JIM GROSS

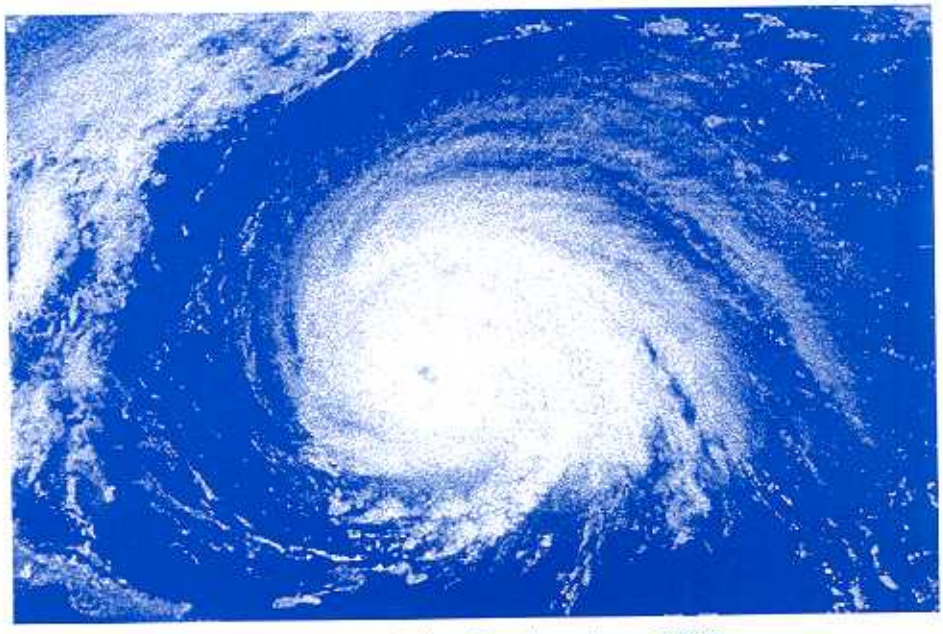
U.S. DEPARTMENT OF COMMERCE/ National Oceanic and Atmospheric Administration

OFCM

OFFICE OF THE FEDERAL COORDINATOR FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

National Hurricane Operations Plan

FCM-P12-1996



Hurricane Luis - September 1995

Washington, DC
May 1996

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NATIONAL HURRICANE OPERATIONS PLAN

FCM-P12-1996

Washington, D.C.
May 1996

CHANGE AND REVIEW LOG

Use this page to record changes and notices of reviews.

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Changes are indicated by a vertical line in the margin next to the change or by shading and strikeouts.

Review Date	Comments	Initial

FOREWORD

This publication is the 34th edition of the National Hurricane Operations Plan (NHOP). It is a compilation of the procedures and agreements reached at the 50th Interdepartmental Hurricane Conference (IHC), which was held in Miami, Florida, March 26-29, 1996. 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 and 6, which describe aircraft reconnaissance and satellite surveillance.

The 1995 Atlantic hurricane season was a very active one. It had the second highest number of both tropical storms (19) and hurricanes (11) since adequate records began in 1871. Seven tropical storms and six hurricanes affected land. Three tropical storms and two hurricanes made landfall in the continental United States. Tropical cyclones in the Atlantic basin were responsible for an estimated 122 deaths. U.S. damages were well over one billion dollars each in Hurricane Marilyn and in Hurricane Opal. In addition, it is estimated that non-U.S. damages of $2.5 billion occurred in the Caribbean from Hurricane Luis and $1.5 billion occurred in Mexico from the combined effects of Hurricanes Opal and Roxanne.

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.

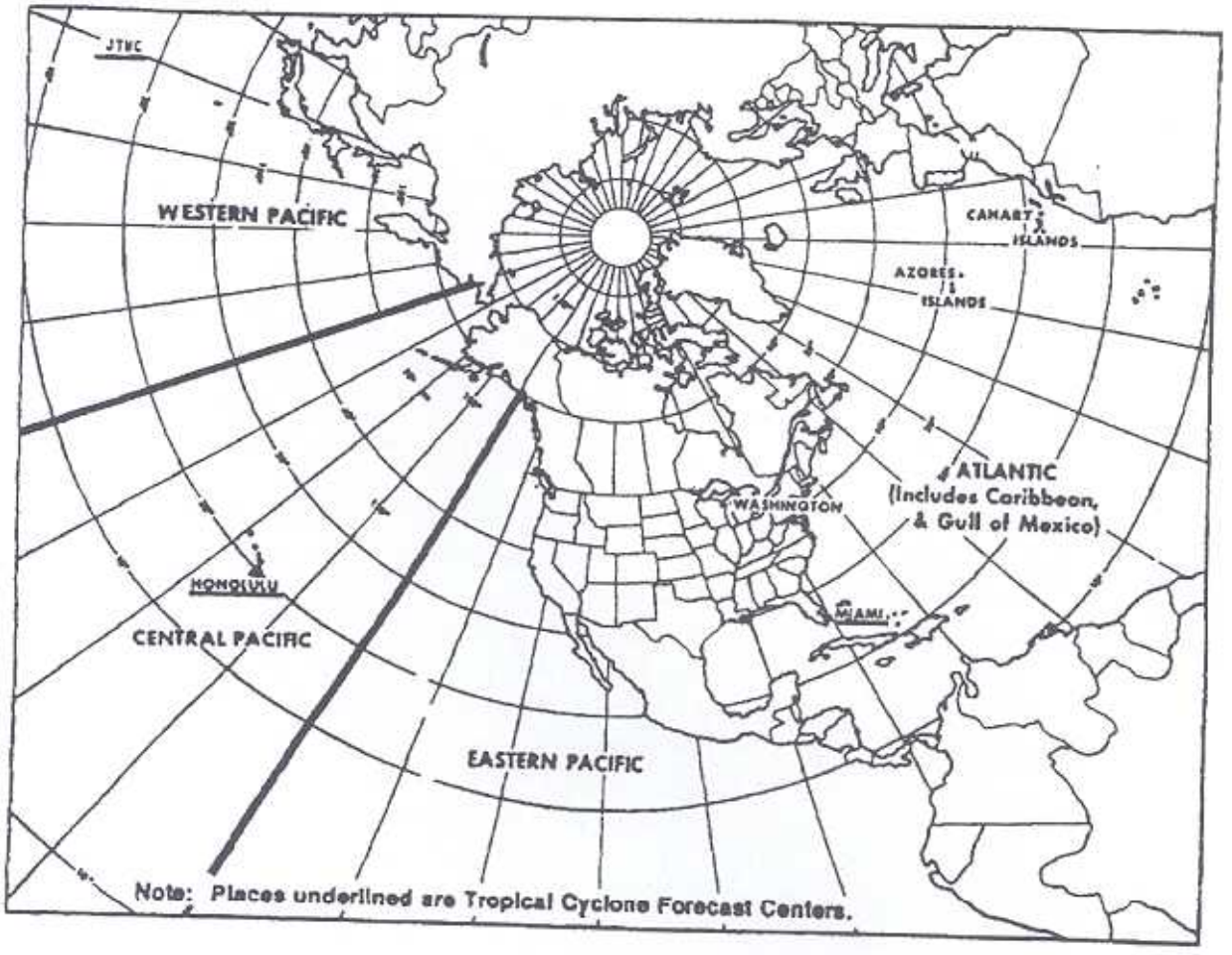

Figure 1-1. Tropical cyclone forecast centers' areas of responsibility

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 Operations Support Squadron/OSW, 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.

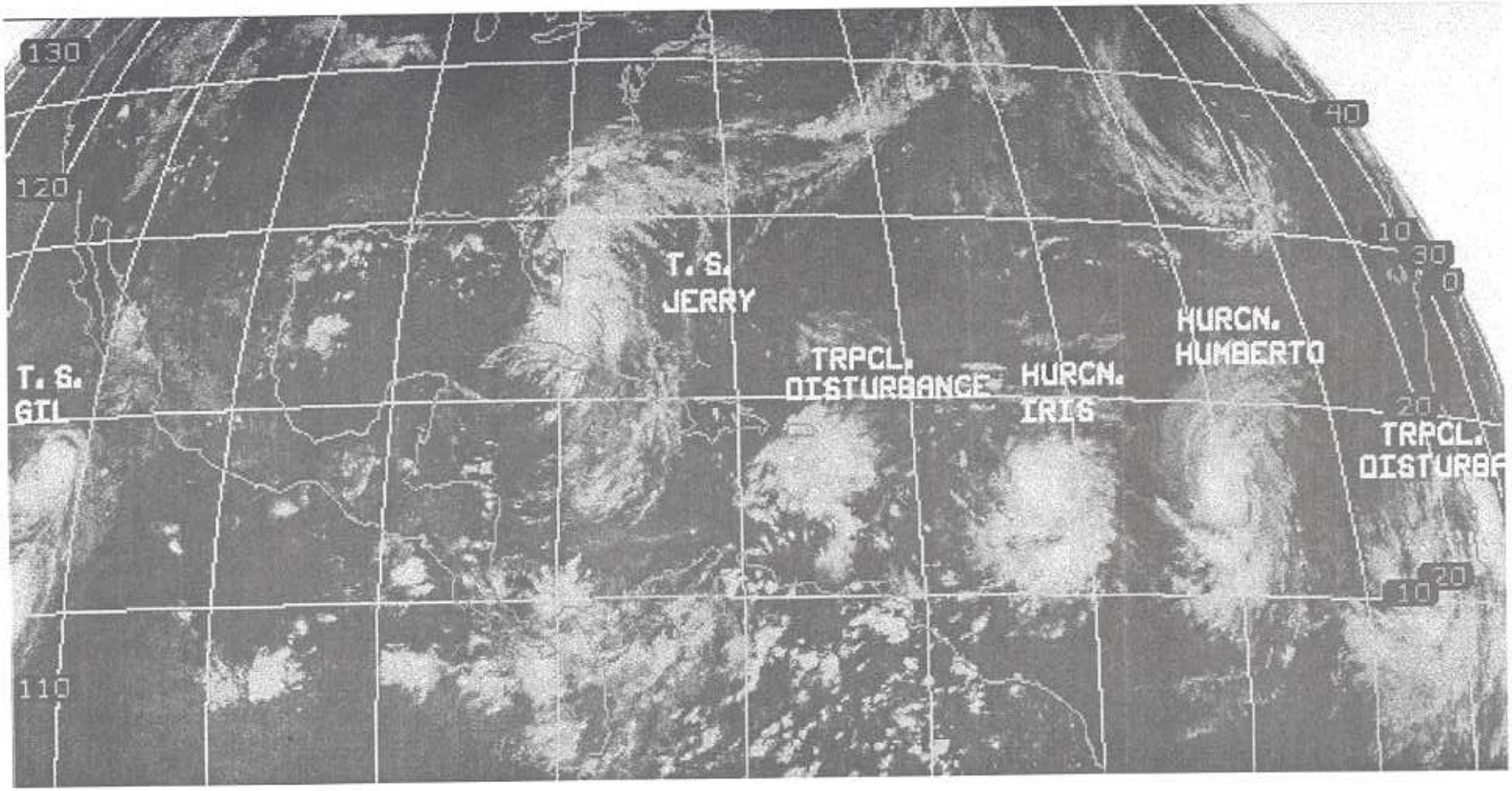

Figure 2-1. Tropical Cyclones in the Atlantic, August 23, 1995.

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 including synoptic surveillance, as specified in Chapter 5, unless relieved of these responsibilities by the Administrator of NOAA.

2.3. DOD Responsibilities. 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-hour 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 weather reconnaissance data monitor services to evaluate and disseminate reconnaissance reports.
- provide, resources permitting, through Air Force Global Weather Central, Offutt AFB, NE and 15th OSS/OSW 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 [Defense Switched Network (DSN)/Commercial] and teletype address 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 prepared and issued by the NHC and CPHC during their respective hurricane seasons. The NHC writes TWOs for both the Atlantic and Eastern Pacific Basins. They are transmitted at 0530, 1130, 1730, and 2230 Eastern Local Time in the Atlantic and at 0400, 1000, 1600, and 2200 Pacific local time. 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 hours. A tropical weather summary of Atlantic, Eastern Pacific, and Central 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. The NHC and the CPHC will, as appropriate, issue tropical cyclone discussion on Atlantic, Eastern Pacific, and Central Pacific tropical cyclones at 0300, 0900, 1500, and 2100 UTC. Discussions will be disseminated for intergovernmental use only and will contain preliminary prognostic positions and maximum wind speed forecasts up to 72 hours; will describe objective techniques, synoptic features, and climatology used; and will provide reasons for track changes.

3.2.3. Tropical Cyclone Public Advisories. Tropical cyclone public advisories are issued by the NHC for all tropical cyclones in the Atlantic. In the Eastern Pacific, tropical cyclone public advisories are issued by NHC for tropical cyclones that are expected to affect land within 48 hours. In the Central Pacific, tropical cyclone public advisories are issued by CPHC for all tropical cyclones within the area of responsibility. Scheduled tropical cyclone public advisories are issued at the same time scheduled tropical cyclone forecast/advisories are issued. Watch and warning break points are listed in Table 3-1.

[NOTE: Tropical cyclone 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.]

3.2.4. Tropical Cyclone Forecast/Advisories. Tropical cyclone forecast/advisories are issued by the NHC and the CPHC. See Section 4.3 for content and format of the advisories. Tropical cyclone forecast/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 minutes before the effective time.

Table 3-1. Defining points for hurricane/tropical storm watches/warnings

La Pesca, MX
Rio San Fernando, MX
Brownsville, TX
Port Mansfield, TX
Baffin Bay, TX
Corpus Christi, TX
Port Aransas, TX
Port O'Connor, TX
Matagorda, TX
Freeport, TX
High Island, TX
Sabine Pass, TX
Cameron, LA
Morgan City, LA
Grand Isle, LA
Mouth of the Mississippi River, LA
Mouth of the Pearl River, LA
Pascagoula, MS
Pensacola, FL
Fort Walton Beach, FL
Destin, FL
Panama City, FL
Apalachicola, FL
Ochlockonee River, FL
St. Marks, FL
Aucilla River, FL
Steinhatchee River, FL
Suwannee River, FL
Cedar Key, FL
Yankeetown, FL
Bayport, FL
Anclote Key, FL
Longboat Key, FL
Venice, FL
Boca Grande, FL
Fort Myers Beach, FL
Bonita Beach, FL
Everglades City, FL
East Cape Sable
Flamingo, FL
Dry Tortugas
Seven Mile Bridge, FL
Craig Key, FL
Angelfish Key, FL
Key Largo, FL
Hallandale, FL
Deerfield Beach, FL
Boynton Beach, FL
Lake Worth, FL
Jupiter Inlet, FL
Stuart, FL
Fort Pierce, FL
Vero Beach, FL
Sebastian Inlet, FL
Cocoa Beach, FL
Titusville, FL
New Smyrna Beach, FL
Flagler Beach, FL
St. Augustine, FL
Fernandina Beach, FL
Brunswick (Altamaha Sound), GA
Savannah, GA
Edisto Beach, SC
Cape Romain, SC
Little River Inlet, SC
Cape Fear, NC
Topsail Beach, NC
New River Inlet, NC
Bogue Inlet, NC
Cape Lookout, NC
Ocracoke Inlet, NC
Cape Hatteras, NC
Oregon Inlet, NC
(The inclusion of Pamlico and Albemarle Sounds should be on a case-by-case basis.)
Currituck Beach Light
NC/VA State line
Cape Charles, VA
Chincoteague, VA
Fenwick Island, DE
Cape Henlopen, DE
Cape May, NJ
Brigantine, NJ
Manasquan Inlet, NJ
(The inclusion of Delaware Bay should be on a case-by-case basis.)
Sandy Hook, NJ
Fire Island Inlet, Long Island, NY
Shinnecock Inlet, Long Island, NY
Montauk Point, Long Island, NY
Port Jefferson Harbor, Long Island, NY
New Haven, CT
Watch Hill, RI
Point Judith, RI
Woods Hole, MA
Chatham, MA
Plymouth, MA
Gloucester, MA
Merrimack River, MA
Portsmouth, NH
Portland, ME
Rockland, ME
Bar Harbor, ME
Eastport, ME

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 tropical cyclone public advisory and tropical cyclone forecast/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 hours 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 tropical cyclone 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. 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 it would affect 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 tropical cyclone public advisory and the tropical cyclone forecast/advisory. Refer to Probability of Hurricane/Tropical Storm Conditions: A User's Manual for further information.

