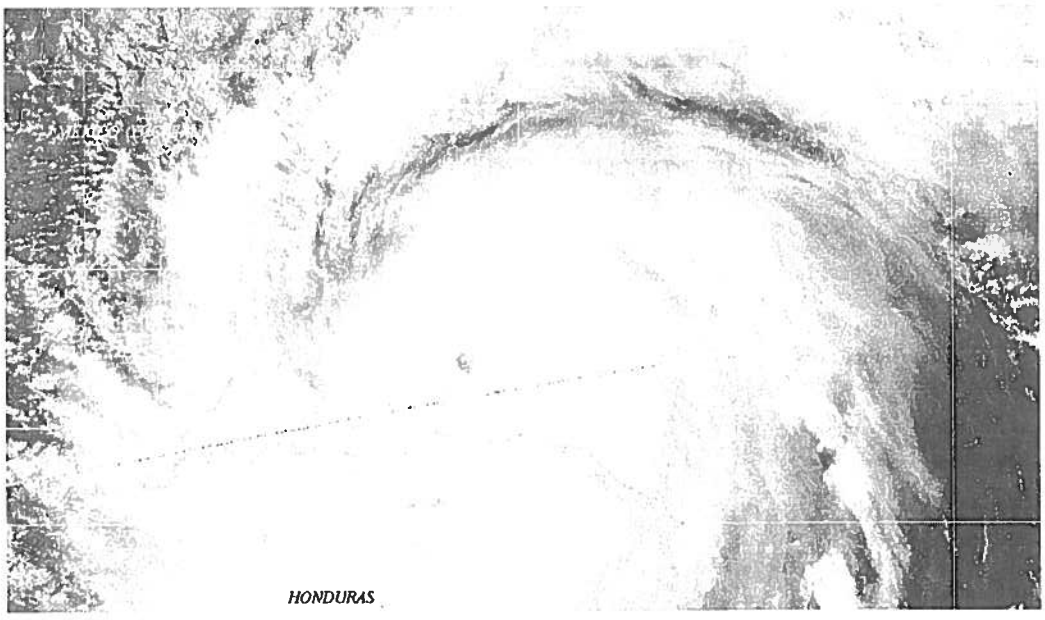
U.S. DEPARTMENT OF COMMERCE/ National Oceanic and Atmospheric Administration

OFCM

OFFICE OF THE FEDERAL COORDINATOR FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

National Hurricane Operations Plan

FCM-P12-1999



Hurricane Mitch - 27 October 1998

Washington, DC
May 1999

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FEDERAL COORDINATOR
FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

8455 Colesville Road, Suite 1500
Silver Spring, Maryland 20910

NATIONAL HURRICANE OPERATIONS PLAN

FCM-P12-1999

Washington, D.C.
May 1999

CHANGE AND REVIEW LOG

Use this page to record changes and notices of reviews.

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FOREWORD

The Interdepartmental Hurricane Conference (IHC) is sponsored annually by the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM) with the goal to bring together the cognizant Federal agencies to address and reach agreement on items of mutual interest and concern related to the provision of hurricane/tropical cyclone forecast and warning services. The procedures and agreements reached at the 53rd IHC, which was held in Biloxi, Mississippi, February 8-12, 1999, resulted in this publication--the 37th edition of the National Hurricane Operations Plan (NHOP).

All of the chapters in this edition have minor updates or changes. Of the 20 action items addressed at the 53rd IHC, 9 were closed through incorporation into the NHOP. The remaining 11 action items were non-NHOP related and are being staffed by Working Group for Hurricane and Winter Storm Operations and Research. One of the most significant is the inclusion of new dropwindsonde taskings. These taskings allow the Tropical Prediction Center/National Hurricane Center to request the deployment of an array of the new Global Positioning System (GPS)-based dropwindsondes to measure the maximum surface wind, as well as the extent of hurricane and tropical storm force winds. Chapter 5, *Aircraft Reconnaissance*, was updated to reflect the details of these eyewall and outer-wind field sampling modules. Chapter 6, *Satellite Reconnaissance*, and Chapter 8, *National Data Buoy Center Reporting Stations*, were also substantially updated.

The advent of the Internet has made possible the rapid, widespread dissemination of information to the general public. This capability has permitted academic institutions and other sources to disseminate storm-surge forecasts which may conflict with official National Weather Service (NWS) guidance. As a result, the following statement was strongly endorsed by the Federal agencies represented at the IHC:

> Because the NWS is the designated Federal agency responsible for producing and disseminating weather warnings and forecasts to the general public, the NWS should be the single Federal source of publicly disseminated storm-surge forecasts for the mainland United States, Puerto Rico and the U.S. Virgin Islands, Hawaii, Guam, American Samoa, and the Confederation of Northern Mariana Islands.

The active 1998 season, which included Hurricane Mitch, the fourth most intense hurricane ever observed in the Atlantic basin, tested the multiagency storm warning support system documented in the NHOP, and the system responded in an highly effective manner--a tribute to the dedication and cooperation of the civilian and military agencies involved.

SAMUEL P. WILLIAMSON
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 (NOAA) of the Department of Commerce (DOC) is responsible for providing forecasts and warnings for the Atlantic and Eastern and Central Pacific Oceans while the Department of Defense (DOD) provides the same services for the Western Pacific and Indian Ocean (see Figure 1-1). NOAA, along with other Federal agencies such as the U.S. Navy and the National Aeronautics and Space Administration (NASA), also conducts supporting research efforts to improve tropical cyclone warning services. The bottom line--this interdepartmental cooperation achieves economy and efficiency in the provision of the tropical cyclone warning services to the Nation. The *National Hurricane Operations Plan* provides the basis for implementing agreements reached at the Interdepartmental Hurricane Conference (IHC), which is sponsored annually by the Office of the Federal Coordinator for Meteorological Services and Supporting Research. The goal of the IHC is to bring together the responsible Federal agencies to achieve agreement on items of mutual concern related to tropical cyclone warning services for the Atlantic and Pacific Oceans.

1.2. Scope. The procedures and agreements contained herein apply to the Atlantic Ocean, Gulf of Mexico, Caribbean Sea, and the Pacific Ocean. The plan defines 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 NHOP practices and procedures. Please note that under the National Weather Service Modernization Plan, the former National Hurricane Center (NHC) was incorporated into the Tropical Prediction Center (TPC), one of the seven service-oriented centers and two central support activities that comprise the National Centers for Environmental Prediction (NCEP)--formerly the National Meteorological Center. The tropical cyclone warning mission still resides with the NHC (Hurricane Specialist Unit), which is a major component of the TPC. For completeness, the NHC will be referred to as TPC/NHC throughout the document.

