINA	ZEE nah	XAVIER	ZAY vier
YOLANDA	yo LAHN da	YORK		YOLANDA	yo LAHN da
ZEKE		ZELDA	ZEL dah	ZEKE	

1997		1998		1999	
ANDRES	ahn DRASE	AGATHA		ADRIAN	
BLANCA	BLAHN kah	BLAS		BEATRIZ	BEE a triz
CARLOS		CELIA		CALVIN	
DOLORES		DARBY		DORA	
ENRIQUE	anh REE kay	ESTELLE		EUGENE	
FELICIA	Fay LISH ee ya	FRANK		FERNANDA	fer NAN dah
GUILLERMO	gee YER mo	GEORGETTE		GREG	
HILDA		HOWARD		HILARY	
IGNACIO	eeg NAH cio	ISIS	EYE sis	IRWIN	
JIMENA	he MAY na	JAVIER	ha VEEAIR	JOVA	HO vah
KEVIN		KAY		KENNETH	
LINDA		LESTER		LIDIA	
MARTY		MADELINE		MAX	
NORA		NEWTON		NORMA	
OLAF	OH lahf	ORLENE	or LEAN	OTIS	
PAULINE		PAINE		PILAR	
RICK		ROSLYN		RAMON	rah MON
SANDRA		SEYMOUR		SELMA	
TERRY		TINA		TODD	
VIVIAN		VIRGIL		VERONICA	
WALDO		WINIFRED		WILEY	
XINA	ZEE nah	XAVIER	ZAY vier	XINA	ZEE nah
YORK		YOLANDA	yo LAHN da	YORK	
ZELDA	ZEL dah	ZEKE		ZELDA	ZEL dah

If over 24 tropical cyclones occur in a year, the Greek alphabet will be used following ZEKE or ZELDA.

Table 3-4. Central Pacific tropical cyclone names

COLUMN 1		COLUMN 2		COLUMN 3		COLUMN 4	
Name	Pronunciation	Name	Pronunciation	Name	Pronunciation	Name	Pronunciation
AKONI	ah-KOH-nee	AKA	AH-kah	ALIKA	ah-LEE-kah	ANA	AH-nah
EMA	EH-mah	EKEKA	eh-KEH-kak	ELE	EH-leh	ELA	EH-lah
HANA	HAH-nah	HALI	HAH-lee	HUKO	HOO-koh	HALOLA	hah-LOH-lah
IO	EE-oo	IOLANA	ee-OH-lah-nah	IOKE	ee-OH-keh	IUNE	ee-OO-neh
KELI	KEH-lee	KEONI	keh-OH-nee	KIKA	KEE-kah	KIMO	KEE-moh
LALA	LAH-lah	LI	LEE	LANA	LAH-nah	LOKE	LOH-keh
MOKE	MOH-keh	MELE	MEH-leh	MAKA	MAH-kah	MALIA	mah-LEE-ah
NELE	NEH-leh	NONA	NOH-nah	NEKI	NEH-kee	NIALA	nee-AH-lah
OKA	OH-kah	OLIWA	oh-LEE-vah	OLEKA	oh-LEH-kah	OKO	OH-koh
PEKE	PEH-keh	PAKA	PAH-kah	PENI	PEH-nee	PALI	PAH-lee
ULEKI	oo-LEH-kee	UPANA	oo-PAH-nah	ULIA	oo-LEE-ah	ULIKA	oo-LEE-kah
WILA	VEE-lah	WENE	WEH-neh	WALI	WAH-lee	WALAKA	wah-LAH-kah

NOTE: Use Column 1 list of names until exhausted before going to Column 2, etc., All letters in the Hawaiian language are pronounced, including double or triple vowels.

Table 3-5. Western Pacific tropical cyclone names

COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4
ANGELA	ABE	AMY	AXEL
BRIAN	BECKY	BRENDAN	BOBBIE
COLLEEN	CECIL	CAITLIN	CHUCK
DAN	DOT	DOUG	DEANNA
ELSIE	ED	ELLIE	ELI
FORREST	FLO	FRED	FAYE
GAY	GENE	GLADYS	GARY
HUNT	HATTIE	HARRY	HELEN
IRMA	IRA	IVY	IRVING
JACK	JEANA	JOEL	JANIS
KORYN	KYLE	KINNA	KENT
LEWIS	LOLA	LUKE	LOIS
MARIAN	MANNY	MELISSA	MARK
NATHAN	NELL	NAT	NINA
OFELIA	OWEN	ORCHID	OSCAR
PERCY	PAGE	PAT	POLLY
ROBYN	RUSS	RUTH	RYAN
STEVE	SHARON	SEITH	SIBYL
TASHA	TIM	TERESA	TED
VERNON	VANESSA	VERNE	VAL
WINONA	WALT	WILDA	WARD
YANCY	YUNYA	YURI	YVETTE
ZOLA	ZEKE	ZELDA	ZACK

NOTE: Names will be assigned in rotation, alphabetically. When the last name, ZACK, has been used the sequence will begin again with ANGELA. This entire list was updated at the 1994 Tropical Cyclone Conference.

3.5. Alternate Warning Responsibilities.

3.5.1. Transfer to Alternate. In the event of impending or actual operational failure of a hurricane forecast center, tropical warning responsibilities will be transferred to an alternate facility in accordance with existing directives and retained there until resumption of responsibility can be made. Alternate facilities are as follows:

PRIMARY	ALTERNATE
NHC	National Meteorological Center, Meteorological Operations Division Washington, DC
CPHC	NHC
CARCAH	53rd Weather Reconnaissance Squadron (53WRS)
JTWC	NAVPACMETOCCEN

3.5.2. Notification. The NAVLANTMETOCCEN, Norfolk, and NAVPACMETOCCEN, Pearl Harbor, will be advised by the NHC; Chief, Aerial Reconnaissance Coordinator, all Hurricanes (CARCAH); and CPHC, as appropriate, of impending or actual transfer of responsibility by the most rapid means available. The NAVPACMETOCCEN, Pearl Harbor, will advise CPHC and NHC of impending or actual transfer of JTWC responsibilities. In the event of an operational failure of CARCAH, direct communication is authorized between 53WRS and the forecast facility. Contact 53WRS at DSN 597-2409/COM 601-377-2409 or through the Keesler AFB Command AFB Command Post at DSN 597-4330/COM 601-377-4330 (ask for the 53WRS).

3.6. Abbreviated Communications Headings.

Abbreviated communications headings are assigned to advisories on tropical and subtropical cyclones and other advisories based on depression numbers or storm name and standard communication procedures.

[NOTE: An abbreviated heading consists of three groups with ONE space between each of the groups. The first group contains a data type indicator (e.g., WT for hurricane), a geographical indicator (e.g., NT for National Hurricane Center), and a number. The second group contains a location identifier of the message originator (e.g., KNHC for National Hurricane Center). The third group is a date-time group in UTC. An example of a complete header is:
WTNT31 KNHC 180400.]

Abbreviated communication headers for the areas of responsibility follow:

3.6.1. Atlantic.

ABNT20 KNHC	Tropical Weather Outlook
ABNT30 KNHC	Tropical Weather Summary (monthly)
WTNT41-45 KNHC	Tropical Cyclone Discussion
WTNT31-35 KNHC	Public Advisory
WTNT21-25 KNHC	Marine Advisory
WTNT61 KNHC	Tropical Cyclone Update
WTNT51 KNHC	Tropical Cyclone Position Estimate
WONT41 KNHC	Special Tropical Disturbance Statement
WTXX90 KNHC	Tropical Cyclone Discussion for WMO Region IV Stations

3.6.2. Eastern and Central Pacific.

3.6.2.1. Advisories. All advisories on hurricanes, tropical storms, and depressions are under WT abbreviated headings, as follows:

ABPZ30 KNHC	Tropical Weather Summary
ABPA30 PHNL	Tropical Weather Summary
WTPZ21-25 KNHC	Marine Advisory
WTPA21-25 PHNL	Marine Advisory
WTPZ31-35 KNHC	Public Advisory
WTPA31-35 PHNL	Public Advisory

3.6.2.2. Numbering. Depressions are numbered internally and storms are named internally, but the number in the abbreviated headings does not relate to either the internal number of the depression or the name of the storm. The first cyclone would have 21 and 31 in the abbreviated headings, the second cyclone would have 22 and 32, the sixth cyclone would have 21 and 31, etc. The abbreviated heading would not change when a depression was upgraded to storm status.

ABPA20 PHNL	Tropical Weather Outlook
ABPZ20 KNHC	Tropical Weather Outlook
WTPZ41-45 KNHC	Tropical Cyclone Discussion
WTPA41-45 PHNL	Tropical Cyclone Discussion
WTPZ51 KNHC	Tropical Cyclone Position Estimate
WTPA51 PHNL	Tropical Cyclone Position Estimate
WTPZ61 KNHC	Tropical Cyclone Update
WTPA61 PHNL	Tropical Cyclone Update
WOPZ41 KNHC	Special Tropical Disturbance Statement
WOPA41 PHNL	Special Tropical Disturbance Statement

CHAPTER 4

NATIONAL WEATHER SERVICE PRODUCTS FOR THE DEPARTMENT OF DEFENSE

4.1. General. The Department of Defense (DOD) and the Department of Commerce (DOC) weather forecasting, reconnaissance, and distribution agencies share technical information and some responsibilities. Mutually supportive relationships have developed over the years and have resulted in a mutual dependency. Due to the nature and distribution of DOD resources and operations, the DOD requires certain meteorological information beyond that available to the general public. Accordingly, the DOC provides DOD with special observations and advisories on tropical and subtropical storms threatening DOD resources or operations.

4.2. Observations. The National Hurricane Center (NHC) and Central Pacific Hurricane Center (CPHC) will make available to DOD all significant tropical and subtropical cyclone observations that they receive.

4.3. Marine Advisories.

4.3.1. General. The NHC and CPHC will provide to DOD forecasts and related information for tropical and subtropical weather disturbances of depression intensity or greater. Forecasts will include advice as to location, movement, intensity, and dimension of the disturbances. Marine advisories will be disseminated through the National Weather Service (NWS) communications facility at Suitland, MD, to the Automatic Digital Weather Switch (ADWS) hub at Tinker AFB, OK, for further relay to DOD agencies. The DOD forecasters, who must give advice concerning an imminent operational decision, may contact the appropriate hurricane center forecaster (see Chapter 2) when published marine advisories require elaboration. Telephone numbers for the hurricane centers are in Appendix H.

4.3.2. Marine Advisory Issue Frequency. The first marine advisory will normally be issued when meteorological data indicate that a tropical or subtropical cyclone has formed. Subsequent advisories will be issued at 0300, 0900, 1500, and 2100 UTC from NHC and CPHC. Advisories will continue to be issued until the system degenerates below depression level. In addition, special advisories will be issued whenever the following criteria are met:

- a signicant change has occurred, requiring the issuance of a revised forecast package or

- conditions require a hurricane or tropical storm watch or warning to be issued

Remarks stating the reason for the special advisory or the relocation will be mandatory in all special advisories or advisories that include a relocated position.

[NOTE: Tropical cyclone updates are permitted without the requirement of a special advisory, including when coastal warnings are cancelled. However, in some cases a special advisory may follow.]

4.3.3. Marine Advisory Content. Marine advisories will contain appropriate information as shown in Figure 4-1. Advisories will contain 12-hr and 24-hr forecasts and 36-hr, 48-hr, and 72-hr outlooks valid from times based on the latest 6-hourly synoptic time.

4.3.4. Numbering of Advisories. All advisories will be numbered sequentially; e.g.,

Advisory Number 1 on Tropical Depression ONE
Advisory Number 2 on Tropical Depression ONE
Advisory Number 3 on Tropical Storm Anita
Advisory Number 4 on Hurricane Anita
Advisory Number 5 on Tropical Depression Anita.

The NHC and CPHC will append an alphabetic designator for intermediate advisories (e.g., 20A).

ZCZC MIATCMAT3 ALL
TTAA00 KNHC DDHHMM
HURRICANE BOB MARINE ADVISORY NUMBER 12
NATIONAL WEATHER SERVICE MIAMI FL
2200Z SUN AUG 18 1991

AT 6 PM EDT...HURRICANE WARNINGS ARE EXTENDED NORTH AND EASTWARD FROM CAPE HENLOPEN DELAWARE THROUGH PLYMOUTH MASSACHUSETTS. THE WARNING AREA INCLUDES LONG ISLAND...LONG ISLAND SOUND...CONNECTICUT EAST OF NEW HAVEN...AND CAPE COD. HURRICANE WARNINGS NOW EXTEND FROM LITTLE RIVER INLET NORTH CAROLINA TO PLYMOUTH MASSACHUSETTS.

TROPICAL STORM WARNINGS ARE EXTENDED TO INCLUDE DELAWARE BAY...AND CONTINUE FOR THE LOWER CHESAPEAKE BAY SOUTH OF THE MOUTH OF PATUXENT RIVER INCLUDING THE GREATER NORFOLK AREA. A HURRICANE WATCH IS ALSO ISSUED NORTHWARD FROM PLYMOUTH MASSACHUSETTS THROUGH EASTPORT MAINE.

CENTER LOCATED NEAR 33.9N 76.0W AT 18/2200Z
POSITION ACCURATE WITHIN 20NM

CURRENT MOTION TOWARD THE NORTH OR 10 DEGREES AT 16 KT

SYNOPTIC CENTER LOCATED NEAR 33.6N 75.9W AT 18/1800Z

DIAMETER OF EYE 20NM
MAX WNDS 100KT...GUSTS 120 KT
64 KT.....100NE 100SE 25SW 25NW WIND RADII IN NM
50 KT.....125NE 125SE 50SW 50NW
34 KT.....150NE 150SE 75SW 75NW
12 FT SEAS 150NE 150SE 75SW 75NW

FORECAST VALID 19/0600Z 36.5N 74.5W
MAX WND 100 KT...GUSTS 120 KT
50 KT...125NE 125SE 50SW 50NW
34 KT...150NE 150SE 75SW 75NW

FORECAST VALID 19/1800Z 41.0N 71.0W
MAX WND 100 KT...GUSTS 120 KT
50 KT...125NE 125SE 50SW 50NW
34 KT...150NE 150SE 75SW 75NW

FORECAST VALID 20/0600Z 46.0N 66.0W
MAX WND 90 KT...GUSTS 105 KT
50 KT...125NE 125SE 50SW 50NW
34 KT...150NE 150SE 75SW 75NW

STORM SURGE OF 4 TO 7 FEET ABOVE NORMAL TIDE IS POSSIBLE IN THE WARNED AREA OF NORTH CAROLINA AND 3 TO 5 FEET IN THE REMAINDER OF THE WARNED AREA. IN ADDITION...LARGE WAVES WITH BEACH EROSION WILL BE EXPERIENCED IN THE WARNED AREAS.

REQUEST FOR 3 HOURLY SHIP REPORTS WITHIN 300 MILES OF 33.9N 76.0W
EXTENDED OUTLOOK...USE FOR GUIDANCE ONLY...ERRORS MAY BE LARGE
OUTLOOK VALID 20/180Z 50.5N 60.0W
MAX WNDS 70 KT...GUSTS 85 KT
50 KT...125NE 125SE 50SW 50NW

OUTLOOK VALID 21/1800Z 56.0N 47.0W
MAX WNDS 60 KT...GUSTS 75 KT
50 KT...125NE 125SE 50SW 50NW

NEXT ADVISORY AT 19/0400Z

Figure 4-1. Marine advisory format

CHAPTER 5

AIRCRAFT RECONNAISSANCE

5.1. General. All Department of Commerce (DOC) tropical and subtropical cyclone aircraft reconnaissance needs will be requested and provided in accordance with the procedures of this chapter. As outlined in the Air Force Reserve (AFRES)/National Oceanic and Atmospheric Administration (NOAA) Memorandum of Agreement (see Appendix C), DOC has identified a requirement for, and the Department of Defense (DOD) maintains aircraft to support, up to five sorties per day (see Figure 5-1). Requirements exceeding five sorties will be accomplished on a "resources-permitting" basis. Congress has directed the DOD to fund an AFRES flying hour program of 1600 hours in support of hurricane reconnaissance coverage. In times of national emergency or war, some or all DOD reconnaissance resources may not be available to fulfill DOC needs.

5.2. Responsibilities.

5.2.1. DOD. The DOD, through AFRES' 53rd Weather Reconnaissance Squadron (53 WRS) is responsible for

- providing operational aircraft for vortex fixes and data, synoptic tracks, and investigative flights in response to DOC needs.

- developing operational procedures to deploy data buoys to satisfy DOC needs.

5.2.2. DOC. The DOC is responsible for aircraft operations that may be requested to

- augment AFRES aircraft reconnaissance when DOC needs exceed the capabilities of DOD resources. This includes the provision of quick response to National Hurricane Center (NHC) requests for reconnaissance on developing tropical cyclones (normally east of 80°W) from August 1 through September 30 on a resources-permitting basis.

- assume responsibility for hurricane reconnaissance over foreign airspace that may be restricted for military operations.

- conduct research flights.

5.2.3 DOT. The DOT is responsible for providing air traffic control services to aircraft when within airspace controlled by the FAA. This includes offshore oceanic airspace. It should



Figure 5-1. WC-130 Weather Reconnaissance Aircraft

be noted that more expeditious handling of winter storm reconnaissance aircraft will result by following the procedures outlined in the FAA/AFRES Letter of Agreement entitled, Meteorological Reconnaissance Flights, and the AFRES/NOAA Letter of Agreement, as found in Appendix C.

5.3. Control of Aircraft. Operational control of aircraft flying tropical and subtropical cyclone reconnaissance will remain with the operating agencies of DOD or DOC as appropriate.

5.4. Reconnaissance Requirements.

5.4.1. Meteorological Parameters. Data needs in priority order are as follows:

- Geographical position of the flight level vortex center (vortex fix) and relative position of the surface center, if known
- Center sea-level pressure determined by dropsonde or extrapolation from within 1,500 ft of the sea surface or from the computed 850 hPa height
- Minimum 700 or 850 hPa height, if available
- Wind profile data for surface and flight level
- Temperature at flight level
- Sea-surface temperature
- Dew-point temperature at flight level

5.4.2. Accuracy.

5.4.2.1. Geographic Position.

- Aircraft position: within 3 nmi
- Storm surface center (wind/pressure): within 6 nmi
- Flight level storm center (wind/pressure): within 6 nmi

5.4.2.2. Wind Direction.

- Surface: within 10 deg
- Flight level for winds greater than 20 kt: within 5 deg

5.4.2.3. Wind Speed.

- Surface: within 10 kt
- Flight level: within 4 kt

5.4.2.4. Pressure Height.

- Surface: within 2 hPa
- Flight level at or below 500 hPa: within 10 m
- Flight level above 500 hPa: within 20 m

5.4.2.5. Temperature.

- Sea surface: within 1°C
- Flight level: within 1°C

5.4.2.6. Dew-Point Temperature.

- From -20°C to +40°C: within 1°C
- Less than -20°C: within 3°C

5.4.2.7. Absolute Altitude: Within 10 m

5.4.2.8. Vertical Sounding.

- Pressure: within 2 hPa
- Temperature: within 1°C
- Dew-point temperature:
  From -20°C to +40°C: within 1°C
  Less than -20°C: within 3°C
- Wind direction: within 10 deg
  Wind speed: within 5 kt

[NOTE: Present weather reconnaissance capabilities do not completely satisfy these requirements; data will be collected as close to stated requirements as possible.]

5.4.3. High Density/High Accuracy (HD/HA) Data Requirements. The HD/HA data include time, latitude, longitude, pressure altitude, D-value, radar altitude, peak winds, flight-level wind speed and direction, temperature, and dew-point temperature. The DOC requires rapid acquisition and transmission of tropical cyclone data, especially within the 24-hr period prior to landfall. If HD/HA capability is lost on an operational mission, the airborne meteorologist will contact CARCAH immediately to determine whether a backup aircraft is required and available.

5.4.4. High Level Synoptic Track Profile Data Requirements. When required, the NHC will request mid-tropospheric reconnaissance data on the periphery of systems approaching the United States. The NHC will provide a specific track profile including control point and control time to Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) for coordination with the reconnaissance units.

5.4.5. Required Frequency and Content of Observations. Requirements are summarized in Table 5-1.

5.4.5.1. Horizontal Observations. Standard RECCO Section 1, plus 4ddff and 9VTTT, if applicable, (9-groups are not required for WC-130s). The format is as specified in Appendix G of the National Hurricane Operations Plan (NHOP).

A. Enroute. Horizontal observations will be taken and transmitted approximately every 30 minutes. If an automated system is not in use, encode observations every 15 min when over water within 15 degrees of the tasked coordinates, and transmit hourly.

B. Fix Missions. A horizontal observation is required at each end point of an Alpha pattern leg. If HD/HA data are not available, then one additional horizontal observation is required midway between the outbound leg and inbound leg of the Alpha flight pattern.

Table 5-1. Requirement for aircraft reconnaissance data

	RECCO	VORTEX	SVD[1]	VERTICAL
ENROUTE	Approximately every 30 minutes while over water	NA	NA	Every 400 nm while over water
INVEST	Every 15 minutes and major turn points	After closing the circulation	NA	NA
FIX	At the end points of Alpha pattern legs (non HD/HA) at end points and midway between outbound and inbound legs	Tasked: DVDM[2] Intermediate: AVDM[3] or DVDM	One per mission. (non HD/HA) One per fix.	Each scheduled fix at 700mb and above, and as tasked. Others at crew discretion.

[1] SVD = Supplementary Vortex Data
[2] DVDM = Detailed Vortex Data Message
[3] AVDM = Abbreviated Vortex Data Message

C. Invest Missions. A horizontal observation is required every 15 minutes and at major turn points.

5.4.5.2. HD/HA Data. HD/HA data are collected every minute (MINOBS) and transmitted to National Hurricane Center (NHC) every 20 min (WC-130) or 30 min (WP-3). See Appendix G for the format of the MINOBS or para 5.9.4.1. for the Aircraft-to-Satellite Data Link (ASDL) data format.

5.4.5.3. Vortex and Supplemental Vortex Observations. Vortex and supplemental vortex observations are collected, encoded, and transmitted in accordance with NHOP pattern requirements (see para 5.8.). See Figures 5-2 and 5-3 and Table 5-2 for data formats.

5.4.5.4. Vertical Observations. The frequency of vertical observations enroute to and from the storm or invest area will be approximately every 400 nmi over water, unless otherwise specified. Center dropsonde data will be provided for scheduled fixes made at 700 hPa or above. The format for all vertical observations is WMO TEMP DROP code (FM 37-VII). See Appendix G for the format.

5.5. Reconnaissance Planning and Flight Notification.

5.5.1. DOC Requests for Aircraft Reconnaissance Data.

5.5.1.1. Coordination. The National Hurricane Center (NHC) will coordinate with the Central Pacific Hurricane Center (CPHC) to determine a list of the total DOC requirements for data on tropical and subtropical cyclones or disturbances for the next 24-hr period (1100 to 1100 UTC) and an outlook for the succeeding 24-hr period. This coordinated request will be provided to CARCAH as soon as possible, but not later than 1630 UTC each day in the format of Figure 5-4. Amendments will be provided as required.

5.5.1.2. Tropical Cyclone Plan of the Day. From the coordinated DOC request, Fig 5-4, CARCAH will publish the Tropical Cyclone Plan of the Day (TCPOD). The format for the TCPOD is shown in Fig 5-5. When DOC reconnaissance needs exceed DOD and DOC resources, CARCAH will coordinate with the NHC to establish priorities of requirements.

VORTEX DATA MESSAGE

MANOP HEADING (PRECEDENCE IMMEDIATE)

MISSION IDENTIFIER AND OBSERVATION NUMBER

(ABBREVIATED) (DETAILED) VORTEX DATA MESSAGE

A	Z	DATE AND TIME OF FIX
B	DEG MIN N S	LATITUDE OF VORTEX FIX
	DEG MIN E W	LONGITUDE OF VORTEX FIX
C	MB M	MINIMUM HEIGHT AT STANDARD LEVEL
D	KT	ESTIMATE OF MAXIMUM SURFACE WIND OBSERVED
E	DEG NM	BEARING AND RANGE FROM CENTER OF MAXIMUM SURFACE WIND
F	DEG KT	MAXIMUM FLIGHT LEVEL WIND NEAR CENTER
G	DEG NM	BEARING AND RANGE FROM CENTER OF MAXIMUM FLIGHT LEVEL WIND
H	MB	MINIMUM SEA LEVEL PRESSURE COMPUTED FROM DROPSONDE OR EXTRAPOLATED FROM WITHIN 1500 FT OF SEA SURFACE
I	C/ M	MAX FLT LVL TEMP/PRESSURE ALT OUTSIDE EYE
J	C/ M	MAX FLT LVL TEMP/PRESSURE ALT INSIDE EYE
K	C/ C	DEWPOINT TEMP/SEA SURFACE TEMP INSIDE EYE
L		EYE CHARACTER: Closed wall, poorly defined, open SW, etc.
M		EYE SHAPE/ORIENTATION/DIAMETER. Code eye shape as: C - circular; CO - Concentric; E-Elliptical. Transmit orientation of major axis in tens of degree, i.e., 01-010 to 190; 17-170 to 350. Transmit diameter in nautical miles. *Examples*: C8 - Circular eye 8 miles in diameter. E09/15/5 - Elliptical eye, major axis 090-270, length of major axis 15 NM, length of minor axis 5NM. CO8-14 - Concentric eye, diameter inner eye 8 NM, outer eye 14 NM.
N	DEG MIN N S	CONFIRMATION OF FIX: Coordinates and time
	DEG MIN E W	
	Z	
O	/	FIX DETERMINED BY/FIX LEVEL FIX DETERMINED BY: 1 - Penetration; 2 - Radar; 3 - Wind; 4 - Pressure; 5 - Temperature. FIX LEVEL (Indicate surface center if visible; indicate both surface and flight level centers only when same): 0 - Surface; 1 - 1500ft; 8 - 850 mb; 7 - 700 mb; 5 - 500 mb; 4 - 400 mb; 3 - 300 mb; 2 - 200 mb; 9 - Other.
P	/ NM	NAVIGATION FIX ACCURACY/METEOROLOGICAL ACCURACY
Q		REMARKS

INSTRUCTIONS: Items A through G (and H when extrapolated) are transmitted from the aircraft immediately following the fix. The remainder of the message is transmitted as soon as available for scheduled fixes and at the ARWO's discretion for unscheduled (intermediate) fixes.

Figure 5-2. Vortex data message

SUPPLEMENTARY VORTEX DATA MESSAGE

MANOP HEADING (*completed by monitors only*)

UR____ ____ 14 ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____

MISSION IDENTIFIER AND OBSERVATION NUMBER (*completed by flight meteorologist and monitor*)

AF____ ____ ____

SUPPLEMENTARY VORTEX DATA MESSAGE

($L_aL_aL_a$)	($L_oL_oL_oL_o$)	($_iHHH$)	(TTT_dT_d)	(ddfff)
01	1	1	1	
02	2	2	2	
03	3	3	3	
04	4	4	4	
05	5	5	5	
06	6	6	6	
07	7	7	7	
($L_aL_aL_a$)	($L_oL_oL_oL_o$)	(fff)		
MF	M	MF		

OBS 01 AT: ____ Z OBS ____ AT ____ Z OBS 01 SFC WND: ____

($L_aL_aL_a$)	($L_oL_oL_oL_o$)	($_iHHH$)	(TTT_dT_d)	(ddfff)
01	1	1	1	
02	2	2	2	
03	3	3	3	
04	4	4	4	
05	5	5	5	
06	6	6	6	
07	7	7	7	
($L_aL_aL_a$)	($L_oL_oL_oL_o$)	(fff)		
MF	M	MF		

OBS 01 AT: ____ Z OBS ____ AT ____ Z OBS 01 SFC WND: ____

REMARKS (*end of message*)

PREPARED BY: ____ TRANSMISSION TIME: ____

LEGEND

01 INDICATOR FOR DATA COLLECTED APPROXIMATELY 105 NM FROM STORM CENTER (INBOUND) OR APPROXIMATELY 15 NM FROM CENTER (OUTBOUND)

OTHER INDICATORS (02/2, 03/3...) FOR DATA AT APPROXIMATELY 15 NM INTERVALS INBOUND OR OUTBOUND FROM STORM CENTER. INDICATORS MAY BE EXPANDED BEYOND 07(08,09...) AS NECESSARY AT APPROXIMATELY 15NM INTERVALS.