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

Brownsville, TX	Fort Pierce, FL
Corpus Christi, TX	Cocoa Beach, FL
Port O'Connor, TX	Daytona Beach, FL
Galveston, TX	Jacksonville, FL
Port Arthur, TX	Savannah, GA

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

New Iberia, LA
New Orleans, LA
Buras, LA
Gulfport, MS
Mobile, AL
Pensacola, FL
Panama City, FL
Apalachicola, FL
St. Marks, FL
Cedar Key, FL
Tampa, FL
Venice, FL
Fort Myers, FL
Marco Island, FL
Key West, FL
Marathon, FL
Miami, FL
West Palm Beach, FL
29N 85W
29N 87W
28N 89W
28N 91W

Charleston, SC
Myrtle Beach, SC
Wilmington, NC
Morehead City, NC
Cape Hatteras, NC
Norfolk, VA
Ocean City, MD
Atlantic City, NJ
New York City, NY
Montauk Point, NY
Providence, RI
Nantucket, MA
Hyannis, MA
Boston, MA
Portland, ME
Bar Harbor, ME
Eastport, ME

28N 93W
28N 95W
27N 96W
25N 96W

Probabilities are not issued for the west coast of the continental United States or Hawaii

3.2.6. Tropical Cyclone Updates. Tropical cyclone updates are brief statements in lieu of or preceding special forecasts 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 Hurricane Centers may issue a position estimate between scheduled advisories/forecasts whenever the storm center is within 200 nautical miles of the U.S. land-based radar and sufficient and regular radar reports are available to the Hurricane Center. 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 Hydrometeorological Prediction Center (HPC) after subtropical and tropical cyclones have moved inland and tropical cyclone public advisories and tropical cyclone forecast/advisories have been discontinued. Storm

summaries shall continue to be numbered in sequence with tropical cyclone public advisories on named storms. Also, these storm summaries will reference the former storm's name and be issued as long as the remnants of the storm pose a serious hydrometeorological threat.

3.2.10. 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.

3.2.11. Tropical Disturbance Rainfall Estimates. As required, the NHC/CPHC will issue satellite based rainfall estimates for tropical disturbances and tropical cyclones within 36 hours of forecast landfall.

3.3. Designation of Tropical and Subtropical Cyclones.

3.3.1. Numbering of Tropical and Subtropical Depressions. The hurricane centers are responsible for numbering tropical and subtropical depressions in their areas of responsibility. Tropical depressions shall be numbered consecutively beginning each season with the spelled out number "ONE". For ease in differentiation, tropical depression numbers assigned by NHC or CPHC shall include the suffix "E" for Eastern Pacific or "C" for Central Pacific respectively, after the number. In both the Atlantic and Pacific, once the depression has reached tropical storm strength, it shall be named and the depression number dropped, not to be used again until the following year.

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

1996		1997		1998	
ARTHUR		ANA		ALEX	
BERTHA	BUR-tha	BILL		BONNIE	
CESAR	say-ZAR	CLAUDETTE	claw-DET	CHARLEY	
DOLLY		DANNY		DANIELLE	dan-YELL
EDOUARD	eh-DWARD	ERIKA	ERR-ree-ka	EARL	
FRAN		FABIAN	FAY-bee-in	FRANCES	
GUSTAV	GOO-stahv	GRACE		GEORGES	ZHORZH
HORTENSE	HOR-tense	HENRI	ahn-REE	HERMINE	her-MEEN
ISIDORE	IS-i-door	ISABEL	IS-a-bell	IVAN	eye-van
JOSEPHINE	JO-ze-feen	JUAN	WAN	JEANNE	JEEN
KYLE		KATE		KARL	
LILI	LIL-ee	LARRY		LISA	LEE-sa
MARCO		MINDY		MITCH	
NANA	NAN-uh	NICHOLAS	NIK-o-las	NICOLE	ni-COLE
OMAR		ODETTE	o-DET	OTTO	
PALOMA	pa-LOW-ma	PETER		PAULA	
RENE	re-NAY	ROSE		RICHARD	RICH-erd
SALLY		SAM		SHARY	SHA-ree
TEDDY		TERESA	te-REE-sa	TOMAS	to-MAS
VICKY		VICTOR	VIC-ter	VIRGINIE	vir-JIN-ee
WILFRED		WANDA		WALTER	

1999		2000		2001	
ARLENE		ALBERTO	al-BAIR-to	ALLISON	
BRET		BERYL	BER-ril	BARRY	
CINDY		CHRIS		CHANTAL	shan-TAHL
DENNIS		DEBBY		DEAN	
EMILY		ERNESTO	er-NES-toe	ERIN	AIR-in
FLOYD		FLORENCE		FELIX	FEEL-ix
GERT		GORDON		GABRIELLE	gay-bree-EL
HARVEY		HELENE	he-LEEN	HUMBERTO	oom-BAIR-to
IRENE		ISAAC	EYE-sak	IRIS	EYE-ris
JOSE	ho-ZAY	JOYCE		JERRY	
KATRINA	ka-TREE-na	KEITH		KAREN	
LENNY		LESLIE		LUIS	loo-EES
MARIA	ma-REEH-ah	MICHAEL	MIKE-el	MARILYN	
NATE		NADINE	nay-DEEN	NOEL	
OPHELIA	o-FEEL-ya	OSCAR		OPAL	
PHILIPPE	fe-LEEP	PATTY		PABLO	PA-blow
RITA		RAFAEL	ra-fa-EL	ROXANNE	rocks-ANN
STAN		SANDY		SEBASTIEN	say-BAS-tyan
TAMMY		TONY		TANYA	TAHN-ya
VINCE		VALERIE		VAN	
WILMA		WILLIAM		WENDY	

If over 21 tropical cyclones occur in a year, the Greek alphabet will be used following the W-named cyclone.

Table 3-3. Eastern Pacific tropical cyclone names

1996		1997		1998	
ALMA	AL mah	ANDRES	ahn DRASE	AGATHA	
BORIS		BLANCA	BLAHN kah	BLAS	
CRISTINA		CARLOS		CELIA	
DOUGLAS		DOLORES		DARBY	
ELIDA	ELL ee dah	ENRIQUE	anh REE kay	ESTELLE	
FAUSTO	FOW sto	FELICIA	fa LEE sha	FRANK	
GENEVIEVE		GUILLERMO	gee YER mo	GEORGETTE	
HERNAN	her NAHN	HILDA		HOWARD	
ISELLE	ee SELL	IGNACIO	eeg NAH cio	ISIS	EYE sis
JULIO	HOO lee o	JIMENA	he MAY na	JAVIER	ha VEEAIR
KENNA		KEVIN		KAY	
LOWELL		LINDA		LESTER	
MARIE		MARTY		MADELINE	
NORBERT		NORA		NEWTON	
ODILE	oh DEAL	OLAF	OH lahf	ORLENE	or LEAN
POLO		PAULINE		PAINE	
RACHEL		RICK		ROSLYN	
SIMON		SANDRA		SEYMOUR	
TRUDY		TERRY		TINA	
VANCE		VIVIAN		VIRGIL	
WINNIE		WALDO		WINIFRED	
XAVIER	ZAY vier	XINA	ZEE nah	XAVIER	ZAY vier
YOLANDA	yo LAHN da	YORK		YOLANDA	yo LAHN da
ZEKE		ZELDA	ZEL dah	ZEKE	

1999		2000		2001	
ADRIAN		ALETTA	ah LET ah	ADOLPH	
BEATRIZ	BEE a triz	BUD		BARBARA	
CALVIN		CARLOTTA		COSME	COS may
DORA		DANIEL		DALILA	
EUGENE		EMILIA	ee MILL ya	ERICK	
FERNANDA	fer NAN dah	FABIO	FAH bee o	FLOSSIE	
GREG		GILMA	GIL mah	GIL	
HILARY		HECTOR		HENRIETTE	hen ree ETT
IRWIN		ILEANA	ill ay AH nah	ISMAEL	ees mah EL
JOVA	HO vah	JOHN		JULIETTE	
KENNETH		KRISTY		KIKO	KEE ko
LIDIA		LANE		LORENA	low RAY na
MAX		MIRIAM		MANUEL	mahn WELL
NORMA		NORMAN		NARDA	
OTIS		OLIVIA		OCTAVE	AHK tave
PILAR		PAUL		PRISCILLA	
RAMON	rah MONE	ROSA		RAYMOND	
SELMA		SERGIO	SIR gee oh	SONIA	SONE yah
TODD		TARA		TICO	TEE koh
VERONICA		VICENTE	vee CEN tay	VELMA	
WILEY		WILLA		WALLIS	
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-ON-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	
	Pronunciation		Pronunciation		Pronunciation		Pronunciation
ANN	AN	ABEL	A-bel	AMBER	AM-ber	ALEX	AL-x
BART	BART	BETH	BETH	BING	BING	BABS	BABS
CAM	KAM	CARLO	KAR-lo	CASS	KASS	CHIP	CHIP
DAN	DAN	DALE	DAY-l	DAVID	DAY-vid	DAWN	DAWN
EVE	EEV	ERNIE	ER-nee	ELLA	EL-lah	ELVIS	EL-vis
FRANKIE	FRANK-ee	FERN	FERN	FRITZ	FRITZ	FAITH	FAITH
GLORIA	GLOR-ee-uh	GREG	GREG	GINGER	JIN-jer	GIL	GIL
HERB	HERB	HANNAH	HAN-ah	HANK	HANK	HILDA	HIL-dah
IAN	EE-an	ISA	EE-sah	IVAN	I-van	IRIS	I-ris
JOY	JOY	JIMMY	JIM-ee	JOAN	JOAN	JACOB	JAY-kob
KIRK	KIRK	KELLY	KEL-ee	KEITH	KEETH	KATE	KATE
LISA	LEE-sah	LEVI	LEE-vi	LINDA	LIN-dah	LEO	LEE-o
MARTY	MAR-tee	MARIE	ma-REE	MORT	MORT	MAGGIE	MAG-ee
NIKI	NI-kee	NESTOR	NES-tor	NICHOLE	nik-KOL	NEIL	NEEL
ORSON	OR-son	OPAL	O-pel	OTTO	OT-tow	OLGA	OL-gah
PIPER	PI-per	PETER	PEE-ter	PENNY	PEN-ee	PAUL	PAUL
RICK	RICK	ROSIE	RO-zee	REX	REX	RACHEL	RAY-chel
SALLY	SAL-lee	SCOTT	SCOTT	STELLA	STEL-lah	SAM	SAM
TOM	TOM	TINA	TEE-nah	TODD	TODD	TANYA	TAHN-yah
VIOLET	VI-uh-let	VICTOR	vik-TOR	VICKI	VIK-ee	VIRGIL	VER-jil
WILLIE	WIL-lee	WINNIE	WIN-ee	WALDO	WAL-doh	WENDY	WEN-dee
YATES	YATES	YULE	YOU-lee	YANNI	YAN-nee	YORK	YORK
ZANE	ZANE	ZITA	ZEE-tah	ZEB	ZEB	ZIA	ZEE-uh

NOTE: Names will be assigned in rotation, alphabetically, starting with ANN for the first tropical cyclone of 1996. When the last name in Column 4 (ZIA) has been used, the sequence will begin again with the first name in Column 1 (ANN).

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 Centers for Environmental Prediction Hydrometeorological Prediction Center (HPC) Camp Springs, MD
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 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 Atlantic Basin), and a number. The second group contains a location identifier of the message originator (e.g., KNHC for Tropical Prediction 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	Tropical Cyclone Public Advisory
WTNT21-25 KNHC	Tropical Cyclone Forecast/Advisory
WTNT71-75 KNHC	Tropical Cyclone Strike Probabilities
WTNT61 KNHC	Tropical Cyclone Update
WTNT51 KNHC	Tropical Cyclone Position Estimate
WONT41 KNHC	Special Tropical Disturbance Statement

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 Outlook
ABPA30 PHNL	Tropical Weather Outlook
WTPZ21-25 KNHC	Tropical Cyclone Forecast/Advisory
WTPA21-25 PHNL	Tropical Cyclone Forecast/Advisory
WTPZ31-35 KNHC	Tropical Cyclone Public Advisory
WTPA31-35 PHNL	Tropical Cyclone 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
FXUS01 KWBC	1 - 2 Day Discussion
FXUS02 KWBC	3 - 5 Day Forecast
FXUS03 KWBC	Northern Hemisphere Discussion
FXUS04 KWBC	Precipitation Discussion

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. Tropical Cyclone Forecast/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. Tropical cyclone forecast/advisories will be disseminated through the National Weather Service (NWS) communications facility at Suitland, MD, to the Automated 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 tropical cyclone forecast/advisories require elaboration. Telephone numbers for the hurricane centers are in Appendix H.

4.3.2. Tropical Cyclone Forecast/Advisory Issue Frequency. The first tropical cyclone forecast/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 forecasts will be issued whenever the following criteria are met:

- a significant 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 forecast or the relocation will be mandatory in all special forecasts or advisories that include a relocated position.

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

4.3.3. Tropical Cyclone Forecast/Advisory Content. Tropical cyclone forecast/advisories will contain appropriate information as shown in Figure 4-1. The forecast will contain 12, 24, 36, 48, and 72-hour forecast positions.

4.3.4. Numbering of Tropical Cyclone Forecast/Advisories. All tropical cyclone forecast/advisories will be numbered sequentially; e.g.,

Tropical Depression ONE Forecast/Advisory Number 1
Tropical Depression ONE Forecast/Advisory Number 2
Tropical Storm Anita Forecast/Advisory Number 3
Hurricane (Typhoon) Anita Forecast/Advisory Number 4
Tropical Depression Anita Forecast/Advisory Number 5