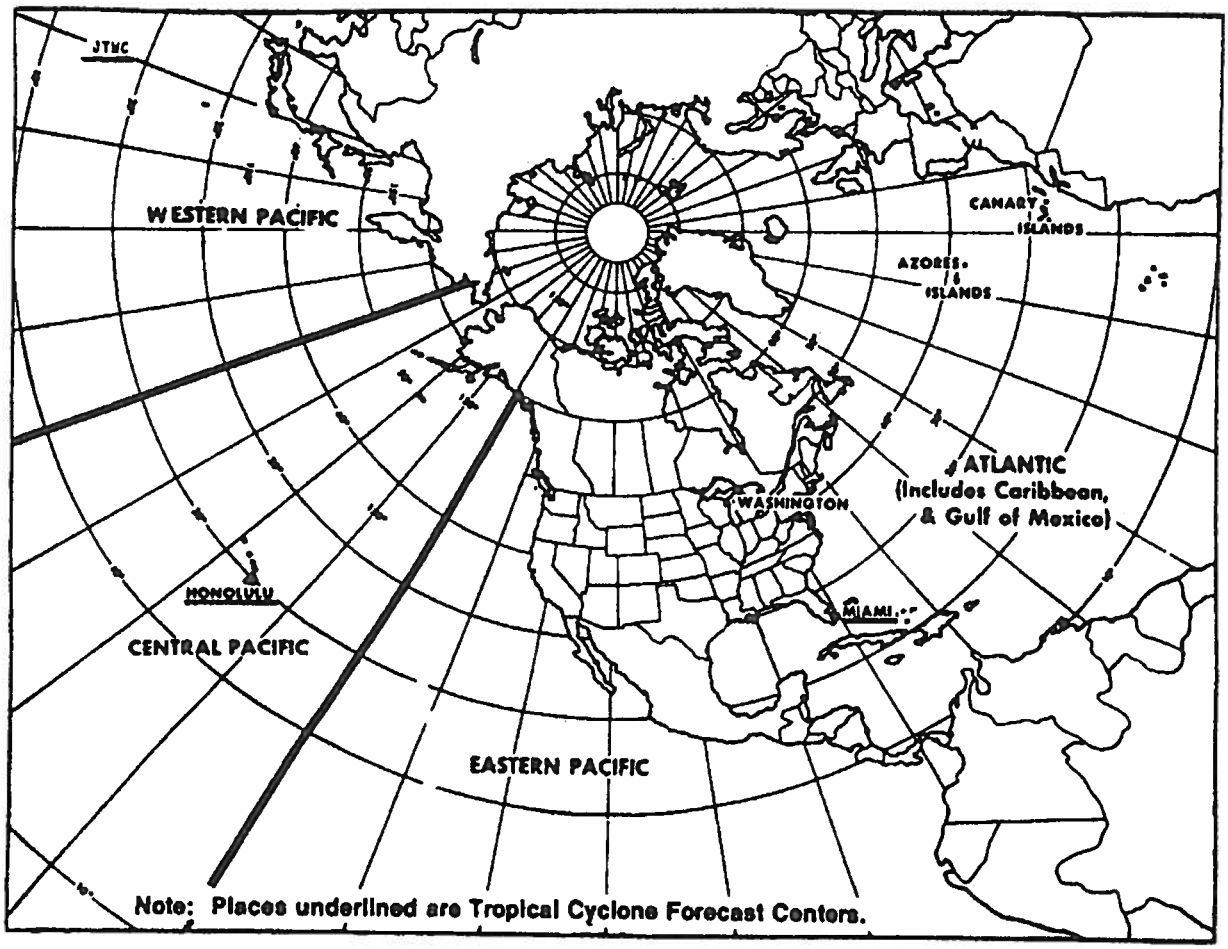

Figure 1-1. Tropical cyclone forecast centers' areas of responsibility

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 taken 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 the appropriate agencies, marine and aviation interests, and the general public.

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

- Consult, as necessary, with the DOD regarding their day-to-day requirements for forecast/advisory services and attempt to meet these requirements within the capabilities of the tropical cyclone warning service.

- Provide, through the Tropical Prediction Center/National Hurricane Center (TPC/NHC), the coordinated DOC requirements for weather reconnaissance and other meteorological data to be acquired by the DOD on tropical or subtropical cyclones and disturbances.

- Provide facilities, administrative support, and the means to disseminate meteorological data for the Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) as agreed to by the DOC and DOD.

- Provide the 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, including the 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, TPC/NHC, Miami, FL. The TPC/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, TPC/NHC, Miami, FL. The TPC/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 (OSS)/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.

- West Pacific Ocean (Guam and Micronesia). Public advisories are prepared by the NWS Forecast Office, Tiyan, Guam, using the tropical cyclone forecasts/advisories prepared by the NAVPACMETOCCEN/ Joint Typhoon Warning Center (JTWC).

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 (NESDIS) 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 Defense Meteorological Satellite Program (DMSP) data for NWS operational use and to comply with TPC/NHC and CPHC satellite data requirements.