MF = INDICATOR FOR MAXIMUM FLIGHT LEVEL WIND OBSERVED

fff = SPEED OF WIND IN KNOTS

dd = TRUE DIRECTION OF FLIGHT LEVEL WIND SPEED IN TERMS OF DEGREES

TTT_dT_d = TEMP/DEWPOINT IN DEGREES CELSIUS: ADD 50 FOR NEGATIVE VALUES

iHHH = PRESSURE HEIGHT DATA IN RECCO FORMAT

$L_aL_aL_a$ = LATITUDE IN DEGREES/TENTHS

$L_oL_oL_oL_o$ = LONGITUDE IN DEGREES/TENTHS

/ = DATA UNKNOWN/UNOBTAINABLE

SAMPLE MESSAGE

URNT 12 KMIA 241703
AF 966 0411 FREDERIC OB 14
SUPPLEMENTARY VORTEX DATA MESSAGE
01178 10899 13107 10906 36027
02177 20895 23100 20908 35042
03178 30691 33092 30607 36052
04177 40887 43088 40907 35070
05178 50883 53070 50908 36088
06178 60880 63000 61010 35108
07178 70877 73882 71211 35120
MF178 MO677 MF120
OBS 01 AT 1530Z OBS 07 AT 1600Z
OBS 01 SFC WND 36025
01177 10872 13000 11010 18120
02178 20868 23070 21009 17098
03178 30862 23088 30909 18080
04177 40858 43093 40908 17050
05177 50854 53102 50908 17048
06178 60850 63108 60905 18031
07177 70844 73114 70902 18025
MF177 MO672 MF120
OBS 01 AT 1630Z OBS 07 AT 1700Z
OBS 07 SFC WIND 16025
REMARKS HEAVY RAIN OUTBOUND

Figure 5-3. Supplementary vortex data messsage

Table 5-2. Vortex data message entry explanation

DATA ITEM	ENTRY
MISSION IDENTIFIER	As determined in Chapter 5, paragraph 5.7.6.
OBSERVATION NUMBER	A two digit number determined by the sequential order in which the observation is transmitted from the aircraft.
(ABBREVIATED) (DETAILED) VORTEX MESSAGE	An abbreviated message has at least item ALPHA through GOLF, item HOTEL (when extrapolated DATA from flight level) and a maximum flight level wind remark in item QUEBEC.
A (ALPHA)	Date and time (UTC) of the flight level center fix. If the flight level center cannot be fixed and the surface center is visible, enter the time of the surface center fix.
B (BRAVO)	The latitude and longitude of the center fix associated with item ALPHA. NOTE: If the surface center is fixable, enter bearing and range from the center in item QUEBEC, e.g., SFC CNTR 270/15 NMI, if the centers are separated by over 5 nmi.
C (CHARLIE)	Indicate the standard atmospheric surface e.g., 850 hPa or 700 hPa. The minimum height of the standard surface observed inside the center. If at 1,500 ft or below or not within 1,500 ft of a standard surface, enter NA.
D (DELTA)	The maximum surface wind observed during the inbound leg associated with this fix.
E (ECHO)	Bearing and range of the maximum surface wind observed (item DELTA) from the coordinates reported in item BRAVO.
F (FOXTROT)	The maximum flight level wind observed during the inbound leg associated with this fix.

Table 5-2. Vortex data message entry explanation (continued)

G (GOLF)	Bearing and range of the maximum flight level wind observed (item FOXTROT) from the coordinates reported in item BRAVO.
H (HOTEL)	The minimum sea level pressure (SLP) to the nearest hectopascal observed at the coordinates reported in item BRAVO. Preface the SLP with "EXTRAP" (extrapolated) when the data are not derived from dropsonde or when the SLP is extrapolated from a dropsonde that terminated early. Clarify the difference in remarks (e.g., SLP EXTRAPOLATED FROM BELOW 1500 FEET/850 HPA/DROPSONDE)
I (INDIA)	MAX FLT LVL TEMP--This temperature is taken just outside the central region of a cyclone (i.e., just outside the eyewall or just beyond the maximum wind band). This temperature may not be the highest recorded on the inbound leg but is representative of the environmental temperature just outside the central region of the storm. PRESSURE ALT--Pressure altitude data (meters) are taken at the same location as the maximum temperature data reported in item INDIA
J (JULIET)	MAX FLT LVL TEMP--The maximum temperature observed within 5 nmi of the center fix coordinates. If a higher temperature is observed at a location more than 5 nmi away from the flight level center (item BRAVO), it is reported in item QUEBEC including bearing and distance from the flight level center. PRESSURE ALT--Pressure altitude data (meters) are taken at the same location as the maximum temperature data reported in item JULIET.
K (KILO)	Dewpoint temperature/sea surface temperature are collected at the same location as the maximum temperature reported in item JULIET. Enter NA if not observed.

Table 5-2. Vortex data message entry explanation (continued)

L (LIMA)	Only report if at least 50 percent of the center has an eyewall, otherwise enter NA. Closed wall--if the center has 100 percent coverage with no eyewall weakness. Open XX--if the center has 50 percent or more but less than 100 percent coverage. State the direction of the eyewall weakness.
M (MIKE)	Self explanatory. Report only if item LIMA is reported, otherwise enter NA.
N (NOVEMBER)	Flight level center coordinates (same as item BRAVO).
O (OSCAR)	Fix determined by: Always report 1. Report 2 if radar indicates curvature or banding consistent with fix location. Report 3 if recorded or observed winds indicate a closed center. Report 4 if the fix pressure is lower than all reported on the inbound leg. Report 5 if the fix temperature is at least higher than any reported on the inbound leg. Fix level: Report 0 alone if fix is made solely on surface winds. Report 0 and the flight-level code if the centers are within 5 nmi of each other.
P (PAPA)	Navigational and meteorological accuracy are reported as the upper limit of probable error. Meteorological accuracy is normally reported as one-half of the diameter of the light and variable wind center.
Q (QUEBEC)	Remarks to enhance the data reported above. The aircraft crew should report the maximum flight level winds observed and the time of observation on their latest pass through any of the four quadrants during the mission in the remarks section of the detailed/abbreviated vortex message.

NHOP COORDINATED REQUEST FOR AIRCRAFT RECONNAISSANCE

__ Original
__ Amendment
(Check One)

I. ATLANTIC REQUIREMENTS

STORM NAME DEPRESSION # SUSPECT AREA	FIX OR ON STATION TIME	COORDI-NATES	FLIGHT PATTERN	FCST MVMT	NHC PRIOR-ITY

SUCCEEDING DAY OUTLOOK _____

REMARKS _____

II. CENTRAL PACIFIC REQUIREMENTS

STORM NAME DEPRESSION # SUSPECT AREA	FIX OR ON STATION TIME	COORDI-NATES	FLIGHT PATTERN	FCST MVMT	NHC PRIOR-ITY

SUCCEEDING DAY OUTLOOK _____

REMARKS _____

III. DISTRIBUTION

A. TO CARCAH BY 1630Z OR AMEND AT ANY TIME

Figure 5-4. NHOP coordinated request for aircraft reconnaissance

TROPICAL CYCLONE PLAN OF THE DAY FORMAT
--ATLANTIC AND CENTRAL PACIFIC OCEANS--

FM: CARCAH, NATIONAL HURRICANE CENTER, MIAMI, FL

TO: (AFRES-APPROVED ADDRESSEES)/(NOAA-APPROVED ADDRESSEES)

SUBJECT: THE TROPICAL CYCLONE PLAN OF THE DAY
VALID _____Z (MONTH) TO _____Z (MONTH) (YEAR)
TCPOD NUMBER.....(YR)-_____

I. ATLANTIC REQUIREMENTS

1. (STORM NAME, DEPRESSION, SUSPECT AREA) or (NEGATIVE RECON REQUIREMENTS)

FLIGHT ONE (NHC PRIORITY, if applicable)

A. _____Z FIX TIMES/ON STATION TIMES

(Resources permitting if applicable)
_____Z

B. _____ MISSION IDENTIFIER

C. _____Z ESTIMATED DEPARTURE TIME

D. _____ DEPARTURE STATION

E. _____ FORECAST POSITION

F. _____ DESTINATION STATION

G. _____ FLIGHT PATTERN

H. _____ FORECAST MOVEMENT

I. _____ REMARKS

FLIGHT TWO (if applicable, same as FLIGHT ONE)

2. (SECOND SYSTEM, if applicable, same as in 1. above)

3. OUTLOOK FOR SUCCEEDING DAY (NHC PRIORITY, if applicable)

A. POSSIBLE _(Unit)_ ON STATION REQUIREMENT NEAR _(Location)_
AT _(Time)_ Z.

II. CENTRAL PACIFIC REQUIREMENTS (Same as in ATLANTIC)

Figure 5-5. Tropical cyclone plan of the day format

5.5.1.3. Anticipated Reconnaissance Requests. Reconnaissance requests can be anticipated for a forecast or actual storm location.

A. For the Atlantic, Gulf of Mexico, Caribbean, and Central Pacific areas, the requests can be

- up to four 6-hourly fixes per day when a storm is within 500 nmi of landfall west of 55°W and north of 08°N and

- up to eight 3-hourly fixes per day when a storm is forecast to be within 300 nmi of the U.S. coast, Hawaiian Islands, Puerto Rico, Virgin Islands, DOD installations, and other DOD assets when specified.

B. Investigative flights may be requested for disturbances in areas defined above, i.e., one or two flights per day dependent upon proximity of landfall and upon known or suspected stage of development.

C. Exceptions may be made when additional reconnaissance is essential to carry out warning responsibilities.

5.5.2. <u>DOD Reconnaissance Aircraft Responsiveness</u>.

5.5.2.1. Requirement Notification. Notification of requirements must precede tasked-on-station time by at least 16 hours plus enroute time to the area of concern.

5.5.2.2. Prepositioning. The "Succeeding Day Outlook" portion of the TCPOD provides advance notification of requirements and authorizes units to preposition aircraft to forward operating locations. For missions requiring prepositioning, the "Succeeding Day Outlook" may not provide adequate advance notification. In this situation, an "Additional Day Outlook" may be included in the TCPOD to authorize units to preposition aircraft.

5.5.2.3. Resources Permitting. When circumstances preclude the appropriate notification lead time, the requirement will be levied as "resources permitting." When a "resources permitting" requirement is levied in an amendment, the NHC will indicate the priority of all existing or remaining requirements.

5.5.2.4. Emergency Requirement. If a storm develops unexpectedly and could cause a serious threat to lives and property within a shorter time than provided for in the paragraphs above, CARCAH will contact the reconnaissance units, or higher headquarters, as appropriate, and request assistance in implementing emergency procedures not covered in this plan. The NHC and CPHC directors have authority to declare an emergency.

5.5.3. Reconnaissance Tropical Cyclone Plan of the Day.

5.5.3.1. Preparation. The CARCAH will coordinate the TCPOD (Figure 5-5) daily during the period from June 1 to November 30 and at other times during the year as required. Transmitted TCPODs will be serially numbered each season.

A. The CARCAH will coordinate the TCPOD with the NHC, 53rd Weather Reconnaissance Squadron (53WRS), and the Aircraft Operations Center before publication.

B. The TCPOD will list all DOC and DOD required tropical and subtropical cyclone reconnaissance operational missions. The remarks section of the TCPOD will include appropriate comments whenever research and operational flights overlap.

C. The DOD-required tropical or subtropical cyclone reconnaissance missions in the Atlantic or the Pacific west to 180° will be identified in the TCPOD as USN or USAF requirements.

D. Amendments to the TCPOD will be published only when requirements change. When amended, the impact on each listed flight will be identified (i.e., No Change, Change Added, or Cancel).

5.5.3.2. Dissemination. The TCPOD will be made available to appropriate agencies, such as FAA, DOD, and NOAA, that provide support to or control of reconnaissance aircraft or are a part of the tropical cyclone warning service. Under normal circumstances, the TCPOD will be disseminated by 1900 UTC each day including weekends and holidays. If there are no current day or succeeding-day reconnaissance requirements, a negative report, which covers the appropriate time frame, will be disseminated. Amendments will be disseminated as required.

[NOTE: The TCPOD is disseminated under the header "MIAREPRPD" for AFOS users and under "NOUS42 NHC: for AFMEDS/AWDS users.]

5.5.4. Air Traffic Control (ATC) Clearances.

5.5.4.1. Air Traffic Control Clearances. Flight plans for reconnaissance flights shall be filed with the FAA as soon as practicable before departure time.

5.5.4.2. Prior Coordination. The 53WRS Current Operations/mission commander will contact the FAA Air Traffic Control System Command Center (ATCSCC) at (202) 267-5500 prior to departure and relay the following data:

- Mission call-sign
- Departure Point and estimated time of departure
- Approximate route to be flown
- Requested altitude(s)
- Any special requests

The ATCSCC will then coordinate with all impacted FAA facilities.

5.5.4.3. ATC Separation. ATC will provide separation between all aircraft on instrument flight rules in other than Class G airspace. Non-participating aircraft may be operating near storm areas; therefore, adherence to ATC clearances is mandatory for safety. When appropriate, military pilots shall clearly state to ATC that a segment of flight will be conducted under the provisions of "due regard."

5.5.4.4. Assigned Altitudes. When storm aircraft are unable to maintain assigned altitudes due to turbulence, ATC shall be advised. When deviation from assigned altitude is required, the pilot shall coordinate with ATC and obtain a clearance prior to changing altitudes. When numerous changes in altitude will be required, the pilot should request a "block altitude" clearance from ATC. Any deviations from ATC clearance shall first be coordinated with the appropriate ATC facility.

5.5.4.5. Release of Dropsondes. When operationally feasible, dropsonde releases shall be coordinated with the appropriate ATC facility and with participating aircraft when in other than Class G airspace at least 10 minutes prior to sensor release. This coordination need only be with participating aircraft when in Class G airspace. Contact between participating aircraft will be made using the frequencies listed in paragraph 5.9.3.

5.5.4.6. ATC Communications Backup. Those TEAL aircraft that have the capability to communicate digitally may use CARCAH for communications relay with ATC when voice communications are either unavailable or unusable. This capability should only be used to preclude an emergency or other safety related situations.

5.6. Reconnaissance Effectiveness Criteria.

5.6.1. General. Specified reconnaissance times are established to allow sufficient time for the forecaster to analyze the data before issuing an advisory. Every effort should be made to obtain data at scheduled times. The following criteria will be used to assess reconnaissance mission effectiveness (see Figure 5-6):

5.6.1.1. Tropical Cyclone Fix Mission.

A. ON-TIME. The fix is made not earlier than 1 hr before nor later than 1/2 hr after scheduled fix time.

B. EARLY. The fix is made from 1 hr before scheduled fix time to one-half of the time interval to the preceding scheduled fix, not to exceed 3 hr.

C. LATE. The fix is made within the interval from 1/2 hr after scheduled fix time to one-half of the time interval to the succeeding scheduled fix, not to exceed 3 hr.

D. MISSED. Data are not obtained within the parameters specified for on-time, early, or late.

[NOTE: Appropriate credit will be given when the aircraft arrives in the requested area but is unable to locate a center due to storm dissipation or rapid movement. Credit will also be given for radar fixes if penetration is not possible due to geographic or other flight restrictions.]

5.6.1.2. Tropical Cyclone Investigative Missions.

A. ON-TIME. An observation must be taken within 250 nmi of the specified coordinates by the scheduled time.

B. LATE. An observation is taken within 250 nmi of the specified coordinates after the scheduled time but not later than the scheduled time plus 2 hr.

C. MISSED. When the aircraft fails to be within 250 nmi of the specified coordinates by the scheduled time plus 2 hr.

MISSION EVALUATION FORM

MEMORANDUM FOR: OL-A, 53WRS/CARCAH

FROM: _____(Director, NHC, CPHC)_____

SUBJECT: Mission_____Evaluation
(Mission Identifier)

PUBLISHED REQUIREMENTS:

Premission Coordinates (As Updated Prior to TKO)_____N_____W

Flight Pattern _____

Mission Requirements Times _____

RECONNAISSANCE MISSION PERFORMANCE:

Flight Flown:	____Completely	____Partially	____Other
Horizontal Data Coverage:	____Complete ____Incomplete	____Timely ____Untimely	____Accurate ____Inaccurate
Vertical Data Coverage:	____Complete ____Incomplete	____Timely ____Untimely	____Accurate ____Inaccurate
Requirements Accomplished:	____On Time ____Missed	____Early	____Late

OVERALL MISSION EVALUATION:

OUTSTANDING_____

UNSATISFACTORY_____ FOR:

COMPLETENESS_____ TIMELINESS_____ ACCURACY_____

EQUIPMENT_____ PROCEDURES_____ OTHER_____

REMARKS: (Brief but specific)

_____
FORECASTER's SIGNATURE

Figure 5-6. Mission evaluation form

5.6.2. Mission Assessment. The NHC or CPHC will provide CARCAH a written assessment of the reconnaissance mission anytime its timeliness or quality is outstanding or substandard (see Figure 5-6). Requirements levied as "resources permitting" will not be assessed for timeliness, but may be assessed for quality of data gathered.

5.6.3. Summaries. The CARCAH will maintain monthly and seasonal reconnaissance summaries detailing missions actually flown to satisfy NHC-levied requirements.

5.7. Aerial Reconnaissance Weather Encoding, Reporting, and Coordination.

5.7.1. Vortex Data. The detailed vortex data message (Figure 5-2) will be prepared with all observed vortex fix information for all scheduled fixes. For intermediate fixes, either an abbreviated or detailed vortex data message (AVDM or DVDM) may be transmitted, depending upon availability of information and forecaster requirements.

5.7.2. Center Fix Data. When proximity to unfriendly territory, air traffic control restriction, or other factors prevent actual penetration of the vortex by the reconnaissance aircraft, it is permissible to fix the cyclone by radar. All aircraft radar fix reports will be made in plain text and appended to a RECCO observation taken at fix time or to a supplementary vortex data message completed up to the time of the radar fix, e.g., RADAR CENTER FIX 21.5N 83.0W, POOR RADAR PRESENTATION, NAV ACCURACY 5NMI. The remark stating the type of radar fix and quality of the radar presentation is in accordance with Chapter 7, paragraph 7.3.

5.7.3. Peripheral Data. Storm penetration and collection of peripheral data will normally begin at the operational altitude approximately 105 nmi from the center as determined by the flight meteorologist. When required, the Supplementary Vortex Data Message will be prepared as specified in Figure 5-3.

5.7.4. Mission Coordination. Mission coordination for all missions will be accomplished through CARCAH. Meteorological discussions for Central Pacific missions may be accomplished directly with the CPHC; however, any changes to tasking will be accomplished through CARCAH.

5.7.5. Post-flight Debriefing. Unless otherwise directed, the flight meteorologist will provide either an airborne or post-flight debriefing to the appropriate hurricane center thru CARCAH to ensure all observations were received and understood.

5.7.6. Mission Identifier. Each reconnaissance report will include the mission identifier as the opening text of the message. Regular weather and hurricane reconnaissance messages will include the five-digit agency/aircraft indicator followed by the CARCAH assigned mission-storm system indicator. Elements of the mission identifier follow:

Agency/Aircraft	Mission Storm System Indicator			
Agency + Aircraft Number[1, 2]	Number of missions this storm system	Depression number or XX if not a depression or greater	Location A,C[3]	Storm name or words CYCLONE or INVEST

-EXAMPLES-

AF985 01XXA INVEST (USAF aircraft 985 on the first mission to investigate a suspect area.)

AF987 0503C CYCLONE (USAF aircraft 987 on the fifth mission on depression number 3. Invest or fix as specified in TCPOD.)

NOAA2 0701A AGNES (NOAA aircraft 42RF on the seventh mission to fix depression number 1, which has acquired the name AGNES.)

5.7.7. Observation Numbering and Content.

5.7.7.1. First Weather Observation. The first weather observation will have appended as remarks the International Civil Aviation Organization (ICAO) four-letter identifier for the departure station, time of departure, and estimated time of arrival (ETA) at the coordinates of the storm.

-EXAMPLE-

AF966 0308A EMMY OB 01 KNHC

97779 TEXT TEXT... DPTD KBIX AT 10/2100Z ETA 31.5N 75.0W AT 11/0015Z

---

[1] AF plus last 3 digits of tail number
[2] NOAA, plus last digit of aircraft registration number
[3] A = Atlantic, C = Central Pacific

5.7.7.2. Numbering Scheme. All observations (RECCO, vortex, supplemental, and dropsonde) from the first to the last will be numbered sequentially. The Improved Weather Reconnaissance System (IWRS) will automatically number MINOBS sequentially, but separately from other observations. When an aircraft is diverted from its original mission to fulfill NHC requirements, conclude the original mission by using the last report remark. The next observation from the diverted aircraft will be labeled OB 01, will use the CARCAH-assigned mission identifier, and will include time of diversion and ETA of coordinates of interest.

-EXAMPLE-

AF968 OlXXA INVEST OB 01 KNHC
97779 TEXT ...
DPTD AF968 1005A CINDY MISSION AT 05/1235Z ETA 18N 85W AT 05/1630Z

5.7.7.3. Final Weather Observation. Append to the final weather observation a remark that includes ETA, destination, number of observations (excluding MINOBS), and monitor(s) that copied the observations.

-EXAMPLE-

AF913 0317A JOAN OB 16 KNHC
97779 TEXT TEXT... ETA KBIX 15/2030Z. LAST REPORT OBS 01 THRU 16 TO KNHC.

5.8. <u>Operational Flight Patterns</u>. This section details the operational flight patterns that provide vortex and peripheral data on tropical and subtropical cyclones.

5.8.1. Flight Pattern ALPHA Operational Details.

5.8.1.1. Flight Levels and Sequence. Flight levels will normally be 1,500 ft, 850 hPa, or 700 hPa, depending on data requirements and flight safety. Legs will be 105 nmi long and flown on cardinal headings. The flight sequence is shown in Figure 5-7. The pattern can be started at any cardinal point and then repeated throughout the mission. Prior to starting an inbound or an outbound track, the aircrew should evaluate all available data, e.g., radar presentation, satellite photo, for flight safety. Once started on course, every effort should be made to maintain a straight track and the tasked altitude. A horizontal observation is required at each leg end point. This data is transmitted immediately. The ALPHA pattern may be modified to satisfy unique customer requirements or because of the proximity of land or warning areas.

5.8.1.2. Center fix data. On each transit of the center a fix will be made and a vortex data message completed. If it is a scheduled fix, the detailed vortex data message will be completed using data gathered on the inbound track since the previous fix and will be transmitted immediately. If it is an intermediate (non-scheduled) fix, an abbreviated vortex data message using data gathered on the inbound track since the previous fix may be prepared in lieu of the detailed message and transmitted immediately. Center dropsonde data will also be provided for scheduled fixes made at 700 hPa or above. The dropsonde will be released at the flight-level center coordinates (item BRAVO of the vortex data message). When making a fix from 850 hPa or 700 hPa extrapolate sea-level pressure using Table 5-3 or Table 5-4, respectively, or use an approved computer program.

5.8.1.3. Supplementary Vortex Messages (SVDM). Two SVDM (one ALPHA pattern) will normally be provided per fix mission. Requests for additional SVDM will be directed to CARCAH. When high density data is not available, supplementary vortex data messages will be provided with each fix.

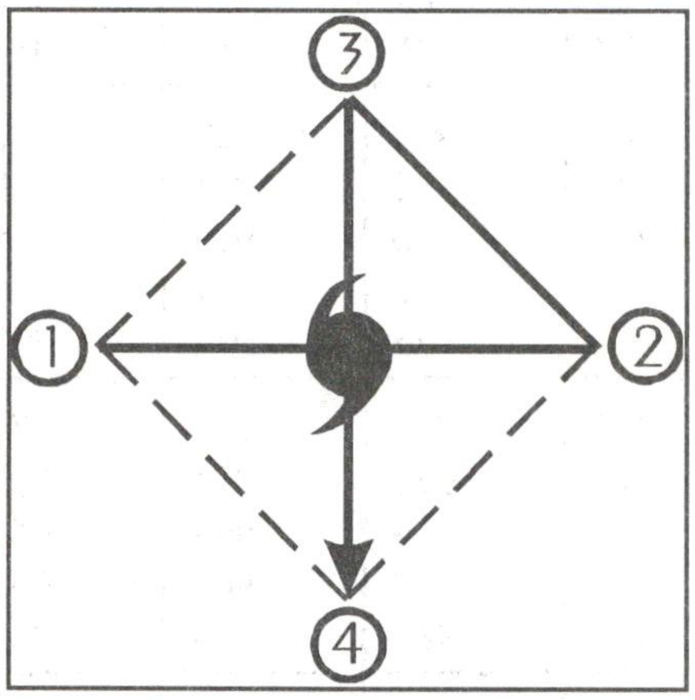

Figure 5-7. Flight pattern ALPHA

Table 5-3. Surface pressure as a function of 850 hPa heights and temperatures

Heights	850 hPa Temperature (°C)								
	14	16	18	20	22	24	26	28	30
1560	1020	1018	1017	1016	1014	1013	1012	1010	1009
1540	1017	1016	1015	1014	1012	1011	1010	1008	1007
1520	1015	1014	1013	1011	1010	1009	1007	1006	1005
1500	1013	1012	1010	1009	1008	1006	1005	1004	1003
1480	1010	1009	1008	1007	1005	1004	1003	1002	1000
1459	1008	1007	1006	1004	1003	1002	1001	999	998
1440	1006	1005	1003	1002	1001	1000	999	997	996
1420	1004	1002	1001	1000	999	998	996	995	994
1400	1001	1000	999	998	996	995	994	993	992
1380	999	998	997	995	994	993	992	991	990
1360	997	995	994	993	992	991	990	989	987
1340	994	993	992	991	990	989	988	986	985
1320	992	991	990	989	988	986	985	984	983
1300	990	989	988	986	985	984	983	982	981
1280	987	986	985	984	983	982	981	980	979
1260	985	984	983	982	981	980	979	978	977
1240	983	982	981	980	979	978	977	976	975
1220	981	980	979	978	977	976	975	974	972
1200	978	977	976	975	974	973	972	971	970
1180	976	975	974	973	972	971	970	969	968
1160	974	973	972	971	970	969	968	967	966
1140	972	971	970	969	968	967	966	965	964
1120	969	968	967	967	966	965	964	963	962
1100	967	966	965	964	963	963	962	961	960
1080	965	964	963	962	961	960	960	959	958
1060	963	962	961	960	959	958	957	957	956
1040	960	959	959	958	957	956	955	954	954
1020	958	957	957	956	955	954	953	952	951
1000	956	955	954	953	953	952	951	950	949

Lapse Rate Used: -6.5 Deg c/km. Assumed dew point depression of 10 deg C.

This table is based on the identical computations used by IWRS to extrapolate SLP from aircraft platform data.

Table 5-4. Surface pressure as a function of 700 hPa heights and temperatures

Heights	700 hPa Temperature (°C)								
	12	14	16	18	20	22	24	26	28
3000	990	987	985	982	980	978	975	973	970
2980	988	985	983	980	978	976	973	971	968
2960	985	983	981	978	976	973	971	969	966
2940	983	981	978	976	974	971	969	967	964
2920	981	979	976	974	972	969	967	965	962
2900	979	976	974	972	969	967	965	962	960
2880	977	974	972	970	967	965	963	960	958
2860	974	972	970	968	965	963	961	958	956
2840	972	970	968	965	963	961	959	956	954
2820	970	968	966	963	961	959	957	954	952
2800	968	966	963	961	959	957	954	952	950
2780	966	964	961	959	957	955	952	950	948
2760	964	961	959	957	955	953	950	948	946
2740	961	959	957	955	953	951	948	946	944
2720	959	957	955	953	951	948	946	944	942
2700	957	955	953	951	949	946	944	942	940
2680	955	953	951	949	946	944	942	940	938
2660	953	951	949	946	944	942	940	938	936
2640	951	949	946	944	942	940	938	936	934
2620	949	946	944	942	940	938	936	934	932
2600	946	944	942	940	938	936	934	932	930
2580	944	942	940	938	936	934	932	930	928
2560	942	940	938	936	934	932	930	928	926
2540	940	938	936	934	932	930	928	926	924
2520	938	936	934	932	930	928	926	924	922
2500	936	934	932	930	928	926	924	922	920
2480	934	932	930	928	926	924	922	920	918
2460	932	930	928	926	924	922	920	918	916
2440	929	928	926	924	922	920	918	916	914
2420	927	925	924	922	920	918	916	914	912
2400	925	923	922	920	918	916	914	912	910
2380	923	921	919	918	916	914	912	910	908
2360	921	919	917	916	914	912	910	908	907
2340	919	917	915	914	912	910	908	906	905
2320	917	915	913	912	910	908	906	904	903
2300	915	913	911	910	908	906	904	903	901
2280	913	911	909	908	906	904	902	901	899
2260	911	909	907	905	904	902	900	899	897
2240	909	907	905	903	902	900	898	897	895
2220	907	905	903	901	900	898	896	895	893
2200	904	903	901	899	898	896	894	893	891
2180	902	901	899	897	896	894	893	891	889
2160	900	899	897	895	894	892	891	889	887
2140	898	897	895	893	892	890	889	887	885
2120	896	895	893	891	890	888	887	885	884
2100	894	893	891	890	888	886	885	883	882

Lapse rate used: -6.5 deg C/km. Assumed dew point depression of 10 deg C.