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ZCZC NHCTCMAT3 ALL
TTAAOO KNHC DDHHMM
HURRICANE BOB FORECAST/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 010 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
64 KT...100NE 100SE 25SW 25NW
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
64 KT...100NE 100SE 25SW 25NW
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
64 KT... 75NE 75SE 25SW 25NW
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 20/1800Z 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 19/0300Z
```

Figure 4-1. Tropical cyclone forecast/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 and deploying data buoys to satisfy DOC needs.

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

- provide synoptic surveillance soundings (see Figure 5-2).
- augment AFRES aircraft reconnaissance when DOC needs exceed the capabilities of DOD resources (see Figure 5-3).
- 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

Figure 5-2. G-IV Weather Surveillance Aircraft

Figure 5-3. NOAA P-3 Weather Surveillance Aircraft

be noted that more expeditious handling of reconnaissance aircraft will result by following the procedures outlined in the FAA/AFRES/NOAA 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 925 hPa or 850 hPa height
- Minimum 700, 850 or 925 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-hour 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. Synoptic Surveillance Data Requirements. When required, the NHC will request mid- and/or upper-tropospheric sounding data on the periphery of systems approaching the United States. The NHC and HRD will coordinate to provide specific tracks including control points, control times and dropwindsonde frequency allocations to Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) for coordination with the reconnaissance units.

5.4.5. Required Frequency and Content of Observations. Requirements, where applicable, 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 minutes 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.

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

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	Two per mission. (non HD/HA) One per fix.	Each scheduled fix at 700mb and above, and as tasked. Others at crew discretion.

5.4.5.2. HD/HA Data. HD/HA data are collected every 30 seconds, organized into a HDOB message with a 30-second, 1-minute or 2-minute data frequency format and transmitted to NHC. See Appendix G for the WC-130 HD/HA data message formats.

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 5-4 and 5-5 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

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

requirements for data on tropical and subtropical cyclones or disturbances for the next 24-hour period (1100 to 1100 UTC) and an outlook for the succeeding 24-hour 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 5-6. Amendments will be provided as required.

5.5.1.2. Tropical Cyclone Plan of the Day. From the coordinated DOC request, Figure 5-6, CARCAH will publish the Tropical Cyclone Plan of the Day (TCPOD). The format for the TCPOD is shown in Figure 5-7. When DOC reconnaissance needs exceed DOD and DOC resources, CARCAH will coordinate with the NHC to establish priorities of requirements.

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 and west of 55°W in the Atlantic.
- 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.
- one synoptic surveillance mission per 24-hour period for potentially landfalling storms.

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.

DATE	SCHEDULED WX TIME	AIRCRAFT NUMBER	ARWO

WX MISSION IDENTIFICATION | OB

(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 FLIGHT LEVEL. IF EXTRAPOLATED, CLARIFY IN REMARKS.
I	C/	M	MAXIMUM FLIGHT LEVEL TEMP/PRESSURE ALTITUDE OUTSIDE EYE
J	C/	M	MAXIMUM FLIGHT LEVEL TEMP/PRESSURE ALTITUDE 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. EO9/15/5 - 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; 9-925mb; 8 - 850 mb; 7 - 700 mb; 6 - 600 mb; 4 - 400 mb; 3 - 300 mb; 2 - 200 mb; NA - Other.
P	/	NM	NAVIGATION FIX ACCURACY/METEOROLOGICAL ACCURACY
Q	REMARKS		

MAX FL WIND _____ KT _____ QUAD _____ Z
SLP EXTRAP FROM (1500 FT/ 925 MB/ 850 MB/ DROPSONDE)
SFC CNTR _____ / _____ NM FROM FL CNTR
MAX FL TEMP _____ C _____ / _____ NM FROM FL CNTR

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 5-4. Vortex data message worksheet

SUPPLEMENTARY VORTEX DATA MESSAGE

WX MISSION ID				OB
SUPPLEMENTARY VORTEX DATA MESSAGE				LEGEND
($L_aL_aL_a$) 01	($L_aL_aL_aL_a$) 1	(JHHH) 1	(TTT_aT_a) 1	(ddfff)
02	2	2	2	
03	3	3	3	
04	4	4	4	
05	5	5	5	
06	6	6	6	
07	7	7	7	
MF ($L_aL_aL_a$)	M ($L_aL_aL_aL_a$)	MF (fff)		
OBS 01 AT: Z	OBS AT Z	OBS 01 SFC WND:		

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 TENS OF DEGREES

TTT_aT_a – TEMP/DEWPOINT IN DEGREES CELSIUS: ADD 50 FOR NEGATIVE VALUES

JHHH – PRESSURE HEIGHT DATA IN RECCO FORMAT

$L_aL_aL_a$ – LATITUDE IN DEGREES/TENTHS

$L_aL_aL_aL_a$ – LONGITUDE IN DEGREES/TENTHS

/ – DATA UNKNOWN/UNOBTAINABLE

($L_aL_aL_a$) 01	($L_aL_aL_aL_a$) 1	(JHHH) 1	(TTT_aT_a) 1	(ddfff)
02	2	2	2	
03	3	3	3	
04	4	4	4	
05	5	5	5	
06	6	6	6	
07	7	7	7	
($L_aL_aL_a$) MF	($L_aL_aL_aL_a$) M	(fff) MF		
OBS 01 AT: Z	OBS AT Z	OBS 07 SFC WND:		

REMARKS (*end of message*)

Figure 5-5. 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. 925, 850 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 eyewal otherwise enter NA. Closed wall--if the center has 100 percent coverage with n eyewall weakness. Open XX--if the center has 50 percent or more but less tha 100 percent coverage. State the direction of the eyewal 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 portion 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 5-6. 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 5-7. Tropical cyclone plan of the day format

5.5.2. DOD and DOC Reconnaissance Aircraft Responsiveness.

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 5-7) 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 KNHC: 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 (703) 904-4401 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. Air Traffic Control (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 at least 10

minutes prior to sensor release. 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:

5.6.1.1. Tropical Cyclone Fix Mission.

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

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

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

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 hours.

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

5.6.1.3. Synoptic Surveillance Missions.

A. SATISFIED. Requirements are considered satisfied upon completion of the assigned track, with the acquired dropwindsonde data transmitted from the aircraft prior to the HPC/MPC deadline for synoptic analysis.

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 5-8). 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 5-4) 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 land, 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 7.3.3.

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. The Supplementary Vortex Data Message (Figure 5-5) will be encoded and reported as specified in Table 5-1.

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.

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 5-8. Mission evaluation form

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 through 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/YY/ZZ, 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 HDOB 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 0lXXA INVEST OB 01 KNHC
97779 TEXT ...
DPTD AF968 WX 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 HDOB), 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. Operational Flight Patterns. 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, 925 hPa, 850 hPa, or 700 hPa, depending on data requirements and flight safety. Legs will normally be 105 nmi long and flown on intercardinal tracks (45 degrees off cardinal tracks). The flight sequence is shown in Figure 5-9. The pattern can be started at any intercardinal point and then repeated throughout the mission. Prior to starting an inbound or 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 (such as extending legs to examine the wind profile of a strong storm) or because of proximity of land or warning areas.

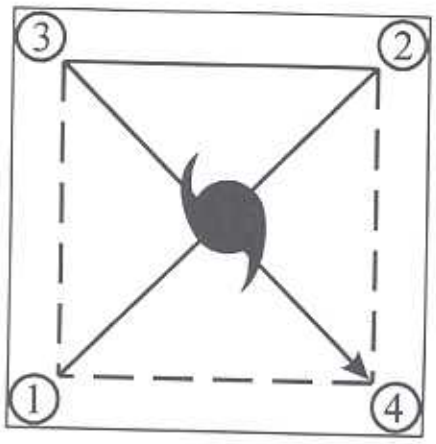

Figure 5-9. Flight pattern ALPHA

5.8.1.2. Vortex 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 925 hPa, 850 hPa or 700 hPa extrapolate sea-level pressure using Table 5-3, Table 5-4 or Table 5-5, 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.

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.

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 5-10. Turns are usually made to take advantage of tailwinds whenever possible.

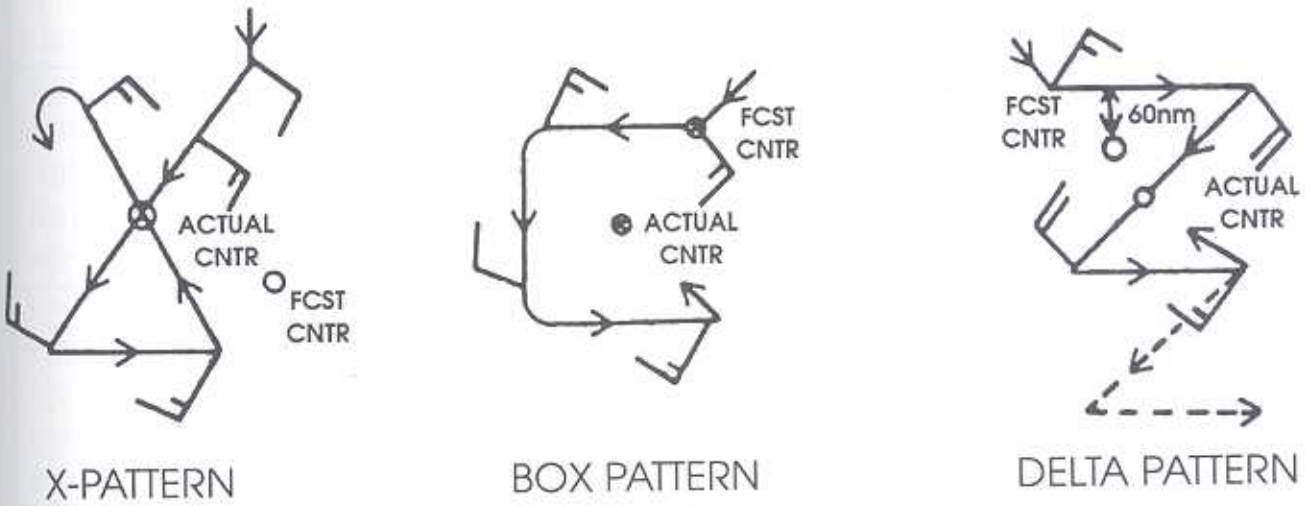

Figure 5-10. Suggested patterns for investigative missions

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.

Table 5-3. Surface pressure as a function of 925 hPa heights and temperatures

Heights	925 hPa Temperature (°C)								
	16	18	20	22	24	26	28	30	32
860	1023	1022	1021	1020	1020	1019	1018	1017	1017
840	1020	1019	1019	1018	1017	1017	1016	1015	1014
820	1018	1017	1016	1016	1015	1014	1014	1013	1012
800	1016	1015	1014	1013	1013	1012	1011	1011	1010
780	1013	1012	1012	1011	1010	1010	1009	1008	1008
760	1011	1010	1010	1009	1008	1008	1007	1006	1006
740	1008	1008	1007	1007	1006	1005	1005	1004	1003
720	1006	1006	1005	1004	1004	1003	1002	1002	1001
700	1004	1003	1003	1002	1001	1001	1000	1000	999
680	1001	1001	1000	1000	999	999	998	997	997
660	999	999	998	997	997	996	996	995	995
640	997	996	996	995	995	994	994	993	993
620	995	994	993	993	992	992	991	991	990
600	992	992	991	991	990	990	989	989	988
580	990	989	989	988	988	987	987	987	986
560	988	987	987	986	986	985	985	984	984
540	985	985	984	984	984	983	983	982	982
520	983	983	982	982	981	981	980	980	980
500	981	980	980	980	979	979	978	978	977
480	978	978	978	977	977	976	976	976	975
460	976	976	975	975	975	974	974	974	973

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 850 hPa heights and temperatures

	850 hPa Temperature (°C)								
Heights	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 5-5. 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.

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.]

5.8.3. Synoptic Surveillance Missions. A synoptic surveillance mission is tasked to measure the large-scale wind and thermodynamic fields within approximately 800 nautical miles of tropical cyclones. Specific flight tracks will vary depending on storm location and synoptic situation.

5.9. Aircraft Reconnaissance Communications.

5.9.1. General. The U.S. Air Force and NOAA WP-3D 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. The NOAA G-1V will normally transmit WMO Temp Drop messages via INMARSAT commercial SATCOM. 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 may 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 mission 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 5-11 depicts these communication links.

5.9.4.1. 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 5-12 depicts these communication links.

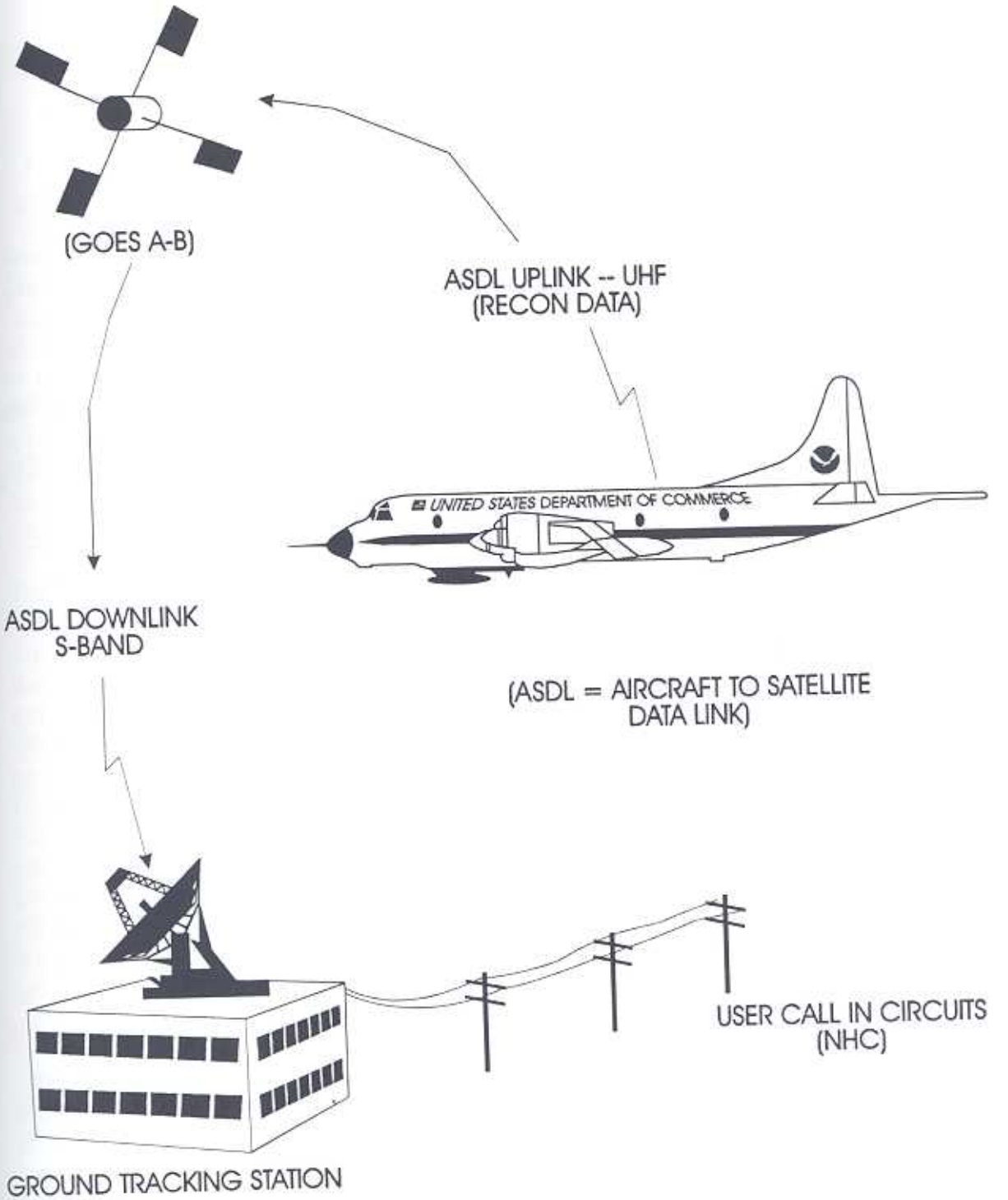

Figure 5-11. Schematic of aircraft to satellite data link for NOAA P-3 aircraft

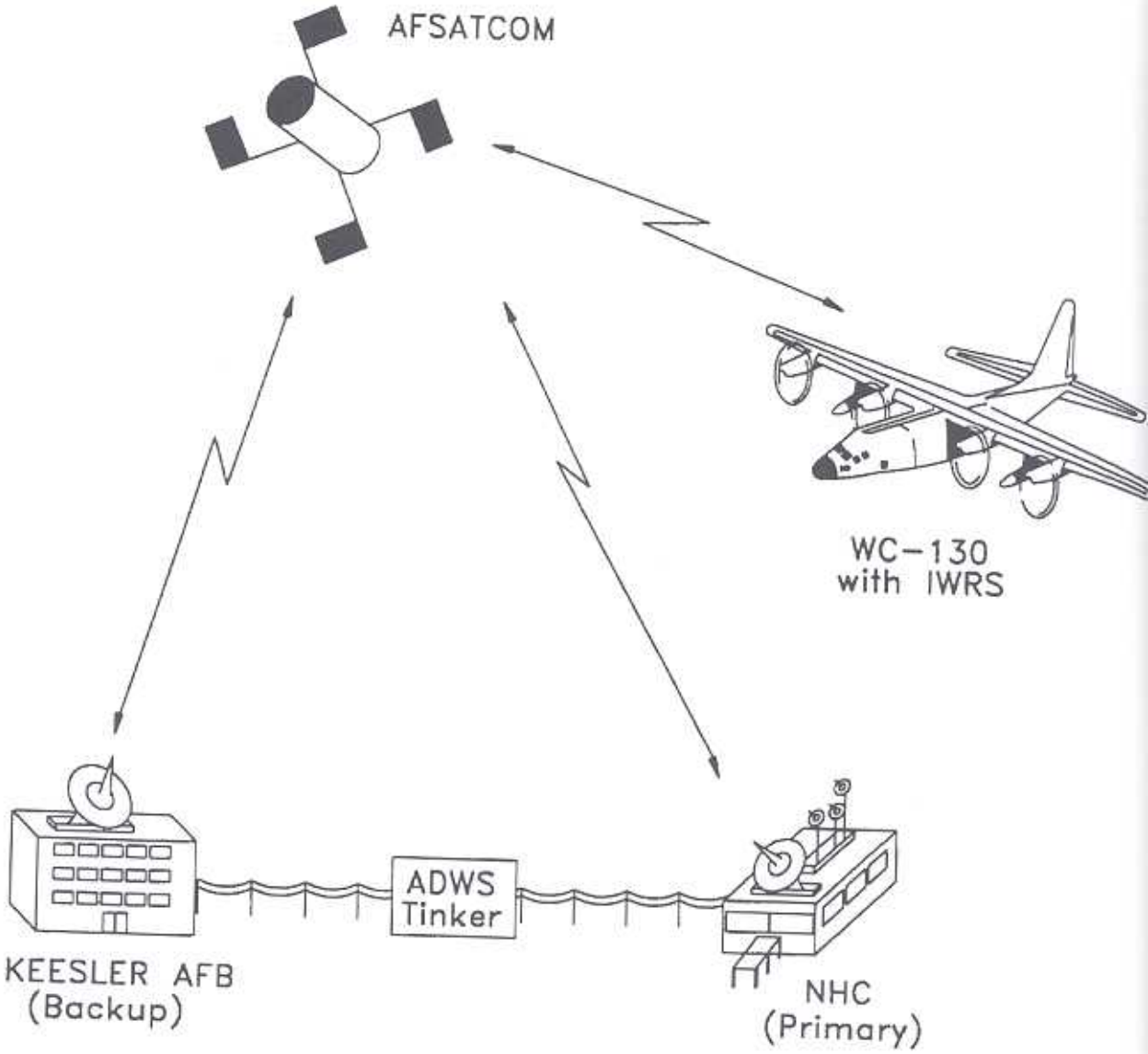

Figure 5-12. Schematic of aircraft to satellite data link for AFRES WC-130 aircraft

CHAPTER 6

SATELLITE SURVEILLANCE OF TROPICAL AND SUBTROPICAL CYCLONES

6.1. Satellites.