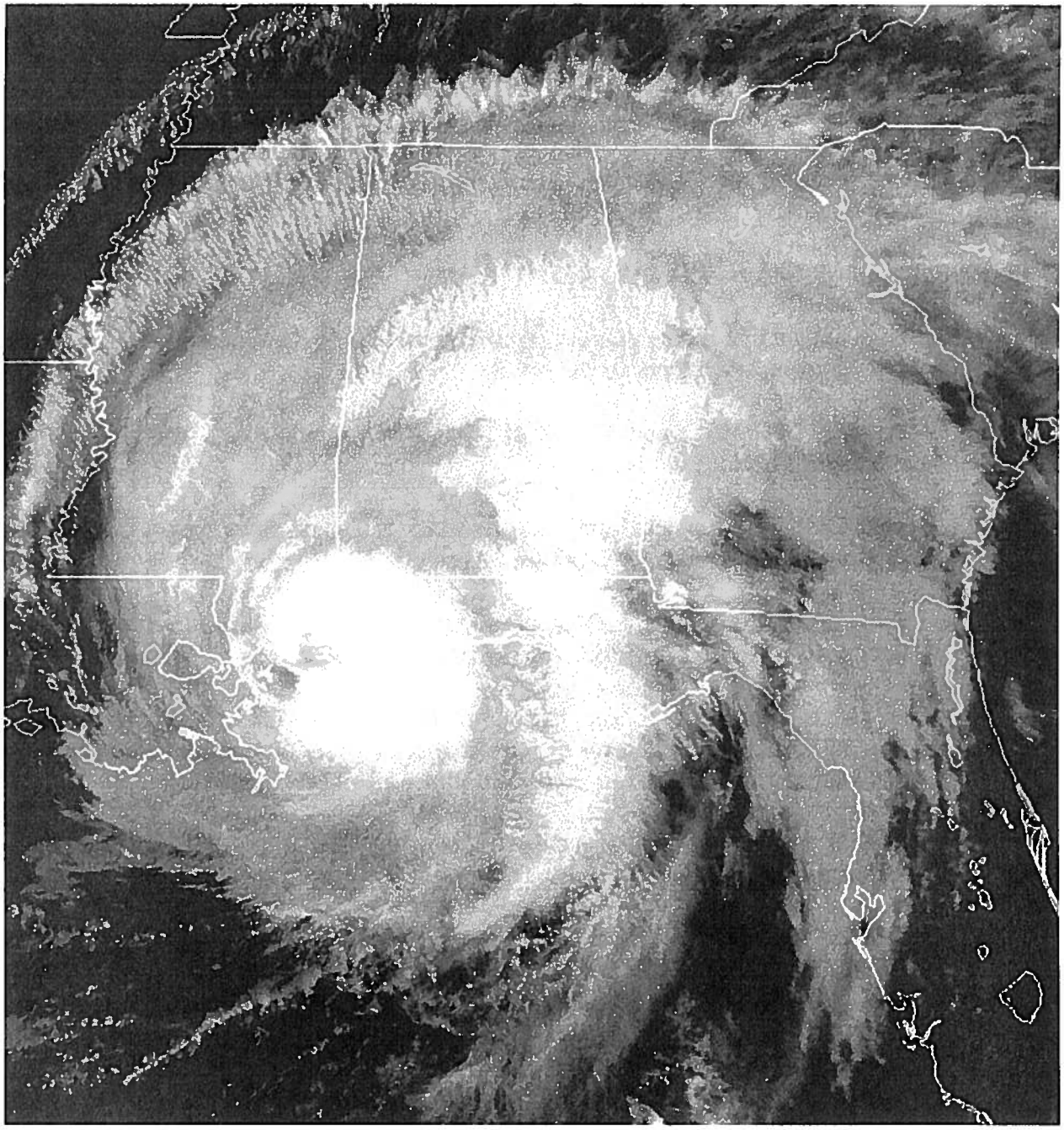

Figure 2-1. Hurricane Georges, September 28, 1998

2.2.5. Data Buoy Systems. Through the National Data Buoy Center (NDBC), the DOC will, subject to available funding, develop, deploy, and operate environmental data buoy systems and automated coastal stations to support the data requirements of TPC/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:

- Disseminate in a timely manner significant meteorological information on tropical and subtropical cyclones to the NWS.

- Provide TPC/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 TPC/NHC a 24-hour aircraft operations interface--Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH).

- Designate CARCAH as the liaison to TPC/NHC. CARCAH will serve as TPC/NHC's point of contact to request special DOD observations in support of this plan; i.e., DMSP fixes, additional upper-air observations, etc.

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

- Provide, resources permitting, through the Air Force Weather Agency (AFWA), Offutt AFB, NE, and the 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.

- Provide NWS with basic meteorological information, forecasts, and associated prognostic reasoning, concerning location, intensity, and forecast movement of tropical and subtropical cyclones for the Northwest Pacific west of 180°.

    - Tropical cyclone forecasts/advisories are the responsibility of the Joint Typhoon Warning Center (JTWC). The JTWC will consult with the NWS Forecast Office (NWSFO) Tiyan, Guam, regarding all tropical cyclones affecting Micronesia and Guam. Consultation will occur prior to issuing initial

and final advisories and prior to issuing any advisory that indicates a significant change in forecast intensity or track from the previous advisory.

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 (FAA), 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 communications 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 with the directors of meteorological services, air traffic control agencies, and disaster preparedness agencies of nations in those areas, regarding the provision of tropical cyclone warning services.

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, Herndon, VA, 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, 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 I).

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

- Provide the current names and telephone numbers of points of contact to the flying units.
- Publish telephone numbers (DSN/Commercial) and teletype code for Service B (Appendix I).

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 Tropical Prediction Center/National Hurricane Center (TPC/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 TPC/NHC and CPHC during their respective hurricane seasons. The TPC/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 0200, 0800, 1400, and 2000 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 TPC/NHC and the CPHC will, as appropriate, issue tropical cyclone discussions 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 TPC/NHC for all tropical cyclones in the Atlantic. In the Eastern Pacific, tropical cyclone public advisories are issued by TPC/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. In the Western Pacific, public advisories are issued by the NWS Forecast Office, Tiyan, Guam, for all tropical cyclones within the Territory of Guam and Micronesia, using tropical cyclone forecasts/advisories prepared by the JTWC as guidance.

[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.]

Table 3-1. Defining Points for Tropical Cyclone 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
Sargent, TX
Freeport, TX
San Louis Pass, TX
High Island, TX
Sabine Pass, TX
Cameron, LA
Intracoastal City, 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
Indian Point, FL
Apalachicola, FL
Ochlockonee River, FL
St. Marks, FL
Aucilla River, FL
Steinhatchee River, FL
Suwanee 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
Florida City, FL
Golden Beach, FL
Hallandale, FL
Deerfield Beach, FL
Boca Raton, 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
South Santee River, SC
Murrells Inlet, SC
Little River Inlet, SC
Cape Fear, NC
Surf City, 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
NC/VA State line
Cape Charles Light, VA
Parramore Island, VA
Chincoteague, VA
Chesapeake Bay, New Point Comfort, VA
Chesapeake Bay, Windmill Point, VA
Chesapeake Bay, Smith Point, VA
Tidal Potomac, Cobb Island, MD
Tidal Potomac, Indian Head, MD
Chesapeake Bay, Drum Point, MD
Chesapeake Bay, North Beach, MD
Chesapeake Bay, Sandy Point, MD
Chesapeake Bay, Pooles Island, MD
Cape Henlopen, DE
Cape May, NJ
Great Egg Inlet, NJ
Little Egg Inlet, NJ
Manasquan Inlet, NJ
Delaware Bay north/south of East Point, NJ to Slaughter Beach, DE
Sandy Hook, NJ
Fire Island Inlet, Long Island (LI), NY
Moriches Inlet, LI, NY
Montauk Point, LI, NY
Port Jefferson Harbor, LI, NY
New Haven, CT
Watch Hill, RI
Point Judith, RI
Westport, MA
Woods Hole, MA
Chatham, MA
Plymouth, MA
Gloucester, MA
Merrimack River, MA
Portsmouth, NH
Portland, ME
Rockland, ME
Bar Harbor, ME
Eastport, ME

3.2.4. Tropical Cyclone Forecast/Advisories. Tropical cyclone forecast/advisories are issued by the TPC/NHC and the CPHC. See Section 4.3 for content and format of the advisories. 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. In the Western Pacific, tropical cyclone forecasts/advisories are issued by the JTWC. Information on the broadcast of tropical cyclone information to coastal and high-seas shipping can be found in Chapter 8, Marine Weather Broadcasts.

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 regularly 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] within 72 hours of forecasted landfall. In addition, TPC/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 reemerge over water and/or (2) the computed probability values are not significant. TPC/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. TPC/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.

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

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

Brownsville, TX
Corpus Christi, TX
Port O'Connor, TX
Galveston, TX
Port Arthur, TX
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
Fort Pierce, FL
Cocoa Beach, FL
Daytona Beach, FL
Jacksonville, FL
Savannah, GA
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, Hawaii, and the Territory of Guam and Micronesia.