This table is based on the identical computations used by IWRS to extrapolate SLP from aircraft platform data.

5.8.2. Investigative Missions. An investigative mission is tasked on tropical disturbances to determine the existence or non-existence of a closed circulation, supply reconnaissance observations in required areas, and locate the vortex center, if any.

5.8.2.1. Flight Levels. Flight level will normally be at or below 1,500 ft absolute altitude but may be adjusted as dictated by data requirements, meteorological conditions, or flying safety factors. During day or night operations when flying safety conditions dictate, an 850 hPa or higher altitude may be flown.

5.8.2.2. Vortex Fix. A detailed vortex data message is required if a vortex fix is made.

5.8.2.3. Closed Circulation. A closed circulation is supported by at least one sustained wind reported in each quadrant of the cyclone. Surface winds are preferred.

5.8.2.4. Flight Pattern. Suggested patterns are the X, Box, or Delta patterns, but the flight meteorologist may choose any approach. See Figure 5-8. Turns are usually made to take advantage of tailwinds whenever possible.

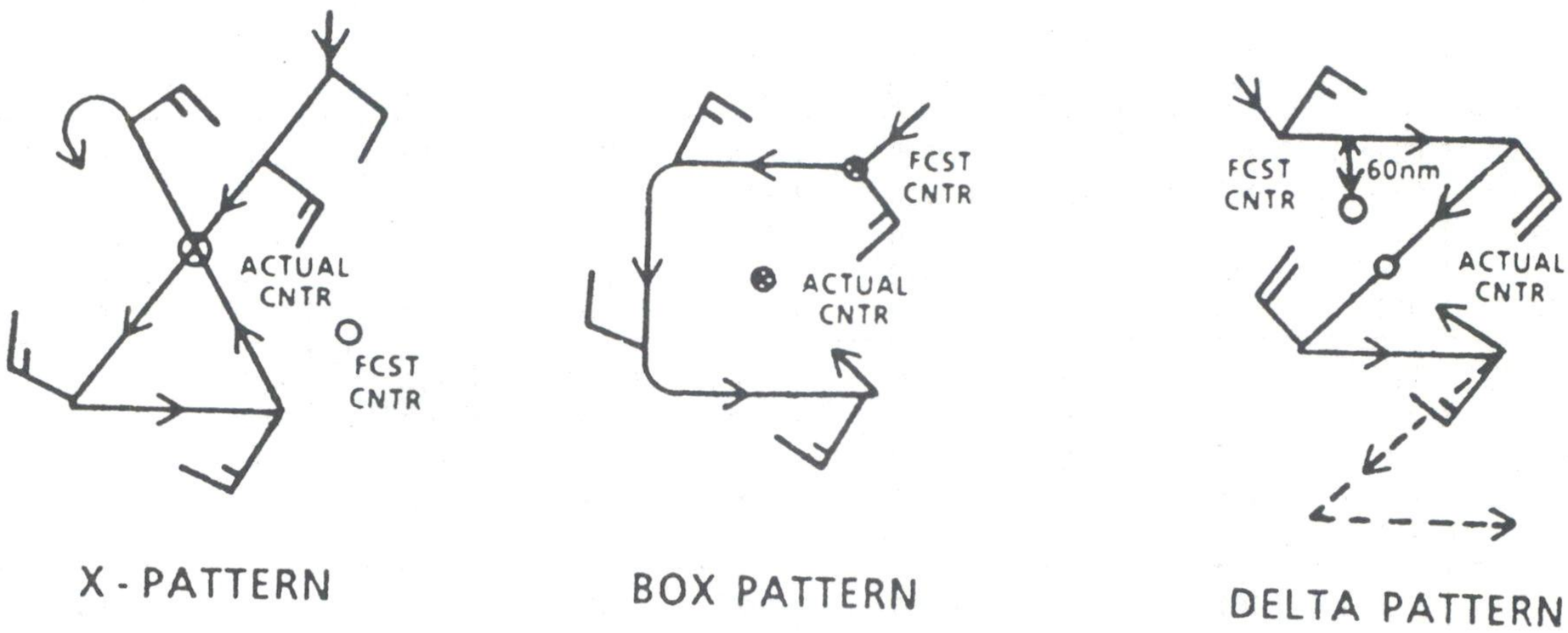

Figure 5-8. Suggested patterns for investigative missions

A. On the X pattern, the aircraft is turned to head directly towards the center, as indicated by the surface or flight level winds. The aircraft is flown through the calm center until winds from the opposite direction occur (second quadrant). The aircraft is then turned to a cardinal heading until a wind shift occurs (third quadrant). Finally, the aircraft is turned towards the center and flown straight through the center to the last quadrant.

B. On the Box pattern, the aircraft is flown on cardinal headings around the suspected center. The track resembles three sides of a square.

C. On the Delta pattern, the aircraft is flown on a cardinal heading to pass 60 nmi from the forecasted center. After observing a wind shift (second quadrant) the aircraft is turned to pass through the center until winds from the opposite direction occur (third quadrant). Finally, the aircraft is turned on a cardinal heading (parallel to the initial heading) to pick up the fourth quadrant winds. If data indicate that the aircraft is far north of any existing circulation, the pattern is extended as shown by the dashed lines.

[NOTE: The depicted pattern may be converted to a mirror image if entry is made from a different direction.]

5.9. Aircraft Reconnaissance Communications.

5.9.1. General. The U.S. Air Force and NOAA aircraft will normally transmit reconnaissance observations via the Air Force Satellite Communications System (AFSATCOM), Aircraft-to-Satellite Data Link, or high frequency (HF) radio phone patch. Flight meteorologists should contact CARCAH following the first fix, and periodically through the mission.

5.9.2. Air-to-Ground Communications (HF Radio). The weather reconnaissance crew will relay weather data via direct telephone patch to the weather data monitor. Monitors will evaluate these reports and disseminate them through the Air Force's Automated Weather Network (AWN) or to the weather communications facility at Suitland, Maryland. When requested, aeronautical stations will provide a discrete frequency for misson use, if possible. Specific radio procedures and terminology will comply with Allied Communications Publication 125, Standard Telephone and Radio Procedures. The use of IMMEDIATE precedence for transmission of hurricane reconnaissance data is authorized because of the perishable nature and potential operational impact of weather data. Data will be routed by direct phone patch between the aircraft and the Miami Weather Monitor (CARCAH). In the central Pacific, Hickam Weather Monitor (Letterman) is available if communications with the Miami Weather Monitor are difficult.

5.9.3. Air-to-Air Communications. When more than one reconnaissance aircraft is known to be operating in a particular area of interest, the following frequencies will be used for airplane-to-airplane communications and coordination unless otherwise directed by air traffic control:

- Primary: VHF 123.05 MHz
- Secondary: UHF 304.8 MHz
- Back-up: HF 4701 KHz USB

5.9.4. Aircraft-to-Satellite Data Link (ASDL) Equipped Aircraft. Aircraft equipped with ASDL have the option to utilize the ASDL system (Figure 5-9) using the data format, and transmission schedule and test discussed below.

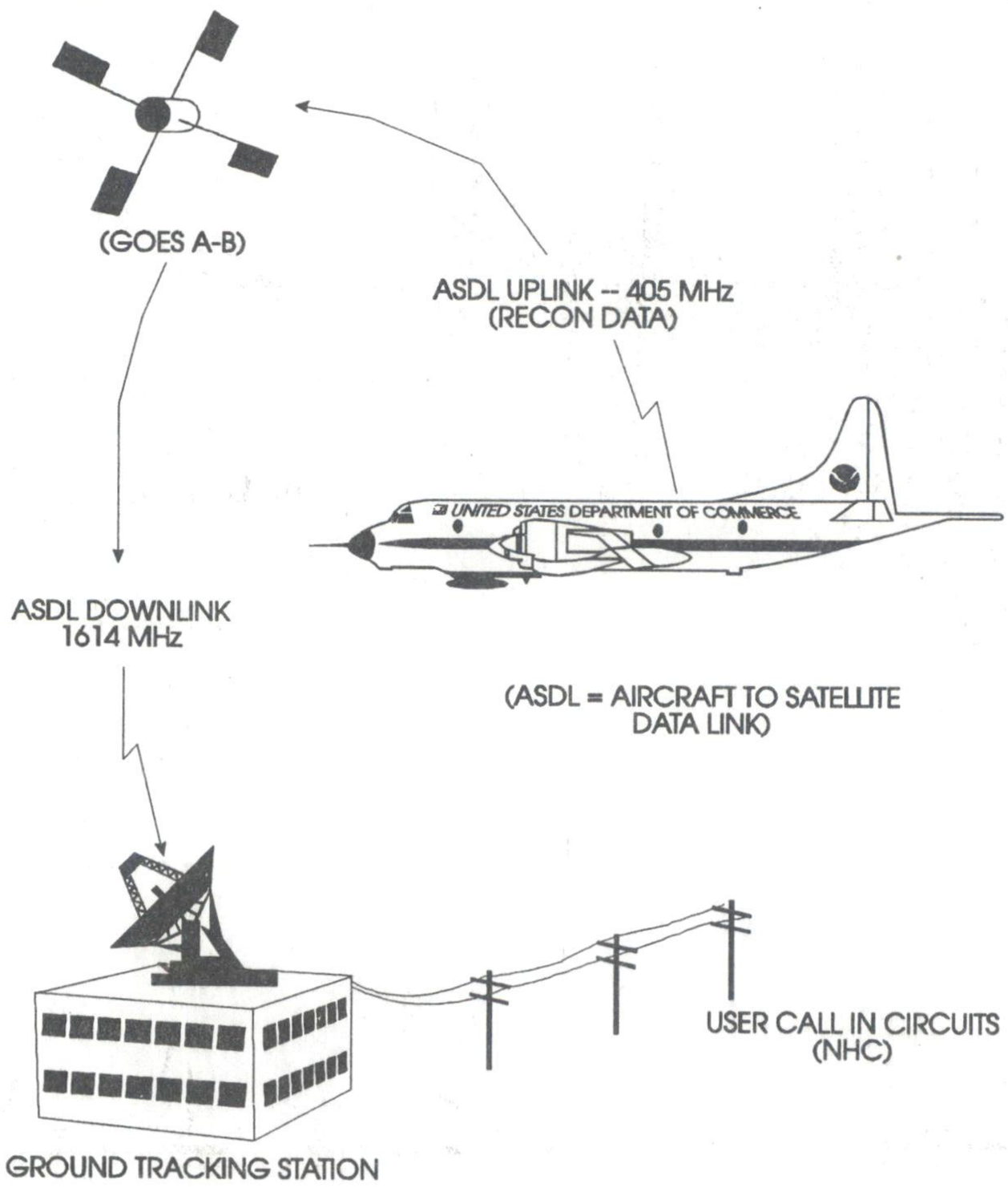

Figure 5-9. Schematic of aircraft to satellite data link for NOAA P-3 aircraft

5.9.4.1. Data Format. The following formats will be used for data transmission by the ASDL system:

- One minute observation--all locations

(Platform Identifier)
15C9419C
(Message Header) (Date/Time)
URNT40 KNHC 291630
(Mission Identifier)
NOAA3 1002 ALLEN

(Time)(Hr/Min/Sec)	(Latitude)(Deg/Min)	(Longitude)(Deg/Min)	(Press Alt)(ft)	(D Value)(ft)
123300	2803	08037	0617	0436

(Wind)(Dir/Speed)
213010
(Temperature)(°C/Tenths)
±138
(Dew Point)(°C/Tenths)
±096
(End of Message)
NNNN

- RECCO Observation--Atlantic Area

(Platform Identifier)
15C9419C
(Message Header) (Date/Time)
URNT40 KNHC 291630
(Observation MANOP Heading)
URNT11 KNHC
(Mission Identifier)
NOAA3 1002 ALLEN OB 03
(RECCO Text)
97779 12427... 93275
(End of Message)
NNNN

- RECCO Observation--Eastern and Central Pacific. This is the same as the one above except that the observation MANOP heading is URPN11 KNHC.

[NOTE: 11 is used for routine tropical cyclone observations; 12 is used for vortex reports, etc.]

(Platform Identifier)
15C9419C
(Message Header) (Date/Time)
URPN11 KNHC 291630
(Observation MANOP Heading)
URPN11 KNHC
(Mission Identifier)
NOAA3 1002 ALLEN 0B 03
(RECCO Text)
97779 12427... 93275
(End of Message)
NNNN

5.9.4.2. Data Transmission Schedule. To aid the transmission of data from several aircraft through one circuit, each aircraft will be assigned a specific block of time within the 30-minute interval for transmission of its data. The schedule is shown in Table 5-5.

Table 5-5. ASDL data transmission schedule

TIME PERIOD	TRANSMITTER
0 - + 5	
+ 5 - +10	AOC 42RF P-3(A)
+10 - +15	AOC 43RF P-3(B)
+15 - +20	
+20 - +25	
+25 - +30	
+30 - +35	
+35 - +40	AOC 42RF P-3(A)
+40 - +45	AOC 43RF P-3(B)
+45 - +50	
+50 - +55	Radar
+55 - +60	Radar

[NOTE: Because only 4 min 28 sec of each 5-min time block can be used for data transmission, roughly 1/2 min is left in each transmission block. This schedule is designed to eliminate diagnostic statements that would appear at the NESDIS computer if data from specific sources arrived at the computer at unscheduled times.]

5.9.4.3. Data Transmission Test. Prior to the beginning of the hurricane season, each ASDL-equipped aircraft will perform a ground or airborne test of the equipment and data ground handling procedures to determine the equipment reliability, transmission errors, and time lapse between transmission of the data from the aircraft and receipt of the data by the hurricane forecaster. Test data will be forwarded to the Chairman, Working Group for Hurricane and Winter Storms Operations.

5.9.5. Improved Weather Reconnaissance System (IWRS) Equipped Aircraft. The AFRES aircraft equipped with IWRS will use the AFSATCOM data link with ground stations at NHC and at Keesler AFB, MS to relay data to the NHC and the AWN. Figure 5-10 depicts these communication links.

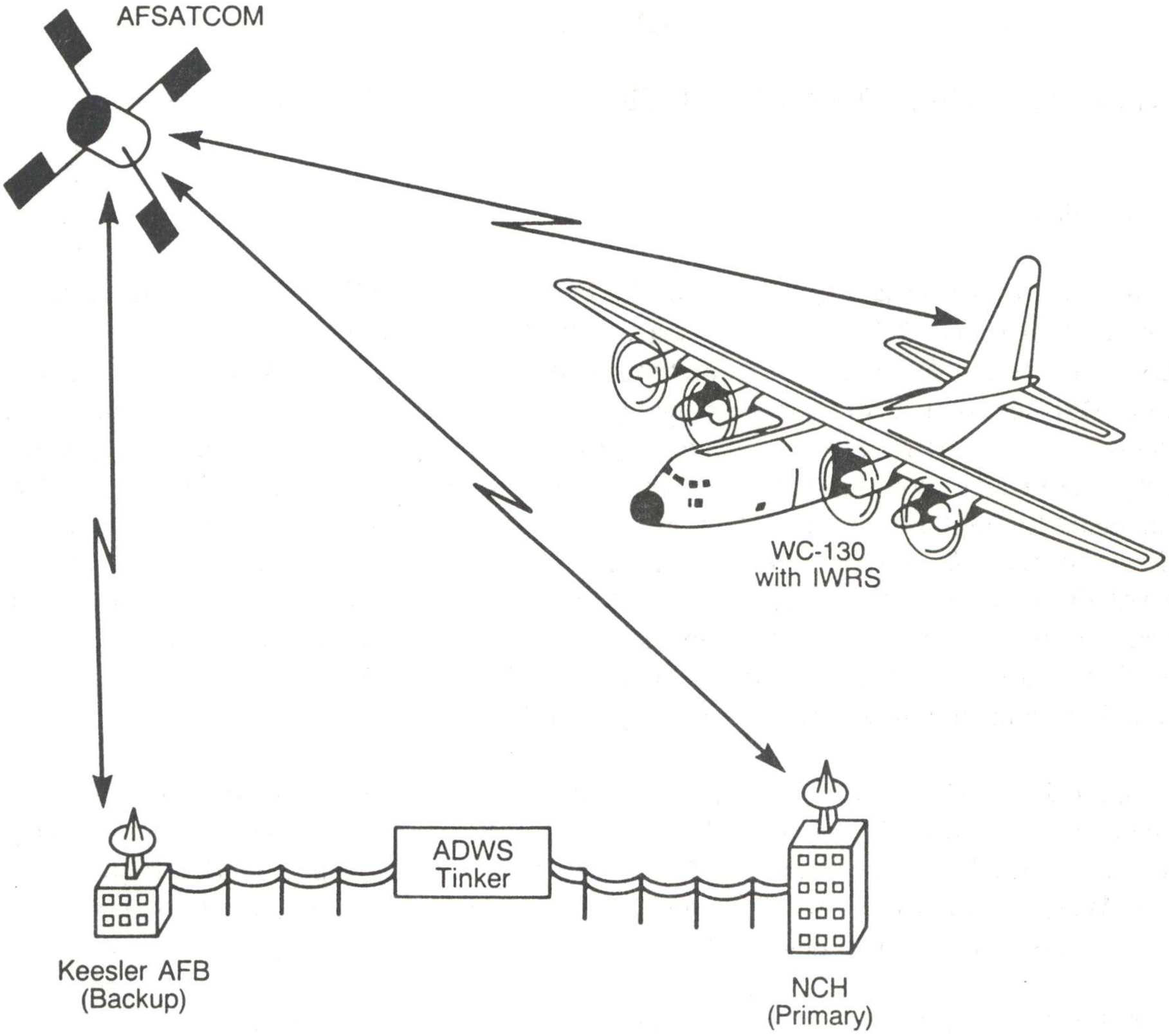

Figure 5-10. Schematic of aircraft to satellite data link for AFRES WC-130 aircraft

CHAPTER 6

SATELLITE SURVEILLANCE OF TROPICAL AND SUBTROPICAL CYCLONES

6.1. Satellites.

6.1.1. Geostationary Operational Environmental Satellite (GOES). The GOES system currently consists of ONE operational spacecraft, GOES-7 stationed at 112°W. The principal GOES products are one-half hourly pictures with implanted grids automatically applied to all sectors. During daylight hours, approximately 1-, 2-, and 4-km resolution fixed standard sectors are produced (see Figure 6-1). During the night (and during daylight) the same geographical coverage standard sectors are produced with 7-km resolution in infrared (IR). The IR data may be enhanced to emphasize various features. Also, 14-km resolution sectors of water vapor are available hourly. A suite of digital and analog products are delivered in near real-time to the National Environmental Satellite, Data, and Information Service's (NESDIS) Synoptic Analysis Branch, Satellite Field Distribution Facilities (SFDFs) (regional communication hubs), National Meteorological Center, Weather Service Forecast Offices (WSFOs), academic community, and other federal and private agencies. (See Figure 6-2 and Table 6-1).

6.1.1.1. GOES-I. GOES-I, the first in a series of new technological GOES satellites, was launched on April 13, 1994. After a successful launch and standard geostationary orbit is achieved, GOES-I will become GOES-8, ultimately operating at a GOES-East position (75 degrees West longitude) by fall 1994. GOES -7, currently a central satellite, will then move to a GOES-West position, 135 degrees West, arriving late December 1994.

6.1.1.2. GOES-8. In comparison to GOES-7, GOES-8 is designed to provide, in a routine scanning mode, additional images of the northern hemisphere and continental United States every half hour, enabling meteorologists to capture rapidly changing, dynamic weather events in near real-time. The GOES-8 imager will be capable of simultaneously detecting and transmitting 4 infrared (IR) spectral channels at the higher resolution of 4 km with the exception of IR moisture data which is available at 8 km resolution, and one visible (VIS) channel, at 1 km resolution. A separate, more accurate sounder will be capable of detecting 19 spectral bands, 18 in the IR and one in the VIS. Increased accuracy in soundings, greater frequency of data transmissions and almost doubled IR image resolution will result in a vast improvement in operational capabilities. Sounding data will be used to generate atmospheric temperature and moisture profiles, total precipitable water, stability indices, and surface and cloud temperatures.

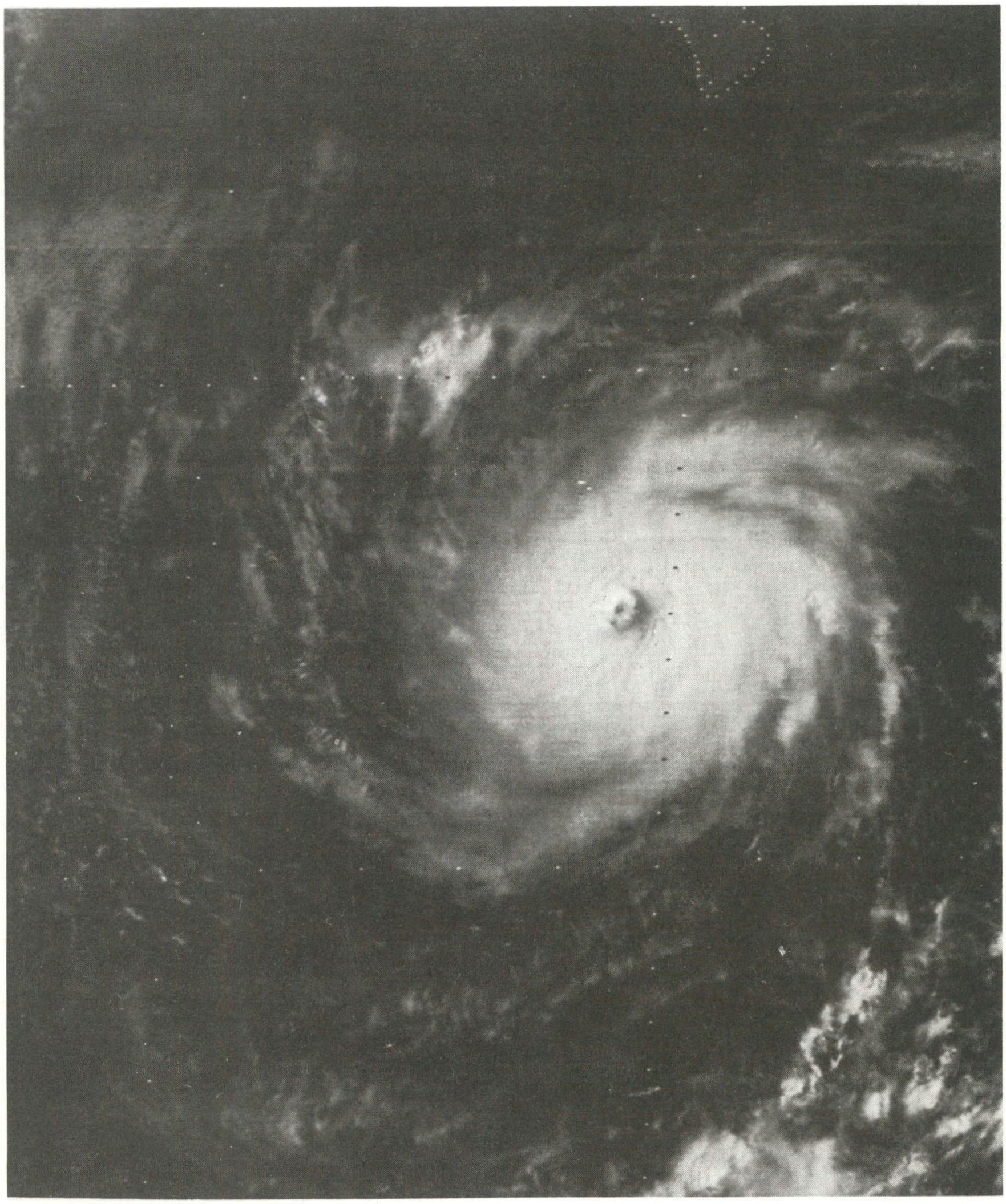

Figure 6-1. Hurricane Kevin, September 30, 1991

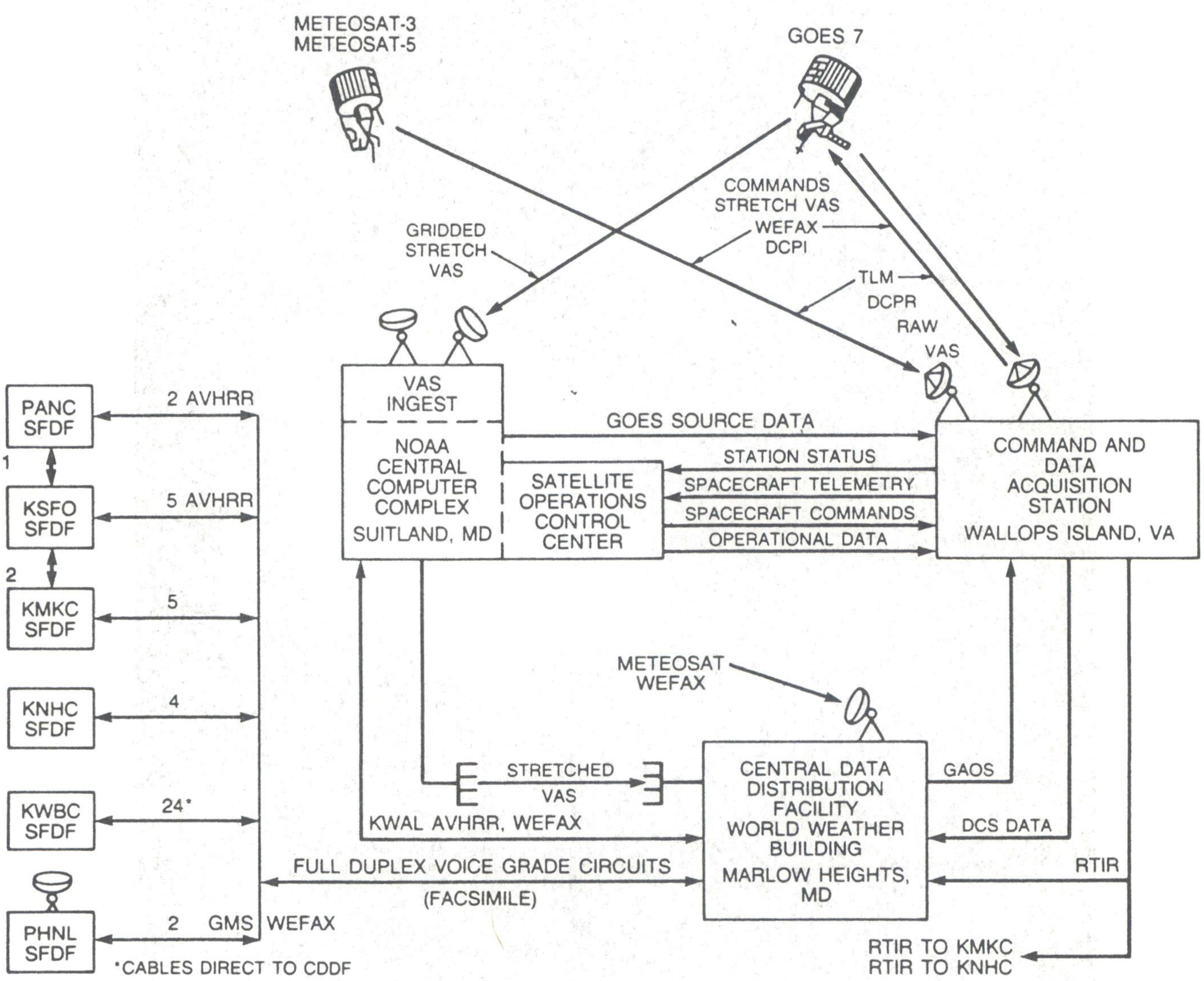

Figure 6-2. GOES central data distribution system

Table 6-1. Satellite and satellite data availability for the current hurricane season

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
GOES-7	VAS	Every 30 min (24hr/day) (Limited scan for short-interval viewing available.)	1. 1-,2-, and 4-km resolution visible standard sectors covering Western, Midwest, and Eastern United States. 2. 7-km resolution equivalent IR standard sectors for U.S. (night). 3. Equivalent IR-enhanced imagery. 4. Full disc IR (day and night) 5. 14-km resolution water vapor sectors (day and night). 6. VDUC interactive/manual products; moisture analysis; quantitative precipitation estimates; cloud top heights; cloud motion wind vectors; operational VAS gradient (thermal) winds. 7. Tropical storm monitoring including intensity analysis.