6.1.1. Geostationary Operational Environmental Satellite (GOES). After the successful launch and check-out at 90 degrees West, GOES-9 began moving to the west in December 1995 to replace the aging GOES-7 spacecraft. In January 1996, GOES-7 operations including primary imaging and sounding functions were turned over to GOES-9 to begin support of GOES-West operations at 135 degrees West. Following the transfer, GOES-7 was allowed to naturally drift to the east to achieve a back-up position for either GOES-8 or GOES-9. NOAA's geostationary satellite constellation now consists of two 3-axis stabilized spacecraft, affording the user community better quality satellite data through additional spectral channels, higher resolution, and sharper images. From 135 degrees West and 75 degrees West, GOES satellite data coverage extends from the central Pacific through the Americas to the eastern Atlantic, including vital tropical regions.

The principal GOES products are one-half hourly pictures with implanted grids automatically applied to all sectors. GOES-8 and GOES-9 consisting of 5 multi-spectral imaging channels at various resolution, correspond to various resolutions available from GOES-Tap products. Hence, absolute resolution is channel dependent. In general, GOES-Tap sectors during the day and night are provided at varying 1-, 2-, 4-, and 8-km resolutions. A vast improvement for GOES-8 and GOES-9 data on GOES-Tap is the higher resolutions in the infrared imagery provided at 4-km and in the water vapor, at 8-km (vs. GOES-7 7-km and 14-km respectively). Channel 2 or 3.9 micron data are also available for the detection of low clouds, fog, and stratus. The IR data may be enhanced to emphasize various features. 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 Centers for Environmental Prediction, Weather Service Forecast Offices (WSFOs), academic community, and other federal and private agencies. (See Figure 6-1 and Table 6-1).

6.1.1.1. GOES-9. GOES-9, a clone of GOES-8, operates on the same principal of 3-axis stabilization to maintain orbit control. The routine scanning mode of GOES-9 will also emulate GOES-8, providing coverage of the Northern Hemisphere, CONUS and Southern Hemisphere every half hour with the exception of 3-hourly full disk. The additional PACUS (retermed from CONUS to reflect GOES-9 coverage) scan allows two views of the U.S. and eastern Pacific Ocean every 30 minutes.

6.1.1.2. GOES-8. GOES-8 supporting a GOES-East station at 75 degrees West, continues to serve NOAA operations including the NWS National Hurricane Center, other Federal agencies, and the private sector. Various imager channels at higher resolutions are

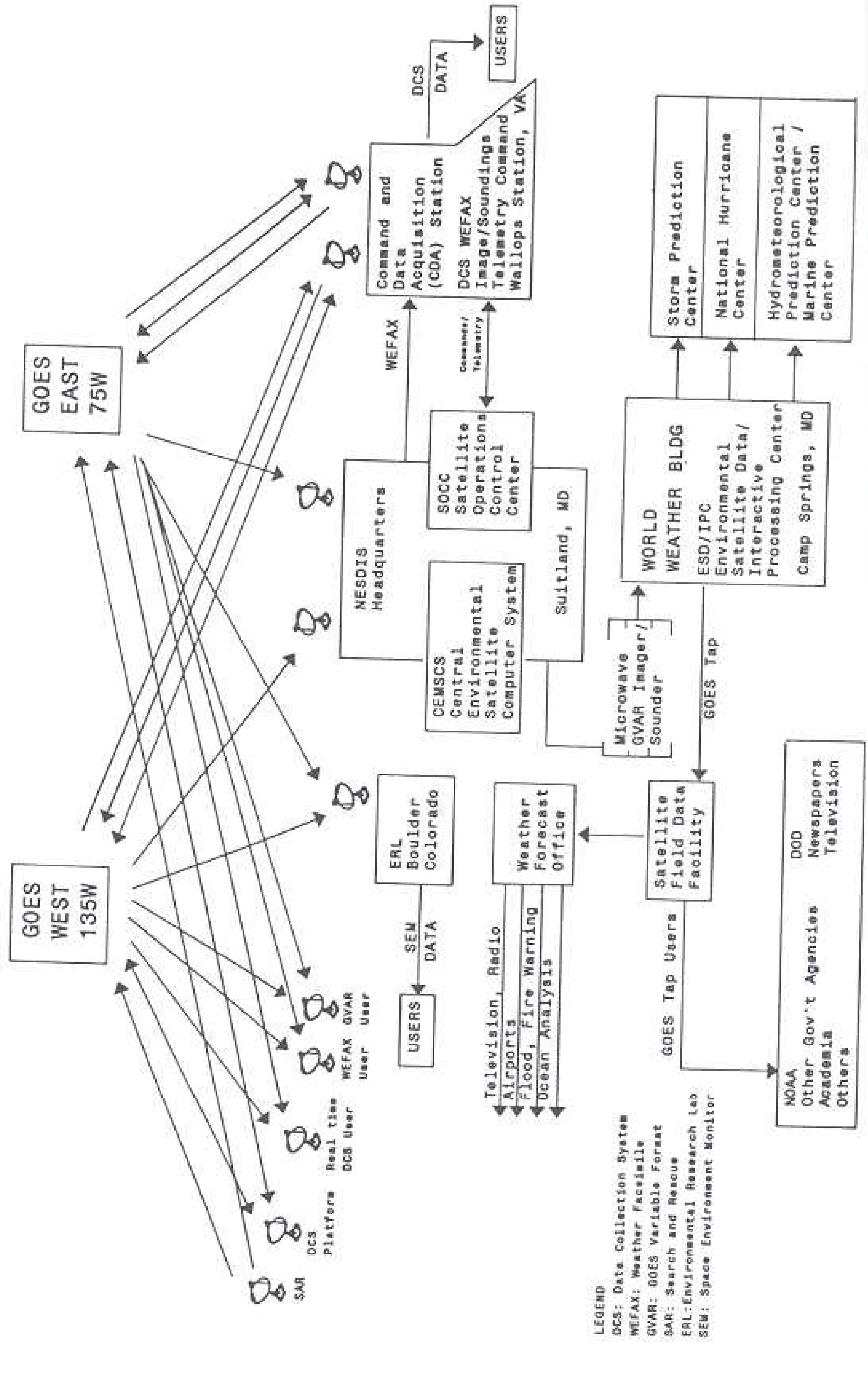

Figure 6-1. The GOES satellite system

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

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
GOES-8 at 75W GOES-9 at 135W	Multispectral Imager and Sounder	Every 30 min, in Routine Scan Mode, provides 3 sectors with prescribed coverages: Northern Hemisphere (NH) or Extended NH; CONUS; and Southern Hemisphere. Exception is transmission of full disk every 3 hours. (Available Rapid Scan Operations yield increased transmissions to 7.5 minute intervals to capture rapidly changing, dynamic weather events).	1. 1, 2, 4, and 8-km resolution visible standard sectors. 2. 4-km equivalent resolution IR sectors. 3. Equivalent and full resolution IR enhanced imagery. 4. Full Disk IR every 3 hours. 5. 8-km water vapor sectors. 6. Interactive products; moisture analysis; quantitative precipitation estimates; cloud top heights; cloud and water vapor motion wind vectors. 7. Operational sounder data to NCO (NCEP Central Operations) numerical models. Sounding 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.
METEOSAT-5	Multi-spectral Spin-Scan Radiometer	(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. 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
NOAA-14	AVHRR GAC and LAC (recorded) HRPT and APT (direct) TOVS	0200D[1]/1400A[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. 5. Sea-surface temperature analysis. 6. Soundings 7. Moisture analysis 8. Remapped GAC sectors.
NOAA-12	same as NOAA-14	0644D/1844A	
DMSP F-10	OLS Imagery (turned off), SSM/I, SSM/T (recorded and direct)	1010D/2210A	1. 0.3 nmi (regional) and 1.5 nmi (global) resolution (visual and infrared) imagery available via stored data recovery through AFGWC. 2. Regional coverage at 0.3 nmi and 1.5 nmi resolution (visual and infrared) imagery available from numerous DOD tactical terminals. 3. SSM/T, SSM/T-2, SSM/I data transmitted to NESDIS and FNMOC from AFGWC.
DMSP F-11	OLS Imagery (turned off), SSM/I, SSM/T, SSM/T2-moisture sounder (direct)(150GHZ channels non-functional)	0627D/1827A	
DMSP F-12	OLS Imagery (recorded and direct), SSM/I (non-functional), SSM/T, SSM/T2 (recorded and direct)	0927D/2127A	

[1] D - descending

[2] A - ascending

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
DMSP F-13	OLS Imagery (recorded and direct), SSM/I, SSM/T	0543D/1743A	1. 0.3 nmi (regional) and 1.5 nmi (global) resolution (visual and infrared) imagery available via stored data recovery through AFGWC. 2. Regional coverage at 0.3 nmi and 1.5 nmi resolution (visual and infrared) imagery available from numerous DOD tactical terminals. 3. SSM/T, SSM/T-2, SSM/I data transmitted to NESDIS and FNMOC from AFGWC.

being utilized to monitor the intensification and movement of tropical cyclones over the Atlantic Ocean. Among many of its attributes, greater detail in the imagery facilitates the detection of the cyclone's center. Sounder data are planned to be incorporated to National Centers for Environmental Prediction's (NCEP's) numerical models as atmospheric moisture and temperature profiles. In addition, sounder data are being exploited to generate Derive Product Imagery such as total precipitable water, atmospheric stability indices, and surface and cloud temperatures.

6.1.2. National Oceanic and Atmospheric Administration (NOAA) Polar-Orbiting Satellites. Two primary operational NOAA polar orbiting satellites, NOAA-12 and NOAA-14, provide imaging coverage four times a day over a respective area in 5 spectral channels. 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 6-1). 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. EUMETSAT Meteosat Geostationary Satellites. Following the planned reorbiting (to a higher, non-geosynchronous orbit) of Meteosat-3 in November 1995, the highly appraised Extended Atlantic Data Coverage (XADC) mission has officially concluded. From June 1995, Meteosat-3 was acting as a viable backup to GOES-8 in the event of a failure. In parallel with

the decommissioning of Meteosat-3, the contract with European Space Agency (ESA) expired and Meteosat operations were transferred over to EUMETSAT where ground systems are now based in Italy.

Meteosat-5, the primary European operational satellite at 0 degrees, continues to provide vital coverage of developing tropical waves off the African Coast and western Atlantic Ocean. 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; Storm Prediction Center (SPC); and the NESDIS and National Centers for Environmental Prediction (NCEP) at the NOAA Science Center (NSC) in Camp Springs, Maryland. Meteosat WEFAX data are also available and distributed on GOES-Tap circuits.

In December 1995, EUMETSAT, the administrator of the Meteosat program, began encrypting digital Meteosat-5 data 24 hours per day to regulate use within Europe. Based on international data policy agreements, U.S. users are allowed access via a domestic satellite to non-encrypted Meteosat data 8 times per day at synoptic times; at other times the data are encrypted. Hence, if half-hourly transmissions are required to support operational requirements, it is necessary for users to register with EUMETSAT to acquire decryption devices for installation at their local site.

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
- marine 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 6-2 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. NESDIS Synoptic Analysis Branch (SAB). The SAB operates 24 hours a day to provide satellite support to the HPC/MPC, National Hurricane Center (NHC), Central Pacific Hurricane Center (CPHC), and other worldwide users. SAB coordinates as conditions warrant with NHC and CPHC, relaying pertinent information on tropical cyclone development, including location, tracking, and intensity analysis. A satellite tropical disturbance summary for the Indian Ocean, including 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, water vapor wind vectors, and thermal wind vectors (sounder derived), moisture analyses, cloud top heights, and tropical rainfall estimates are provided to HPC and NHC. Telephone numbers for the SAB are located in Appendix H.

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 6-2. Sample satellite tropical weather discussion

[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)."

6.4. Air Force Support and the Defense Meteorological Satellite Program (DMSP). Data covering the National Hurricane Operations Plan areas of interest are received centrally at the Air Force Global Weather Central (AFGWC) and locally at several direct readout sites. 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, resources permitting, transmit twice daily teletype bulletins, describing the location and intensity classification of the system, using format shown in Figure 6-3 to the National Hurricane Center on organized disturbances evident at the tropical classification of one point five (T-1.5) or higher. AFGWC will, resources permitting, 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 Operations Support Squadron will provide fix and intensity information to the CPHC on systems upon request.

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

6.6. Current Intensity and Tropical Classification Number. 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.

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

WMO HEADING	TIME ISSUED	OCEANIC AREA	TYPE OF DATA
TCIO11 KWBC	0300 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°	IR
TCPW10 PHNL	2200 UTC	Western Pacific (north and south) from 100°E to 180°	VIS/IR
TCPA11 PHNL	1000 UTC	Central Pacific (north and south) from 180° to 140°W	IR
TCPA10 PHNL	2200 UTC	Central Pacific (north and south) from 180° 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 (16)
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 IN or SI, followed by checksum. Sample entry: 29.9N/0
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 infrared 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 4.6/4.6-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	66	26.3N	89.3W
7. W	80	27.0N	89.7W
8. NW	95	28.6N	89.2W

Figure 6-3. 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 Doppler radar, the WSR-88D. Installation of the WSR-88D network began in late 1990, and is expected to be complete by 1997. 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. For Air Force sites, Air Force Supplement 1, FMH No. 7, Part A pertains. 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

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
Baton Rouge, LA	WSR-88D		30°20' N	89°49' W
Binghamton, NY	WSR-88D		42°12' N	75°59' W
Boston, MA	WSR-88D		41°57' N	71°08' W
Brownsville, TX	WSR-88D		25°55' N	97°25' W
Charleston, SC	WSR-57	deliv. 3/96	32°33' N	80°47' W
Corpus Christi, TX	WSR-74C	deliv. 5/96	27°47' N	97°30' W
Houston, TX	WSR-88D		29°28' N	95°05' W
Jackson, MS	WSR-88D		32°19' N	90°05' W
Jacksonville, FL	WSR-88D		30°29' N	81°42' W
Key West, FL	WSR-88D		24°36' N	81°42' W
Lake Charles, LA	WSR-88D		30°07' N	93°13' W
Melbourne, FL	WSR-88D		28°07' N	80°39' W
Miami, FL	WSR-88D		25°37' N	80°25' W
Mobile, AL	WSR-88D		30°41' N	88°15' W
Morehead City, NC	WSR-88D		34°46' N	76°53' W
New York City, NY	WSR-88D		40°52' N	72°52' W
Philadelphia, PA	WSR-88D		39°57' N	74°25' W
Portland, ME	WSR-88D		43°53' N	70°15' W
San Juan, PR[1]	WSR-74S		18°16' N	65°46' W