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 to post or cancel 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 nm of a U.S. land-based radar and sufficient and regular radar reports are available to the center. Position estimates disseminated to the public, DOD, and other Federal agencies will provide geographical positions in two ways: by latitude and longitude and 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 summaries will reference the former storm's name and be issued as long as the remnants of the storm pose a serious hydrometeorological threat. As required, storm summaries will be issued four times daily at 0500, 1100, 1700, and 2300 UTC.

3.2.10. Tropical Weather Discussion. TPC/NHC issues these discussions four times a day. 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 TPC/NHC/CPHC will issue satellite-based rainfall estimates for tropical disturbances and tropical cyclones within 36 hours of forecasted landfall.

3.2.12. Satellite Interpretation Message. CPHC issues these messages four times a day to describe synoptic features and significant weather areas. FAA contractions are used.

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 shall include the suffix "E" for Eastern Pacific, "C" for Central Pacific, or "W" for Western Pacific, 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 TPC/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 TPC/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 CPHC after advising the NAVPACMETOCCEN, Pearl Harbor.

3.3.1.4. Pacific West of 180° and North of 0°. Depression numbers, with suffix W; e.g., ONE-W, TWO-W, THREE-W, are assigned by JTWC.

3.3.1.5. 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 NAVPACMETOCCEN/JTWC. The names listed in Table 3-5 are for information only. Effective January 1, 2000, Table 3-5 will be replaced by Table 3-6 (International Tropical Cyclone Names for the Western Pacific and South China Sea).

3.4. Transfer of Warning Responsibility.

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

3.4.2. CPHC to JTWC/(RSMC, Tokyo). When a tropical or subtropical cyclone crosses 180°from east to west, the coordinated transfer of warning responsibility from CPHC to NAVPACMETOCCEN/JTWC will be made and the appropriate advisory issued. At the same time, the CPHC will coordinate with the RSMC, Tokyo so that they are aware that CPHC will be suspending the issuance of advisories.

3.4.3. JTWC/(RSMC, Tokyo) to CPHC. When a tropical or subtropical cyclone crosses 180° from west to east, the coordinated transfer of warning responsibility from NAVPACMETOCCEN/JTWC to CPHC will be made. The NAVPACMETOCCEN/JTWC will append the statement, "Next advisory by CPHC-HNL" to their last advisory. At the same time, the CPHC will coordinate with RSMC, Tokyo so that they are aware that CPHC will be assuming the issuance of advisories.

Table 3-2. Atlantic Tropical Cyclone Names

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		LORENZO	
MARIA	ma-REEH-ah	MICHAEL	MIKE-el	MICHELLE	
NATE		NADINE	nay-DEEN	NOEL	
OPHELIA	o-FEEL-ya	OSCAR		OLGA	
PHILIPPE	fe-LEEP	PATTY		PABLO	PA-blow
RITA		RAFAEL	ra-fa-EL	REBEKAH	
STAN		SANDY		SEBASTIEN	say-BAS-tyan
TAMMY		TONY		TANYA	TAHN-ya
VINCE		VALERIE		VAN	
WILMA		WILLIAM		WENDY	

2002		2003		2004	
ARTHUR		ANA		ALEX	
BERTHA	BUR-tha	BILL		BONNIE	
CRISTOBAL	CRIS-to-ball	CLAUDETTE	claw-DET	CHARLEY	
DOLLY		DANNY		DANIELLE	dan-YELL
EDOUARD	eh-DWARD	ERIKA	ERR-ree-ka	EARL	
FAY		FABIAN	FAY-bee-in	FRANCES	
GUSTAV	GOO-stahv	GRACE		GASTON	GAS-tone
HANNA		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		MATTHEW	
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	

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

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	ISRAEL	
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

2002		2003		2004	
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 VEE AIR
KENNA		KEVIN		KAY	
LOWELL		LINDA		LESTER	
MARIE		MARTY		MADELINE	
NORBERT		NORA		NEWTON	
ODILE	oh DEAL	OLAF	OH lahf	ORLENE	or LEAN
POLO		PATRICIA		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	

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
ANGELA	AN-gel-ah	ABE	ABE	AMY	A-mee	AXEL	AX-ell
BRIAN	BRY-an	BECKY	BECK-ee	BRENDAN	BREN-dan	BOBBIE	BOB-ee
COLLEEN	COL-leen	CECIL	CEE-cil	CAITLIN	KATE-lin	CHUCK	CHUCK
DAN	DAN	DOT	DOT	DOUG	DUG	DEANNA	dee-AN-na
ELSIE	ELL-see	ED	ED	ELLIE	ELL-ee	ELI	EE-lye
FORREST	FOR-rest	FLO	FLO	FRED	FRED	FAYE	FAY
GAY	GAY	GENE	GEEN	GLADYS	GLAD-iss	GARY	GAR-ee
HUNT	HUNT	HATTIE	HAT-ee	HARRY	HAR-ee	HELEN	HELL-en
IRMA	IR-ma	IRA	EYE-ra	IVY	EYE-vee	IRVING	ER-ving
JACK	JACK	JEANA	JEAN-ah	JOEL	JOLE	JANIS	JAN-iss
KORYN	ko-RIN	KYLE	KYE-ell	KINNA	KIN-na	KENT	KENT
LEWIS	LOU-iss	LOLA	LOW-lah	LUKE	LUKE	LOIS	LOW-iss
MARIAN	MAH-rian	MANNY	MAN-ee	MELISSA	mel-LISS-ah	MARK	MARK
NATHAN	NAY-than	NELL	NELL	NAT	NAT	NINA	NEE-nah
OFELIA	oh-FEEL-ya	OWEN	OH-en	ORCHID	OR-kid	OSCAR	OS-car
PERCY	PURR-see	PAGE	PAGE	PAT	PAT	POLLY	PA-lee
ROBYN	ROB-in	RUSS	RUSS	RUTH	RUTH	RYAN	RYE-an
STEVE	STEEV	SHARON	SHAR-on	SETH	SETH	SIBYL	SIB-ill
TASHA	TA-sha	TIM	TIM	TERESA	teh-REE-sah	TED	TED
VERNON	VER-non	VANESSA	vah-NES-ah	VERNE	VERN	VAL	VAL
WINONA	wi-NO-nah	WALT	WALT	WILDA	WILL-dah	WARD	WARD
YANCY	YAN-see	YUNYA	YUNE-yah	YURI	YOUR-ee	YVETTE	ee-VET
ZOLA	ZO-lah	ZEKE	ZEEK	ZELDA	ZEE-dah	ZACK	ZACK

NOTE: Names will be assigned in rotation, alphabetically. When the last name in Column 4 (ZACK) has been used, the sequence will begin again with the first name in Column 1 (ANGELA). This table is valid through the 1999 tropical cyclone season only--it will be superseded by Table 3-6.