Table 6-1. Satellite and satellite data availability for the current hurricane season (continued)

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
GOES-8	Multispectral Imager and Sounder	Every 30 min, in routine scanning mode, transmitts a full disk image and a CONUS sector (Available rapid scan operations yield increased transmissions to capture rapidly changing, dynamic weather events).	1. 1,2, and 4-km resolution visible standard sectors. 2. 4-km equivalent resolution IR sectors. 3. Equivalent IR enhanced imagery. 4. Full Disk IR. 5. 8-km water vapor sectors. 6. VDUC interactive products; moisture analysis; quantitative precipitation estimates; cloud top heights; cloud and water vapor motion wind vectors. 7. Souding products such as gradient winds, vertical temperature and humidity profiles, precipitable water, and lifted index (measure of atmospheric stability). 8. Tropical storm, monitoring, including intensity analysis.

Table 6-1. Satellite and satellite data availability for the current hurricane season (continued)

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
METEOSAT-3 METEOSAT-5	Multi-spectral Spin-Scan Radiometer Multi-spectral Spin-Scan Radiometer	Every 30 min (24 hr/day)	1. 2.5 km resolution digital VIS imagery; 5 km resolution digital IR imagery. 2. 5 km resolution VIS and IR WEFAX imagery. 3. 5 km water vapor imagery 4. VDUC interactive products from METEOSAT-3: cloud motion wind vectors; cloud top heights; quantitative precipitation estimates; and moisture analysis. 5. Tropical storm monitoring, including intensity analysis.
NOAA-J (14) Launch Target Date Sept. 1994	AVHRR GAC and LAC (recorded) HRPT and APT (direct) TOVS	0140D[1]/1340A[2]	1. 1-km resolution HRPT and Local Area Coverage (LAC) data. 2. 4-km resolution APT and Global Area Coverage (GAC) data. 3. Mapped imagery. 4. Unmapped imagery (all data types) at DMSP sites.
NOAA-12	same as NOAA-J	0721D/1021A	5. Sea-surface temperature analysis.
NOAA-11	same as NOAA-J	0458D/1658A	6. Soundings 7. Moisture analysis 8. Remapped GAC sectors.

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[1] D - descending

[2] A - ascending

Table 6-1. Satellite and satellite data availability for the current hurricane season (continued)

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
DMSP F-8	Microwave imager (SSM/I) (recorded and direct) (85GHz channels non-functional)	0625D/1825D	1. AFGWC 1.5 nmi resolution visual and infrared imagery. 2. Hickam Direct Readout 0.3 and 1.5 nmi resolution visual and infrared imagery.
DMSP F-10	OLS Imagery (recorded and direct) SSM/I, SSM/T (recorded and direct)	0910/2110A	3. SSM/T data transmitted to NESDIS via shared processing. 4. SSM/I data validation ongoing.
DMSP F-11	OLS Imagery (recorded and direct) SSM/I, SSM/T, SSM/T2-moisture sounder (recorded and direct)(150GHZ channels non-functional)	0525D/1725A	

6.1.2. National Oceanic and Atmospheric Administration (NOAA) Polar-Orbiting Satellites. These Advanced Television Infrared Observation Satellites (NOAA Series) cross the United States twice daily near the equatorial crossing times indicated in Table 6-1. Data are available via direct readout--high resolution picture transmission (HRPT) or automatic picture transmission (APT)--or central processing. Data from the Advanced Very High Resolution Radiometer (AVHRR) are available on a limited basis through the GOES distribution system (Figure 6-2). The Air Force Global Weather Central (AFGWC), Offutt AFB, NE, receives global NOAA imagery data direct from central readout sites on a pass-by-pass basis. The Command and Data Acquisition (CDA) stations at Fairbanks, Alaska, and Wallops, Virginia, acquire recorded global area coverage data, and then route the data to NESDIS computer facilities in Suitland, Maryland, where the data are processed and distributed to the NOAA, the Department of Defense, and private communities.

6.1.3. European Space Agency (ESA) Geostationary Meteorological Satellite (METEOSAT). Two operational satellites, METEOSAT-3 and METEOSAT-5, stationed at 0°W and at 50°W respectively, provide extensive coverage of the Atlantic Ocean from Africa to the coasts of Central and North America. METEOSAT-3, now supporting the Extended Atlantic Data Coverage mission and emulating a GOES-East operation, was commissioned in February 1993. METEOSAT data, including applied grid information, are generated and transmitted every half hour. Conventionally, the full disk IR, Visible (VIS), and water vapor have a 5 km resolution whereas specialized VIS sectors provide a maximum 2.5 km resolution. The digital data are transmitted to the National Hurricane Center (NHC) in Miami, Florida; National Severe Storms Forecast Center, Kansas City, Missouri; and the NESDIS and National Meteorological Center (NMC) at the NOAA Science Center (NSC) in Camp Springs, Maryland. METEOSAT WEFAX data are also available and distributed on GOES-Tap circuits.

6.2. National Weather Service (NWS) Support.

6.2.1. Station Contacts. The GOES imagery is available in support of the surveillance of tropical and subtropical cyclones at specific NWS offices. Satellite meteorologists can be contacted at these offices; telephone numbers are in Appendix H.

6.2.2. Products. There are four types of satellite products issued by the centers and their alternates. Chapter 3 describes these products, their communications headings, and their schedules. The products are

- satellite tropical weather discussions
- satellite interpretation messages
- tropical weather discussions
- tropical disturbance rainfall estimates

6.2.3. Satellite Tropical Weather Discussion. The Miami and Honolulu WSFOs distribute satellite discussions (see Figure 6-3 for an example) for prescribed oceanic regions at the times indicated in Table 6-2. The Miami WSFO is responsible for the tropical regions of the Atlantic and Eastern Pacific; Honolulu WSFO monitors the tropical regions of the Central and Western Pacific. These satellite discussions describe significant weather in tropical regions including tropical storm activity over the Atlantic, Eastern Pacific, Central Pacific, and Western Pacific Oceans.

6.3. <u>NESDIS Synoptic Analysis Branch</u> (SAB). The SAB operates 24 hrs a day to provide satellite support to the National Meteorological Center (NMC), National Hurricane Center (NHC), Central Pacific Hurricane Center (CPHC), and other worldwide users. A tropical weather discussion for the Indian Ocean, including the location and current intensity of tropical storms, is also disseminated twice per day at the times indicated in Table 6-2. For numerical model input and forecasting applications, data from cloud motion wind vectors, moisture analyses, cloud top heights, and tropical rainfall estimates are provided to NMC and NHC. Telephone numbers for the SAB are located in Appendix H.

6.4. <u>Air Force Support and the Defense Meteorological Satellite Program (DMSP).</u> Data covering the National Hurricane Operations Plan areas of interest are received centrally at the Air Force Global Weather Central (AFGWC) and locally at the direct readout site at 15th Weather Squadron, Hickam AFB, HI. The USAF uses all available meteorological satellite data when providing fix and intensity information to NWS hurricane forecasters. The DOD will provide DMSP coverage of tropical and subtropical cyclones whenever possible.

6.4.1. North Atlantic and Eastern Pacific Surveillance. The AFGWC readouts will augment NESDIS surveillance for the North Atlantic and Eastern Pacific. The AFGWC will maintain a capability to respond to emergency requests for source tropical cyclone fixes. If requested, the teletype bulletins, describing the location and intensity classification of the system, will use the format shown in Figure 6-4. AFGWC will maintain the capability to provide gale wind radius analysis utilizing SSM/I data for all systems with maximum intensities greater than 50 kt.

6.4.2. Central Pacific Surveillance. AFGWC will maintain the capability to provide surveillance support cited in para 6.4.1 to the Central Pacific Hurricane Center (CPHC). 15th Weather Squadron will provide fix and intensity information to the CPHC on systems upon request.

6.5. <u>Satellites and Satellite Data Availability for the Current Hurricane Season</u>. Table 6-1 lists satellite capabilities for the current hurricane season.

AXNT20 KNHC 210800Z

TROPICAL WEATHER DISCUSSION

ALL MOVEMENTS AND TRENDS 24 HOURS UNLESS OTHERWISE STATED

EAST PACIFIC GOES WEST IR NITE 210745Z
TROPICAL STORM SUSAN. SEE LATEST NHC ADVISORY.[1]

ITC 2 TO 4 DEGS WIDE EXTNDG FM 6N 80W TO 11N 116W IS BRKN TO OCNLY OVC WITH HVST ACTIVITY ARND 11N 116W. SCTD ACTV ITC FROM 9N 116W TO 12N 134W 2 DEG WIDE WAS BKN YDA. BRKN TO OVC AREA 3 TO 5 DEG IN DIA IS MDTLY ACTV CNTRD NEAR 11N 116W HAS MVD W 5 DEG WITH LTL CHG.

ATLANTIC GOES EAST IR NOTE 210630Z

NO TROPICAL STORMS OBSERVED

ITC 3 TO 5 DEG WIDE FRM 10N 20W TO 14N 50W IS MSTLY BRKN AND MDTLY ACTV WITH LTL CHG. BRKN ACTV ITC FM 14N 50W TO 17N 57W 4 DEG WIDE HAS INCREASED IN WIDTH.

Figure 6-3. Sample satellite tropical weather discussion

6.6. <u>Current Intensity and Tropical Classification Number</u>. The current intensity (C.I.) number relates directly to the intensity of the storm. The empirical relationship between the C.I. number and a storm's wind speed is shown in Table 6-3. The C.I. number is same as the tropical classification number (T-number) during the development stages of a tropical cyclone, but is held higher than the T-number while a cyclone is weakening. This is done because a lag is often observed between the time a storm pattern indicates weakening has begun and the time when the storm's intensity decreases. An added benefit from this rule is the stability it adds to the analysis when short-period fluctuations in the cloud pattern occur. In practice, the C.I. number is not lowered until the T-number has shown weakening for 12 hours or more.

[1] Whenever a tropical system is located in the Atlantic, Caribbean, Eastern or Central Pacific, Part 1, will carry the following statement: "See latest (NHC or CPHC) advisory(ies)."

Table 6-2. Communications headings for satellite tropical weather discussion summaries

HEADING	TIME ISSUED	OCEANIC AREA	TYPE OF DATA
TCIO11 KWBC	0400 UTC	Indian Ocean	IR Night
TCIO10 KWBC	1500 UTC	Indian Ocean	VIS/IR Day
TCPW11 PHNL	1000 UTC	Western Pacific (north and south) from 100°E to 180°W	IR
TCPW10 PHNL	2200 UTC	Western Pacific (north and south) from 100°E to 180°W	IR
TCPA11 PHNL	1000 UTC	Central Pacific (north and south) from 180°W to 140°W	IR
TCPA10 PHNL	2200 UTC	Central Pacific (north and south) from 180°W to 140°W	VIS/IR
AXNT20 KNHC	00,06,12,18 UTC	Atlantic Ocean South of 32°N to Equator.... Caribbean, Gulf of Mexico	VIS/IR
AXPZ20 KNHC	0135, 0735 1335, 1935 UTC	Eastern Pacific South of 32°N to the Equator.... east of 140° W	VIS/IR

MESSAGE HEADING:
TPNT KGWC (Atlantic) or **TPPZ1 KGWC** (Eastern and Central Pacific)

A CYCLONE DESIGNATOR	A. Designator of tropical cyclone category including name/number. When a cloud system has not yet been designated by name/number enter TROPICAL DISTURBANCE. Sample entry: TROPICAL STORM AMY (15)
B DATE/TIME (Z) OF FIX	B. Date and nodal crossing time in Zulu; round time to nearest minute. Sample entry: 252303z.
C LATITUDE OF POSITION	C. Latitude to nearest tenth of degree (N or S), followed by checksum. Sample entry: 29.9N/O
D LONGITUDE OF POSITION	D. Longitude to nearest tenth of degree followed by checksum. Sample entry: 56.7 W/8
E VIS/IR POSITION CODE NUMBER SSM/I CONFIDENCE NUMBER	E. Enter SSM/I Confidence Number and source of data (DMSP, NOAA, etc.). Spell out VIS/IR Position Code Number (PCN). Select MI Confidence Number and PCN number from code below: GEOGRAPHICAL GRIDDING: ONE: eye fix; THREE: well defined circulation center; FIVE: poorly defined circulation center EPHEMERIS GRIDDING: TWO: eye fix; FOUR: well defined circulation center; SIX: poorly defined circulation center Sample entry: MI4/DMSP/SIX
F DVORAK CLASSIFICATION	F. Dvorak classification for storm intensity as described in NOAA Technical Report NESDIS 11. Dvorak classification will be made a minimum of twice each day based on infared and/or visual data. If a new Dvorak classification number cannot be derived, use the last reported number. Include in parentheses the date and nodal time of the data on which the Dvorak analysis is based. Sample entry: T 4.5/4.5/D1.0/25HRS (252306Z)
G REMARKS	G. Include information, as appropriate, on data type, eye characteristics, spiral rainbands, unexpected changes in storm movement, departures from Dvorak (modeled) intensities, etc.
H NADIR REFERENCE DISTANCE	H. Include crosstrack distance in degrees latitude between fix center and satellite nadir subtrack. Sample Entry: Center WAS 5.4 DEG EAST OF NADIR
I GALE WIND RADIUS ANALYSIS	I. Experimental gale wind (34kt) radius boundary utilizing image mapped SSM/I ocean surface wind speed algorithm estimates. Sample Entry: Gale Wind Radius Anal-Boundary Compass Points

DIR	DIST-NM	LAT	LONG
1. N	140	29.4N	88.2W
2. NE	130	28.9N	86.6W
3. E	80	27.0N	86.7W
4. SE	65	26.2N	87.4W
5. S	65	25.9N	88.2W
6. SW	65	26.3N	89.3W
7. W	80	27.0N	89.7W
8. NW	95	28.5N	89.2W

Figure 6-4. Center fix data form and message format (satellite)

Table 6-3. The empirical relationship* between the C.I. number and the maximum wind speed and the relationship between the T-number and the minimum sea-level pressure.

C.I. NUMBER	MAXIMUM WIND SPEED	T-NUMBER	MINIMUM SEA-LEVEL PRESSURE (Atlantic)	(NW Pacific)
1	25 kt	1		
1.5	25	1.5		
2	30	2	1009 hPa	1000 hPa
2.5	35	2.5	1005	997
3	45	3	1000	991
3.5	55	3.5	994	984
4	65	4	987	976
4.5	77	4.5	979	966
5	90	5	970	954
5.5	102	5.5	960	941
6	115	6	948	927
6.5	127	6.5	935	914
7	140	7	921	898
7.5	155	7.5	906	879
8	170	8	890	858

*Dvorak, V, 1984: Tropical Cyclone Intensity Analysis Using Satellite Data. NOAA Tech Report NESDIS 11, Washington, D.C.

CHAPTER 7

SURFACE RADAR REPORTING

7.1. General. Radar observations of tropical cyclones will be made at Department of Defense (DOD), National Weather Service (NWS), and Federal Aviation Administration (FAA) radar facilities and at other cooperating radar facilities according to established agreements with NWS. Participating radar sites are listed in Table 7-1.

7.2. Replacement of the WSR-57 with the WSR-88D. A joint effort of the DOD, NWS, and FAA is underway to replace the WSR-57 with a new Doppler radar, the WSR-88D. Installation of the WSR-88D network began in late 1990, and is expected to be complete by 1996. The new WSR-88D is fundamentally different from the WSR-57 in several respects. In addition to providing conventional data, the WSR-88D provides velocity data. The WSR-88D is a computerized data collection and processing system. Radar scanning strategies are governed by computer, using predetermined volume coverage patterns (VCPs). The VCP in use depends upon which weather phenomena are under surveillance. Once the data has been collected, it is processed automatically by a suite of algorithms which operate a suite of products for forecaster use.

7.3. Procedures. Until the WSR-88D network is fully operational and commissioned, radar observations will be required from the remaining WSR-57's, WSR-74 and other cooperating radar facilities. Observation requirements are thus given below for both systems.

7.3.1. Radar Observation Requirements for non-WSR-88D sites. Radar observations of tropical cyclones will be made in accordance with the Federal Meteorological Handbook number 7 (FMH-7), Part A, Weather Radar Observations, if the radar is still in operational use. Stations that normally transmit hourly radar observations (network stations) will include tropical cyclone features in routine reports at 35 minutes past the hour (H+35), and will make and transmit special observations at H+10 whenever an eye or center is observed. It is highly desirable for stations that do not normally transmit hourly reports (local warning radars) to make and transmit a radar observation whenever an eye, center, or spiral band is observed. Local warning radar sites may transmit only abbreviated special observations defined in FMH-7, at H+10, and H+35.

7.3.2. Radar Observation Requirements, WSR-88D. Radar observations of tropical cyclones will be made in accordance with the Federal Meteorological Handbook number 11 (FMH 11), Part D, Unit Description and Operational Applications. Features that might be observed are summarized in FMH-11, Part B, Chapter 9, Radar Characteristics of Hurricanes. The Radar Coded Message (RCM) is an automated product intended to alleviate much of the manual entry of radar observations necessary with the WSR-57. The RCM is transmitted automatically to the Automation of Field Operations and Services System (AFOS) network at H+20 and H+50. In the design phase, provision was made for tropical cyclone observations

Table 7-1. Participating radar stations

LOCATION	RADAR TYPE	88D status	LATITUDE	LONGITUDE
		NATIONAL WEATHER SERVICE RADARS		
Albany, NY	WSR-88D		42°35' N	74°04' W
Apalachicola, FL	WSR-57		29°44' N	84°59' W
Atlantic City, NJ	WSR-57		39°27' N	74°35' W
Baton Rouge, LA	WSR-74C		30°32' N	91°90' W
Binghamton, NY	WSR-88D		42°12' N	75°59' W
Boston, MA	WSR-88D		41°57' N	71°08' W
Brownsville, TX	WSR-57	deliv. 2/95	25°54' N	97°26' W
Cape Hatteras, NC	WSR-57		35°16' N	75°33' W
Charleston, SC	WSR-57	deliv. 1/95	32°54' N	80°02' W
Chatham, MA	WSR-74S		41°39' N	69°57' W
Corpus Christi, TX	WSR-74C	deliv. 12/95	27°46' N	97°30' W
Daytona Bch, FL	WSR-57		29°11' N	81°03' W
Galveston, TX	WSR-57		29°18' N	94°48' W
Houston, TX	WSR-88D		29°28' N	95°05' W
Jackson, MS	WSR-88D		32°19' N	90°05' W
Jacksonville, FL		deliv. 12/94		
Key West, FL	WSR-74S	deliv. 12/95	24°33' N	81°45' W
Lake Charles, LA	WSR-57	deliv. 2/94	30°07' N	93°13' W
Miami, FL	WSR-88D		25°37' N	80°25' W
Melbourne, FL	WSR-88D		28°07' N	80°39' W
Mobile, AL	WSR-74C	deliv. 12/94	30°41' N	88°15' W
Morehead City, NC	WSR-88D			
New York City, NY	WSR-88D		40°52' N	72°52' W
Norfolk, VA		deliv. 05/94	36°56' N	76°18' W
Patuxent, MD	WSR-74S		38°17' N	76°25' W
Pensacola, FL	WSR-57		30°21' N	87°19' W
Philadelphia, PA	WSR-88D		39°57' N	74°27' W
Portland, ME	WSR-88D		43°53' N	70°15' W
San Juan, PR	WSR-74S		18°16' N	65°46' W
Savannah, GA	WSR-74C		32°08' N	81°12' W
Shreveport, LA		deliv. 03/95		
Slidell, LA	WSR-57		30°17' N	89°49' W
State College, PA	WSR-88D		40°55' N	78°00' W
Sterling, VA	WSR-88D		38°58' N	77°29' W
Tampa, FL	WSR-57	deliv. 1/94	27°42' N	82°24' W
Tallahassee, FL		deliv. 11/94		
Victoria, TX	WSR-100-5		28°51' N	96°55' W
Waycross, GA	WSR-57		31°15' N	82°24' W
West Palm Bch, FL	WSR-74S		26°41' N	80°06' W
Wilmington, NC	WSR-57	deliv. 9/94	34°16' N	77°55' W

Table 7-1. Participating radars stations (continued)

LOCATION	RADAR TYPE	88D status	LATITUDE	LONGITUDE
		DEPARTMENT OF DEFENSE		
Andrews AFB, MD	WSR-88D	PUP	38°48'N	76°53'W
Barksdale AFB, LA	FPS-77	deliv. 4/95	32°30'N	93°40'W
Bermuda NAS	FPS-106		32°22'N	64°41'W
Cape Canaveral AFS, FL	WSR-88D	PUP	28°28'N	80°33'W
Chase Field NAS, TX	FPS-106		28°22'N	97°40'W
Cherry Point MCAS, NC	FPS-106		34°54'N	76°53'W
Corpus Christi NAS, TX	FPS-106		27°42'N	97°16'W
Dover AFB, DE[1]	WSR-88D		38°50'N	75°26'W
Fort Hood, TX[1]	WSR-88D		30°43'N	97°23'W
Fort Rucker, AL[1]	WSR-88D		31°28'N	85°28'W
Griffis AFB, NY[1]	WSR-88D		43°28'N	75°27'W
Eglin AFB, FL[1]	WSR-88D	UCP\PUP	30°34'N	85°55'W
Hickam AFB, HI	WSR-88D		21°19'N	157°55'W
Howard AFB, PN	FPQ-21		08°55'N	79°36'W
Hurlburt Field, FL	WSR-88D	PUP	30°26'N	86°41'W
Jacksonville NAS, FL	FPS-106		30°14'N	81°41'W
Keesler AFB, MS	FPS-77	deliv. 6/94	30°24'N	88°55'W
Maxwell AFB, AL[1]	WSR-88D		32°32'N	85°47'W
McGuire AFB, NJ	WSR-88D	PUP	40°00'N	74°36'W
New Orleans NAS, LA	FPS-106		29°50'N	90°01'W
Norfork NAS, VA	FPS-106		36°56'N	76°18'W
Pope AFB, NC	FPQ-21	deliv. 4/94	35°12'N	79°01,W
Robins AFB, GA[1]	WSR-88D	UCP/PUP	32°40'N	83°21'W
Seymour Johnson AFB, NC	WSR-88D	PUP	35°20'N	77°58'W
Guantanamo Bay, Cuba	FPS-106		19°54'N	75°10'W
Roosevelt Roads, PR	FPS-106		18°15'N	65°38'W

[1] NHC has dial-in access to these DOD sites.

Table 7-1. Participating radars stations (continued)

LOCATION	TYPE RADAR	88D status	LATITUDE	LONGITUDE
		COOPERATING SITES		
FAA				
	Grand Turk, BWI	deliv. 4/95		
NASA				
Bay St Louis, MS	CPS-9		30°42'N	89°07'W
Wallops Station, VA	MPS-19		37°50'N	75°29'W
	SPS-12		37°56'N	75°28'W
	FPS-16		37°50'N	75°29'W
	FPQ-6		37°52'N	75°31'W
Universities				
MIT	CPS-9		42°42'N	71°06'W
	M-33		42°42'N	71°06'W
Texas A&M	CPS-9		30°37'N	96°21'W
Univ of Miami	SP-1M		25°43'N	80°17'W
	CPS-68		25°43'N	80°17'W

to be appended to the RCM, Part C of FMH-11. However, entry of this optional text message is not an operational requirement at this time.

The physical characteristics of the tropical cyclone are best represented by use of the precipitation mode, usually Volume Coverage Pattern (VCP) 21. A recommended product list appears in FMH-11 Part D, Application versus Product Table 4-1.

7.3.3. Central Region Report. The following fix definitions and criteria are generic, in that they do not depend specifically upon the use of either the WSR-88D or any any other operational radar.

If the central region of a storm is defined by an identifiable wall cloud, the fix is reported as an "**EYE**". If the central region is recognizable, but not well-defined by a wall cloud, it is reported as a "**CENTER.**" When the eye or center is only occasionally recognizable or some other central region uncertainty exists, the eye or center is reported as "PSBL EYE" or "PSBL CENTER." Remarks stating the degree of confidence will be included with eye fixes only and will be classified as either "good," "fair," or "poor." A "good" fix is reported when the eye is symmetrical--virtually surrounded by wall cloud; a "poor" fix is reported when the eye is asymmetrical--less than 50 percent surrounded by wall cloud; a "fair" fix is reported to express a degree of confidence between "good" and "poor."

7.3.4. Transmission of Radar Reports. Timely transmission of tropical cyclone radar reports is essential. Normally, radar reports are transmitted over the AFOS or the Air Force Meteorological Data System (AFMEDS). Radar facilities not having weather transmission capability may call the nearest National Weather Service Office collect.

CHAPTER 8

NATIONAL DATA BUOY CENTER REPORTING STATIONS

8.1. General.

8.1.1. Automated Reporting Stations. The National Data Buoy Center (NDBC) maintains automated reporting stations in the Gulf of Mexico, off the east and west coasts of the United States, at coastal land areas, and in Micronesia. Also, a stockpile of six rapid response drifting data buoys is available for aerial deployment in the event of emergencies. These data acquisition systems obtain measurements of meteorological and oceanographic parameters for operations and research purposes. Moored buoy station locations and configurations are given in Table 8-1. The locations of Coastal Marine Automated Network (C-MAN) stations are listed in Table 8-2. Figures 8-1 through 8-3 show the locations of all moored buoys and C-MAN stations. Figure 8-4 is a detailed chart of the current and planned Gulf of Mexico network. Figure 8-5 shows the Automated Meteorological Observing Stations for the Western Pacific. An example of a drifting buoy is shown in Figure 8-6. The operational status and measurement capability of stations can be obtained from the Data Systems Division, NDBC, Bldg. 1100, Stennis Space Center, MS 39529 (601-688-1720).

8.1.2. Data Acquisition. Moored buoy and C-MAN stations routinely acquire, store, and transmit data every hour. Data obtained operationally include sea-level pressure, wind speed and direction, and air temperature. Sea-surface temperature and wave spectral data are measured by all moored buoys and a limited number of C-MAN stations.

8.1.3. Drifting Buoys. Drifting buoys are available as Wind Speed Direction (WSD) Drifters. A WSD buoy measures sea-level pressure, wind speed and direction, air temperature, and sea-surface temperature. Asynoptic reports are through Polar Orbiting Environmental Satellites (POES).

8.2. Requests for Drifting Buoy Deployment.

The Department of Commerce (DOC) through the National Oceanic and Atmospheric Administration (NOAA) will initiate a request through the Office of the Federal Coordinator for Meteorological Services and Supporting Research to the Air Force Reserve (AFRES) for each desired aerial deployment of drifting data buoys for a pre-storm array in the Atlantic or Pacific Oceans. Normally, AFRES C-130 aircraft are tasked for this mission. Requests for deployment should allow at least a 30-day lead time. For deployments in advance of a U.S. land-threatening hurricane, a 36- to 48-hr notification is required. All requests will include specifics regarding onloading base, accompanying technicians, desired pickup times, offload points, reimbursement funding, and any other pertinent data.