Savannah, GA[1]	WSR-74C		32°08' N	81°12' W
Shreveport, LA	WSR-88D		32°27' N	93°50' W
State College, PA	WSR-88D		40°55' N	78°00' W
Sterling, VA	WSR-88D		38°58' N	77°29' W
Tallahassee, FL	WSR-88D		30°24' N	84°20' W
Tampa, FL	WSR-88D		27°42' N	82°24' W
Victoria, TX[1]	WSR-100-5		28°51' N	96°55' W
Wakefield, VA	WSR-88D		36°59' N	77°00' W
Wilmington, NC	WSR-88D		33°59' N	78°26' W
	FAA			
Kohala, HI	WSR-88D		20°06'N	155°45'W
Molokai, HI	WSR-88D		21°08'N	157°11'W
San Juan, PR	WSR-88D		18°07'N	66°05'W
South Hawaii, HI	WSR-88D		19°06'N	155°34'W
South Kauai, HI	WSR-88D		21°54'N	159°33'W

[1] Full-time operations

Table 7-1. Participating radar stations (continued)

LOCATION	RADAR TYPE	LATITUDE	LONGITUDE
	DEPARTMENT OF DEFENSE		
Cherry Point MCAS, NC	FPS-106	34°54'N	76°53'W
Dover AFB, DE[1]	WSR-88D	38°50'N	75°26'W
Eglin AFB, FL[1]	WSR-88D	30°34'N	85°55'W
Fort Hood, TX[1]	WSR-88D	30°43'N	97°23'W
Fort Polk, LA	WSR-88D	31°09'N	92°58'W
Fort Rucker, AL[1]	WSR-88D	31°28'N	85°28'W
Guantanamo Bay, Cuba	FPS-106	19°54'N	75°10'W
Howard AFB, PN	FPQ-21	08°55'N	79°36'W
Jacksonville NAS, FL	FPS-106	30°14'N	81°41'W
Maxwell AFB, AL[1]	WSR-88D	32°32'N	85°47'W
Moody AFB, GA	WSR-88D	30°33'N	83°00'W
New Orleans NAS, LA	FPS-106	29°50'N	90°01'W
Norfolk NAS, VA	FPS-106	36°56'N	76°18'W
Robins AFB, GA	WSR-88D	32°40'N	83°21'W
Roosevelt Roads, PR	FPS-106	18°15'N	65°38'W

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

	COOPERATING SITES		
NASA			
Bay St Louis, MS	CPS-9	30°42'N	89°07'W
Wallops Flight Facility,	UHF + S Band	31°51'N	75°31'W
Atmospheric Sciences	ASR-7	37°56'N	75°28'W
Research Facility,	RIR-716	37°50'N	75°29'W
Wallops Island, VA	RIR-716	37°56'N	75°28'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

H+20 and H+50. In the design phase, provision was made for tropical cyclone observations 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 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 AWDS. 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 limited number of drifting buoys are available at this time for special projects, including rapid response deployment ahead of tropical cyclones. 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. The operational status and measurement capability of stations can be obtained from NDBC Data Systems Division, Building 1100, Stennis Space Center, MS 39529, phone 601-688-1720, or on-line via Seaboard http://seaboard.ndbc.noaa.gov

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 (Figure 8-5). Asynoptic reports are through Polar Orbiting Environmental Satellites (POES).

8.2. Requests for Drifting Buoy Deployment.

The Department of Commerce (DOC) through 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 53 Weather Reconnaissance Squadron through HQ Air Force Reserve (AFRES) for each desired aerial deployment of drifting data buoys for a pre-storm array in the Atlantic or Pacific Oceans. 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-hour notification is required. All requests will include specifics regarding onloading base, accompanying technicians, desired pickup times, offload points, reimbursement funding, and other pertinent data.

8.2.1. National Hurricane Center. The National Hurricane Center forecasters will issue through the Tropical Cyclone Plan of the Day (TCPOD) an alert or outlook for drifting buoy deployment 48 hours prior to the planned deployment. Hard tasking for the deployment will be issued 24 hours prior to the event via the TCPOD.

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
42035	29.2°N 94.4°W	3 m	5 m
42036[1]	28.5°N 84.5°W	3 m	5 m
42037	24.5°N 81.4°W	2.4 m	3 m
42039	28.8°N 86.0°W	3 m	5 m
42040	29.2°N 88.2°W	3 m	5 m
MOORED BUOYS IN THE ATLANTIC OCEAN			
41001	34.7°N 72.6°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
41021	31.9°N 80.9°W	3 m	5 m
41022	31.7°N 80.9°W	3 m	5 m
44004	38.5°N 70.6°W	6 m	5 m
44005	42.7°N 68.7°W	6 m	5 m
44007[1]	43.5°N 70.1°W	3 m	5 m
44008[1]	40.5°N 69.4°W	3 m	5 m
44009[1]	38.4°N 74.7°W	3 m	5 m
44011	41.1°N 66.6°W	6 m	5 m
44013[1]	42.4°N 70.8°W	3 m	5 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
44028	41.4°N 71.1°W	12 m	13.8 m
MOORED BUOYS IN THE PACIFIC OCEAN (SOUTH of 45°N)			
46002	42.5°N 130.4°W	6 m	5 m
46006	40.8°N 137.7°W	6 m	5 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

[1]Temporary site established in support of other programs

MOORED BUOYS IN THE PACIFIC OCEAN (SOUTH of 45°N)

ATION ID	LOCATION	HULL SIZE	ANEMOMETER HEIGHT
6023[1]	34.3°N 120.7°W	3 m	5 m
6025[1]	33.7°N 119.1°W	3 m	5 m
6026	37.7°N 122.7°W	3 m	5 m
6027	41.8°N 124.4°W	3 m	5 m
6028[1]	35.8°N 121.9°W	3 m	5 m
6030[1]	40.4°N 124.5°W	3 m	5 m
6042[1]	36.8°N 122.4°W	3 m	5 m
6045[1]	33.8°N 118.4°W	3 m	5 m
6050[1]	44.6°N 124.5°W	3 m	5 m
6053[1]	34.2°N 119.8°W	10 m	10 m
6054[1]	34.3°N 120.4°W	10 m	10 m
6059	38.0°N 130.0°W	6 m	5 m
1001[1]	23.4°N 162.3°W	6 m	5 m
1002[1]	17.2°N 157.8°W	6 m	5 m
1003[1]	19.3°N 160.8°W	6 m	5 m
1004[1]	17.4°N 152.5°W	6 m	5 m
1026[1]	21.4°N 156.9°W	3 m	5 m
1027	20.4°N 157.1°W	3 m	5 m

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
CDRF1	29.1°N 83.0°W	Cedar Key, FL
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
KTNF1	29.8°N 83.6°W	Keaton Beach, FL
LONF1[1]	24.8°N 80.5°W	Long Key, FL
PTAT2	27.8°N 97.1°W	Port Aransas, TX
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
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

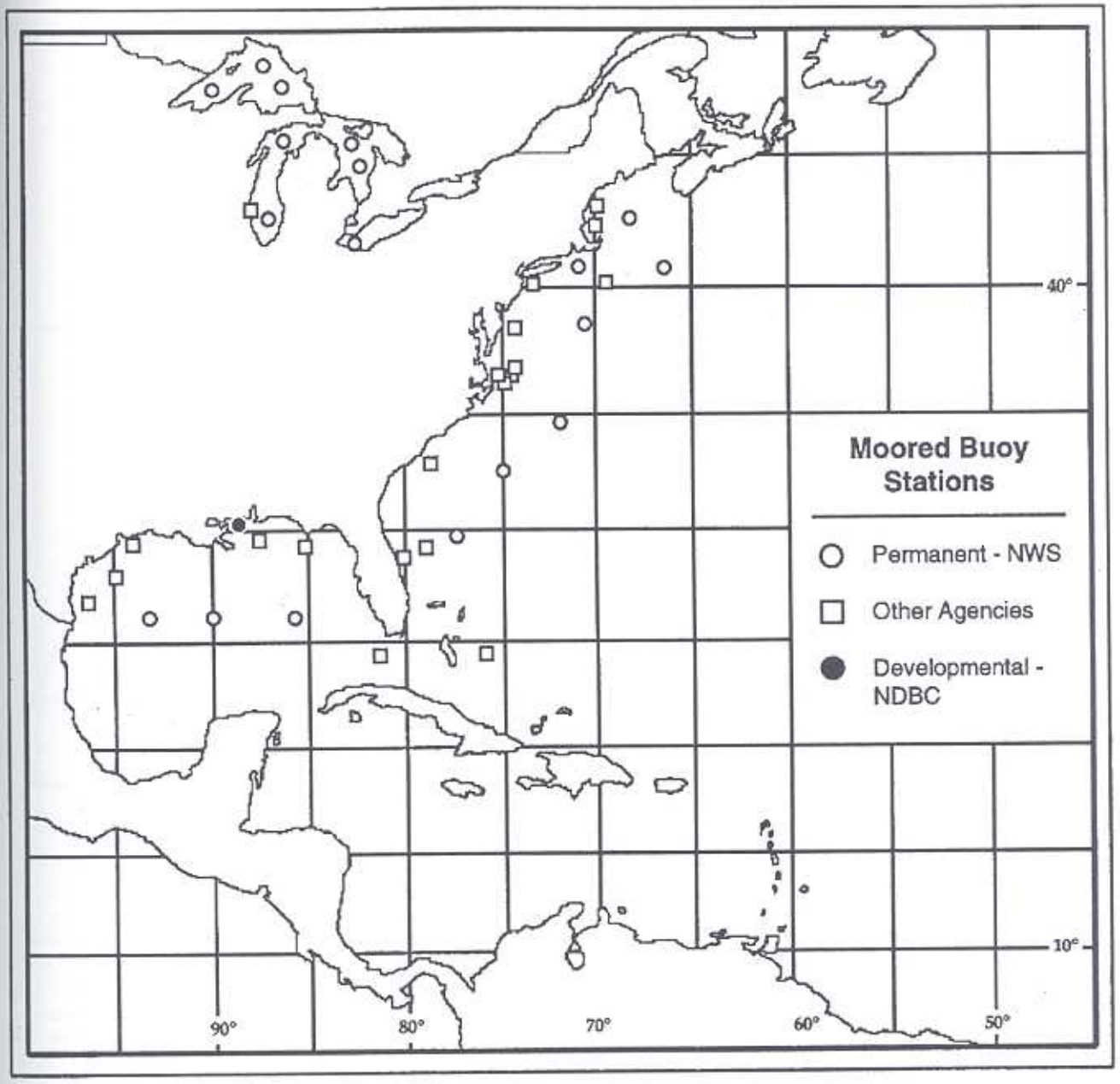

Figure 8-1. NDBC moored buoy locations in the Atlantic Ocean, Gulf of Mexico a nd Great Lakes

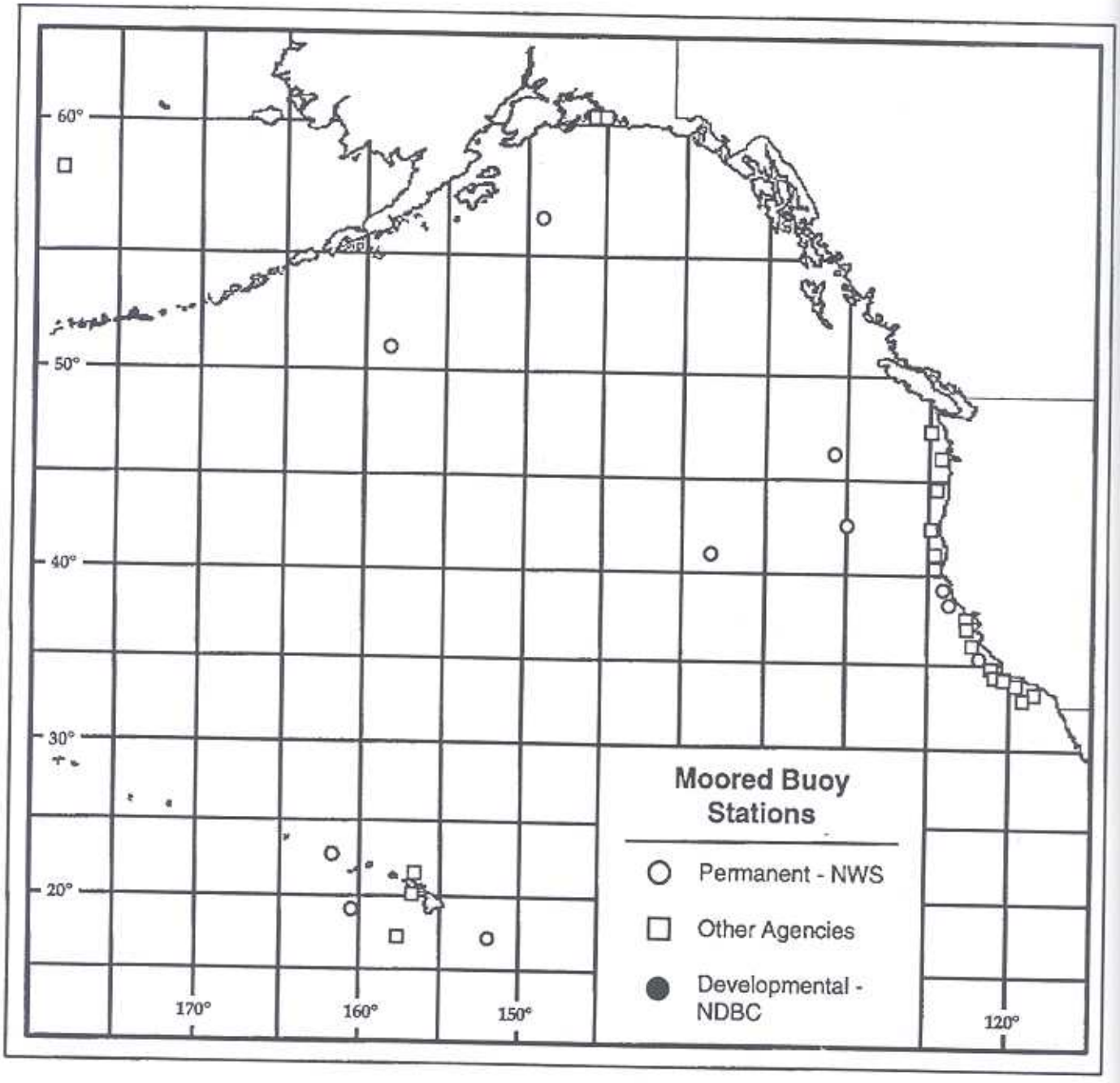

Figure 8-2. NDBC moored buoy locations in the Pacific Ocean

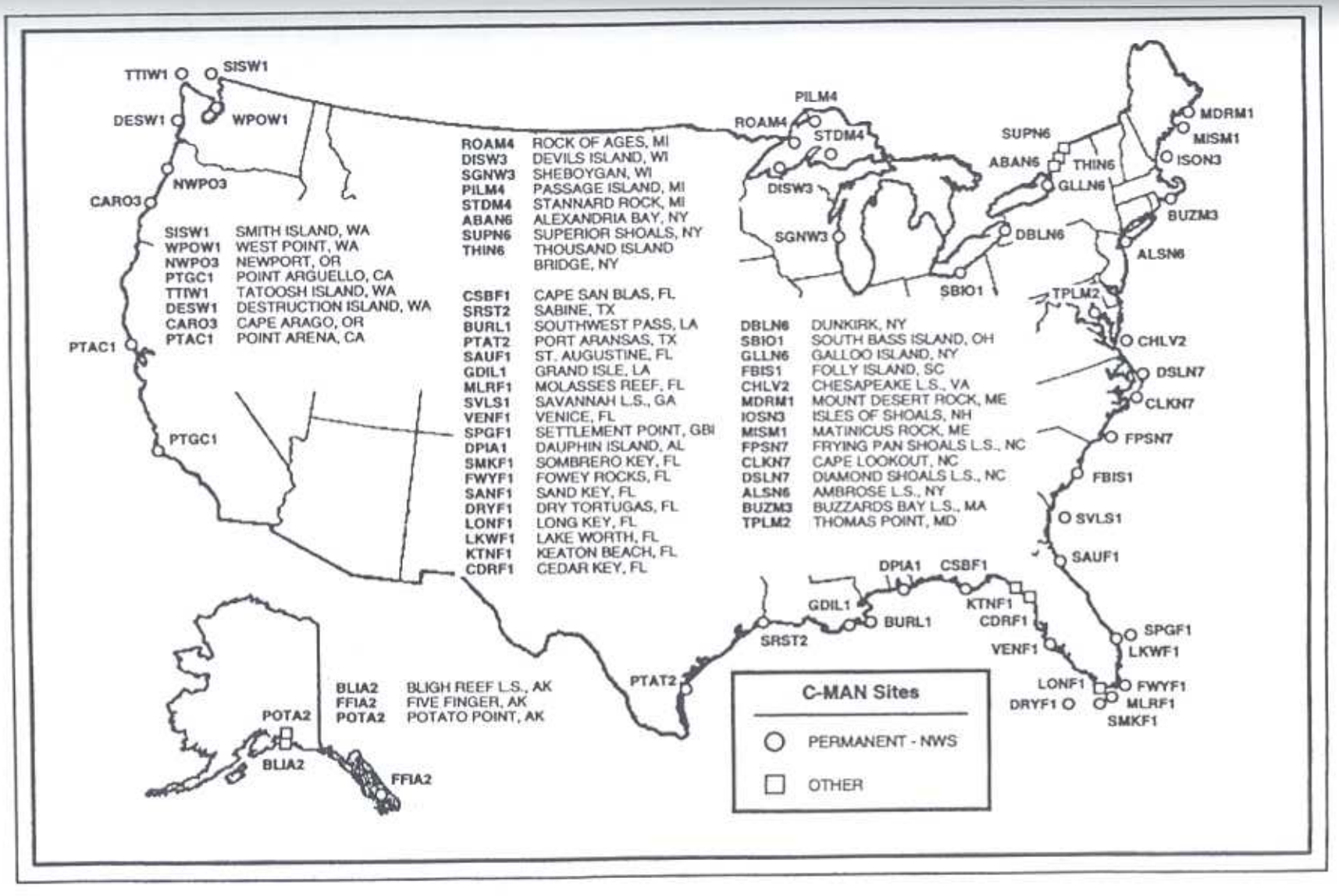

Figure 8-3. C-MAN station locations in the Coastal U.S.

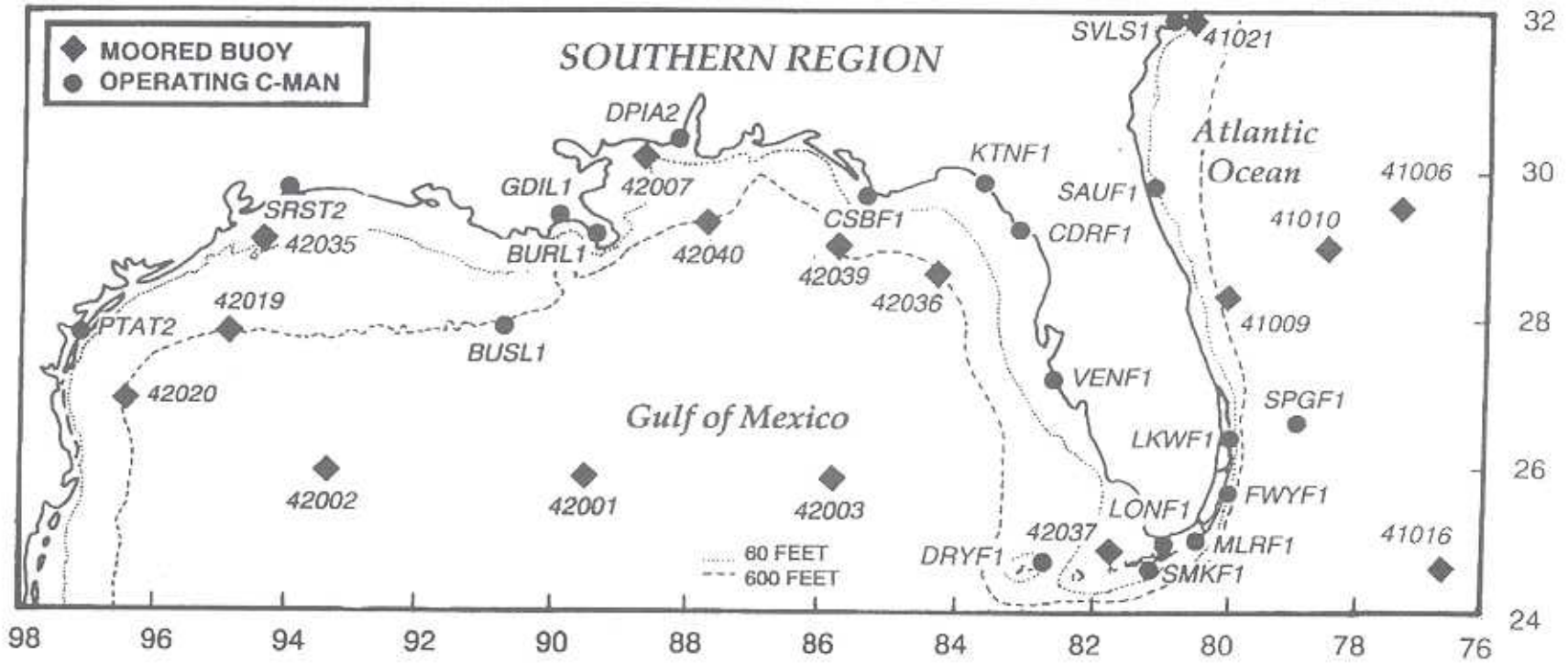

Figure 8-4. NDBC planned and current Gulf of Mexico moored buoy network

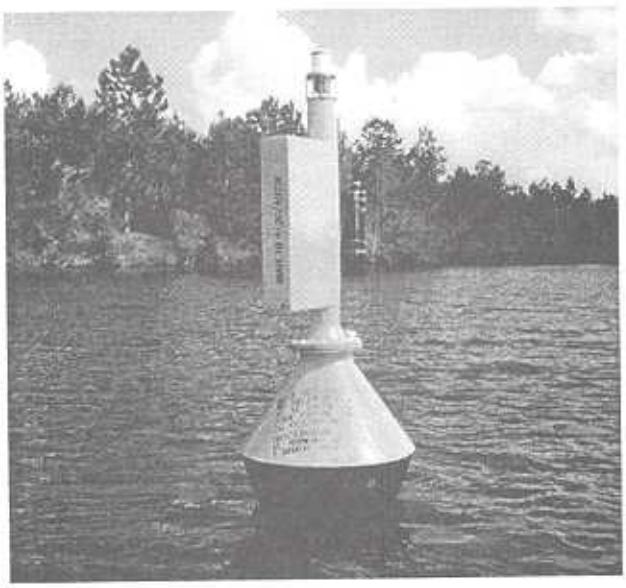

Figure 8-5. A Wind Speed and Direction (WSD) drifting buoy

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 8-6.

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 BUOY 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.

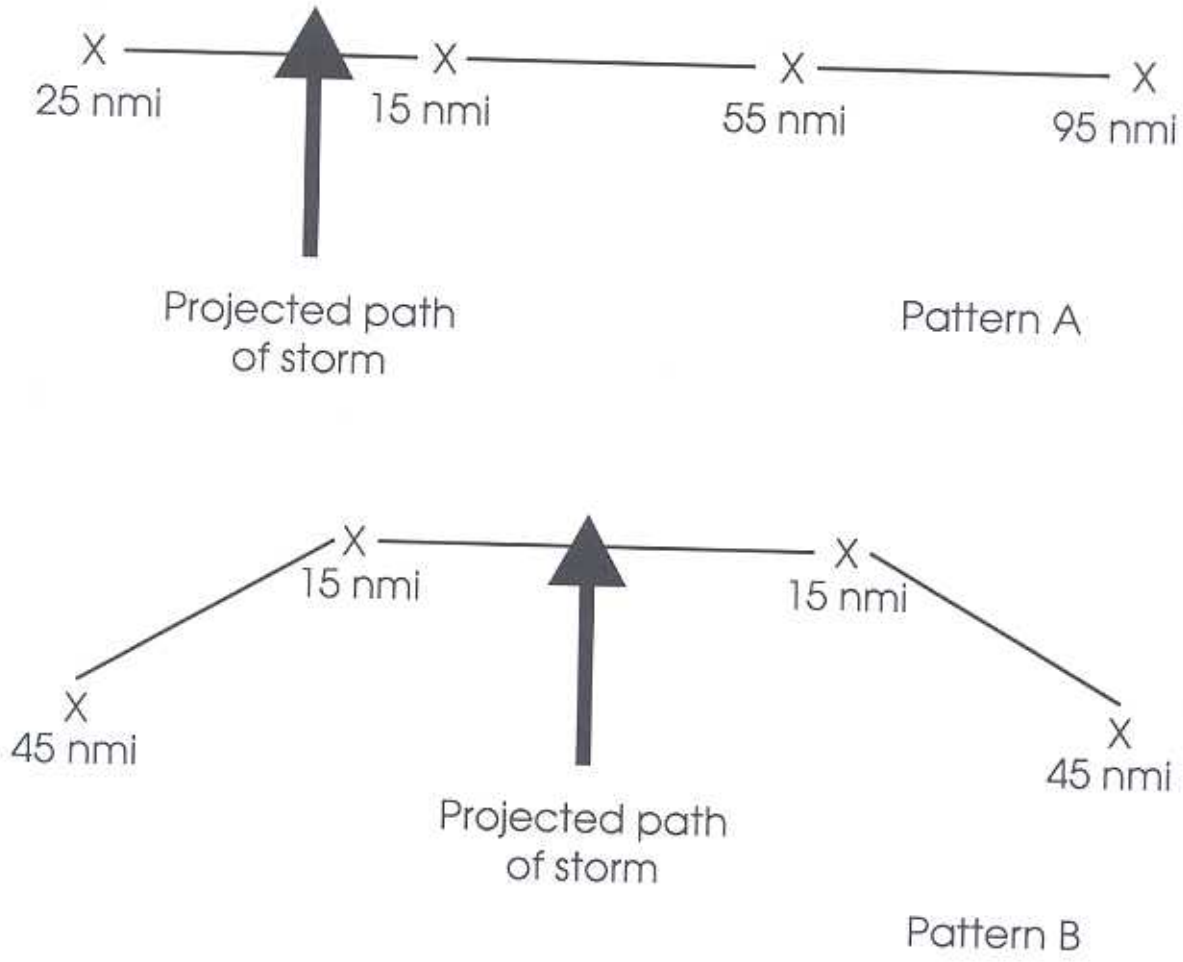

Figure 8-6. Drifting data buoy deployment patterns

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)

$M_iM_iM_jM_j$	$A_1b_wn_in_jn_k$	YYGGi_w	$99L_aL_aL_a$		$Q_cL_oL_oL_oL_o$	
i_ri_r///	/ddff	$1s_nTTT$	$(2s_nT_dT_dT_d)$	4PPPP	5appp	9GGgg
22200	$Qs_nT_wT_wT_w$	$1P_{ww}P_{ww}H_{ww}H_{ww}$	70 $H_{ww}H_{ww}H_{ww}$	$8s_wT_bT_bT_b$		
333	912ff	(00fff)				
555	11fff	22fff	(3GGgg	$4ddf_mf_m$)		
$(6G_cG_cg_cg_c$	$d_1d_1d_1f_1f_1f_1$ $d_6d_6d_6f_6f_6f_6$)	$d_2d_2d_2f_2f_2f_2$	$d_3d_3d_3f_3f_3f_3$	$d_4d_4d_4f_4f_4f_4$	$d_5d_5d_5f_5f_5f_5$	

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

CMAN YYGGi_w

XXXXn_i	i_Ri_xhVV Nddff	(00fff) $1s_nTTT$	$2s_nT_dT_dT_d$	4PPPP	5appp	$6RRRt_R$ 9GGgg
222//	$0s_nT_wT_wT_w$	$1_{ww}P_{ww}P_{ww}H_{ww}H_{ww}$	$70H_{ww}H_{ww}H_{ww}$			
333	912ff	(00fff)				
444	$1P_{av}P_{av}P_{av}$/					
555	11fff	22fff	(3GGgg)	$(4ddf_mf_mf_m)$		
$(6G_cG_cg_cg_c$	$d_1d_1d_1f_1f_1f_1$ $d_6d_6d_6f_6f_6f_6$)	$d_2d_2d_2f_2f_2f_2$ (TIDE1111)	$d_3d_3d_3f_3f_3f_3$	$d_4d_4d_4f_4f_4f_4$	$d_5d_5d_5f_5f_5f_5$	

CODE FORM FM 18 BUOY
REPORT OF A DRIFTING BUOY OBSERVATION

Section 0:	ZZYY $Q_c L_a L_a L_a L_a L_a$	$A_1 b_w n_b n_b n_b$ $L_0 L_0 L_0 L_0 L_0 L_0$		YYMMJ (6QQ$_L$//)	GGggi$_w$
Section 1:	111$Q_d Q_x$	Oddff ((2$s_n T_d T_d T_d$) (3$P_o P_o P_o P_o$)	or	(1s_nTTT) (29UUU)) (4PPPP)	(5appp)
Section 2:	222$Q_c Q_x$	(0$S_n T_w T_w T_w$) (20$P_{ww} P_{ww} P_{ww}$)		(1$P_{ww} P_{ww} H_{ww} H_{ww}$) (21$H_{ww} H_{ww} H_{ww}$)	
Section 3:	333$Q_{d1} Q_{d2}$ 8887k_2 66$k_6$9k_3	(2$z_0 z_0 z_0 z_0$) (2$z_n z_n z_n z_n$) (2$z_0 z_0 z_0 z_0$) (2$z_n z_n z_n z_n$)		(3$T_0 T_0 T_0 T_0$ (3$T_n T_n T_n T_n$) ($d_0 d_0 c_0 c_0 c_0$) ($d_n d_n c_n c_n c_n$)	(4$S_0 S_0 S_0 S_0$) (4$S_n S_n S_n S_n$)
Section 4:	444	(1$Q_p Q_2 Q_{tw} Q_4$)		(2$Q_n Q_L$ //)	
	(($Q_c L_a L_a L_a L_a L_a$	$L_0 L_0 L_0 L_0 L_0 L_0$)	or	(YYMMJ GGgg/))	
	(7$V_B V_B d_B d_B$)	(8$V_i V_i V_i V_i$)		(9$i_d Z_d Z_d Z_d Z_d$)	

CHAPTER 9

MARINE WEATHER BROADCASTS

9.1. **General.** The United States Coast Guard (USCG), under 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 USCG 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 USCG 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).

9.3 **Internet Access.** Further information concerning these broadcasts can be found on the Coast Guard's World Wide Web Internet Site at http://www.navcen.uscg.mil/marcomms/marcomms.htm

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. News Media Releases. 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. Distribution. 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

- Director, NOAA Aircraft Operations Center
  P.O. Box 6829
  MacDill AFB, FL 33608-0829

- Federal Coordinator for Meteorology
  Suite 1500, 8455 Colesville Road
  Silver Spring, MD 20910

APPENDIX A

ABBREVIATIONS

-A-

AB	Data type header for Tropical Weather Outlook
ADWS	Automated Digital Weather Switch
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 Telecommunications Network
AIM	Airman's Information Manual
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	Continental 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 Meteorological 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)
HPC	Hydrometeorological Prediction (NCEP)
HRD	Hurricane Research Division (NOAA/OAR/ERL/AOML)
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
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
MPC	Marine Prediction Center (NCEP)

mph	mile/miles per hour
MVMT	movement

-N-

NASA	National Aeronautics and Space Administration
NAVLANTMETOCCEN	Naval Atlantic Meteorology and Oceanography Center
NAVLANTMETOC DET	Naval Atlantic Meteorology and Oceanography Detachment
NAVLANTMETOCFAC	Naval Atlantic Meteorology and Oceanography Facility
NAVMETOCCOM	Naval Meteorology and Oceanography Command
NAVPACMETOCCEN	Naval Pacific Meteorology and Oceanography Center
NAVTRAMETOCFAC	Naval Training Meteorology and Oceanography Facility
NCEP	National Center for Environmental Prediction (NOAA/NWS)
NCO	NCEP Central Operations
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
nmi	nautical miles
NOAA	National Oceanic and Atmospheric Administration
NSC	NOAA Science 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 Meteorological 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 Confidence 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
SPC	Storm Prediction Center (NCEP)
SVD	Supplementary Vortex Data

-T-

TAFB	Tropical Analysis Forecast Branch (TPC)
TCA	Terminal Control Area
TCD	Tropical Cyclone 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
TPC	Tropical Prediction Center
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 buoy)
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 (ARSA). 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 Airman's Information Manual (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 longitude 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 (1-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, Hawaii

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 hours 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 hours.

-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 (PCA). 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 Surveillance (formerly 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 motion and intensity.

-T-

Terminal Control Area (TCA). 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-hour period.

Tropical Depression. A tropical cyclone in which the maximum sustained surface wind speed (1-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 hours 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 (1-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 hours 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 hours. 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 contro 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, Federal Aviation Administration (FAA) and NOAA, dated February 16, 1996; 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.