Table 3-6. International Tropical Cyclone Names for the Western Pacific and South China Sea

	I	II	III	IV	V
Contributor	**NAME**	**NAME**	**NAME**	**NAME**	**NAME**
Cambodia	Damrey	Kong-rey	Nakri	Krovanh	Sarika
China	Longwang	Yutu	Fengshen	Dujuan	Haima
DPR Korea	Kirogi	Toraji	Kalmaegi	Maemi	Meari
HK, China	Kai-tak	Man-yi	Fung-wong	Choi-wan	Ma-on
Japan	Tembin	Usagi	Kammuri	Koppu	Tokage
Lao PDR	Bolaven	Pabuk	Phanfone	Ketsana	Nock-ten
Macau	Chanchu	Wutip	Vongfong	Parma	Muifa
Malaysia	Jelawat	Sepat	Rusa	Melor	Merbok
Micronesia	Ewiniar	Fitow	Sinlaku	Nepartak	Nanmadol
Philippines	Bilis	Danas	Hagupit	Lupit	Talas
RO Korea	Kaemi	Nari	Changmi	Sudal	Noru
Thailand	Prapiroon	Vipa	Megkhla	Nida	Kularb
U.S.A.	Maria	Francisco	Higos	Omais	Roke
Viet Nam	Saomai	Lekima	Bavi	Conson	Sonca
Cambodia	Bopha	Krosa	Maysak	Chanthu	Nesat
China	Wukong	Haiyan	Haishen	Dianmu	Haitang
DPR Korea	Sonamu	Podul	Pongsona	Mindulle	Nalgae
HK, China	Shanshan	Lingling	Yanyan	Tingting	Banyan
Japan	Yagi	Kajiki	Kujira	Kompasu	Washi
Lao PDR	Xangsane	Faxai	Chan-hom	Namtheun	Matsa
Macau	Bebinca	Vamei	Linfa	Malou	Sanvu
Malaysia	Rumbia	Tapah	Nangka	Meranti	Mawar
Micronesia	Soulik	Mitag	Soudelor	Rananim	Guchol
Philippines	Cimaron	Hagibis	Imbudo	Malakas	Talim
RO Korea	Chebi	Noguri	Koni	Megi	Nabi
Thailand	Durian	Ramasoon	Hanuman	Chaba	Khanun
U.S.A.	Utor	Chataan	Etau	Kodo	Vicente
Viet Nam	Trami	Halong	Vamco	Songda	Saola

NOTE: This will become the official international name list effective **January 1, 2000.** Names will be assigned in rotation starting with Damrey for the first tropical cyclone of the year 2000 which is of tropical storm strength or greater. When the last name in column 5 (Saola) is used, the sequence will begin again with the first name in column 1 (Damrey).

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
TPC/NHC	National Centers for Environmental Prediction Hydrometeorological Prediction Center (HPC) Camp Springs, MD
CPHC	TPC/NHC
CARCAH	53rd Weather Reconnaissance Squadron (53 WRS)
JTWC	NAVPACMETOCCEN Yokosuka
NWSO Tiyan, Guam	CPHC

3.5.2. Notification. The NAVLANTMETOCCEN, Norfolk, and NAVPACMETOCCEN, Pearl Harbor, will be advised by TPC/NHC, CARCAH, and CPHC, as appropriate, of impending or actual transfer of responsibility by the most rapid means available. The JTWC will advise CPHC and TPC/NHC of impending or actual transfer of JTWC responsibilities. In the event of an operational failure of CARCAH, direct communication is authorized between 53 WRS and the forecast facility. Contact 53 WRS 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 53 WRS).

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 TPC/NHC). 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. 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 Summary (monthly)
TYPS10 PHNL	Southern Hemisphere Tropical Cyclone Summary
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
WTPQ31-35 PGUM	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 Summary (monthly)
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
WTPQ51-55 PGUM	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
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 Tropical Prediction Center/National Hurricane Center (TPC/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 TPC/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 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 Automatic Digital Weather Switch (ADWS) hub at Tinker AFB, OK, for further relay to DOD agencies. The DOD forecasters, who must give advice concerning an imminent operational decision, may contact the appropriate hurricane center forecaster (see Chapter 2) when published tropical cyclone forecast/advisories require elaboration. Telephone numbers for the hurricane centers are in Appendix I.

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 TPC/NHC and CPHC. The public advisories issued by the NWS Forecast Office (NWSO) Tiyan, Guam, are issued 1 hour after the JTWC guidance. Advisories will continue to be issued until the system is classified below the depression intensity 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.
- 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 issued by the TPC/NHC and CPHC will contain appropriate information as shown in Figure 4-1. Tropical cyclone public advisories issued by the NWS Forecast Office, Tiyan, Guam, will contain appropriate information as shown in Figure 4-2. The forecast will contain 12, 24, 36, 48, and 72-hour forecast positions. A code string is appended at the end of the line "NATIONAL WEATHER SERVICE MIAMI FL." This is the Automated Tropical Cyclone System (ATCF) Storm Identification Character String recognized by the WMO for tracking and verification of tropical cyclones. The ATCF storm identifier is three spaces after "FL" and uses the format below.

NATIONAL WEATHER SERVICE MIAMI FL BSNOYR
where: BS is the basin (AL, EP, or CP)
NO is the storm number (01, 02, 03,...99)
YR is the last two digits of the year.

4.3.3.1. Definition of Wind Radii by Quadrant. The working definition of the wind radius for a quadrant is: use the largest radius of that wind speed found in the quadrant. *Example: TPC/NHC's quadrants are defined as NE (0°-90°), SE (90°-180°), SW (180°-270°), and NW (270°-360°). Given a maximum 34-knot radius of 150 nm at 0°, 90 nm at 120°, and 40 nm at 260°, the following line would be carried in the forecast/advisory: 150NE 90SE 40SW 150NW.*