Table 8-1. Data buoy locations and configuration

STATION ID	LOCATION	HULL SIZE	ANEMOMETER HEIGHT
MOORED BUOYS IN THE GULF OF MEXICO			
42001	25.9°N 89.7°W	10 m	10 m
42002	25.9°N 93.6°W	10 m	10 m
42003	25.9°N 85.9°W	10 m	10 m
42007[1]	30.1°N 88.8°W	12 m	10 m
42019[1]	27.9°N 95.0°W	3 m	5 m
42020[1]	27.0°N 96.5°W	3 m	5 m
42025[1]	24.9°N 80.4°W	1.8 m	NA
42036[1]	28.5°N 84.5°W	3 m	5 m
MOORED BUOYS IN THE ATLANTIC OCEAN			
41001	34.9°N 73.0°W	6 m	5 m
41002	32.3°N 75.2°W	6 m	5 m
41004[1]	32.5°N 79.1°W	3 m	5 m
41006	29.3°N 77.4°W	6 m	5 m
41009[1]	28.5°N 80.2°W	3 m	5 m
41010[1]	28.9°N 78.5°W	6 m	5 m
41016[1]	24.6°N 76.S°W	12 m	10 m
44004	38.5°N 70.6°W	6 m	5 m
44005	42.5°N 68.6°W	6 m	5 m
44007[1]	43.5°N 70.1°W	12 m	14 m
44008[1]	40.5°N 69.4°W	12 m	14 m
44009[1]	38.4°N 74.7°W	12 m	14 m
44011	41.1°N 66.6°W	6 m	5 m
44013[1]	42.4°N 70.8°W	12 m	14 m
44014[1]	36.6°N 74.8°W	3 m	5 m
44025[1]	40.3°N 73.2°W	3 m	5 m
MOORED BUOYS IN THE PACIFIC OCEAN (SOUTH of 45°N)			
32302[1]	18.0°S 85.1°W	3 m	5 m
46002	42.5°N 130.4°W	6 m	5 m
46006	40.8°N 137.7°W	12 m	10 m
46011[1]	34.9°N 120.9°W	3 m	5 m
46012[1]	37.4°N 122.7°W	3 m	5 m
46013[1]	38.2°N 123.3°W	3 m	5 m
46014[1]	39.2°N 124.0°W	3 m	5 m
46022[1]	40.7°N 124.5°W	3 m	5 m
46023[1]	34.3°N 120.7°W	3 m	5 m
46025[1]	33.7°N 119.1°W	3 m	5 m
46026	37.7°N 122.7°W	12 m	14 m
46027	41.8°N 124.4°W	3 m	5 m
46028[1]	35.8°N 121.9°W	3 m	5 m
46030[1]	40.4°N 124.5°W	3 m	5 m
46040[1]	44.8°N 124.3°W	3 m	5 m
46042[1]	36.8°N 122.4°W	3 m	5 m
46045[1]	33.8°N 118.4°W	3 m	5 m
46050[1]	44.6°N 124.5°W	3 m	5 m
46051[1]	34.5°N 120.7°W	3 m	5 m
46053[1]	34.2°N 119.8°W	10 m	10 m
46054[1]	34.3°N 120.4°W	10 m	10 m
51001[1]	23.4°N 162.3°W	6 m	5 m
51002[1]	17.2°N 157.8°W	6 m	5 m
51003[1]	19.3°N 160.8°W	6 m	5 m
51004[1]	17.4°N 152.5°W	6 m	5 m
51026[1]	21.4°N 157.0°W	3 m	3 m
52009[1]	13.7°N 144.7°W	3 m	5 m

[1]Temporary site established in support of other programs

Table 8-2. C-MAN sites

STATION ID	LOCATION	STATION NAME
	C-MAN SITES IN THE GULF OF MEXICO	
BURL1	28.9°N 89.4°W	Southwest Pass, LA
BUSL1[1]	27.9°N 90.9°W	Bullwinkle Block 65
CSBF1	29.7°N 85.4°W	Cape San Blas, FL
DPIA1	30.2°N 88.1°W	Dauphin Island, AL
DRYF1[1]	24.6°N 82.8°W	Dry Tortugas, FL
GDIL1	29.3°N 90.0°W	Grand Isle, LA
LONF1[1]	24.8°N 80.5°W	Long Key, FL
PTAT2	27.8°N 97.1°W	Port Aransas, TX
SANF1[1]	24.5°N 81.9°W	Sand Key, FL
SRST2	29.7°N 94.1°W	Sabine, TX
VENF1	27.1°N 82.4°W	Venice, FL
	C-MAN SITES IN THE ATLANTIC OCEAN	
ALSN6	40.5°N 73.8°W	Ambrose Light, NY
BUZM3	41.4°N 71.0°W	Buzzards Bay, MA
CHLV2	36.9°N 75.7°W	Chesapeake Light, VA
CLKN7	34.6°N 76.5°W	Cape Lookout, NC
DSLN7	35.2°N 75.3°W	Diamond Shoals, NC
FBIS1	32.7°N 79.9°W	Folly Island, SC
FPSN7	33.5°N 77.6°W	Frying Pan Shoals, NC
FWYF1[1]	25.6°N 80.1°W	Fowey Rocks, FL
IOSN3	43.0°N 70.6°W	Isle of Shoals, NH
LKWF1	26.6°N 80.0°W	Lake Worth, FL
MDRM1	44.0°N 68.1°W	Mt Desert Rock, ME
MISM1	43.8°N 68.9°W	Matinicus Rock, ME
MLRF1	25.0°N 80.4°W	Molasses Reef, FL
SAUF1	29.9°N 81.3°W	St. Augustine, FL
SMKF1	24.6°N 81.2°W	Sombrero Key, FL
SPGF1	26.7°N 79.0°W	Settlement Point, GBI
SVLS1	31.9°N 80.7°W	Savannah Light, GA
TPLM2	38.9°N 76.4°W	Thomas Point, MD
	C-MAN SITES IN THE EASTERN PACIFIC OCEAN (SOUTH OF 45°N)	
CARO3	43.3°N 124.4°W	Cape Arago, OR
NWPO3	44.6°N 124.1°W	Newport, OR
PTAC1	39.0°N 123.7°W	Point Arena, CA
PTGC1	34.6°N 120.6°W	Point Arguello, CA

[1] Temporary site established in support of other programs

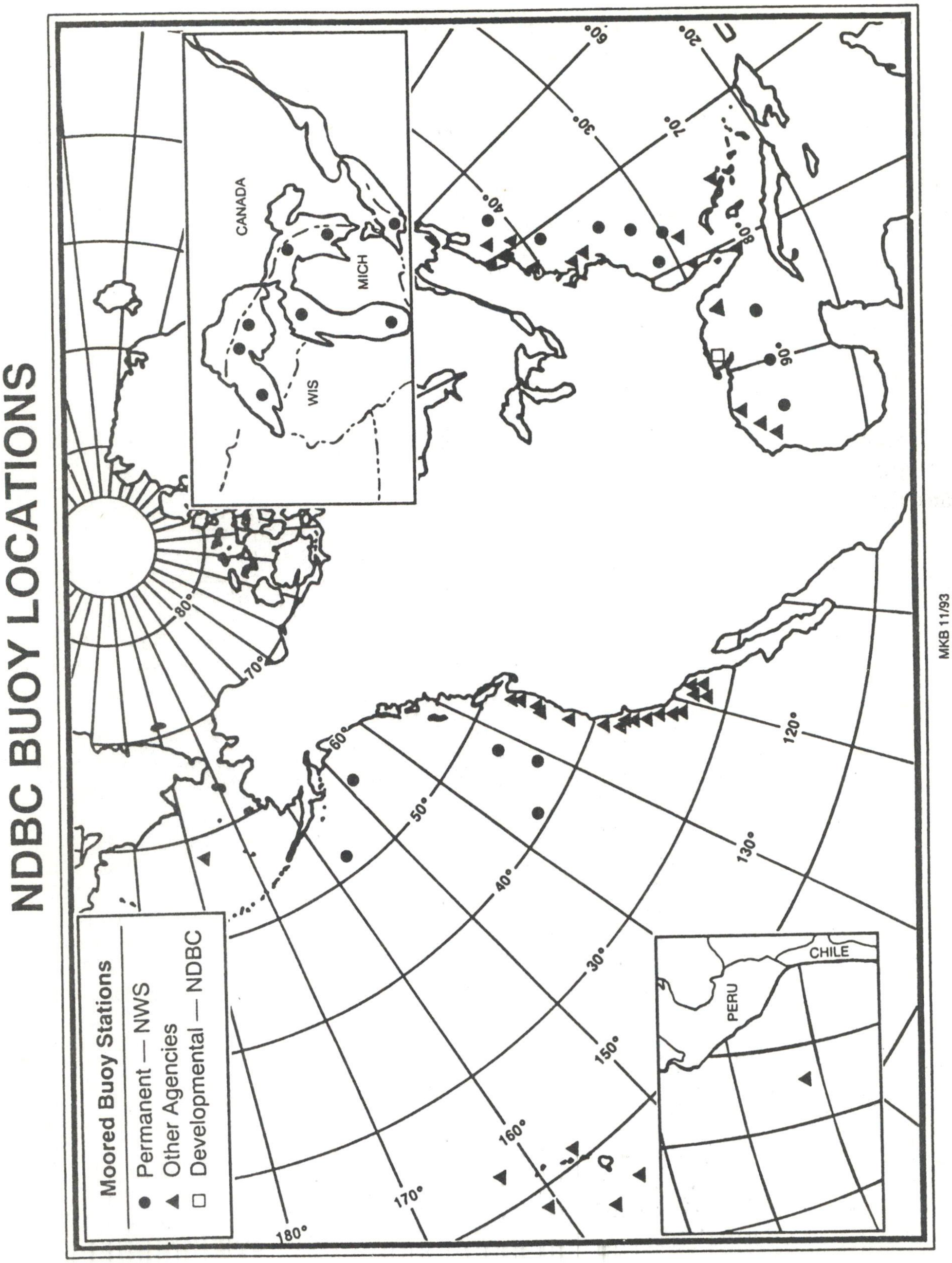

Figure 8-1. NDBC moored buoy locations in the Atlantic Ocean, Gulf of Mexico and Great Lakes

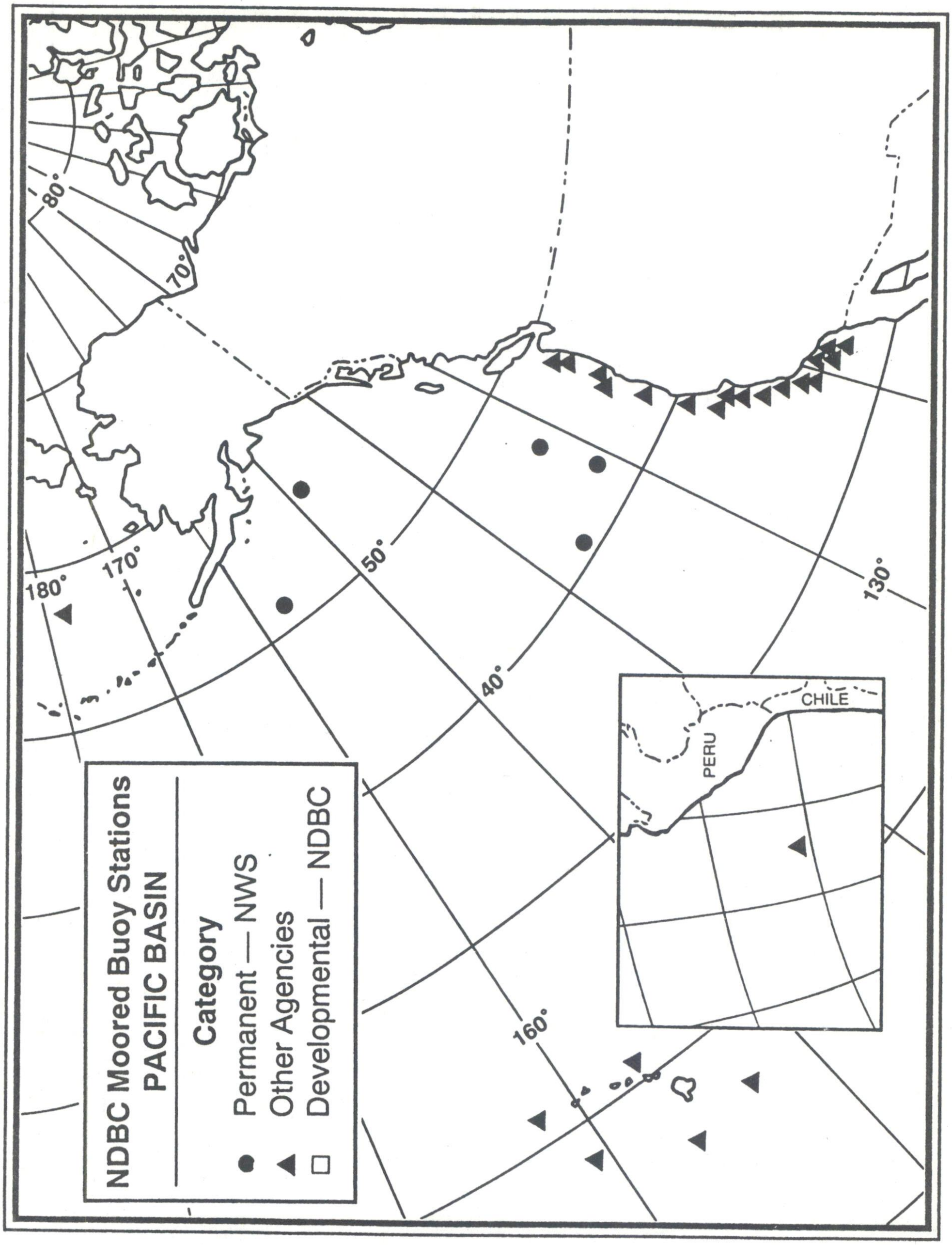

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Figure 8-2. NDBC moored buoy locations in the Pacific Ocean

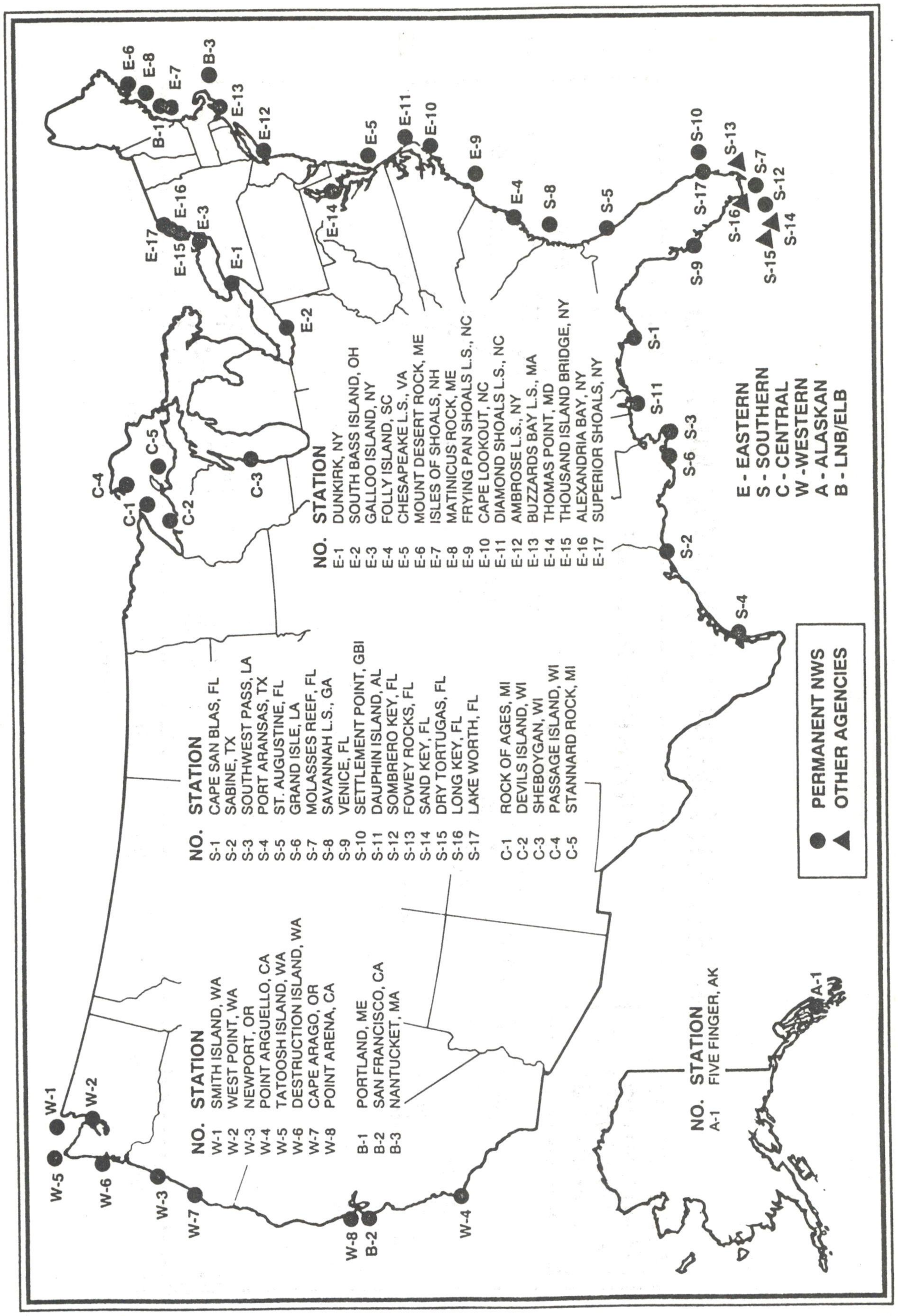

Figure 8-3. C-Man station locations in the Coastal U.S.

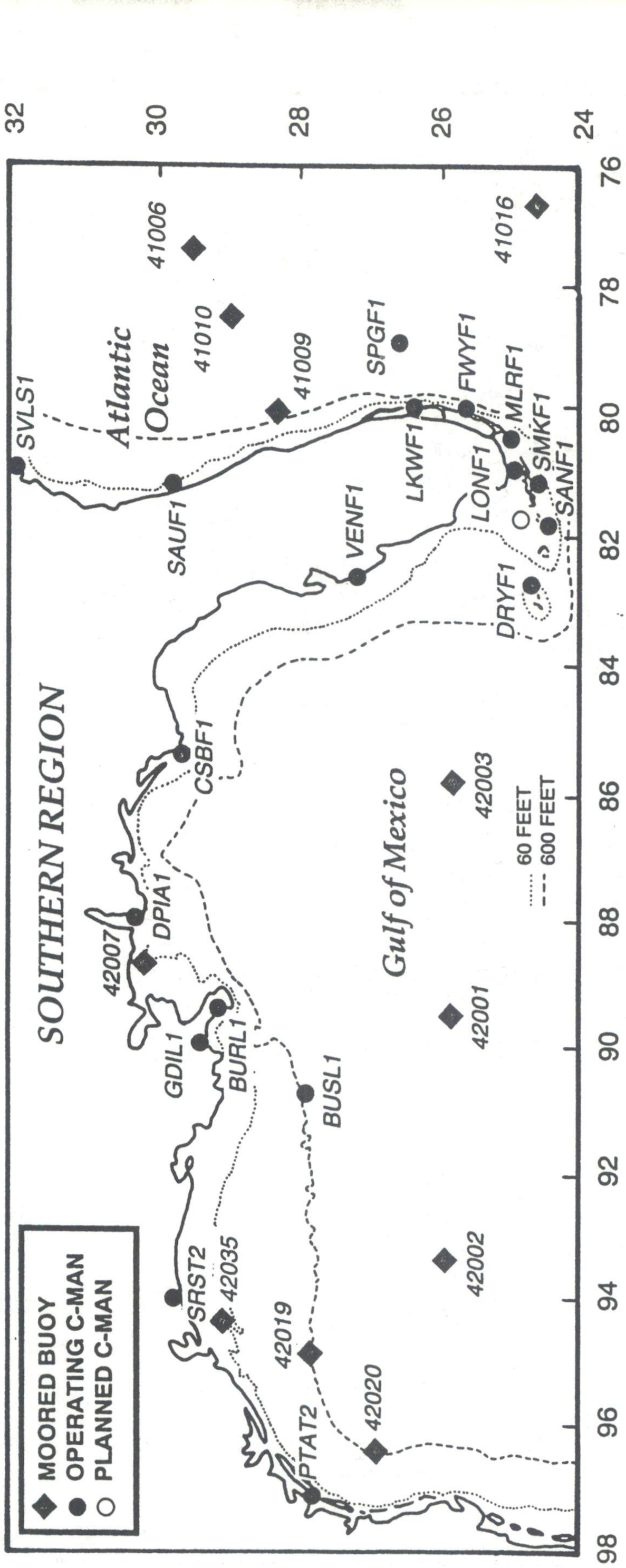

Figure 8-4. NDBC planned and current Gulf of Mexico moored buoy network

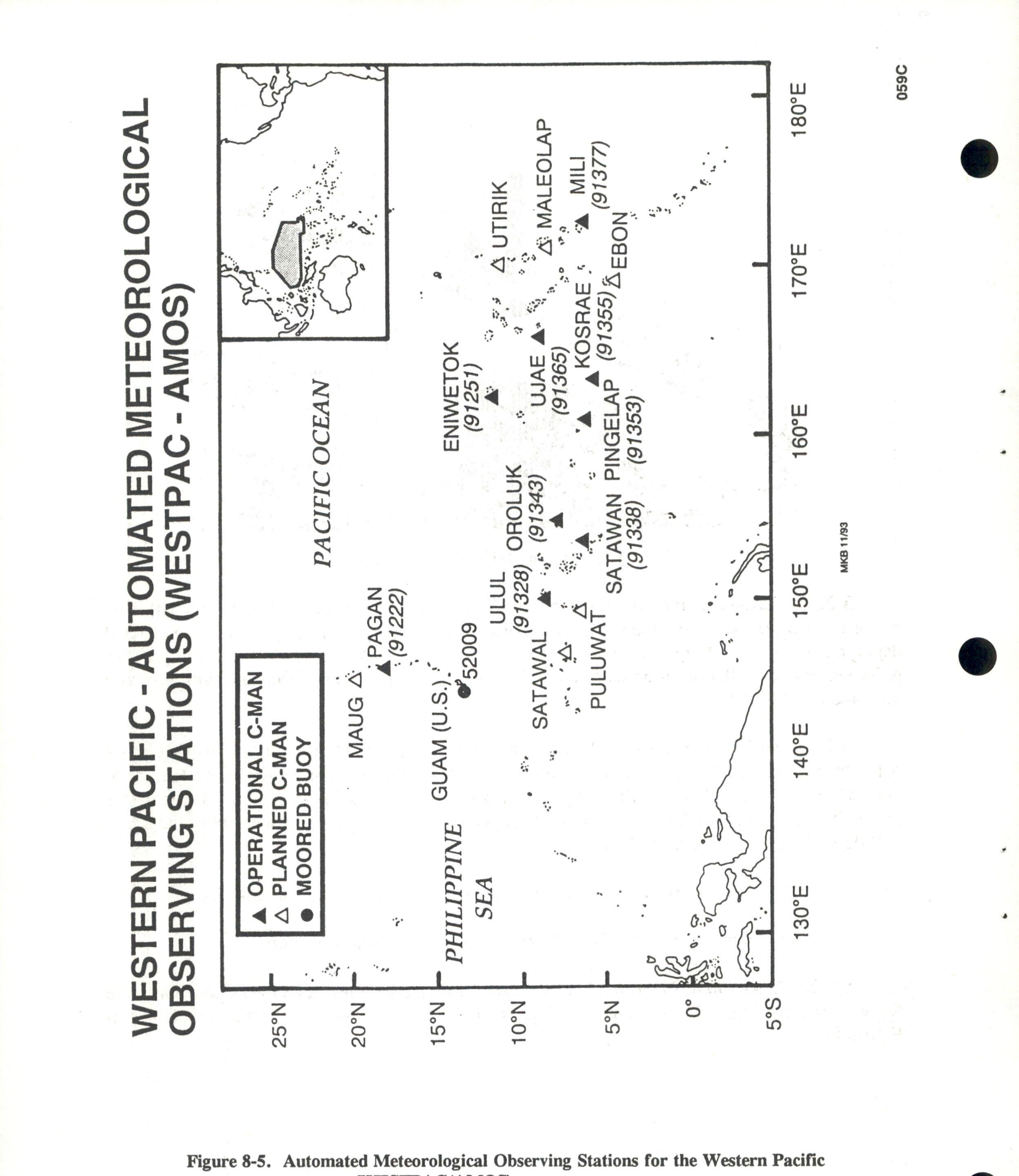

Figure 8-5. Automated Meteorological Observing Stations for the Western Pacific (WESTPAC/AMOS)

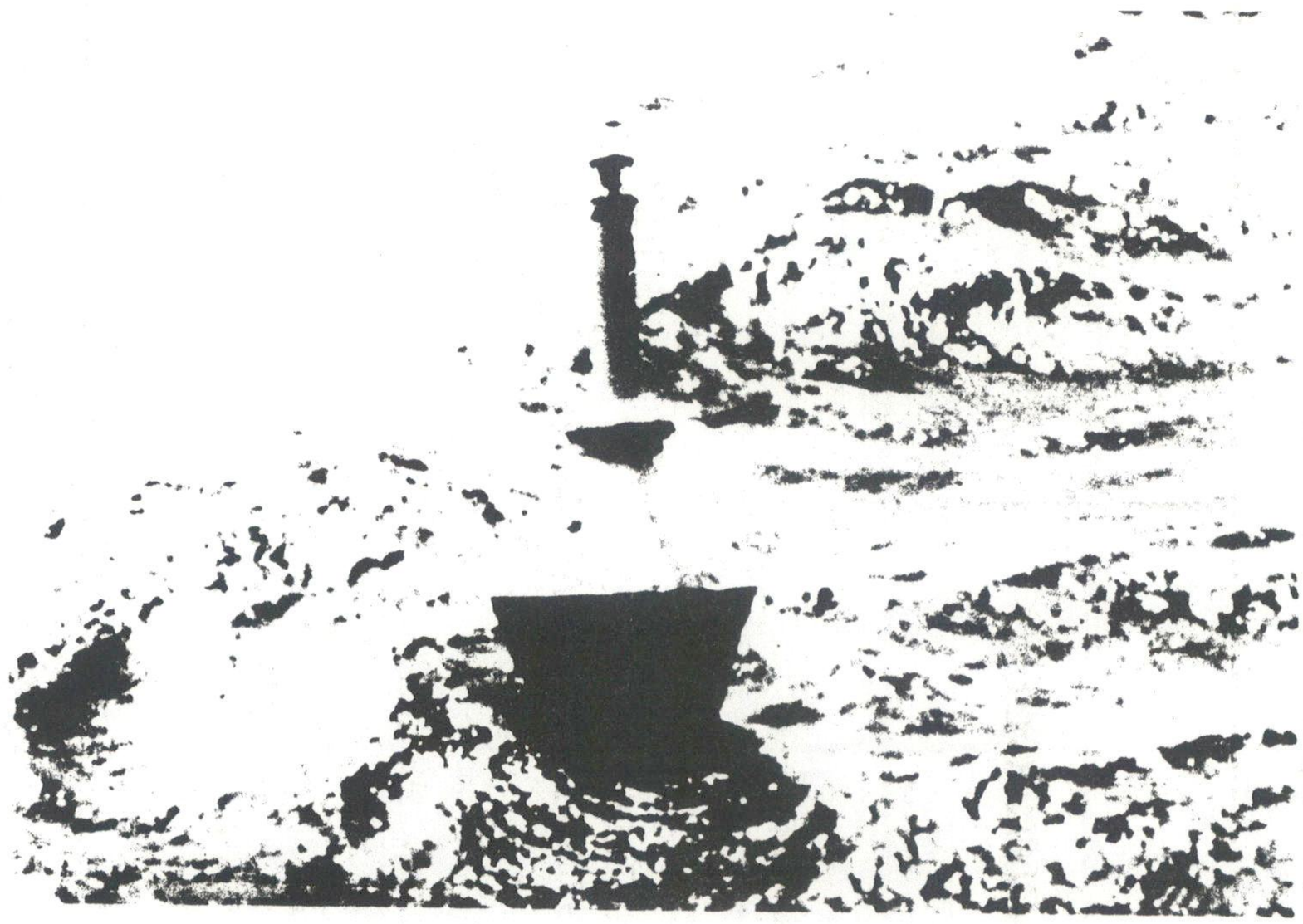

Figure 8-6. A drifting data buoy

8.2.1. National Hurricane Center. The National Hurricane Center forecasters will issue an alert or outlook for a possible request for drifting buoy deployment 48 hr prior to the planned deployment. A formal request for deployment will be issued 24 hr prior to the event. At this point either a cancellation or an extension of the alert will be issued. Decisions will normally be made by 0900 EDT.

8.2.2. Deployment Buoys. The DOC desires the deployment of up to four drifting buoys between 100 and 180 nmi from the storm center, depending on the dynamics of the storm system. The DOC will ensure the buoys and mission-related DOC personnel are available for pickup by Department of Defense aircraft. The specific DOC request for placement of the buoys will depend on several factors, including:

- Characteristics of the storm including size, intensity, and velocity
- Storm position relative to the coast and population centers

8.2.3. Deployment Position. The final deployment position will be provided prior to the flight crew briefing. Two examples of possible buoy deployment patterns are shown in Figure 8-7.