NWS, Melbourne, FL (W/SR49)	1
NWS, Eureka, CA	1
NOAA Budget Officer, Office of Management and Budget	1

DEPARTMENT OF DEFENSE

OFFICE OF THE JOINT CHIEFS OF STAFF

Joint Staff/J33/JOD and JRC	2

UNIFIED/SPECIFIED COMMANDS

USACOM/J335	1
USCENTCOM/J3-W	1
USCINCEUR/J3-OD-WE	1
USFORSCOM/FCJ2-WE	1
USCINCPAC/J316 (ENV.GP)	1
USCINCSO/SCJ3-SWO	1
USTRANSCOM/TCJ3/J4-OW	1
USSOCOM/SOJ3-W	1

DEPARTMENT OF THE AIR FORCE

HQ USAF/XOW	3
HQ ACC/DOW	34
HQ AFMC/DOW	2
HQ AFSPC/DOW	5
HQ AFSOC/DOW	1
HQ AMC/DOW	10
HQ ANGRC/DOSW	48
HQ AOC/XPPD	1
HQ AETC/TTO	2
HQ AETC/DOTW	10
HQ AU/WE	1
HQ AWS/XO	2
HQ AWS/TECH LIBRARY	1
HQ PACAF/DOW	6
HQ USSTRATCOM/J-3615	2
HQ USAFE/DOOW	2
AFGWC/DO	4
AFGWC/SYFV	1
15 OSS/OSW	1
45 SPW/XP and SE	4
45 WS/CC	3
78 OSS/OSW	1

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_i

0 0NM	5 50NM
1 10NM	6 60-80NM
2 20NM	7 80-100NM
3 30NM	8 100-150NM
4 40NM	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 $GGggi_d$ $YQL_aL_aL_a$ $L_oL_oL_oBf_c$ $h_ah_ah_ad_td_a$

ddfff TTT_dT_dw /jHHH

SECTION TWO (ADDITIONAL)

$1k_nN_sN_sN_s$ $Ch_sh_sH_tH_t$ 4ddff

$6W_sS_sW_dd_w$ $7I_rI_tS_bS_e$ $7h_ih_iH_iH_i$ $8d_rd_rS_rO_e$

$8E_wE_ic_ei_e$ $9V_iT_wT_wT_w$

SECTION THREE (INTERMEDIATE)

9XXX9 $GGggi_d$ $YQL_aL_aL_a$ $L_oL_oL_oBf_c$ $h_ah_ah_ad_td_a$

ddfff TTT_dT_dw /jHHH

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 17 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

1 Atch
Distribution List

FEDERAL AVIATION ADMINISTRATION (FAA)
UNITED STATES AIR FORCE RESERVE (AFRES)
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION (NOAA)

LETTER OF AGREEMENT

EFFECTIVE:

SUBJECT: METEOROLOGICAL RECONNAISSANCE FLIGHTS

1. PURPOSE: Establishes procedures to be used by the 53rd Weather Reconnaissance Squadron (53 WRS), the NOAA Aircraft Operations Center (AOC), 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 for 5 years from the date of the last signature heron, unless expressly canceled by one of the participating agencies with 30 days' notification.

3. REFERENCES:

a. National Hurricane Operations Plan (NHOP)

b. National Winter Storm Operations 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 53 WRS and AOC 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 53 WRS and AOC are 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 53 WRS or AOC and are routed through other than Aeronautical Radio (ARINC). Aircraft conducting weather reconnaissance flights in support of the NHOP and the NWSOP may communicate directly with the FAA via Satellite Communications (SATCOM) when practicable.

6. PROCEDURES:

a. The 53 WRS Current Operations (53 WRS/DOO) or the AOC Flight Operations Division, as appropriate, will contact the FAA Central Altitude Reservation Function (CARF) 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 53rd WRS, AOC and CARF.

b. CARF will process the ALTRV APREQ, accomplishing coordination with impacted facilities. The 53rd WRS and AOC shall coordinate with scheduling/using agencies to transit Special Use Airspace (restricted, warning, etc.) along their route of flight.

c. The 53 WRS/DOO and the AOC Flight Operations Division will contact the Air Traffic Control System Command Center (ATCSCC) as soon as possible prior to an NHOP mission and provide information specified in the NHOP in the paragraph entitled "Prior Coordination." The ATCSCC will then coordinate this information with all FAA facilities impacted.

d. The 53 WRS shall only use the call sign "TEAL," and AOC shall only use the call sign "NOAA," 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 53 WRS, AOC (if and when AOC is tasked to fly NWSOP missions) and CARF. These tracks shall be reviewed annually, no later than June 1.

f. During NHOP and 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. Weather instrument release at FLANN."

g. During NHOP and NWSOP missions, commencing 5 minutes prior to release of dropsondes from FL 190 or higher, 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 53 WRS and AOC flights are unable to contact ATC to request an en route clearance, a clearance request may be relayed through the Chief, Aerial Reconnaissance

Coordination, 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.

28 Sep 95

United States Air Force Reserve
Director of Operations

10/15/95

National Oceanic & Atmospheric Administration
Director, NOAA Corps Operations

2/16/96

Federal Aviation Administration
Director of Air Traffic

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

1 Atch
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APPENDIX D

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Director, NWS Southern Region (W/SR)	56
Director, NWS Western Region (W/WR)	15
Director, NWS Pacific Region (W/PR)	15
WFSO, Boston, MA (W/ER09)	5
WFSO, Coral Gables, FL (W/SR53A)	1
WFSO, San Juan, PR	5
WSO, Buffalo, NY	1

325 OSS/OSW	1
416 OSS/DOW	1
3246 TW/WS	2
3395 TCHTG/TTKO	2
Phillips Laboratory/GPAS	1
SM-ALC/LHFBB	2
Det 13, 1st Weather Group	2

AFRES

HQ USAF/REO	3
HQ AFRES/DOO	2
403 AW/DO	3
53 WRS	75
CARCAH (OL-A 53 WRS)	10

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CINCPACFLT (N3WX)	1
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Air Traffic Operations ATO-110	1
Air Traffic Operations ATO-130	3
Air Traffic Control System Command Center (ATCSCC) ATO-200	9
Air Traffic System Effectiveness ATH-1	2
FAA Regional Air Traffic Division Managers	
ACE-500 Kansas City	1
AEA-500 New York	1
AGL-500 Chicago	1
ANE-500 Boston	1
ANM-500 Seattle	1
ASO-500 Atlanta	1
ASW-500 Dallas/Fort Worth	1
AWP-500 Los Angeles	1
Albuquerque ARTCC	2
Atlanta ARTCC	3
Boston ARTCC	6
Honolulu ARTCC	3
Jacksonville ARTCC	4
Memphis ARTCC	1
Miami ARTCC	2
San Juan ARTCC	3
Washington ARTCC	2
AAC-932 Oklahoma City, OK	1
AIA-101	3
ALM-400	1
AOP-4	1
APA-200	3
ATH-150	1
ATR-200	1
Houston AIFSS	3
Miami (QAS) AIFSS	2
New York AIFSS	1

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Commandant, USCG Headquarters (G-NIO)	2
Commandant, USCG (FLAGPLOT)	1
Commander, Atlantic Area, USCG	2
Commander, Pacific Area, USCG	2

Commander, Maintenance and Logistics Command Atlantic	2
Commander, Maintenance and Logistics Command Pacific	1
Commander, First Coast Guard District	1
Commander, Fifth Coast Guard District	2
Commander, (RE) Seventh Coast Guard District	3
Commander, Eighth Coast Guard District	3
Commander, Eleventh Coast Guard District	1
Commander, Fourteenth Coast Guard District	2
Commanding Officer, USCG Air Station, Barbers Point, HI	1
Commanding Officer, USCG Air Station, Floyd Bennett Field, Brooklyn, NY	1
Commanding Officer, USCG Air Station, Clearwater, FL	1
Commanding Officer, USCG Air Station, Corpus Christi, TX	1
Commanding Officer, USCG Air Station, Elizabeth City, NC	1
Commanding Officer, USCG Air Station, Kodiak, AK	1
Commanding Officer, USCG Air Station, McClellan AFB, CA	1
Commanding Officer, USCG Air Station, New Orleans, LA	1
Commanding Officer, USCG Air Station, Opa Locka, FL	1
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World Agriculture Outlook Board	1

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DEPARTMENT OF STATE

Office of Advanced Technology	1

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Director, Atmospheric Sciences Division	1

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FRC Region I	1

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Congressional Research Service, Library of Congress	1
University of Chicago Library, The Joseph Regenstein Library	1
South Florida Water Management District	1
Natural Hazards Research and Applications Information Center	1
Department of Atmospheric Sciences, Colorado State University	1
Cumberland County Maine Emergency Management Agency	1
Meteorological Services, Inc., Tampa, FL	1
GTE Government Systems	3
Larkin Associates	1
Nash C. Roberts, Jr. Consultants, New Orleans, LA	1
	1

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Meteorological Operations Division, Canadian Meteorological Centre (AES), Dorval, QU	1
Officer in Charge, METOC Centre, Maritime Command Headquarters, Halifax, NS	1
Base Meteorological Officer, CFB Greenwood, NS	1
Maritime Weather Centre (AES), Bedford NS	1
Atmospheric Environment Service, Downsview, ON	1
Transport Canada, Altitude Reservation Unit	2
Transport Canada, Monkton ACC	2

UNITED KINGDOM

Assistant Director, Head of Defense Services, Meteorological Office	1

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.

---

[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 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.

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
Antilles	an-TILL-leez
Aruba	ah-ROO-ba
Azores	uh-ZOHRZ
Bahamas	ba-HAHM-ahs
Barahona	ba-ra-HO-na
Barbuda	bar-BOO-dah
Barranquilla	bahr-rahn-KEE-yah
Basse-Terre	baha-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-tree
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-FRAHCS
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
Mayaguez	may-yah-GWAYS
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, HDOB, AND TEMP DROP CODES, TABLES AND REGULATIONS

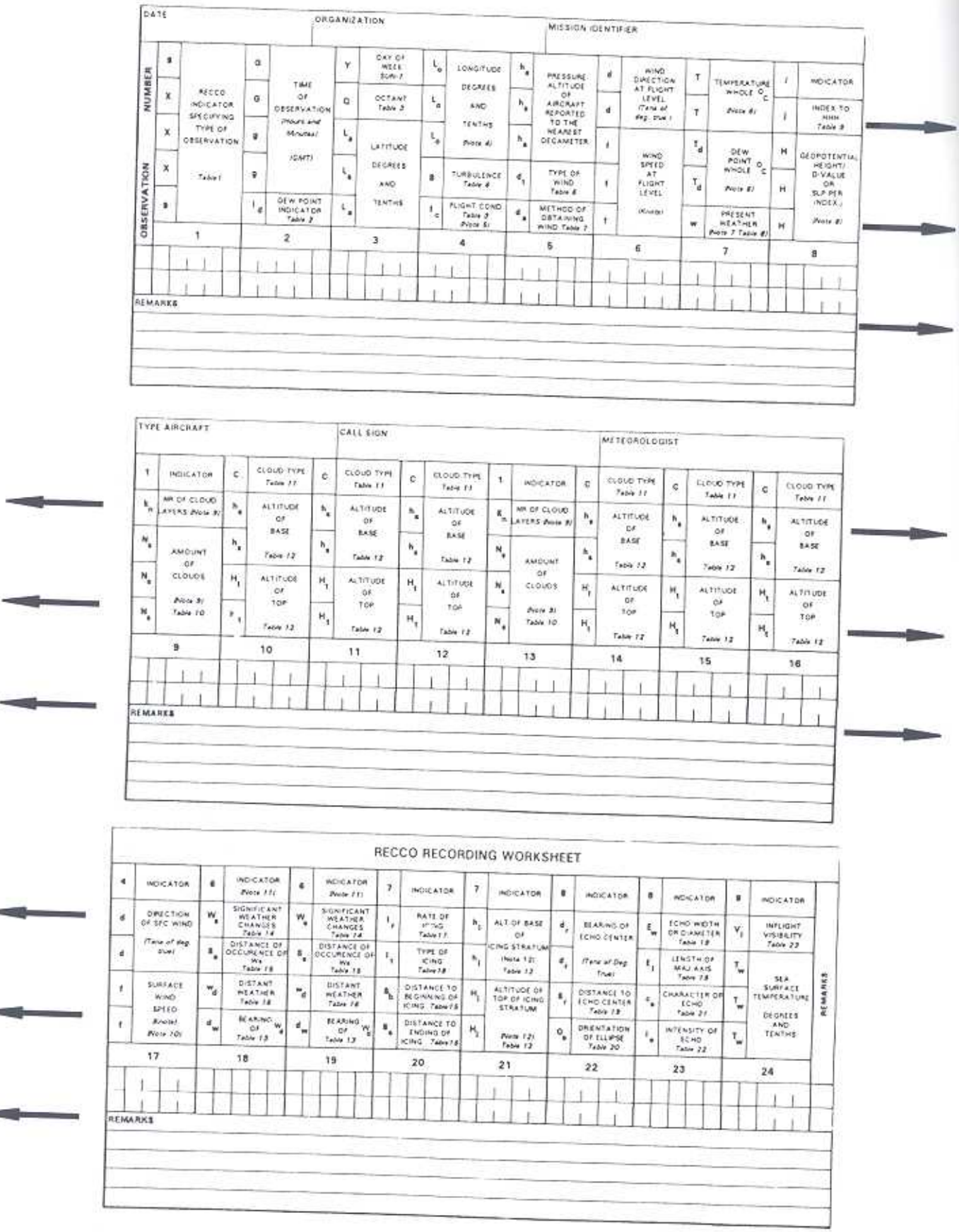

Figure G-1. Reconnaissance code recording form

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 capability

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° W - 180°	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
1 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 (continuous or intermittent precip - from stratiform 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 i

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 Altitude 925 mb surface in geopotential meters
/ 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 Stratocumulus (Sc)
7 Stratus (St)
8 Cumulus (Cu)
9 Cumulonimbus (Cb)
/ Cloud type unknown due to darkness or other analogous phenomena

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

00 Less than 100
01 100 ft
02 200 ft
03 300 ft
etc, etc
49 4,900 ft
50 5,000 ft
51-55 Not used
56 6,000 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	5	SW
1	NE	6	W
2	E	7	NW
3	SE	8	N
4	S	9	all directions

TABLE 14 W_s

0 No change
1 Marked wind shift
2 Beginning or ending or 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-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 KNHC, OBS 09 and 10 to KBIX."

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 encoded as 02, the distinction between -52°C and 2°C being made from i_d. Missing or 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 NEG 52°C".

7. When two or more types of w co-exist, the type with the higher code figure will be reported. Code Figure 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 /, 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 //.

HDOB messages are created automatically by IWRS. Each HDOB consists of 20 lines of HD/HA data. Each HD/HA data line is composed of 30 second averages for each parameter reported, except max wind which is a 10 second average. The highest max wind recorded during the encoding interval is used in the HDOB.

The encoding interval of the HD/HA data lines in the HDOB message is operator adjustable to 30 seconds, 1 minute or 2 minutes. A 30 second encoding interval encodes every HD/HA data line and creates an HDOB every 10 minutes. A 1 minute interval encodes every other HD/HA data line and generates an HDOB every 20 minutes. Likewise, a 2 minute interval encodes every fourth HD/HA data line and generates an HDOB every 40 minutes. Regardless of the encoding interval selected, the highest max wind value since the previous encoded HD/HA data line will be reported in the observation. Samples of each type message is shown below. Each complete message would have 20 data lines.