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

```
ZCZC NHCTCMAT3 ALL
TTAAOO KNHC DDHHMM
HURRICANE BOB FORECAST/ADVISORY NUMBER 12
NATIONAL WEATHER SERVICE MIAMI FL   AL0291
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

WTPQ31 PGUM 011600
BULLETIN
SUPER TYPHOON STORMY ADVISORY NUMBER 14
NATIONAL WEATHER SERVICE OFFICE TIYAN GU
2AM LST MON NOV 02 1998

...STORMY HAS BEEN UPGRADED TO A SUPER TYPHOON...

TYPHOON WARNINGS REMAIN IN EFFECT FOR GUAM...ROTA...TINIAN AND SAIPAN IN THE MARIANA ISLANDS.

AT 1AM...1500Z...THE CENTER OF SUPER TYPHOON STORMY WAS LOCATED NEAR LATITUDE 13.0 DEGREES NORTH AND LONGITUDE 149.2 DEGREES EAST...OR ABOUT 300 MILES EAST OF GUAM.

STORMY IS MOVING TOWARD THE WEST-NORTHWEST AT 15 MPH... AND IS EXPECTED TO CONTINUE MOVING IN THE SAME DIRECTION FOR THE NEXT 24 HOURS. ON ITS PRESENT COURSE TYPHOON CONDITIONS WILL BEGIN TO AFFECT THE MARIANAS AROUND NOON TODAY.

MAXIMUM SUSTAINED WINDS ARE 150 MPH...WITH HIGHER GUSTS. TYPHOON FORCE WINDS EXTEND OUTWARD 60 MILES FROM THE CENTER AND TROPICAL STORM FORCE WINDS EXTEND OUTWARD 150 MILES FROM THE CENTER.

EXTREMELY HAZARDOUS SURF IN EXCESS OF 20 FEET AND TORRENTIAL RAINS OF 7 TO 9 INCHES ARE EXPECTED AS STORMY MOVES THROUGH THE MARIANAS TONIGHT. BEACH EROSION AND FLOODING OF LOW-LYING AREAS ARE LIKELY.

THIS IS A VERY POWERFUL TYPHOON AND IS A VERY SERIOUS THREAT TO THE MARIANAS. FINAL PREPARATIONS FOR THE ONSET OF DAMAGING WINDS...ESPECIALLY BY PEOPLE LIVING ALONG THE COASTLINE AND IN POORLY DESIGNED STRUCTURES...SHOULD BE COMPLETED IMMEDIATELY. RESIDENTS SHOULD SEEK SAFE SHELTER AND REMAIN INSIDE UNTIL THE ALL-CLEAR IS GIVEN BY CIVIL DEFENSE OFFICIALS.

REPEATING THE 1 AM POSITION...13.0 NORTH LATITUDE AND 149.2 EAST LONGITUDE MOVING WEST-NORTHWEST AT 15 MPH WITH MAXIMUM SUSTAINED WINDS OF 150 MPH.

AN INTERMEDIATE ADVISORY IS SCHEDULED TO BE ISSUED BY THE NATIONAL WEATHER SERVICE AT 5AM GUAM LST...FOLLOWED BY THE NEXT COMPLETE ADVISORY ISSUED AT 8AM LST.

NNNN

Figure 4-2. Tropical cyclone public 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 Command (AFRC)/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 AFRC 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. The Global Decision Support System (GDSS) JCS Priority Code for tasked, operational weather reconnaissance is **1A3** (IAW DOD Regulation 4500.9-R and Joint Publications 4-01 and 4-04). The Force Activity Designator (FAD)/Urgency of Need Designator (UND) Supply Priority Designator Determination code is **IIA2** (IAW Joint Publication 4-01 and Air Force Manual 23-110, Volume 2, Part 13, Attachment 3A-2.)

5.2. Responsibilities. The DOD, through the AFRC's 53rd Weather Reconnaissance Squadron (53 WRS), and DOC, through NOAA's Aircraft Operations Center (AOC), operate a complementary fleet of aircraft to conduct hurricane/tropical cyclone reconnaissance, synoptic surveillance, and research missions.

5.2.1. DOD. The DOD is responsible for:

- Providing operational aircraft for vortex fixes and data, synoptic surveillance missions, 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 AFRC 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.

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

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 be noted that more expeditious handling of reconnaissance aircraft will result by following the procedures outlined in the FAA/AFRC/NOAA Letter of Agreement (LOA) entitled, Meteorological Reconnaissance Flights, and the AFRC/NOAA LOA, 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 which own the aircraft.

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 nm.
- Storm surface center (wind/pressure): within 6 nm.
- Flight level storm center (wind/pressure): within 6 nm.

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 TPC/NHC will request mid- and/or upper-tropospheric sounding data on the periphery of systems approaching the United States. The TPC/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).

- En route. 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.

- Fix Missions. A horizontal observation is required at the end point of each 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 pattern.

- 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
EN ROUTE	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: VDM[2] Intermediate: VDM[2]	Two per mission. (non HD/HA) One per fix.	Each scheduled fix at 700 mb 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 encoding interval and transmitted to TPC/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; see Table 5-2 for data formats.

5.4.5.4. Vertical Observations. The frequency of vertical observations en route to and from the storm or invest area will be approximately every 400 nm over water, unless otherwise specified. Center dropwindsonde data will be provided for scheduled fixes made at 700 hPa or above. The distribution of vertical observations for eyewall and outer-wind field sampling are specified in paragraph 5.8.4. The format for all vertical observations is WMO TEMP DROP code (FM 37-VII). See Appendix G for the format.

[1] SVD = Supplementary Vortex Data
[2] VDM = Vortex Data Message

5.5. Reconnaissance Planning and Flight Notification.

5.5.1. DOC Requests for Aircraft Reconnaissance Data.

5.5.1.1. Coordination. The Tropical Prediction/National Hurricane Center (TPC/NHC) will coordinate with the Central Pacific Hurricane Center (CPHC) to determine a list of the total DOC requirements for data on tropical and subtropical cyclones or disturbances for the next 24-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 TPC/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.

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

DATE	SCHEDULED FIX TIME	AIRCRAFT NUMBER	ARWO

WX MISSION IDENTIFICATION	OB

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. E09/15/5 - Elliptical eye, major axis 090-270, length of major axis 15 NM, length of minor axis 5NM. CO8-14 - Concentric eye, diameter inner eye 8 NM, outer eye 14 NM.