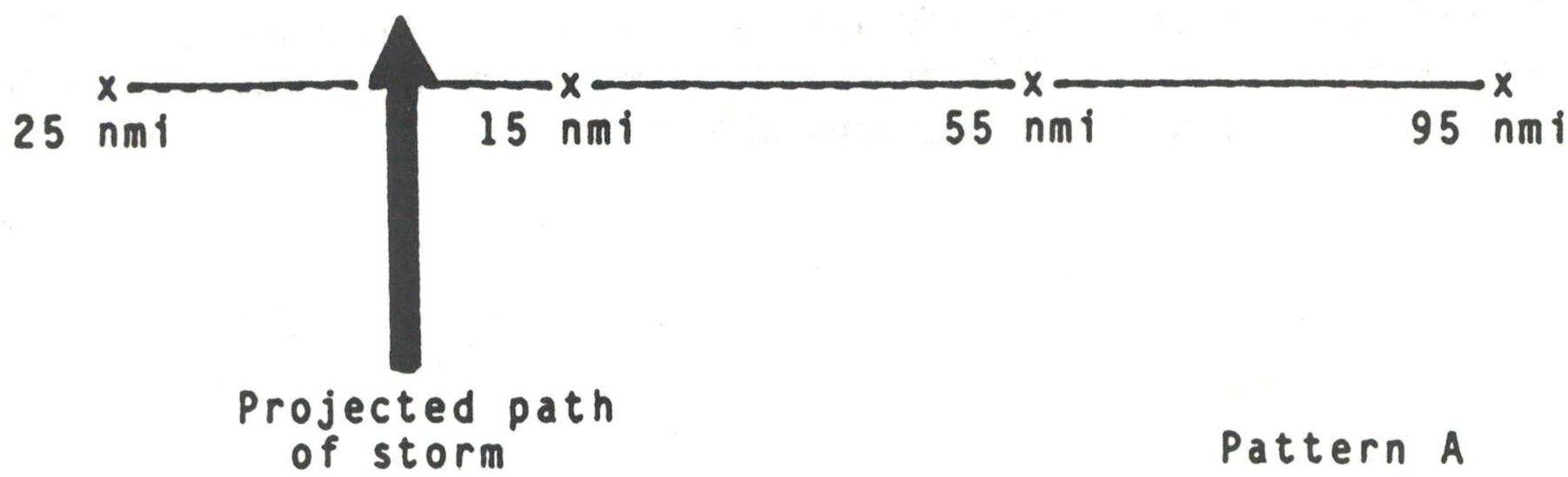

Figure 8-7. Drifting data buoy deployment patterns

8.3. Communications. Moored buoy and C-MAN data are transmitted by ultra-high frequency communications via the Geostationary Operational Environmental Satellite to the National Environmental Satellite, Data, and Information Service and then are relayed to the National Weather Service Telecommunications Gateway (NWSTG) for processing and dissemination. Moored buoy data are formatted into the World Meteorological Organization (WMO) FM13-IX SHIP code, and C-MAN data are formatted into C-MAN code, which is very similar to the WMO FM 12-IX SYNOP code. The SHIP code is defined in Federal Meteorological Handbook 2, Surface Synoptic Codes. Code forms are shown in Table 8-3. The C-MAN code is contained in the C-MAN Users' Guide, which is available from NDBC Data Systems. Drifting buoy data are telemetered through the NOAA polar orbiting satellites to the U.S. ARGOS Global Processing Center, Landover, Maryland, for processing. These data are formatted by Service ARGOS into the WMO FM18 (DRIFTER) code defined in the WMO Manual on Codes, Volume I, and then are routed to the NWSTG for distribution and dissemination to users in the United States and overseas over the Global Telecommunications System.

Table 8-3. Code forms for moored data buoys, C-MAN stations and drifting buoys

CODE FORM FM 13 IX (SHIP) REPORT OF SYNOPTIC
SURFACE OBSERVATION FROM A SEA STATION (AUTOMATIC WEATHER STATION)

$M_iM_iM_jM_j$	$A_1b_wn_bn_bn_b$	YYGGi	$99L_aL_aL_a$		$Q_cL_oL_oL_oL_o$
i_ri_x / / /	/ddff	$1s_nTTT$	$(2s_nT_dT_dT_d)$	4PPPP	5appp 9GGgg
22200	$Os_nT_wT_wT_w$	$1P_{wa}P_{wa}H_{wa}H_{wa}$	$70\ H_{wa}H_{wa}H_{wa}$		
333	912ff	(00fff)			
555	11fff	22fff	(3GGgg	$4ddf_mf_m$)	
$(6G_cG_cg_cg_c$	$d_1d_1d_1f_1f_1f_1$	$d_2d_2d_2f_2f_2f_2$	$d_3d_3d_3f_3f_3f_3$	$d_4d_4d_4f_4f_4f_4$	$d_5d_5d_5f_5f_5f_5$
	$d_6d_6d_6f_6f_6f_6$)				

U.S. NATIONAL CODE FORM (C-MAN LAND STATION CODE)
MODIFIED CODE FORM FM 12-IX

CMAN YYGGi						
$XXXXn_t$	$i_RR\ i_xhVV$	Nddff	(00fff)	$1s_nTTT$	4PPPP 5appp	6RRRt 9GGgg
222 / /	$Os_nT_wT_wT_w$	$1_{wa}P_{wa}H_{wa}H_{wa}$	$70H_{wa}H_{wa}H_{wa}$			
333	912ff	(00fff)				
555	11fff	22fff	(3GGgg)	$(4ddf_mf_mf_m)$	(66666)	
$(6G_cG_cg_cg_c$	$d_1d_1d_1f_1f_1f_1$	$d_2d_2d_2f_2f_2f_2$	$d_3d_3d_3f_3f_3f_3$	$d_4d_4d_4f_4f_4f_4$	$d_5d_5d_5f_5f_5f_5$	
	$d_6d_6d_6f_6f_6f_6$)	(TIDE1111)				

CODE FORM FM 18 (DRIFTER)
REPORT OF A DRIFTING BUOY OBSERVATION

$M_iM_iM_jM_j$						
	$A_1b_wn_bn_bn_b$	YYMMJ	$GGggi_w$	$Q_cL_aL_aL_aL_aL_a$	$L_oL_oL_oL_oL_oL_o$	
(0ddff	$1s_nTTT$	2PPPP	3appp)			
222	$0S_nT_wT_wT_w$	$1P_{wa}P_{wa}H_{wa}H_{wa}$	$20P_{wa}P_{wa}P_{wa}$	$21H_{wa}H_{wa}H_{wa}$		
333	$8887k_2$	$2Z_oZ_oZ_oZ_o$	$3T_oT_oT_oT_o$	$4S_oS_oS_oS_o$	...	
		$2Z_nZ_nZ_nZ_n$	$3T_nT_nT_nT_n$	$4S_nS_nS_nS_n$		
	$66k_69k_3$	$2Z_oZ_oZ_oZ_o$	$d_od_oC_oC_oC_o$	...		
		$2Z_nZ_nZ_nZ_n$	$d_nd_nc_nc_nc_n$			
444	$(1Q_pQ_zQ_{tw}Q_4)$	$(2Q_nQ_L$ //)				
	$((Q_cL_aL_aL_aL_aL_a$	$L_oL_oL_oL_oL_oL_o)$	or $(H_LV_BV_Bd_Bd_B))$			
	$(8V_iV_iV_iV_i)$	$(9i_dZ_dZ_dZ_dZ_d)$				

CHAPTER 9

MARINE WEATHER BROADCASTS

9.1. General. The Department of Transportation (DOT) is responsible for broadcasting marine tropical cyclone advisories issued by the National Hurricane Center and the Central Pacific Hurricane Center. Table 9-1 lists the stations involved. The broadcasts are for the purpose of providing warnings to meet international obligations in the Department of Commerce area of forecast responsibility given in Chapter 2.

9.2. Broadcast Procedures. The DOT will arrange for broadcast of all marine tropical cyclone advisories immediately upon receipt. The latest tropical cyclone forecast will be transmitted according to the schedule and on the frequencies given in Worldwide Marine Weather Broadcasts. The latest position estimate will be used by DOT along with the latest forecast for storms on which positions estimates are being issued. The broadcasts will be made in voice, radiotelex, NAVTEX, and high frequency Morse telegraphy. The Morse telegraphy broadcast will be discontinued by 1999, at the full implementation of the Global Maritime Distress and Safety System (GMDSS).

Table 9-1. Marine tropical cyclone forecast broadcast stations

STATION CALL LETTERS	AGENCY	LOCATION
NMF	DOT	Boston, MA
NMO	DOT	Honolulu, HI
NMA	DOT	Miami, FL
NMG	DOT	New Orleans, LA
NMN	DOT	Portsmouth, VA
NMC	DOT	San Francisco, CA

CHAPTER 10

PUBLICITY

10.1. <u>News Media Releases</u>. News media releases, other than warnings and advisories, for the purpose of informing the public of the operational and research activities of the Departments of Commerce, Defense, and Transportation should reflect the joint effort of these agencies by giving due credit to the participation of other agencies.

10.2. <u>Distribution</u>. Copies of these releases should be forwarded to the following agencies:

- NOAA Office of Public Affairs
  Herbert C. Hoover Building
  14th and Constitution Avenue, N.W.
  Washington, DC 20230

- Commander, Naval Meteorology and Oceanography Command
  1020 Balch Boulevard
  Stennis Space Center, MS 39529-5005

- Hq Air Force Reserve (AFRES/PA)
  Robins AFB, GA 31093

- The Joint Chiefs of Staff (J36/JRC)
  Washington, DC 20318-3000

- Federal Aviation Administration (APA-310)
  800 Independence Avenue, S.W.
  Washington, DC 20591

- Federal Coordinator for Meteorology
  Suite 900, 6010 Executive Boulevard
  Rockville, MD 20852

APPENDIX A

ABBREVIATIONS

-A-

AB	Data type header for Tropical Weather Outlook
ADWS	Automated Digital Weather System
AES	Atmospheric Environmental Service (Canada)
AFB	Air Force Base
AFGWC	Air Force Global Weather Central
AFMEDS	Air Force Meteorological Data System (replaced COMEDS)
AFOS	Automation of Field Operations and Services
AFRES	Air Force Reserve
AFS	Air Force Station
AFSATCOM	Air Force Satellite Communications System
AFTN	Aeronautical Fixed Telecommuncations Network
AMC	Air Mobility Command
AMCR	Air Mobility Command Regulation
AMOS	Automated Meteorological Observing Station
AOC	Aircraft Operations Center (NOAA)
APT	Automatic Picture Transmission
ARGOS	ARGOS, Inc., a French data collection system
ARSA	Airport Radar Service Area
ARTCC	Air Route Traffic Control Center
ARWO	Aerial Reconnaissance Weather Officer
ASDL	Aircraft-to-Satellite Data Link
ASID	Air-Sea Interaction Drifter
ATC	Air Traffic Control
ATCSCC	Air Traffic Control System Command Center
AVDM	Abbreviated Vortex Data Message
AVHRR	Advanced Very High Resolution Radiometer

-C-

CARCAH	Chief, Aerial Reconnaissance Coordination, All Hurricanes
CARF	Central Altitude Reservation Facility
CDDF	Central Data Distribution Facility (NESDIS)
C.I.	Current Intensity
C-MAN	Coastal-Marine Automated Network
COM	Commercial (telephone)
CONUS	Continental United States
COMEDS	CONUS Meteorological Data System (USAF)
CPHC	Central Pacific Hurricane Center
CW	Continuous Wave
°C	degree/degrees Celsius

-D-

DA	Daylight Ascending
DAF	Department of the Air Force
DCS	Data Collection System
deg	degree (latitude or longitude)
Det	Detachment
DMSP	Defense Meteorological Satellite Program
DOC	Department of Commerce
DOD	Department of Defense
DOT	Department of Transportation
DPTD	departed
DRIBU	Drifting Buoy Code

DROP	Dropsonde/dropwindsonde
DSN	Defense Switched Network (formerly AUTOVON)
DTG	Date/Time Group
DVDM	Detailed Vortex Data Message

-E-

EDT	Eastern Daylight Time
ESA	European Space Agency
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure

-F-

FAA	Federal Aviation Administration
FACSFAC	Fleet Aerial Control and Surveillance Facility
FCM	Federal Coordinator for Meteorological Services and Supporting Research
FCMSSR	Federal Committee for Meteorological Services and Supporting Research
FCST	forecast
FCSTR	forecaster
FL	Flight Level
FLT LVL	Flight Level
FMH	Federal Meterological Handbook
ft	foot/feet
FTS	Federal Telephone System

-G-

GAC	Global Area Coverage
GOES	Geostationary Operational Environmental Satellite
GMDSS	Global Maritime Distress and Safety System
GMS	Geostationary Meteorological Satellite
GTS	Global Telecommunications System

-H-

HA	High Accuracy
HD	High Density
HF	High Frequency
hPa	hectopascal/hectopascals
h	hour/hours
HNL	Honolulu (CPHC)
HRPT	High Resolution Picture Transmission

-I-

ICAO	International Civil Aviation Organization
ICMSSR	Interdepartmental Committee for Meteorological Services and Supporting Research
ID	identification
IFR	Instrument Flight Rules
INIT	initials
IR	Infrared
IWRS	Improved Weather Reconnaissance System

-J-

JTWC	Joint Typhoon Warning Center

-K-

km	kilometer/kilometers
KBIX	ICAO identifier for Keesler AFB, MS
KMIA	ICAO identifier for Miami, FL (NHC)
KMKC	ICAO identifier for Kansas City, MO WSFO
KNEW	ICAO identifier for New Orleans, LA WSFO
KSFO	ICAO identifier for San Francisco, CA
kt	knot/knots
KWAL	ICAO identifier for Wallops Island, VA

-L-

LAC	Local Area Coverage
LF	Light Fine (satellite data terminology)
LI	Long Island
LS	Light Smooth (satellite data terminology)

-M-

m	meter/meters
MANOP	communications header
MAX	maximum
METEOSAT	European Space Agency geostationary meteorological satellite
min/MIN	minute
MINOB	Minute Observation (IWRS)
MOU	Memorandum of Understanding
mph	mile/miles per hour
MVMT	movement

-N-

NASA	National Aeronautics and Space Administration
NAVLANTMETOCCEN	Naval Atlantic Meteorology and Oceanography Center
NAVLANTMETOCCOM DET	Naval Atlantic Meteorology and Oceanography Command Detachment
NAVLANTMETOCCOM FAC	Naval Atlantic Meteorology and Oceanography Command Facility
NAVMETOCCOM	Naval Meteorology and Oceanography Command
NAVPACMETOCCEN	Naval Pacific Meteorology and Oceanography Center
NDBC	National Data Buoy Center
NESDIS	National Environmental Satellite, Data, and Information Service
NFDC	National Flight Data notice to airman Center
NHC	National Hurricane Center
NHOP	National Hurricane Operations Plan
NLT	Not Later Than
NMC	National Meterological Center
nmi	nautical mile/miles
NOAA	National Oceanic and Atmospheric Administration
NSC	NOAA Science Center
NSSFC	National Severe Storms Forecast Center
NSTL	National Space Technology Laboratories (NASA)
NTMO	FAA National Traffic Management Officer
NWS	National Weather Service

-O-

OAC	Oceanic Aircraft Coordinator (USN)
OBS	observation
OFCM	Office of the Federal Coordinator for Meterological Services and Supporting Research
OSS	Operations Support Squadron (USAF)

-P-

PA	Public Affairs
PANC	ICAO identifier for Anchorage, AK
PCA	Positive Control Area
PCN	Position Code Number
PHNL	ICAO identifier for Honolulu, HI
POD	Plan of the Day
POES	Polar Orbiting Environmental Satellite

-R-

RECCO	Reconnaissance Code
RECON	reconnaissance
REQT	requested
ROCC	Regional Operational Control Center
RTIR	Real-Time Infrared

-S-

SAB	Synoptic Analysis Branch
SFC	surface
SFDF	Satellite Field Distribution Facility
SLP	Sea Level Pressure
SSH	Mission Sensor Infrared Temperature Sounder (DMSP)
SSIR	Mission Sensor Infrared
SSM/I	Mission Sensor Microwave Imager
SSM/T	Mission Sensor Microwave Temperature Sounder
SST	Sea Surface Temperature
SVD	Supplementary Vortex Data

-T-

TCA	Terminal Control Area
TCD	Tropical Cylone Discussion
TCPOD	Tropical Cyclone Plan of the Day
TD	Tropical Depression
TEMP	temperature
TEMP	temporary
TEMP DROP	Dropwindsonde Code
TF	Thermal Fine
TKO	takeoff
TMO	Traffic Management Officer in air route centers and towers
T-number	Tropical classification number
TOVS	TIROS-N Operational Vertical Sounder
TS	Thermal Smooth
TWO	Tropical Weather Outlook

-U-

UHF	Ultra High Frequency
US/U.S.	United States
USAF	United States Air Force
USCG	United States Coast Guard
USN	United States Navy
UTC	Universal Coordinated Time

-V-

VAS	VISSR Atmospheric Sounder
VDUC	VAS Data Utilization Center
VIS	Visible
VISSR	Visible and Infrared Spin Scan Radiometer
VTPR	Vertical Temperature Profile Radiometer

-W-

WEFAX	Weather Facsimile
WESTPAC	Western Pacific
WMO	World Meteorological Organization
WND	wind
WO	Data type header for special tropical disturbance statements
WRS	Weather Reconnaissance Squadron
WS	(National) Weather Service
WS	Weather Squadron
WSD	Wind Speed and Direction (data bouy)
WSFO	Weather Service Forecast Office
WSR	Weather Surveillance Radar
WT	Data type header for hurricane bulletins
WW	Data type header for subtropical storm bulletins

-X-

XMTD	transmitted

-Z-

Z	Zulu (UTC)

APPENDIX B

GLOSSARY

-A-

Agency. Any Federal agency or organization participating in the tropical cyclone warning service.

Airport Radar Service Area. Regulatory airspace surrounding designated airports wherein ATC provides radar vectoring and sequencing on a full-time basis for all IFR and VFR aircraft. The service provided in an ARSA is called ARSA Service which includes: IFR/IFR-standard IFR separation; IFR/VFR-traffic advisories and conflict resolution; and VFR/VFR-traffic advisories and, as appropriate, safety alert. The AIM contains an explanation of ARSA. The ARSA's are depicted on VFR aeronautical charts.

Area Manager. Supervisor in charge of air route traffic control center or airport tower, shift to shift.

-C-

Center Fix. The location of the center of a tropical or subtropical cyclone obtained by means other than reconnaissance aircraft penetration. See also Vortex Fix.

Continental Control Area. The airspace of the 48 contiguous States, the District of Columbia and Alaska, excluding the Alaska peninsula west of Long. 160° 00' 00"W, at and above 14,500 feet MSL, but does not include:

a. The airspace less than 1,500 feet above the surface of the earth; or
b. Prohibited and restricted areas, other than the restricted areas listed in the AIM.

Control Area. Airspace designated as Colored Federal airways, VOR Federal airways, control areas associated with jet routes outside the continental control area, additional control areas, control area extensions, and area low routes. Control areas do not include the continental control area, but unless otherwise designated, they do include the airspace between a segment of a main VOR Federal airway and its associated alternate segments with the vertical extent of the area corresponding to the vertical extent of the related segment of the main airway. The vertical extent of the various categories of airspace contained in control areas is defined in the AIM.

Control Zone. Controlled airspace which extends upward from the surface of the earth and terminates at the base of the continental control area. Control zones that do not underlie the continental control area have no upper limit. A control zone may include one or more

airports and is normally a circular area with a radius of 5 statute miles and any extensions necessary to include instrument approach and departure paths.

Controlled Airspace. Airspace designated as a control zone, airport radar service area, terminal control area, transition area, control area, continental control area, and positive control area within which some or all aircraft may be subject to air traffic control. (See also ICAO-Controlled Airspace).

Cyclone. An atmospheric closed circulation rotating counter-clockwise in the Northern Hemisphere.

-E-

Eye. The relatively calm center of the tropical cyclone that is more than one half surrounded by wall cloud.

Eye Wall. An organized band of cumuliform clouds immediately surrounding the center of a tropical cyclone. Eye wall and wall cloud are used synonymously.

-H-

High Density/High Accuracy (HD/HA) Data. Those data provided by automated airborne systems--WP-3s or WC-130s equipped with the Improved Weather Reconnaissance System.

Hurricane/Typhoon. A warm-core tropical cyclone in which the maximum sustained surface wind speed (l-min mean) is 64 kt (74 mph) or more.

Hurricane Season. The portion of the year having a relatively high incidence of hurricanes. The seasons for the specific areas are as follows:

• Atlantic, Caribbean, and the Gulf of Mexico	June 1 to November 30
• Eastern Pacific	May 15 To November 30
• Central Pacific	June 1 to November 30

Hurricane Warning Offices. The designated hurricane warning offices follow:

- National Hurricane Center, Miami, Florida
- Central Pacific Hurricane Center, Honolulu, HI

Hurricane Warning. A warning that sustained winds of 64 kt (74 mph) or higher associated with a hurricane are expected in a specified coastal area in 24 hr or less. A hurricane warning can remain in effect when dangerously high water or a combination of dangerously high water and exceptionally high waves continue, even though winds may be less than hurricane force.

Hurricane Watch. An announcement for specific coastal areas that a hurricane or an incipient hurricane condition poses a possible threat, generally within 36 hr.

-I-

ICAO-Controlled Airspace. Airspace of defined dimensions within which air traffic control service is provided to controlled flights.

-M-

Miles. The term "miles" used in this plan refers to nautical miles (nmi) unless otherwise indicated.

Mission Identifier. The nomenclature assigned to tropical and subtropical cyclone aircraft reconnaissance missions for weather data identification. It's an agency-aircraft indicator followed by a Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) assigned mission-system indicator.

-N-

National Traffic Management Officer. Supervisor in charge of the Operational Air Traffic Control System for the United States - 24 hour operations.

-P-

Positive Control Area. Airspace designated in the AIM within which there is positive control of aircraft. Flight in PCA is normally conducted under instrument flight rules. PCA is designated throughout most of the conterminous United States and its vertical extent is from 18,000 feet MSL to and including flight level 600. In Alaska PCA does not include the airspace less than 1,500 feet above the surface of the earth nor the airspace over the Alaska Peninsula west of longitude 160 degrees West. Rules for operating in PCA are found in the AIM.

Present Movement. The best estimate of the movement of the center of a tropical cyclone at a given time and at a given position. This estimate does not reflect the short-period, small-scale oscillations of the cyclone center.

-R-

Reconnaissance Aircraft Sortie. A flight that meets the requirements of the tropical cyclone plan of the day.

Relocated. A term used in an advisory to indicate that a vector drawn from the preceding advisory position to the latest known position is not necessarily a reasonable representation of the cyclone's movement.

-S-

Storm Surge. An abnormal rise in sea level accompanying a hurricane or other intense storm, and whose height is the difference between the observed level of the sea surface and the level that would have occurred in the absence of the cyclone. Storm surge is usually estimated by subtracting the normal or astronomic tide from the observed storm tide.

Storm Tide. The actual level of sea water resulting from the astronomic tide combined with the storm surge.

Subtropical Cyclone. A low pressure system that develops over subtropical waters that initially has a non-tropical circulation but in which some elements of tropical cyclone cloud structure are present.

Subtropical Depression. A subtropical cyclone in which the maximum sustained surface wind speed (1-min mean) is 33 kt (38 mph) or less.

Subtropical Storm. A subtropical cyclone in which the maximum sustained surface wind speed (1-min mean) is 34 kt (39 mph) or greater.

Synoptic Track. Weather reconnaissance mission flown to provide vital meteorological information in data sparse ocean areas as a supplement to existing surface, radar, and satellite data. Synoptic flights better define the upper atmosphere and aid in the prediction of tropical cyclone development and movement.

-T-

Terminal Control Area. Controlled airspace extending upward from the surface or higher to specified altitudes, within which all aircraft are subject to operating rules and pilot and equipment requirements specified in the AIM. TCA's are depicted on Sectional, World Aeronautical, En Route Low Altitude, DOD FLIP, and TCA charts.

Transition Area. Controlled airspace extending upward from 700 feet or more above the surface of the earth when designated in conjunction with an airport for which an approved instrument approach procedure has been prescribed; or from 1,200 feet or more above the surface of the earth when designated in conjunction with airway route structures or segments. Unless otherwise specified, transition areas terminate at the base of the overlying controlled airspace. Transition areas are designed to contain IFR operations in controlled airspace during portions of the terminal operation and while transiting between the terminal and en route environment.

Tropical Cyclone. A warm-core, nonfrontal low pressure system of synoptic scale that develops over tropical or subtropical waters and has a definite organized surface circulation.

Tropical Cyclone Plan of the Day. A coordinated mission plan that tasks operational weather reconnaissance requirements during the next 1100 to 1100z UTC day or as required, describes reconnaissance flights committed to satisfy both operational and research requirements, and identifies possible reconnaissance requirements for the succeeding 24-hr period.

Tropical Depression. A tropical cyclone in which the maximum sustained surface wind speed (l-min mean) is 33 kt (38 mph) or less.

Tropical Disturbance. A discrete tropical weather system of apparently organized convection--generally 100 to 300 mi in diameter--originating in the tropics or subtropics, having a nonfrontal migratory character, and maintaining its identity for 24 hr or more. It may or may not be associated with a detectable perturbation of the wind field.

Tropical Storm. A tropical cyclone in which the maximum sustained surface wind speed (l-min mean) ranges from 34 kt (39 mph) to 63 kt (73 mph).

Tropical Storm Warning. A warning for tropical storm conditions including sustained winds within the range of 39 to 73 mph (34 to 63 kt) that are expected in a specified coastal area within 24 hr or less.

Tropical Storm Watch. An announcement that a tropical storm poses or tropical storm conditions pose a threat to coastal areas generally within 36 hr. A tropical storm watch should normally not be issued if the system is forecast to attain hurricane strength.

Tropical Wave. A trough or cyclonic curvature maximum in the trade-wind easterlies. The wave may reach maximum amplitude in the lower middle troposphere or may be the reflection of an upper tropospheric cold low or equatorial extension of a middle latitude trough.

Tropical Weather System. A designation for one of a series of tropical weather anomalies. As such, it is the basic generic designation, which in successive stages of intensification, may

be classified as a tropical disturbance, wave, depression, storm, or hurricane.

Typhoon/Hurricane. A warm-core tropical cyclone in which the maximum sustained surface wind speed (1-min mean) is 64 kt (74 mph) or more.

-U-

Uncontrolled Airspace. Uncontrolled Airspace is that portion of the airspace that has not been designated as continental control area, control area, terminal control area, or transition area and within which ATC has neither the authority nor the responsibility for exercising control over air traffic.

-V-

Vortex Fix. The location of the surface and/or flight level center of a tropical or subtropical cyclone obtained by reconnaissance aircraft penetration. See Center Fix, also.

-W-

Wall Cloud. An organized band of cumuliform clouds immediately surrounding the center of a tropical cyclone. Wall cloud and eye wall are used synonymously.

APPENDIX C

OFFICIAL INTERAGENCY AGREEMENTS

The following enclosures are Memorandum of Agreement (MOA) between the Air Force Reserve (AFRES) and the National Oceanic and Atmospheric Administration (NOAA), dated May 4, 1992; Letter of Agreement (LOA) between the AFRES and Federal Aviation Administration, dated September 1, 1993; and a Letter of Agreement (LOA) between the AFRES and NOAA Corps Air Operations, dated August 3, 1993. The purpose of these MOA's and LOA's is to establish policies, principles, and procedures under which the FAA, AFRES and NOAA Corps will provide aircraft weather reconnaissance to NOAA.

MEMORANDUM OF AGREEMENT

BETWEEN

THE UNITED STATES AIR FORCE RESERVE

AND

THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

PURPOSE: The National Oceanic and Atmospheric Administration (NOAA) does not have the capability to fully support all operational requirements in support of tropical storm reconnaissance. This memorandum establishes policies, principles, and procedures under which the Air Force Reserve (AFRES) will provide aircraft weather reconnaissance support to NOAA.

1. REFERENCES:

a. SAF/PAT Message, 312020Z JUL 90, Subj: Deactivation of WC-130 Mission

b. National Hurricane Operations Plan (NHOP)

2. BACKGROUND: The Air Force Reserve will maintain an aircraft weather reconnaissance force of 12 WC-130s (currently 8 PAA and 4 BAI, planned to become 10 PAA and 2 BAI with congressional approval) to meet the Department of Commerce (DOC) requirements for aircraft reconnaissance. NOAA has a requirement for up to five sorties per day in support of the NHOP. The Office of Management and Budget determined that the Department of Defense (DOD) should provide support to NOAA, and DOD will bear all costs directly attributable to providing this reconnaissance support. This support will be limited to congressional funding for hours of aircraft flying time per year.

3. IMPLEMENTATION: Implementation details are contained in "GENERAL PROVISION".

4. GENERAL PROVISION:

a. AFRES agrees:

(1) To meet NOAA's requirement to conduct, within the limits of military capability, aerial weather reconnaissance for purposes of providing tropical cyclone warning services.