```
SXXX50 KNHC 040952
AF967 1017A OPAL HDOB 39 KNHC
 0942. 2643N 08846W 03036 5374 127 106 140 136 112 02680 0000000000
 0943  2641N 08847W 03036 5442 116 116 136 136 120 02612 0000000000
 0943. 2640N 08849W 03065 5521 100 087 140 140 099 02561 0000000000
 0944  2638N 08850W 03028 5591 087 059 186 160 074 02454 0000000000
 0944. 2637N 08850W 03053 5630 097 028 202 158 036 02440 0000000000
 0945  2635N 08850W 03059 5647 197 009 218 148 018 02429 0000000000
                              .
                              .
                              .
```

30 second data interval

```
SXXX50 KNHC 040952
AF967 1017A OPAL HDOB 39 KNHC
 0942  2644N 08844W 03039 5333 135 094 138 136 096 02724 0000000000
 0943  2641N 08847W 03036 5442 116 116 136 136 120 02612 0000000000
 0944  2638N 08850W 03028 5591 087 059 186 160 099 02454 0000000000
 0945  2635N 08850W 03059 5647 197 009 218 148 036 02429 0000000000
 0946  2632N 08849W 03028 5632 274 052 226 148 067 02413 0000000000
 0947  2628N 08849W 03057 5488 271 118 194 130 124 02587 0000000000
                              .
                              .
                              .
```

one minute data interval