N		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.
O	NM	NAVIGATION FIX ACCURACY/METEOROLOGICAL ACCURACY
P	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

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

OBS 01 AT: Z | OBS AT Z | OBS 01 SFC WND:

01 ($L_aL_aL_a$)	1 ($L_oL_oL_oL_o$)	1 (jHHH)	1 (TTT_dT_d)	(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	($L_oL_oL_oL_o$) M	(fff) MF		

OBS 01 AT: Z | OBS AT Z | OBS 07 SFC WND:

REMARKS (*end of message*)

LEGEND

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

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

MF = INDICATOR FOR MAXIMUM FLIGHT LEVEL WIND OBSERVED

fff = SPEED OF WIND IN KNOTS

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

TTT_dT_d = 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

$L_oL_oL_oL_o$ = LONGITUDE IN DEGREES/TENTHS

/ = DATA UNKNOWN/UNOBTAINABLE

Figure 5-5. Supplementary vortex data message

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.
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 nm, if the centers are separated by over 5 nm.
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. If a significant secondary maximum wind is observed, report it in remarks.

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 nm of the center fix coordinates. If a higher temperature is observed at a location more than 5 nm away from the flight level center (item BRAVO), it is reported in item QUEBEC including bearing and distance from the flight level center. PRESSURE ALT--Pressure altitude data (meters) are taken at the same location as the maximum temperature data reported in item JULIET.
K (KILO)	Dewpoint temperature/sea surface temperature are collected at the same location as the maximum temperature reported in item JULIET. Enter NA if not observed.

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

L (LIMA)	Only report if at least 50 percent of the center has an eyewall, otherwise enter NA. Closed wall--if the center has 100 percent coverage with no eyewall weakness. Open XX--if the center has 50 percent or more but less than 100 percent coverage. State the direction of the eyewall weakness.
M (MIKE)	Self explanatory. Report only if item LIMA is reported, otherwise enter NA.
N (NOVEMBER)	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 nm of each other.
O (OSCAR)	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.
P (PAPA)	Remarks to enhance the data reported above. Required remarks include: (1) mission identifier and observation number; (2) the maximum flight level wind observed, time of observation, and the relative quadrant of the storm of the observed wind on the latest pass through any portion of the storm; (3) the method of deriving the central SLP when extrapolated; and (4) the bearing and range of the surface center and/or maximum flight level temperature if not within 5 nm of the flight level center.

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: (AFRC-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/INVEST TIME

(Resources permitting if applicable)
_____Z

B. _____ MISSION IDENTIFIER

C. _____Z DEPARTURE LOCATION/TIME

D. _____ FORECAST POSITION

E. _____ DESTINATION

F. _____Z TIME ON STATION

G. _____ ALTITUDE(S) ON STATION

H. _____ REMARKS (if needed)

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 en route 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 TPC/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 TPC/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.

- The CARCAH will coordinate the TCPOD with TPC/NHC, the 53 WRS, and NOAA AOC before publication.

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

- 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.

- 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. The TCPOD can also be seen on the Internet at www.hurricanehunters.com/wxdata.htm and clicking on Plan of the Day.]

5.5.4. Air Traffic Control (ATC) Clearances.

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

5.5.4.2. Prior Coordination. The 53 WRS Current Operations/mission commander and participating research aircraft mission representatives will contact the FAA Air Traffic Control System Command Center (ATCSCC) at (703) 904-4525 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. Nonparticipating 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.

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

- 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.

- 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.

- 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.

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

- LATE. An observation is taken within 250 nm of the specified coordinates after the scheduled time but not later than the scheduled time plus 2 hours.

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

5.6.1.3. Synoptic Surveillance Missions.

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

- MISSED. When parameters listed in para A. above are not satisfied.

5.6.2. Mission Assessment. The TPC/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). Mission requirements levied as "resources permitting" will not be assessed for timeliness but may be assessed for quality of data gathered.

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

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

5.7.1. Vortex Data. A vortex data message (Figure 5-4) will be prepared for all scheduled fixes, using all observed vortex fix information. For intermediate fixes, limited vortex data 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 5NM. 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 nm 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.

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

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

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