(a) Total flying hours will not exceed 1600 hours annually. To date, Congress has fully funded 1600 hours for FY 92 only. Unless the congressional budget language is permanently changed for FY 93 and beyond, the flying hour program will consist of 1000 fully funded weather hours in addition to another 600 hours that may be taken from the tactical airlift program, as required.

(b) The operational area for AFRES weather reconnaissance will include the Atlantic Ocean, Gulf of Mexico, the Caribbean Sea, and the North

Pacific Ocean. AFRES will be able to support two deployed locations simultaneously with the required maximum of five sorties daily.

(2) To provide an aircraft operations interface [Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH)] with NOAA at the National Hurricane Center. To date, funding for the CARCAH position has not been forthcoming from HQ USAF. AFRES is prepared to provide the manpower positions out-of-hide through 1 Oct 92. AFRES reserves the right to review periodically the CARCAH function in order to see if we can save government funds by consolidating manpower positions and moving the operational functions of CARCAH to Keesler AFB.

b. NOAA agrees to notify AFRES promptly for flight scheduling in accordance with this implementing agreement. Tasking will be through the Director, National Hurricane Center.

c. AFRES has no obligation to support winter storm or other weather operations. However, subject to aircraft and aircrew availability, the 403 AW/CC may, at NOAA request, approve specific winter storm or other weather-related missions. These missions will fall under the purview and limitations of this agreement; i.e., 1600 hours annually for all weather reconnaissance, etc.

5. MOBILIZATION: This memorandum remains in effect during periods of mobilization subject to aircraft and Reserve personnel availability, in accordance with 33 U.S.C. 855. There is no wartime tasking for the 815 WOF. Upon mobilization, however, aircrews will be limited to the six primary assigned weather crews. In addition, maintenance support could be sharply limited. Therefore, after mobilization, weather operations may be severely curtailed or eliminated.

6. EFFECTIVE AND TERMINATION DATES: This memorandum is effective the date signed by the last approving official and will be reviewed every three years from the effective date. Changes or revisions to this memorandum require the approval of both parties involved.

FOR THE UNITED STATES
AIR FORCE RESERVE

JACK W. BLAIR, JR, Colonel, USAFR
Deputy Chief of Staff, Operations

Date 19 Jan 92

FOR THE NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION

JENNIFER JOY WILSON
Asst Secretary and Deputy Administrator
for Oceans and Atmosphere

Date MAY 4 1992

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6010 Executive Boulevard, Suite 900
Rockville, MD 20852

NOAA/NWS/W
1325 East West Hwy, Rm 18130
Silver Spring, MD 20910-3233

Atch 1

FEDERAL AVIATION ADMINISTRATION (FAA)
UNITED STATES AIR FORCE RESERVE (AFRES)

LETTER OF AGREEMENT

EFFECTIVE: SEP - 1 1993

SUBJECT: METEOROLOGICAL RECONNAISSANCE FLIGHTS

1. PURPOSE: Establishes procedures to be used by the 815th Weather Squadron (815WS) and the FAA during winter storm missions in support of the NWSOP, and during hurricane/tropical cyclone missions in support of the NHOP.

2. CANCELLATION: This Letter of Agreement (LOA) remains in effect until expressly cancelled by one of the participating agencies with 30 days notification.

3. REFERENCES:

a. National Hurricane Operations Plan (NHOP)
b. National Winter Storm Operation Plan (NWSOP)

4. SCOPE: The responsibilities and procedures outlined herein are for use in the conduct of weather reconnaissance flights in support of the NHOP and the NWSOP within the airspace for which the FAA provides air traffic control (ATC) services.

5. RESPONSIBILITIES:

a. Aircraft commanders are the sole responsible party for all dropsonde or other sensor releases.

b. The aircraft commander is responsible for determining the content and duration of a broadcast concerning the release of a dropsonde or other sensor.

c. The FAA will provide ATC services and separation from nonparticipating aircraft to 815WS aircraft operating in other than Class G airspace. It is the responsibility of the aircraft commander to remain clear of obstacles and nonparticipating aircraft when operating in Class G airspace.

d. The 815WS is responsible for ensuring that air traffic clearances and messages are relayed to/from the FAA in an accurate manner when those relays are initiated by the 815WS and are routed through other than Aeronautical Radio Inc. (ARINC).

6. PROCEDURES:

a. The 815WS Current Operations (815WS/DOO) will contact the FAA Central Altitude Reservation Function (CARF) at DSN 851-1971/72 or commercial (202) 267-9416 and submit an Altitude Reservation Approval Request (ALTRV APREQ) at least 12 hours prior to an NWSOP mission, and pass the information

specified in the NWSOP within the paragraph entitled "Prior Coordination." Individual exceptions may be made to the 12 hour requirement on a case-by-case basis through coordination between the 815WS and CARF.

b. CARF will process the ALTRV APREQ, accomplishing coordination with impacted facilities. 815WS shall coordinate with using agencies to transit Special Use Airspace (restricted, warning, etc.) along their route of flight.

c. The 815WS/DOO will contact the Air Traffic Control System Command Center (ATCSCC) at (202) 267-5500 as soon as possible prior to an NHOP mission and pass the information specified in the NHOP, paragraph 5.5.4, Air Traffic Control (ATC), Prior Coordination. The ATCSCC will then coordinate this information with all FAA facilities impacted.

d. The 815WS shall only use the callsign "TEAL" and will only be given priority handling when specifically requested.

e. Tracks flown in support of the NWSOP shall be defined in supplements to this LOA. Changes, additions, and deletions to these tracks shall be coordinated between the 815WS and CARF. These tracks shall be reviewed annually, no later than June 1.

f. During NWSOP missions, dropsonde instrument releases shall be coordinated with ATC by advising of a pending drop at least 10 minutes prior to drop when in direct radio contact with ATC. When contact with ATC is via ARINC, dropsonde release coordination shall be included with the position report prior to the point where the dropsonde will be released. EXAMPLE: *"TEAL 63, SLATN at 1215, FL310, estimating FLANN at 1250, CHAMP next, Dropsonde release at FLANN."*

g. During NWSOP missions, commencing 5 minutes prior to release of dropsondes, the aircraft commander will broadcast in the blind on 121.5 and 243.0 to advise any traffic in the area of the pending drop.

h. When 815WS flights are unable to contact ATC to request an en route clearance, a clearance request may be relayed through Chief, Aerial Reconnaissance Coordinator, All Hurricanes (CARCAH). This relay may only be used to preclude an emergency or safety related situation.

i. ATC may request that CARCAH relay information to/from a mission aircraft when other methods of communications are not possible.

William H. Pollard
Federal Aviation Administration
Associate Administrator
for Air Traffic

James E. Sehorn, BRIG GEN, USAFR
United States Air Force Reserve
Director of Operations

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 403d AIRLIFT WING (AFRES)
KEESLER AIR FORCE BASE MISSISSIPPI 39534-5000

LETTER OF AGREEMENT

1. PURPOSE: This Letter of Agreement (LOA) establishes procedures whereby 815th Weather Squadron (815WS) and/or National Oceanic and Atmospheric Administration (NOAA) aircraft can operate within the same general airspace while conducting weather reconnaissance or weather research in a real or suspected tropical disturbance.

2. DEFINITIONS (for purposes of this LOA):

a. WEATHER RECONNAISSANCE and WEATHER RESEARCH will be considered synonymous terms during missions for the purpose of entering airspace defined below as an AREA OF INTEREST.

b. PARTICIPATING AIRCRAFT - those aircraft which operate under the parameters established by the National Hurricane Operations Plan (NHOP). NOAA aircraft will use the callsign "NOAA" such as "NOAA 42" and 815WS aircraft will use the callsign "TEAL" such as "TEAL 14."

c. CONTROLLING AGENCY - Air Traffic Control (ATC) facility issuing clearances to participating aircraft.

d. CARCAH - Chief, Aerial Reconnaissance Coordination, All Hurricanes.

e. AREA OF INTEREST - An area defined by latitude and longitude coordinates as a center point to include all airspace within a 250 nautical mile radius around that point and extending from the surface to 24,000 feet (AGL). Center coordinates are published by CARCAH in the TROPICAL CYCLONE PLAN OF THE DAY (TCPOD), item "E".

f. ALTITUDE CONFLICT - A flight condition during which participating aircraft operate within an AREA OF INTEREST within 2,000 feet (vertical separation) of each other.

g. QUADRANT OF OPERATIONS - Geographic area within the AREA OF INTEREST defined as Northeast, Southeast, Southwest or Northwest from the center coordinates. One-fourth of the AREA OF INTEREST.

3. RESPONSIBILITIES AND PROCEDURES:

a. The 815WS and/or NOAA will be tasked to fly a particular mission by CARCAH, or if not tasked, will advise CARCAH of intent to operate within the AREA OF INTEREST. Such advice should be given CARCAH at least twelve (12) hours before intended take-off and in no case less than three (3) hours before intended takeoff. Such advice shall include number of aircraft scheduled to fly, callsigns, scheduled takeoff times, estimated arrival time in the AREA OF INTEREST, altitudes to be flown, and estimated departure time from the AREA.

b. CARCAH will determine if a potential ALTITUDE CONFLICT exists and will advise the 815 WS and NOAA Operations centers and any airborne PARTICIPATING AIRCRAFT of the altitudes to be flown. PARTICIPATING AIRCRAFT will comply with the provisions of paragraphs 3d and 3e of this LOA to insure safe altitude separation.

c. CARCAH will advise the 815WS and NOAA operations centers whenever more than one PARTICIPATING AIRCRAFT will be in the AREA OF INTEREST at one time. Respective operations centers will advise the affected air crews. If notification by CARCAH occurs less than one hour before takeoff, CARCAH will advise the affected crew(s) by any means available.

d. PARTICIPATING AIRCRAFT crews will comply with the NHOP Chapter 5, AIRCRAFT RECONNAISSANCE. When advised that another PARTICIPATING AIRCRAFT will be operating within the same AREA OF INTEREST, crews will follow procedures in paragraph 5.9.3, AIR-TO-AIR COMMUNICATIONS.

e. PARTICIPATING AIRCRAFT crews will set 29.92 (inches hg) in at least one pressure altimeter. When contact is made with other PARTICIPATING AIRCRAFT, crews will confirm other aircraft's pressure altitude and geographic position as well as planned QUADRANT OF OPERATIONS and true heading. Crews will not deviate from the briefed QUADRANT and will not fly within 2,000 feet (vertical) of other participants without the concurrence of other PARTICIPATING AIRCRAFT.

f. PARTICIPATING AIRCRAFT experiencing loss of all radio communications will follow standard "LOST COMM" procedures.

4. EFFECTIVE AND TERMINATION DATES: This LOA is effective at 2359 (ZULU) on the date signed by the last approving official and will remain in effect until terminated in writing by either party. Changes to this LOA must be agreed to in writing by both parties.

FOR THE 403d AIRLIFT WING

JOE L. CAMPBELL, Brig Gen, USAFR
Commander

Date 29 Jul 93

FOR THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AIRCRAFT OPERATIONS CENTER

F.D. MORAN, RADM, NOAA
Director

Date 3 Aug 93

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OFCM
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Federal Aviation Administration
ATP-130
800 Independence Avenue, S.W.
Washington, D.C. 20591

CARCAH
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Coral Gables, FL 33146

APPENDIX D

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APPENDIX E

SAFFIR-SIMPSON HURRICANE SCALE[1]

CATEGORY ONE HURRICANE -- WEAK

Winds[2]: 75-95 mph (65-82 kt) at standard anemometer elevations. F-scale is 1.0-1.4. Damage is primarily to shrubbery, trees, foliage, and unanchored mobile homes. No real damage occurs to building structures. Some damage is done to poorly constructed signs.[3]

Storm Surge: Nominally is 4-5 ft (1.2-1.5 m) above normal. Low-lying coastal roads are inundated, minor pier damage occurs, some small craft in exposed anchorages break moorings.

CATEGORY TWO HURRICANE -- MODERATE

Winds: 96-110 mph (83-95 kt) at standard anemometer elevations. F-scale is 1.5-1.9. Considerable damage is done to shrubbery and tree foliage, some trees are blown down. Major structural damage occurs to exposed mobile homes. Extensive damage occurs to poorly constructed signs. Some damage is done to roofing material, windows, and doors; no major damage occurs to building structures.

Storm Surge: Nominally is 6-8 ft (1.8-2.4 m) above normal. Coastal roads and low-lying escape routes inland are cut by rising water 2-4 hr before arrival of center. Considerable pier damage occurs, marinas are flooded. Small craft in unprotected anchorages break moorings. Evacuation of some shoreline residences and low-lying island areas is required.

CATEGORY THREE HURRICANE -- STRONG

Winds: 111-130 mph (96-113 kt) at standard anemometer elevations. F-scale is 2.0-2.4. Damage occurs to shrubbery and trees: foliage is blown off trees, large trees are blown down. Practically all poorly constructed signs are blown down, some roofing material damage occurs, some window and door damage occurs, and some structural damage occurs to small residences and utility buildings. Mobile homes are destroyed. There is a minor amount of curtainwall failure.

Storm Surge: Nominally is 9-12 ft (2.7-3.7 m) above normal. Serious flooding occurs at the coast with many smaller structures near the coast destroyed. Larger structures are damaged by battering of floating debris. Low-lying escape routes inland are cut by rising water 3-5 hr before the center arrives. Terrain continuously lower than 5 ft (1.5 m) above sea level may be flooded inland 8 mi (12.9 km) or more. Evacuation of low-lying residences within several blocks of the shoreline may be required.

CATEGORY FOUR HURRICANE -- VERY STRONG

Winds: 131-155 mph (114-135 kt) at standard anemometer elevations. F-scale is 2.5-2.9. Shrubs and trees are blown down, all signs are down. Extensive roofing material damage occurs, extensive window and door damage occurs, complete failure of roof structures occurs on many small residences, and complete destruction of mobile homes occurs. Some curtainwalls experience failure.

Storm Surge: Nominally is 13-18 ft (3.9-5.5 m) above normal. Terrain continuously lower than 10 ft (3 m) above sea level may be flooded inland as far as 6 mi (9.7 km). Major damage occurs to lower floors of structures near the shore due to flooding and battering action. Low-lying escape routes inland may be cut by rising water 3-5 hr before the storm center arrives. Major erosion of beach areas occurs. Massive evacuation of all residences within 500 yds (457 m) of the shoreline may be required and of single-story residences on low ground within 2 mi (3.2 km) of the shoreline.

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1 **The Saffir-Simpson Hurricane (SSH) Scale does not apply to the Pacific Islands**

2 **Definition of a sustained wind (from Fujita and Simpson, 1972). A sustained wind is one that persists for the minimum time period to establish optimal dynamic forces on a nominal building structure.**

3 **T. Fujita, 1971: "Proposed Characteristics of Tornadoes and Hurricanes by Area and Intensity," University of Chicago (SMRP) Research Paper No. 91.**

CATEGORY FIVE HURRICANE -- DEVASTATING

Winds: Greater than 155 mph (135 kt) at standard anemometer elevation. F-scale is 3.0 or greater. Shrubs and trees are down, roofing damage is considerable, all signs are down. Very severe and extensive window and door damage occurs. Complete failure of roof structures occurs on many residences and industrial buildings. Extensive glass failures occur, some complete buildings fail, small buildings are overturned and blown over or away, and complete destruction of mobile homes occurs.

Storm Surge: Height is nominally greater than 18 ft (5.5 m) above normal. Major damage occurs to lower floors of all structures located less than 15 ft (4.6 m) above sea level and within 500 yd (457 m) of the shoreline. Low-lying escape routes inland are cut by rising water 3-5 hr before the storm center arrives. Massive evacuations of residential areas situated on low ground within 5-10 mi (8-16 km) of the shoreline may be required.

APPENDIX F

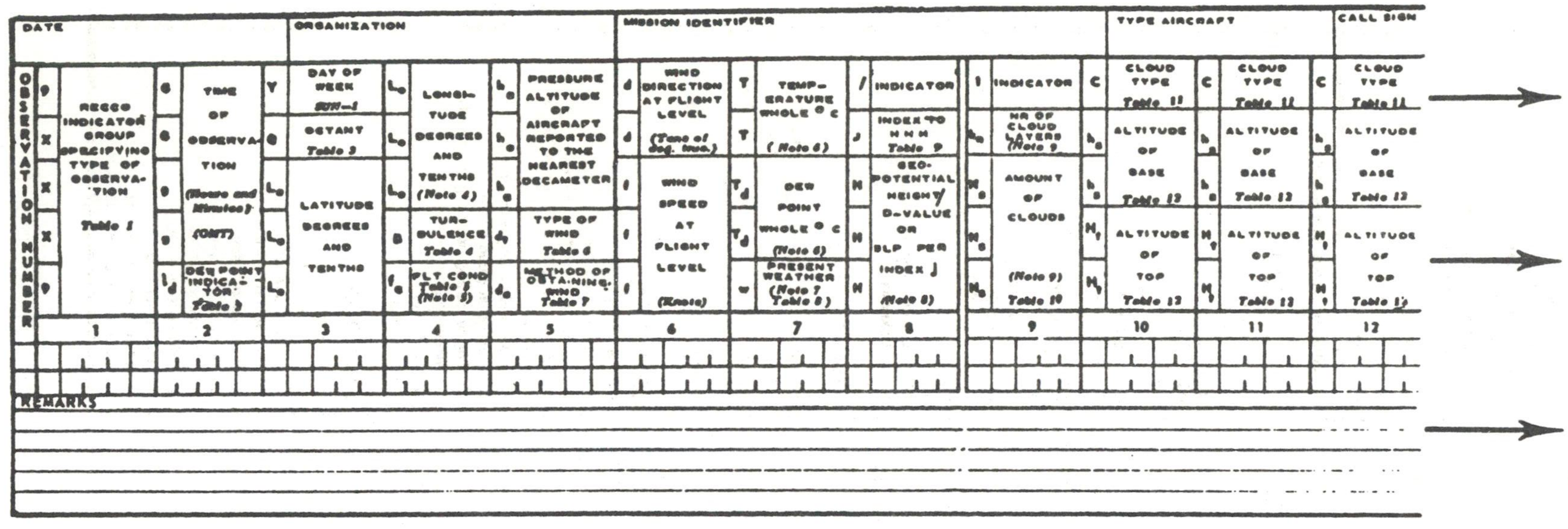
PHONETIC PRONUNCIATION LISTING

CARIBBEAN BASIN

Abaco	AB-a-ko
Anguilla	ang-GWIL-a
Antigua	an-TEE-gua
Aruba	ah-ROO-ba
Antille	san-TIL-leez
Azores	suh-ZOHRZ
Bahamas	ba-HAHM-ahs
Barbuda	bar-BOO-dah
Barranquilla	bahr-rahn-KEE-yah
Barahona	ba-ra-HO-na
Basse-Terre	bahs-TER
Bermuda	ber-MYOO-da
Biloxi	bi-LUX-ee
Bimini	BIM-i-ni
Bonaire	ba-NAIR
Cap Haitien	kahp ah-ee-SYAN
Caracas	kah-RAH-kahs
Caribbean	kar-a-BE-an
Castries	KAS-trees
Cayman	kay-MAHN
Charlotte Amalie	SHAR-lot a-MAHL-ye
Cozumel	koh-soo-MEL
Curacao	koor-a-SOH
Dominica	dom-i-NEE-ka
Eleuthera	el-OO-thera
Exuma	ek-SOO-ma
Flores	FLO-rish
Fort de France	for-de-FRAHNS
Grenada	gre-NAY-dah
Guadaloupe	GWAH-deh-loop
Guatemala	gwaht-eh-MAH-la
Leeward	LEE-ward
Maracaibo	mar-a-KYE-boh
Maracay	Mah-rah-KYE
Marigot	ma-ree-GOH
Merida	MAY-re-thah
Miami	mye-AM-ee
Montego	mon-TEE-go
Montserrat	mont-se-RAT
Nicaragua	nik-a-RAH-gwah
Ocho Rios	OH-cho REE-os
Oranjestad	o-RAHN-yuh-stat
Paramaribo	par-a-MAR-i-boh
Parguera	par-GWER-a
Pointe-a-Pitre	pwan-ta-PEE-tr
Ponce	PON-sa
Port-au-Prince	port-oh-PRINS
Saba	SAH-ba
Sao Miguel (Azores)	soun ME-gel
St. Croix	SAINT croy
St. Lucia	SAINT LOO-she-a
Soufriere	soo-free-AR
Surinam	SOOR-i-nam
Tampico	tam-PEE-ko
Tela	TAY-lah
Tobago	to-BAY-go
Yucatan	yoo-ka-TAN

APPENDIX G

RECCO, MINOB, AND TEMP DROP CODES, TABLES AND REGULATIONS



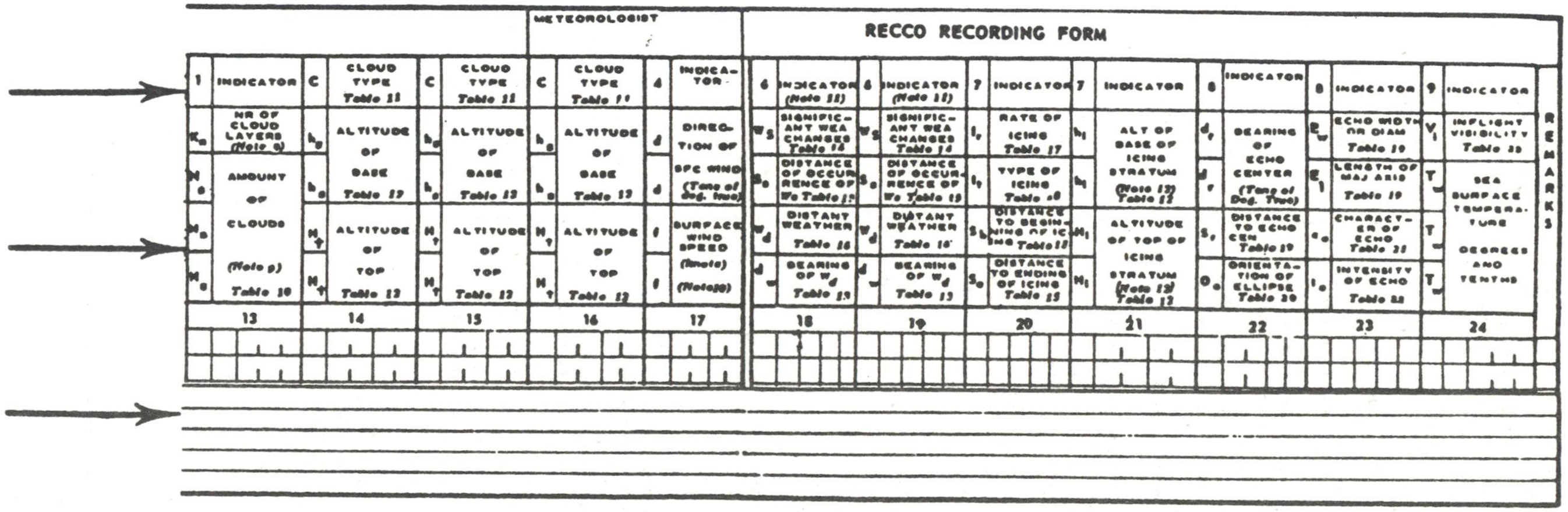


Figure G-1. Reconnaissance code recording form

Table G-1. Reconnaissance code tables

TABLE 1 XXX

222 Sec One Observation without radar capability
555 Sec Three (intermediate) observation with or without radar capability
777 Sec One Observation with radar capabilities

TABLE 2 i_d

0 No dew point capability/acft below 10,000 meters
1 No dew point capability/acft at or above 10,000 meters
2 No dew point capability/acft below 10,000 meters and flight lvl tem -50°C or colder
3 No dew point capability/acft at or above 10,000 meters and flight lvl temp -50°C or colder
4 Dew point capability/acft below 10,000 meters
5 Dew point capability/acft at or above 10,000 meters
6 Dew point capability/acft below 10,000 meters and flight lvl temp -50°C or colder
7 Dew point capability/acft at or above 10,000 meters and flight lvl temp -50°C or colder

TABLE 3 Q

0	0° -90° W	Northern
1	90° W - 180°	Northern
2	180° - 90° E	Northern
3	90° - 0° E	Northern
4	Not Used	
5	0° - 90° W	Southern
6	90° - 180° W	Southern
7	180° - 90° E	Southern
8	90° - 0° E	Southern

TABLE 4 B

0 None
1 Light turbulence
2 Moderate turbulence in clear air, infrequent
3 Moderate turbulence in clear air, frequent
4 Moderate turbulence in cloud, infrequent
5 Moderate turbulence in cloud, frequent
6 Severe Turbulence in clear air, infrequent
7 Severe Turbulence in clear air, frequent
8 Severe Turbulence in cloud, infrequent
9 Severe Turbulence in cloud, frequent

TABLE 5 f_c

0 In the clear
8 In and out of clouds
9 In clouds all the time (continuous IMC)
/ Impossible to determine due to darkness or other cause

TABLE 6 d_t

0 Spot of Wind
I Average wind
/ No wind reported

TABLE 7 d_a

0 Winds obtained using doppler radar or inertial systems
1 Winds obtained using other navigation equipment and/or techniques
/ Navigator unable to determine or wind not compatible

TABLE 8 w

0 Clear
1 Scattered (trace to 4/8 cloud coverage)
2 Broken (5/8 to 7/8 cloud coverage)
3 Overcast/undercast
4 Fog, thick dust or haze
5 Drizzle
6 Rain (continous or intermittent precip - from strata clouds)
7 Snow or rain and snow mixed
8 Shower(s) (continuous or intermittent precip - from cumuliform clouds)
9 Thunderstorm(s)
/ Unknown for any cause, including darkness

TABLE 9 j

0 Sea level pressure in whole millibars (*thousands fig if any omitted*)
1 Altitude 200 mb surface in geopotential decameters (*thousands fig if any omitted*)
2 Altitude 850 mb surface in geopotential meters (*thousands fig omitted*)
3 Altitude 700 mb surface in geopotential meters (*thousands fig omitted*)
4 Altitude 500 mb surface in geopotential decameters
5 Altitude 400 mb surface in geopotential decameters
6 Altitude 300 mb surface in geopotential decameters
7 Altitude 250 mb surface in geopotential decameters (*thousands fig if any omitted*)
8 D _ Value in geopotential decameters; if negative 500 is added to HHH
9 No absolute altitude available or geopotential data not within ± 30 meters/4 mb accuracy requirements

TABLE 10 N_s

0 No additional cloud layers (place holder)
1 1 okta or less, but not zero (*1/8 or less sky covered*)
2 2 oktas (*or 2/8 of sky covered*)
3 3 oktas (*or 3/8 of sky covered*)
4 4 oktas (*or 4/8 of sky covered*)
5 5 oktas (or 5/8 of sky covered)
6 6 oktas (*or 6/8 of sky covered*)
7 7 oktas or more but not 8 oktas
8 8 oktas or sky completely covered
9 Sky obscured (place holder)

TABLE 11 C

0 Cirrus (Ci)
1 Cirrocumulus (Cc)
2 Cirrostratus (Cs)
3 Altocumulus (Ac)
4 Altostratus (As)
5 Nimbostratus (Ns)
6 Statocumulus (Sc)
7 Stratus (St)
8 Cumulus (Cu)
9 Cumulonimbus (Cb)
/ Cloud type unknown due to darkess or other analogous phenomena

TABLE 12 $h_s h_s H_t H_t h_i h_i H_i H_i$

00 Less than 100
01 l00 ft
02 200 ft
03 300 ft
etc, etc
49 4,900 ft
50 5,000 ft
51-55 Not used
56 5,600 ft
57 7,000 ft
etc, etc
79 29,000 ft
80 30,000 ft
81 35,000 ft
82 40,000 ft
etc, etc
89 Greater than 70,000 ft
// Unknown

TABLE 13 d_w

0	No report	
1	NE	7 NW
2	E	8 N
3	SE	9 all directions
4	S	
5	SW	
6	W	

TABLE 14 W_s

0 No change
1 Marked wind shift
2 beginning or ending of marked turbulence
3 Marked temperature change (not with altitude)
4 Precipitation begins or ends
5 Change in cloud forms
6 Fog or ice fog bank begins or ends
7 Warm front
8 Cold Front
9 front, type not specified

TABLE 15 $S_b S_e S_s$

0 No report
1 Previous position
2 Present position
3 30 nautical miles
4 60 nautical miles
5 90 nautical miles
6 120 nautical miles
7 150 nautical miles
8 180 nautical miles
9 More than 180 nautical miles
/ Unknown (not used for S_s)

Table G-1. Reconnaissance code tables (continued)

TABLE 16 w_d

0 No report
1 Signs of a tropical Cyclone
2 Ugly threatening sky
3 Duststorm or sandstorm
4 Fog or ice fog
5 Waterspout
6 Cirrostratus shield or bank
7 Altostratus or altocumulus shield or bank
8 Line of heavy cumulus
9 Cumulonimbus heads or thunderstorms

TABLE 17 I_r

7 Light
8 Moderate
9 Severe
/ Unknown or contrails

TABLE 18 I_t

0 None
1 Rime ice in clouds
2 Clear ice in clouds
3 Combination rime and clear ice in clouds
4 Rime ice in precipitation
5 Clear ice in precipitation
6 Combination rime and clear ice in precip
7 Frost (icing in clear air)
8 Nonpersistent contrails (*less than 1/4 nautical miles long*)
9 Persistent contrails

TABLE 19 S_r, E_w, E_l

0 0NM
1 10NM
2 20NM
3 30NM
4 40NM
5 50NM
6 60-80NM
7 80-100NM
8 100-150NM
9 Greater than 150NM
/ Unknown

TABLE 20 O_e

0 Circular
1 NNE - SSW
2 NE - SW
3 ENE - WSW
4 E - W
5 ESE - WNW
6 SE - NW
7 SSE - NNW
8 S - N
/ Unknown

TABLE 21 c_e

1 Scattered Area
2 Solid Area
3 Scattered Line
4 Solid Line
5 Scattered, all quadrants
6 Solid, all quadrants
/ Unknown

TABLE 22 i_e

2 Weak
5 Moderate
8 Strong
/ Unknown

TABLE 23 V_i

1 Inflight visibility 0 to and including 1 nautical mile
2 Inflight visibility greater than 1 and not exceeding 3 nautical miles
3 Inflight visibility greater than 3 nautical miles

RECCO SYMBOLIC FORM

SECTION ONE (MANDATORY)

9XXX9 GGggi$_d$ YQL$_a$L$_a$L$_a$ L$_o$L$_o$L$_o$Bf$_c$ h$_a$h$_a$h$_a$d$_t$d$_a$

ddfff TTT$_d$T$_d$w /jHHH

SECTION TWO (ADDITIONAL)

1k$_n$N$_s$N$_s$N$_s$ Ch$_s$h$_s$H$_t$H$_t$ 4ddff

6W$_s$S$_s$W$_d$d$_w$ 7I$_r$I$_t$S$_b$S$_e$ 7h$_i$h$_i$H$_i$H$_i$ 8d$_r$d$_r$S$_r$O$_e$

8E$_w$E$_l$c$_e$i$_e$ 9V$_i$T$_w$T$_w$T$_w$

SECTION THREE (INTERMEDIATE)

9XXX9 GGggi$_d$ YQL$_a$L$_a$L$_a$ L$_o$L$_o$L$_o$Bf$_c$ h$_a$h$_a$h$_a$d$_t$d$_a$

ddfff TTT$_d$T$_d$w /jHHH

Table G-2. Reconnaissance code regulations

1. At the time of the observation the aircraft observing platform is considered to be located on the axis of a right vertical cylinder with a radius of 30 nautical miles bounded by the earth's surface and the top atmosphere. Present weather, cloud amount and type, turbulence, and other subjective elements are reported as occurring within the cylinder. Flight level winds, temperature, dew point, and geopotential values are sensed or computed and reported as occurring at the center of the observation circle. Radar echoes, significant weather changes, distant weather, and icing are phenomena that may also be observed/reported. Code groups identifying these phenomena may be reported as necessary to adequately describe met conditions observed.