```
SXXX50 KNHC 040952
AF967 1017A OPAL HDOB 39 KNHC
 0942  2644N 08844W 03039 5333 135 094 138 136 096 02724 0000000000
 0944  2638N 08850W 03028 5591 087 059 186 160 120 02454 0000000000
 0946  2632N 08849W 03028 5632 274 052 226 148 067 02413 0000000000
 0948  2625N 08849W 03050 5378 263 113 172 140 124 02690 0000000000
 0950  2620N 08849W 03047 5268 259 094 142 134 109 02797 0000000000
 0952  2614N 08849W 03044 5217 262 075 162 108 090 02845 0000000000
                              .
                              .
                              .
```

two minute data interval

Figure G-2. Sample HDOB messages

Table G-3. HDOB message format

HHMM$L_aL_a$mmH $L_oL_oL_o$mmH PPPPP DDDD WWW SSS TTT ddd MMM RRRRR FFFFFFFFFF

HHMM:	The time of observation in hours and minutes (UTC). A period following HHMM indicates a data time of 30 seconds past the minute.
$L_aL_a$mmH:	The latitude of the observation in degrees, minutes and hemisphere (N or S).
$L_oL_oL_o$mmH:	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/HDOB 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

EXTRACT FROM: WMO-No. 306 MANUAL ON CODES
FM 37-IX Ext. TEMP DROP - Upper-level pressure, temperature, humidity and wind report from a sonde released by carrier balloons or aircraft.

CODE FORM:

PART A

SECTION 1 $M_iM_iM_jM_j$ $YYGGI_d$ $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ $MMMU_{La}U_{Lo}$

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 $88P_tP_tP_t$ $T_tT_tT_{at}D_tD_t$ $d_td_tf_tf_tf_t$
or
88999

SECTION 4 $77P_mP_mP_m$ $d_md_mf_mf_mf_m$ $(4v_bv_bv_av_a)$
or
$66P_mP_mP_m$ $d_md_mf_mf_mf_m$ $(4v_bv_bv_av_a)$
or
77999

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). When wind data are included 50 is added to YY.

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

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

99 Indicator for data on position follow.

$L_aL_aL_a$ 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.

$L_oL_oL_oL_o$ 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.

SECTION 2 - SURFACE AND STANDARD ISOBARIC SURFACES

99 Indicator for data for the surface level follow.

$P_oP_oP_o$ Pressure of specified levels in whole millibars, thousands digits omitted. ($P_oP_oP_o$ is always surface level.)

P_1P_1
P_nP_n Pressure of standard isobaric surfaces in units of tens of millibars. (1000mbs = 00, 925mbs = 92, 850mbs = 85, 700mbs = 70, etc.)

$h_1h_1h_1$
$h_nh_nh_n$ Height of the standard pressure level in geopotential meters or decameters above the surface. Encoded in meters up to but not including 500mbs. Encoded in decameters at and above 500mbs omitting, if necessary, the thousands or tens of thousands digits. Add 500to hhh for negative 1000mb heights. Report 1000mb groups as 00/// ///// when surface pressure is less than 950mbs.

T_oT_o
T_1T_1
T_nT_n Tens and units digit of air temperature (not rounded off) in degrees Celsius, at specified levels beginning with surface.

T_{ao}
T_{a1}
T_{an} Approximate tenths value and sign (plus or minus) of the air temperature. Even = plus; Odd = minus.

D_oD_o
D_1D_1
D_nD_n Dewpoint depression (with respect to water) at standard isobaric surfaces beginning with surface level. When the depression is 4.9C or less encode the units and tenths digits of the depression. Encode depressions of 5.0C through 5.4C as 50. Encode depressions of 5.5C through 5.9C as 56. Dewpoint depressions of 6.0C and above are encoded in tens and units with 50 added. Dewpoint depressions for relative humidities less than 20% are encoded as 80. When air temperature is below -40C report D_nD_n as two solidi.

d_od_o
d_1d_1
d_nd_n True direction from which wind is blowing rounded to nearest 5 degrees. Report hundreds and tens digits. The unit digit (0 or 5) is added to the hundreds digit of wind speed.

$f_of_of_o$
$f_1f_1f_1$
$f_nf_nf_n$ Wind speed in knots. Hundreds digit is sum of hundreds digit of speed and unit digit of direction, i.e. 295° at 125 kts encoded as 29625.

NOTE: 1. When flight level is just above a standard surface and in the operator's best meteorological judgement, the winds are representative of the winds at the standard surface, then the operator may encode the standard surface winds using the data from flight level. If the winds are not representative, then encode /////.

2. The wind group relating to the surface level ($d_od_of_of_of_o$) will be included in the report; when the corresponding wind data are not available, the group will be encoded/////.

SECTION 3 - DATA FOR TROPOPAUSE LEVELS

88 Indicator for data for tropopause level(s) follow.

$P_tP_tP_t$ 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 Dew point depression at the tropopause level.

d_td_t True direction at the tropopause level rounded to nearest 5 degrees. Report hundreds and tens digits. The unit digit (0 or 5) is added to the hundreds digit of wind speed.

$f_tf_tf_t$ Wind speed in knots. Hundreds digit is sum of hundreds digit of speed and unit digit of direction, i.e. 295° at 125 kts encoded as 29625.

88999 Indicator that tropopause data have not been observed.

SECTION 4 - MAXIMUM WIND DATA

66 Indicator that data for maximum wind level and for vertical wind shear follow when max wind occurs at flight level.

77 Indicator that data for maximum wind level and for vertical wind shear follow when max wind level does not coincide with flight level.

$P_mP_mP_m$ Pressure at maximum wind level in whole milibars.

d_md_m True direction from which wind is blowing at the maximum wind level rounded to nearest 5 degrees. Report hundreds and tens digits. The unit digit (0 or 5) is added to the hundreds digit of wind speed.

$f_mf_mf_m$ Wind speed in knots. Hundreds digit is sum of hundreds digit of speed and unit digit of direction, i.e. 295° at 125 kts encoded as 29625.

4 Data for vertical wind sheer follow.

v_bv_b Absolute value of vector difference between max wind and the wind 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".

v_av_a Absolute value of vector difference between max wind and the wind 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".

CODE FORM:

PART B

SECTION 1 $M_iM_iM_jM_j$ YYGG/ $99L_aL_aL_a$ $Q_cL_oL_oL_o$ $MMMU_{La}U_{Lo}$

SECTION 5 $n_on_oP_oP_oP_o$ $T_oT_oT_{ao}D_oD_o$

$n_1n_1P_1P_1P_1$ $T_1T_1T_{a1}D_1D_1$

$n_nn_nP_nP_nP_n$ $T_nT_nT_{an}D_nD_n$

SECTION 6 21212 $n_on_oP_oP_oP_o$ $d_od_of_of_of_o$

$n_1n_1P_1P_1P_1$ $d_1d_1f_1f_1f_1$

$n_nn_nP_nP_nP_n$ $d_nd_nf_nf_nf_n$

SECTION 9 51515 $101A_{df}$ A_{df} or

$101A_{df}$ A_{df} $0P_nP_nP'_nP'_n$. or

$101A_{df}$ A_{df} $P_nP_nh_nh_nh_n$

NOTE: Code groups to be developed regionally.

PART B

SECTION - 1 IDENTIFICATION AND POSITION

M_iM_i Identification letters of the part of the report = BB.

/ Filler figure for last digit of YYGG group. No wind groups reported for any of the significant isobaric surfaces.

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

SECTION 5 - DATA FOR SIGNIFICANT TEMPERATURE AND RELATIVE HUMIDITY LEVELS

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

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

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

$101A_aA_a$ Specifications of regional additional data being reported

0 Group indicator

P_nP_n Pressure of specified levels in tens of millibars. (1007 mb = 01, 945 mb = 95, 726 mb = 73)

$P'_nP'_n$

$P_nP_nh_nh_nh_n$ Data reported in the same manner as in Part A - Section 2.

51515 Additional data in regional code follow.

10166 Geopotential data are doubtful between the following levels, $0P_nP_nP'_nP'_n$. 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 is doubtful, a 10166 is reported for the entire run.

10167 Temperature data are doubtful between the following levels: $0P_nP_nP'_nP'_n$. This code figure shall be reported when only temperature data are doubtful for a portion of the descent. If a 10167 group is reported a 10166 will also be reported. EXAMPLE: Temperature is doubtful from 540mbs to 510mbs. SLP is 1020mbs. The additional data groups would be: 51515 10166 00251 10167 05451.

10190 Extrapolated altitude data follows:

1. When the sounding begins within 25mbs 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. EXAMPLE: Assume the release was made from 310mbs and the 300mb height was 966 decameters. The last reported standard level in Part A is the 400mb level. The data for the 300mb level is reported in Part B as 10190 30966.

2. When the sounding does not reach surface, but terminates within 25mbs 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 $P_nP_nh_nh_nh_n$. EXAMPLE: Assume termination occurred at 980mbs and the extrapolated height of the 1000mb level was 115 meters. The 1000mb 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 850mbs and surface. Surface pressure is reported in Part A as $99P_oP_oP_o$ ///// and in Part B as $00P_oP_oP_o$ /////. 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 (NCEP, HPC)	Camp Springs, MD	C	COM 301-763-8201
AOC	Tampa Bay, FL		COM 813-828-3310
CPHC - Forecaster and Warning Desk - Admin - Dir/Coord - Operations	Honolulu, HI	C	COM 808-973-5284 COM 808-973-5270 COM 808-973-5272 FAX 808-973-5281
CPHC Satellite Coordinator	Honolulu, HI	C	COM 808-973-5285
NDBC - Data Systems Division	SSC, MS		COM 601-688-1720
NESDIS E/SP23	Camp Springs, MD	C	COM 301-763-8444
NHC	Miami, FL	BC	COM 305-229-4470
TAFB Lead Forecaster (TPC/NHC)	Miami, FL	BC	COM 305-229-4425
Hydrometeorological Prediction Center (HPC)	Camp Springs, MD	C	COM 301-763-8096
NCEP Senior Duty Met (Data QC)	Camp Springs, MD	C	COM 301-763-8298
NWS Hydrometeorological Services Core (Headquarters)	Silver Spring, MD		COM 301-713-1726 FAX 301-713-1598
	INTERDEPARTMENTAL		
OFCM	Silver Spring, MD		COM 301-427-2002 DSN 851-1460

[1] B AFMEDS
C AFOS

AGENCY	LOCATION	TTY	TELEPHONE	
AFGWC	Offutt AFB, NE	B	COM DSN	402-294-2586 271-2586
CARCAH OLA, 53 WRS	Miami, FL	BC	COM DSN	305-229-4474 434-3420
FACSFAC VACAPES OAC	Oceana, VA		COM DSN	804-433-1233 433-1233
15 OSS/OSW (Weather Monitor)	Hickam AFB, HI	B	COM DSN	808-449-1634/7638 315-449-1634/6262
325 OSS/OSW (Southeast Air Defense Sector/WE)	Tyndall AFB, FL	B	COM DSN	904-283-2845 523-2845
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		COM DSN FAX	671-349-5240/5302 315-349-5240/5302 671-344-6106
53 WRS/DO	Keesler AFB, MS	B	COM DSN	601-377-2409 597-2409
53 WRS (Office)	Keesler AFB, MS		COM DSN	601-377-3207 597-3207
53 WRS (Alternate CARCAH)	Keesler AFB, MS	B	COM DSN	601-377-1939 597-1939

DEPARTMENT OF TRANSPORTATION/FEDERAL AVIATION ADMINISTRATION

ARTCC PHONE DIRECTORY

	ARTCC ID	TMO	ADMINISTRATION	AREA MANAGER
ANCHORAGE	ZAN	907-269-1108	907-269-1137	907-269-1103
ALBUQUERQUE	ZAB	505-856-4590	505-856-4500	505-856-4500
CHICAGO	ZAU	708-906-8268	708-906-8220	708-906-8341
BOSTON	ZBW	603-886-7666	603-886-7675	603-886-7635
WASHINGTON	ZDC	703-771-3471	703-771-3440	703-771-3470
DENVER	ZDV	303-651-4246	303-651-4261	303-651-4248
FT. WORTH	ZFW	817-858-7537	817-858-7520	817-858-7503
HOUSTON	ZHU	713-230-5577	713-230-5540	713-230-5560
INDIANAPOLIS	ZID	317-247-2243	317-247-2222	317-247-2242
JACKSONVILLE	ZJX	904-549-1543	904-549-1578	904-549-1537
KANSAS CITY	ZKC	913-791-8505	913-791-8450	913-791-8500
LOS ANGELES	ZLA	805-265-8250	805-265-8200	805-265-8205
SALT LAKE CITY	ZLC	801-320-2581	801-320-2500	801-320-2560
MIAMI	ZMA	305-716-1540	305-716-1500	305-716-1588
MEMPHIS	ZME	901-368-8250	901-368-8103	901-368-8234
MINNEAPOLIS	ZMP	612-463-5116	612-463-5130	612-463-5180
NEW YORK	ZNY	516-468-1010	516-468-1001	516-468-1080
OAKLAND	ZOA	510-745-6332	510-745-6475	510-745-6331
CLEVELAND	ZOB	216-774-0228	216-774-0119	216-774-0226
SEATTLE	ZSE	206-351-3525	206-351-3500	206-351-3520
ATLANTA	ZTL	404-946-7697	404-946-7883	404-946-7622
HONOLULU	HNL	N/A	808-734-6667	
SAN JUAN	SJU		909-253-4567	
TORONTO	YYZ		800-837-3801	
MONTREAL	YUL		514-636-3289	
MONCTON	YOM		506-851-7381	
OTTAWA	YOW		613-954-7425	
WINNIPEG	YWG		203-983-8338	
EDMONTON	YEG		403-890-8397	
GANDER	YQX		709-256-6770	
VANCOUVER	YVR		604-666-6673	

Note:
TMO - Traffic Management Officer

Area Manager - Watch Supervisor

ARTCC - Air Route Traffic Control Center

AIR TRAFFIC OPERATIONS ATO-100	COM 202-267-9320
AIR TRAFFIC MANAGEMENT SERVICE AIR TRAFFIC CONTROL SYSTEM COMMAND CENTER - ATO 200	COM 703-904-4401 800-333-4286
HERNDON, VA. CENTRAL ALTITUDE RESERVATION FUNCTION (CARF)	703-904-4427 DSN 725-3331/725-3333
NATIONAL NOTAM CENTER WASHINGTON, D.C.	202-267-3390
ATCSCC NATIONAL OPERATIONS MANAGER (NOM)	703-904-4525/703-904-4953 800-333-4286 MILITARY USE ONLY

CANADIAN OFCF (ARU)

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

CENTER WEATHER SERVICE UNITS (CWSU) in FAA Coastal Facilities

Boston ARTCC	603-886-7698
New York ARTCC	516-468-1083
Washington ARTCC	703-771-3480
Jacksonville ARTCC	904-549-1839
Miami ARTCC	305-716-1635
Houston ARTCC	713-230-5676
Los Angeles ARTCC	805-265-8258
Oakland ARTCC	510-745-3457
Seattle ARTCC	206-351-3741
Anchorage ARTCC	907-269-1145

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