2. The intermediate observation (Section Three) is reported following Section One (or Section Two if appended to Section One) in the order that it was taken.

3. Plain language remarks may be added as appropriate. These remarks follow the last encoded portion of the horizontal or vertical observation and will clearly convey the intended message. Vertical observations will not include meteorological remarks. These remarks must begin with a letter or word-E.G. "FL TEMP" vice "700 MB FL TEMP." The last report plain language remarks are mandatory, i.e., "LAST REPORT. OBS 01 thru 08 to RJTY, OBS 09 and 10 to RPMK."

4. The hundreds digit of longitude is omitted for longitudes from 100° to 180°.

5. Describe conditions along the route of flight actually experienced at flight level by aircraft.

6. TT, T_dT_d. When encoding negative temperatures, 50 is added to the absolute value of the temperature with the hundreds figure, if any, being omitted. A temperature of -52°C is given as 02, the distinction between -52°C and 2°C being made from i_d. Missing unknown temperatures are reported as //. When the dew point is colder than -49.4°C, Code T_dT_d as // and report the actual value as a plain language remark - E.G. DEW POINT -52°C.

7. When two or more types of w co-exist, the type with the higher code figure will be reported. Code Figures 1, 2 and 3 are reported based on the total cloud amount through a given altitude, above or below the aircraft, and when other figures are inappropriate. The summation principle applies only when two or more cloud types share a given altitude.

8. When j is reported as a 9, HHH is encoded as ///.

9. If the number of cloud layers reported exceeds 3, k_n in the first 1-group reports the total number of cloud layers. The second 1-group reports the additional number of layers being reported exclusive of those previously reported. In those cases where a cloud layer(s) is discernible, but a descriptive cloud picture of the observation circle is not possible, use appropriate remarks such as "clouds blo" or As blo" to indicate the presence of clouds. In such cases, coded entries are not made for group 9. The sequence in which cloud amounts are encoded depends upon type of cloud, cloud base, and vertical extent of the cloud. The cloud with the largest numerical value of cloud type code (C) is reported first, regardless of coverage, base, or vertical extent. Among clouds of the same cloud type code sharing a common base, the cloud of greatest vertical extent is reported first. The summation principle is not used; each layer is treated as though no other clouds were present. The total amount of clouds through one altitude shared by several clouds will not exceed 8 oktas. Only use code figure 0 as a place holder when you can determine that no additional cloud layers exist. In case of undercast, overcast, etc., use code figure 9 as a placeholder.

10. Due to limitations in the ability to distinguish sea state features representative of wind speeds above 130 knots, surface wind speeds in excess of 130 knots will not be encoded. Wind speeds of 100 to 130 knots inclusive will be encoded by deleting the hundreds figure and adding 50 to dd. For wind speeds above 130 knots, dd is reported without adding 50 and ff is encoded as // with a plain language remark added, I.E., -sfc wind above 130 knots.

11. Significant weather changes which have occurred since the last observation along the track are reported for W_s.

12. When aircraft encounters icing in level flight, the height at which the icing occurred will be reported for h_ih_i. The H_iH_i will be reported as //.

SXXX50 KMIA 231120
AF966 01XXA CYCLONE MINOB 15 KNHC

1059	2619N	06556W	00350	0013	017	022	198	168	023	00378	0000000000
1100	2619N	06552W	00349	0013	016	023	196	170	023	00377	0000000000
1101	2619N	06549W	00349	0013	015	023	196	168	023	00378	0000000000
1102	2619N	06546W	00350	0012	015	024	196	172	025	00378	0000000000
1103	2619N	06542W	00350	0012	015	024	198	170	024	00378	0000000000
1104	2619N	06539W	00350	0011	015	024	196	174	024	00376	0000000000
1105	2619N	06535W	00350	0011	013	024	196	172	024	00377	0000000000
1106	2619N	06532W	00351	0011	015	024	196	174	024	00378	0000000000
1107	2619N	06529W	00351	0011	013	025	196	176	025	00378	0000000000
1108	2619N	06525W	00352	0011	014	024	196	176	025	00378	0000000000
1109	2619N	06522W	00354	0010	018	024	198	170	025	00379	0000000000
1110	2619N	06519W	00352	0010	013	025	200	170	026	00377	0000000000
1111	2619N	06515W	00354	0007	013	025	196	176	026	00377	0000000000
1112	2619N	06512W	00356	0007	015	026	194	176	026	00378	0000000000
1113	2618N	06508W	00357	0006	017	026	196	176	028	00378	0000000000
1114	2618N	06505W	00357	0005	018	028	196	178	028	00378	0000000000
1115	2617N	06502W	00358	0003	019	028	198	178	029	00376	0000000000
1116	2616N	06458W	00357	0002	023	031	198	178	032	00375	0000000000
1117	2615N	06455W	00358	0001	022	030	200	174	031	00374	0000000000
1118	2614N	06452W	00356	0001	021	030	200	179	030	00372	0000000000

Figure G-2. Sample MINOB message

Table G-3. MINOB message format

HHMM $L_aL_aL_ammH$ $L_aL_aL_ammH$ PPPPP DDDD WWW SSS TTT ddd MMM RRRRR FFFFFFFFFF

HHMM:	The time of observation in hours and minutes (UTC).
$L_aL_aL_ammH$:	The latitude of the observation in degrees, minutes and hemisphere (N or S).
$L_oL_oL_ommH$:	The longitude of the observation in degrees, minutes and hemisphere (E or W).
PPPPP:	The pressure altitude in meters.
DDDD:	The absolute value of the D-value in meters (a 5 occupies the thousands place if the D-value is negative. For example, -34m is encoded as 5034.
WWW:	The wind direction in degrees, with 0 being true north, increasing clockwise.
SSS:	The wind speed in knots.
TTT:	The air temperature in degrees and tenths Celsius. The tenths digit is even for temperatures at or above 0°C, odd for temperatures below 0°C.
ddd:	The dew point temperature, encoded the same way as air temperature.
MMM:	The maximum wind speed in knots measured during the minute. This is the peak wind speed averaged over a 10-sec period.
RRRRR:	Radar altitude in meters
FFFFFFFFFF:	Default status for the MINOB data. A "1" indicates the parameter is defaulted (suspect value) or based on a parameter that is defaulted. A "0" indicates the value is not defaulted. The field indicate default for (in order): latitude, longitude, pressure altitude, D-value, wind direction, wind speed, air temperature, dew point, maximum wind speed, radar altimeter.

Table G-4. TEMP DROP code breakdown

CODE FORM:

PART A

SECTION 1	$M_iM_iM_jM_j$	$YYGGI_d$	$99L_aL_aL_a$	$Q_cL_oL_oL_oL_o$	$MMMUL_aU_{Lo}$
SECTION 2	$99P_oP_oP_o$	$T_oT_oT_{ao}D_oD_o$	$d_od_of_of_of_o$		
	$P_1P_1h_1h_1h_1$	$T_1T_1T_{a1}D_1D_1$	$d_1d_1f_1f_1f_1$		
	.....	.....	.....		
	$P_nP_nh_nh_nh_n$	$T_nT_nT_{an}D_nD_n$	$d_nd_nf_nf_nf_n$		
SECTION 3	$88P_tP_tP_t$ or 88999	$T_tT_tT_{at}D_tD_t$	$d_td_tf_tf_tf_t$		
SECTION 4	$77P_mP_mP_m$ or $66P_mP_mP_m$ or 77999	$d_md_mf_mf_mf_m$	$(4V_bv_bv_av_a)$		

PART A

SECTION 1 - IDENTIFICATION AND POSITION

M_iM_i Identification letters of the report = XX

M_jM_j Identification letters of the part of the report = AA

YY Day of the month (GMT) = 01,02 etc. When wind data are included (Dropwindsonde observation), 50 is added to YY.

GG Actual time of the observation, to the nearest whole hour (GMT).

1_d Highest level for which wind is available. 7 = 700mbs, 5 = 5000mbs, etc. If flight level is above a standard surface, for example 495, report a 5 for 500 MBs in the 1_d group. When no winds are reported in any part of the message encode as "/"

99 Indicator for aircraft position

$L_aL_aL_a$ Latitude, in tenths of a degree.

Q_c Quadrant of the globe. The earth is divided by the Greenwich Meridian and the Equator into quadrants. The code figure reported depends on the latitude and longitude of the observation position. i.e., 7 = NW, 1 = NE, 3 = SW, 5 = SE.

$L_oL_oL_oL_o$ Longitude, in tenths of a degree.

MMM Marsden square. The number of the Marsden Square for aircraft position at the time of the observation is reported for MMM. Always report three digits for MMM, with zeros reported for the hundreds and tens digits when required. When an observation is within a depicted 10 degree square, report the number of that square. When on an even 10 degree latitude or longitude circle, the Marsden Square for MMM is obtained by moving in the direction of larger latitude and/or longitude.

EXAMPLE: assuming a position of 18.1N, 131.4W, MMM is 050; assuming a position of 30.0N, 140.0E, MMM is 130. At the equator or on the prime meridian, report the Marsden square compatible with the Q_c reported.

U_{La} Units digit in the reported latitude

U_{Lo} Units digit in the reported longitude

Table G-4. TEMP DROP code breakdown (continued)

SECTION 2- SURFACE AND STANDARD ISOBARIC SURFACES

99-	Indicator for surface
$P_oP_oP_o$	Pressure in whole millibars, thousands digits omitted. ($P_oP_oP_o$ is always surface level)
P_1P_1	Pressure of mandatory standard isobaric surfaces in units of tens of millibars. (1000mbs=00, 850mbs=85, 700mbs=70, etc.)
...	
P_nP_n	
$h_1h_1h_1$	Height of the mandatory pressure level in geopotential meters or decameters above the surface. Encoded in meters
...	up to 501mbs; Encoded in decameters above 501mbs. Add 500 to hhh for negative 1000mb heights. Report 1000mb groups $h_nh_nh_n$as 00/// ///// when surface pressure is less than 950mbs.

T_oT_o	Tens and units digit of air temperature (not rounded off) in degress.
T_1T_1	Celsius, at specified levels beginning with surface.
...	
T_nT_n	
T_{ao}	Approximate tenths value and sign (plus or minus) of the air
T_{a1}	temperature. Even = plus 0dd = minus
...	
T_{an}	
D_oD_o	Dewpoint depression (with respect to water) at standard isobaric surfaces beginning with surface level. When the D_1D_1 depression is 4.9C or less encode the units and tenths digits of the depression. Encode depression of 5.0 through 5.4 as
...	50; Encode depressions of 5.5 through 5.9 as 56. Dewpoint depressions of 6.0 and above are encoded in tens and units
D_nD_n	with 50 added. Dewpoint depressions for relative humidities less than 20% are encoded as 80. When air temperature is below -40°C report D_nD_n as two solidi.
d_od_o	True direction (rounded off to nearest 5 degrees) in tens of degrees.
d_1d_1	from which the wind is blowing. (Dropwindsonde)
...	
d_nd_n	
$f_of_of_o$	Wind speed in knots (Dropwindsonde)
$f_1f_1f_1$	
...	
$f_nf_nf_n$	

[NOTE: When flight level is just above a mandatory surface (Dropwindonde) and, in the operator's best meterological judgement, the winds are representative of the winds at the mandatory surface, then the operator may encode the mandatory surface winds using the data from flight level. If the winds are not representative, then encode /////.]

SECTION 3 - DATA FOR TROPOPAUSE LEVELS

88	Indicator for tropopause data.
$P_tP_tP_t$	Pressure at the tropopause level reported in whole millibars
T_tT_t	Air temperature in whole degrees Celsius, at the tropopause level.
T_{at}	Approximate tenths value and sign (plus or minus) of the air temperature at the tropopause level.
D_tD_t	Dewpoint depression at the tropopause level.
d_td_d	True direction (rounded off to the nearest 5 degrees), in tens of degrees, from which the wind is blowing at the tropopause level.

Table G-4. TEMP DROP code breakdown (continued)

$f_t f_t f_t$	Wind speed, in knots, at the tropopause level
88999	Tropopause data not available.

SECTION 4 - MAXIMUM WIND DATA

66	Indicator that data for maximum wind level and for vertical wind shear follow (the top of the wind sounding corresponds to the highest wind speed observed throughout the descent.)
77	Indicator that data for maximum wind level and for vertical wind shear follow (maximum wind level does not coincide with the top of the wind sounding.)
$P_m P_m P_m$	Pressure at maximum wind level in whole millibars
$d_m d_m$	True wind direction (rounded off to nearest 5 degrees), in tens of degrees, from which the maximum wind is blowing.
$f_m f_m f_m$	Maximum wind speed in knots
4	Indicator for vertical wind shear data
$v_a v_a$	Absolute value of vector difference between max wind and wind blowing 3000 feet ABOVE the level of maximum wind. Reported to the nearest knot. Use "//" if missing and 4 group is reported. A vector difference of 99 knots or more is reported with the code figure 99.
$v_b v_b$	Absolute value of vector difference between max wind and wind blowing 3000 feet BELOW the level of maximum wind. Reported to the nearest knot. Use "//" if missing and 4 group is reported. A vector difference of 99 knots or more is reported with the code figure 99.

CODE FORM:

PART B

SECTION 1	$M_i M_i M_j M_j$	YYGG/	$99L_aL_aL_a$	$Q_cL_oL_oL_oL_o$	$MMMUL_aU_{Lo}$
SECTION 5	$n_0n_0P_0P_0P_0$	$T_0T_0T_{a0}D_0D_0$			
	$n_1n_1P_1P_1P_1$	$T_1T_1T_{a1}D_1D_1$			
	.....	.....			
	$n_nn_nP_nP_nP_n$	$T_nT_nT_{an}D_nD_n$			
SECTION 6	21212	$n_0n_0P_0P_0P_0$	$d_0d_0f_0f_0f_0$		
	$n_1n_1P_1P_1P_1$	$d_1d_1f_1f_1f_1$			
	.....	.....			
	$n_nn_nP_nP_nP_n$	$d_nd_nf_nf_nf_n$			
SECTION 9	51515	10166	10167	10190	10191

PART B

SECTION 1 - IDENTIFICATION AND POSITION

M_jM_j	Identification letters of the part of the report = BB
/	Filler figure for YYGG group

All other groups are the same as reported in Part 1 - Section 1

Table G-4. TEMP DROP code breakdown (continued)

SECTION 5 - DATA FOR SIGNIFICANT TEMPERATURE AND RELATIVE HUMIDITY LEVELS

n_0n_0 Number of level, starting with surface level. Only surface level will be numbered as "00". When a mandatory level is also
n_1n_1 selected as significant, repeat the level in section 5. Encode significant levels $n_nn_n$to indicate missing data as nn/// /////.
...
n_nn_n

$P_0P_0P_0$ Pressure at specified levels in whole millibars, beginning with surface.
$P_1P_1P_1$
...
$P_nP_nP_n$

Temperature and humidity data groups are reported in the same manner as the temperature and humidity data in PART A - Section 2.

SECTION 6 - DATA FOR SIGNIFICANT WIND LEVELS

21212 Data for significant levels with respect to wind follow. Wind data groups are reported in the same manner as the wind data in PART A - Section 2

SECTION 9 - ADDITIONAL DATA GROUPS

51515 Additional data in regional code follow.

10166 Geopotential data are doubtful between the following levels. $P_nP_nP'_nP'_n$. This code figure is used only when geopotential data are doubtful from a level to termination of the descent.

NOTE: When radar altimeter is inoperative and surface reference is used, or if the ARWO advises that geopotential platform data are doubtful, a 10166 is reported for the entire run.

10167 Temperature Data are doubtful between the following levels: $0P_1P_1P_2P_2$

This code figure shall be reported when only temperature data are doubtful for a portion(s) of the descent. If the 10167 group is reported a 10166 will also be reported.

EXAMPLE: Temperature is missing from 540mbs to 510mbs. SLP is 1020mbs. The code would be 10166 00251 10167 05451.

10190 Extrapolated altitude data follows:

(1) When the sounding begins within 25 mbs below a standard surface, the height of the surface is reported in the format 10190 $P_nP_nh_nh_nh_n$. The temperature group is not reported.

EXAMPLES: Assume the release was made from 310 mbs and the 300 mb height was 966 decameters. The last reported standard level in Part A is the 400 mb level. The data for the 300 mb level is reported in Part B as 10190 30966.

(2) When the sounding does not reach surface, but terminates within 25 mbs of a standard surface, the height of the standard surface is reported in Part A of the code in standard format and in Part B of the code in the format 10190 PnPnhnhnhn (aircraft reference).

EXAMPLE: Assume termination occurred at 980 mbs and the extrapolated height of the 1000 mb level was 115 meters. The 1000 mb level would be reported in Part A of the code as 00115 ///// and in Part B as 10190 00115.

10191 Extrapolated surface pressure precedes. Extrapolated surface pressure is only reported when the termination occurs between 850 mbs and surface pressure is reported in Part A as $99P_0P_0P_0$///// and Part B as $00PP_0P_0P_0$ /////. When surface pressure is extrapolated, the 10191 group is the last additional data group reported in Part B.

APPENDIX H

TELEPHONE AND TELETYPE LISTING

DEPARTMENT OF COMMERCE

AGENCY	LOCATION	TTY[1]	TELEPHONE
Alternate NHC (NMC, Met Ops Div)	Camp Springs, MD	A C	COM 301-763-8201
AOC	Miami, FL		COM 305-526-7100 DSN 434-1600
CPHC - Forecaster and Warning Desk - Admin - Operations	Honolulu, HI	C	COM 808-541-1697 COM 808-836-1831 FAX 808-836-1126
CPHC Satellite Coordinator	Honolulu, HI	C	COM 808-836-2776
NDBC (Data Systems Div) (See USCG entry)	SSC, MS		COM 601-688-2836 DSN 485-4411
NESDIS E/SP23	Camp Springs, MD	A C	COM 301-763-8444
NHC	Coral Gables, FL	ABC	COM 305-666-5547
NHC Satellite Coordinator	Coral Gables, FL	ABC	COM 305-666-4612
NMC Meteorological Operations Division	Camp Springs, MD	A C	COM 301-763-8096
NWS Warning and Forecast Branch (Headquarters)	Washington, DC		COM 301-713-0090

[1] A TG7073
B AFMEDS
C AFOS
D AFTN
E TTY Address is KCFC7D7X

AGENCY	LOCATION	TTY	TELEPHONE	
AFGWC	Offutt AFB, NE	AB	COM DSN	402-291-2586 271-2586
CARCAH OLA, 53 WRS	Coral Gables, FL	ABC	COM DSN	305-661-5076 434-3420
CINCLANTFLT OAC	Oceana, VA		COM DSN	804-433-2851 433-2851 ext 233
15 WS (Weather Monitor)	Hickam AFB, HI	B	COM DSN	808-449-1634 315-449-1634
15 WS (Hawaii ROCC/WE)	Hickam AFB, HI	B	COM DSN	808-449-7638 /7637 315-449-6262
416 OSS/DOW (formerly Det 8, 26WS) (Northeast Air Defense Sector/WE)	Griffiss AFB, NY	B	COM DSN	315-330-2410 587-2410
325 OSS (formerly Det 9, 3 WS) (Southeast Air Defense Sector/WE)	Tyndall AFB, MS	B	COM DSN	904-283-3215 523-3215
Keesler AFB Command Post	Keesler AFB, MS		COM DSN	601-377-4330 597-4330
NAVLANTMETOCCEN	Norfolk, VA	B	COM DSN 	804-444-7750 /3770 564-7750 /3770
NAVPACMETOCCEN	Pearl Harbor, HI	B	COM COM DSN	808-471-0353 808-474-4856 474-4856
NAVPACMETOCCEN WEST/JTWC	Guam	D	COM DSN FAX	011-671-344-4224 /5240 344-4224 /5240 011-671-477-6143

53 WRS/DO	Keesler AFB, MS	B	COM 601-377-2409 DSN 597-2409
53 WRS (Office)	Keesler AFB, MS		COM 601-377-3207 DSN 597-3207
53 WRS (Alternate CARCAH)	Keesler AFB, MS	B	COM 601-377-1939 DSN 597-1939

INTERDEPARTMENTAL

AGENCY	LOCATION	TTY	TELEPHONE
OFCM	Rockville, MD		COM 301-443-8704 DSN 851-1460

FTS2000

ARTCC PHONE DIRECTORY EFF. 5/11/92

	ARTCC ID	TMO	ADMINISTRATION	AREA MANAGER
ANCHORAGE	ZAN	8-907-269-1108	N/A	8-907-333-0714
ALBUQUERQUE	ZAB	8-505-823-0547	8-505-823-0509	8-505-823-0500
CHICAGO	ZAU	8-708-801-9240	8-708-801-9268	8-708-801-9287
BOSTON	ZBW	8-603-886-7666	8-603-886-7675	8-603-886-7635
WASHINGTON	ZDC	8-703-771-3471	8-703-771-3440	8-703-771-3470
DENVER	ZDV	8-303-651-4246	8-303-651-4261	8-303-651-4248
FT. WORTH	ZFW	8-817-858-7537	8-817-858-7520	8-817-858-7503
HOUSTON	ZHU	8-713-230-5577	8-713-230-5540	8-713-230-5560
INDIANAPOLIS	ZID	8-317-247-2243	8-317-247-2222	8-317-247-2242
JACKSONVILLE	ZJX	8-904-632-1543	8-904-632-1578	8-904-632-1537
KANSAS CITY	ZKC	8-913-791-8505	8-913-791-8450	8-913-791-8500
LOS ANGELES	ZLA	8-805-265-8250	8-805-265-8250	8-805-265-8203
SALT LAKE CITY	ZLC	8-801-539-3238	8-801-539-3235	8-801-539-3237
MIAMI	ZMA	8-700-820-1241	8-700-820-1243	8-700-820-1210
MEMPHIS	ZME	8-700-681-0181	8-700-681-0181	8-700-681-0181
		EXT-250	EXT-222	EXT-234
MINNEAPOLIS	ZMP	8-612-463-5116	8-612-463-5130	8-612-463-5180
NEW YORK	ZNY	8-516-737-3432	8-516-737-3490	8-516-737-3458
OAKLAND	ZOA	8-700-449-6332	8-700-449-6475	8-700-449-6331
CLEVELAND	ZOB	8-216-774-0228	8-216-774-0119	8-216-774-0226
SEATTLE	ZSE	8-206-931-5431	8-206-931-5283	8-206-931-5222
ATLANTA	ZTL	8-404-946-7697	8-404-946-7883	8-404-946-7622
HONOLULU	HNL	N/A	9-808-734-6667	
SAN JUAN	SJU	8-909-253-4567		
TORONTO	YYZ	9-800-837-3801		
MONTREAL	YUL	9-514-636-3289		
MONCTON	YOM	9-506-851-7381		
OTTAWA	YOW	9-613-954-7425		
WINNIPEG	YWG	9-203-983-8338		
EDMONTON	YEG	9-403-890-8397		
GANDER	YQX	9-709-256-6770		
VANCOUVER	YVR	9-604-666-6673		

NOTE:
TMO - TRAFFIC MANAGEMENT OFFICER
AREA MANAGER - WATCH SUPERVISOR
ARTCC - AIR ROUTE TRAFFIC CONTROL CENTER

AIR TRAFFIC RULES AND PROCEDURES SERVICE - PROCEDURES DIVISION, ATP-100	COMM 202-267-3725
AIR TRAFFIC MANAGEMENT SERVICE AIR TRAFFIC CONTROL SYSTEM COMMAND CENTER - ATM 200 WASHINGTON, D.C.	COMM 202-267-5500 / 202-267-3822 FTS 202-267-5500 800-333-4286
WASHINGTON D.C. CENTRAL ALTITUDE RESERVATION OFFICE	 202-267-9416 AV. 851-1971
NATIONAL NOTAM CENTER WASHINGTON, D.C.	202-267-3390
ATCSCC NTMO	202-267-5500/267-3822 800-333-4286 MILT. USE ONLY
ATCSCC WEATHER UNIT	202-267-9396

<u>CANADIAN OFCF (ARU)</u>

ADMIN HOURS	9-613-998-6583	
TELECONFERENCE	9-613-954-7425 9-613-957-6390	
ARU OPS (24 HRS)	9-613-957-6343 9-613-992-9740 9-613-992-7940 9-613-992-9751	(ATCSCC OF CANADA)
ARU FAX	9-613-957-6412	

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WORKING GROUP FOR HURRICANE AND WINTER STORMS OPERATIONS

MR. RAINER DOMBROWSKY, Chairman
Department of Commerce
National Weather Service

MR. JEFFREY MACLURE
Department of State

MR. DANE CLARK
Department of Commerce
National Environmental Satellite,
Data, and Information Service

CDR CRAIG LILLY, USN
Department of Defense
United States Navy

MR. ERIC MEINDL
Department of Commerce
National Data Buoy Center

MR. MIKE LENICK
FAA Administration and Procedures
Department of Transportation
Air Traffic Rules and Procedures Service
Procedures Division, ATP-100

LCDR CYNTHIA ANN NELSON, USN, Secretary
Office of the Federal Coordinator
for Meteorological Services and
Supporting Research