5.7.6. Mission Identifier. 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]	Sequential number of mission in this storm	Depression number or XX/YY/ZZ, if not a depression or greater	Location A,E,C,or W[3]	Storm name or words CYCLONE, INVEST, or TRAIN
	For non-tasked missions, WXWX, or for a numbered depression or stronger, WX+ depression number.			

-EXAMPLES-

AF966 0201C CYCLONE	(USAF aircraft 966 on the second mission on tropical depression number 1 in the Central Pacific. Invest or fix as specified in the TCPOD.)
AF984 0403E CARLOS	(USAF aircraft 984 on the fourth mission on tropical depression 3 which formed in the Eastern Pacific and acquired the name Carlos.)
NOAA2 01XXA INVEST	(NOAA aircraft 42RF on the first mission to investigate a suspect area in the Atlantic, Gulf of Mexico or Caribbean.)
NOAA3 WX01A AGNES	(NOAA aircraft 43RF on a non-tasked mission into AGNES.)

[1] AF plus last 3 digits of tail number
[2] NOAA, plus last digit of aircraft registration number
[3] A=Atlantic, Caribbean, or Gulf of Mexico, E=Eastern Pacific, C=Central Pacific, W=Western Pacific

5.7.7. Observation Numbering and Content. The mission identifier will be the first mandatory remark followed by the observation number.

5.7.7.1. First Weather Observation. In addition, the first weather observation will have appended as remarks the four-letter ICAO identifier for the departure station, time of departure, and estimated time of arrival (ETA) at the invest points, coordinates of the storm, or control point, as applicable.

-EXAMPLE-

URNT11 KNHC DDZZZZ
97779 TEXT TEXT...
RMK AF987 0308A EMMY OB 01 DPTD KBIX AT 10/2100Z ETA 31.5N 75.0W 11/0015Z
NNNN

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 TPC/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-

URNT10 KNHC DDZZZZ
97779 TEXT TEXT...
RMK AF987 0lXXA INVEST OB 01 DPTD AF987 WX MISSION AT 05/1235Z ETA 18N
85W 05/1630Z
NNNN

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-

URNT10 KNHC DDZZZZ
97779 TEXT TEXT...
RMK AF987 0317A JOAN OB 16 ETA KBIX 15/2030Z. LAST REPORT OBS 01 THRU
16 TO KNHC.
NNNN

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 nm 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.

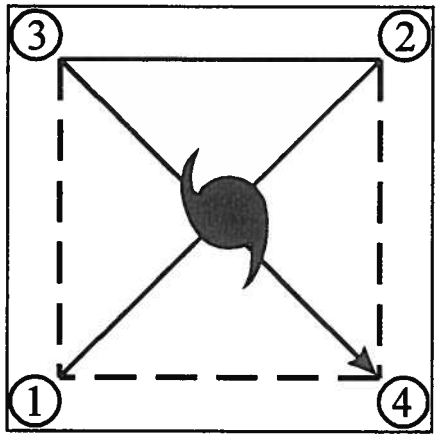

Figure 5-9. Flight pattern ALPHA

5.8.1.2. Vortex fix data. On each transit of the center a fix will be made and a vortex data message completed, using data gathered on the inbound track since the previous fix and will be 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, the sea-level pressure will be extrapolated using the tables in Appendix F or by using 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 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. The preferred approach is to fly to the tasked coordinates of the forecasted center and then execute a pattern as observed conditions dictate. 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.

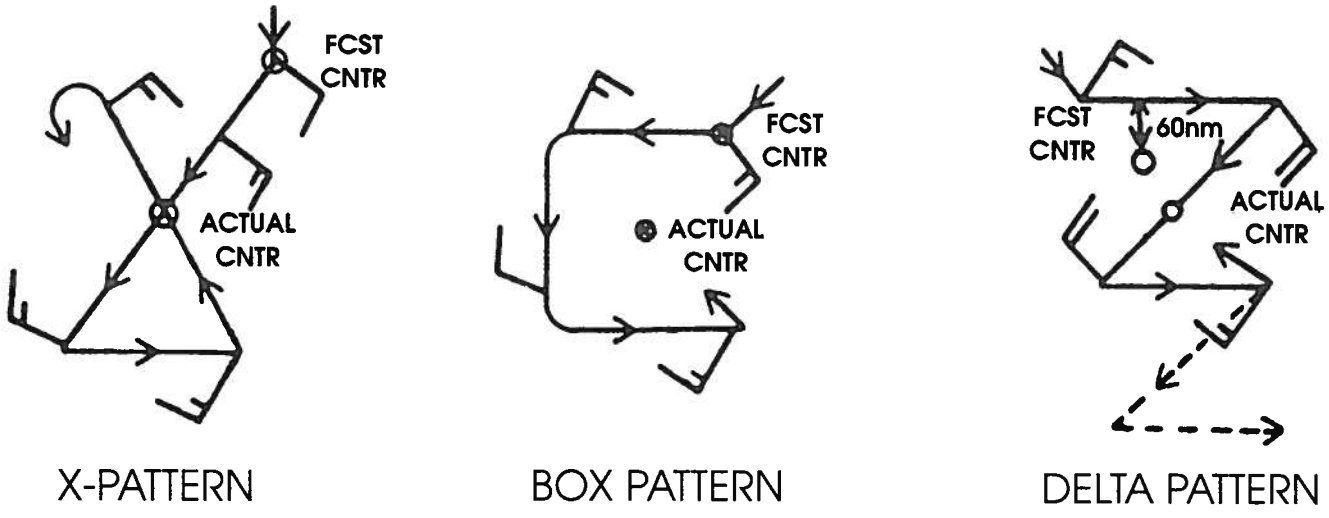

Figure 5-10. Suggested patterns for investigative missions

- 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.

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

- On the Delta pattern, the aircraft is flown on a cardinal heading to pass 60 nm 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, and multiple aircraft may be required to satisfy surveillance mission requirements.

5.8.4. Eyewall and Outer-Wind Field Sampling Modules. These are patterns of dropwindsonde releases designed to measure the maximum surface wind, as well as the extent of hurricane and tropical storm force surface winds. They are meant to be flown using the operational alpha pattern. Dropwindsonde releases in these modules are in addition to any other releases required by paragraph 5.4.5.4.

5.8.4.1. Eyewall Module. While executing a standard alpha pattern to satisfy a fix requirement, one sounding will be taken during each inbound and outbound passage through the eyewall (except as noted below), for a total of four soundings. The releases should be made at or just inward (within 1-2 km) of the flight-level radius of maximum wind (RMW). If the radar presentation is suitable, the inner edge of the radar eyewall may be used to identify the release point. If possible, and when resources and safety permit, two dropwindsondes, spaced less than 30 seconds apart, should be deployed on the inbound leg on the side of the storm believed to have the highest surface winds (normally the right-hand side). In this case, the outer of the two releases should be made at the RMW, with the second release following as soon as possible. Typically, the eyewall module will be tasked within 48 hours of a forecasted hurricane landfall.

5.8.4.2 Outer-Wind Field Module. On an alpha pattern, deploy dropwindsondes at 50 nm intervals from the center on each of two successive inbound and outbound legs, outward to 200 nm. A release should also be made at the midpoint of the cross (downwind) leg, for a total of 17 soundings. The length of the legs and the sounding interval may be adjusted, depending on the size of the storm.

5.9. Aircraft Reconnaissance Communications.

5.9.1. General. The 53 WRS WC-130 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-IV will normally transmit WMO Temp Drop messages via INMARSAT commercial SATCOM. Flight meteorologists should contact CARCAH following the first fix, and periodically throughout 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 CARCAH.

5.9.3. Air-to-Air Communications. When more than one 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 Storm Operations and Research.

5.9.5. Improved Weather Reconnaissance System (IWRS)-Equipped Aircraft. The AFRC aircraft equipped with IWRS will use the SATCOM data link with ground stations at TPC/NHC and at Keesler AFB, MS, to relay data to the TPC/NHC and the AWN. Figure 5-12 depicts these communication links.

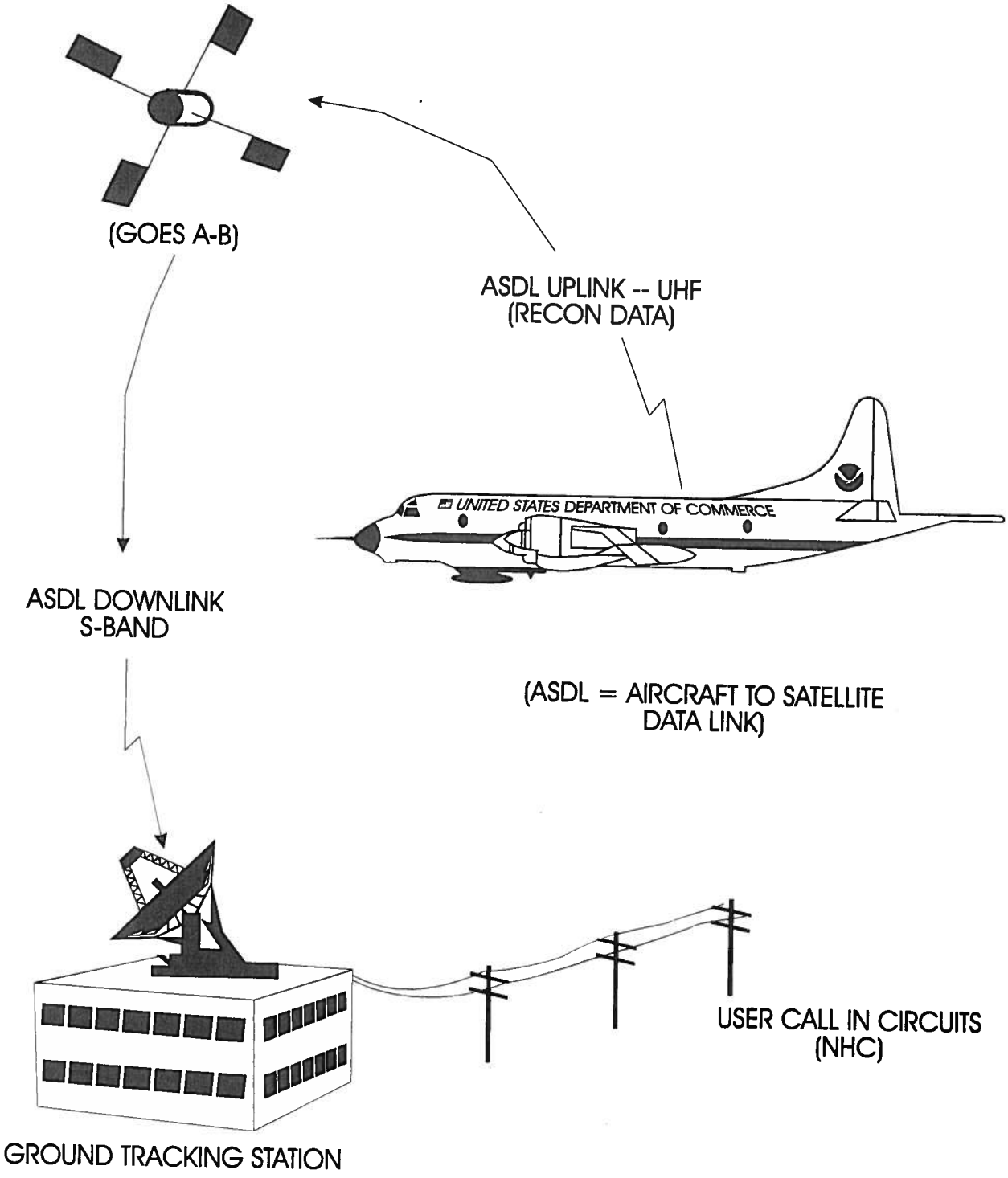

Figure 5-11. Schematic of aircraft-to-satellite data link for NOAA P-3 aircraft

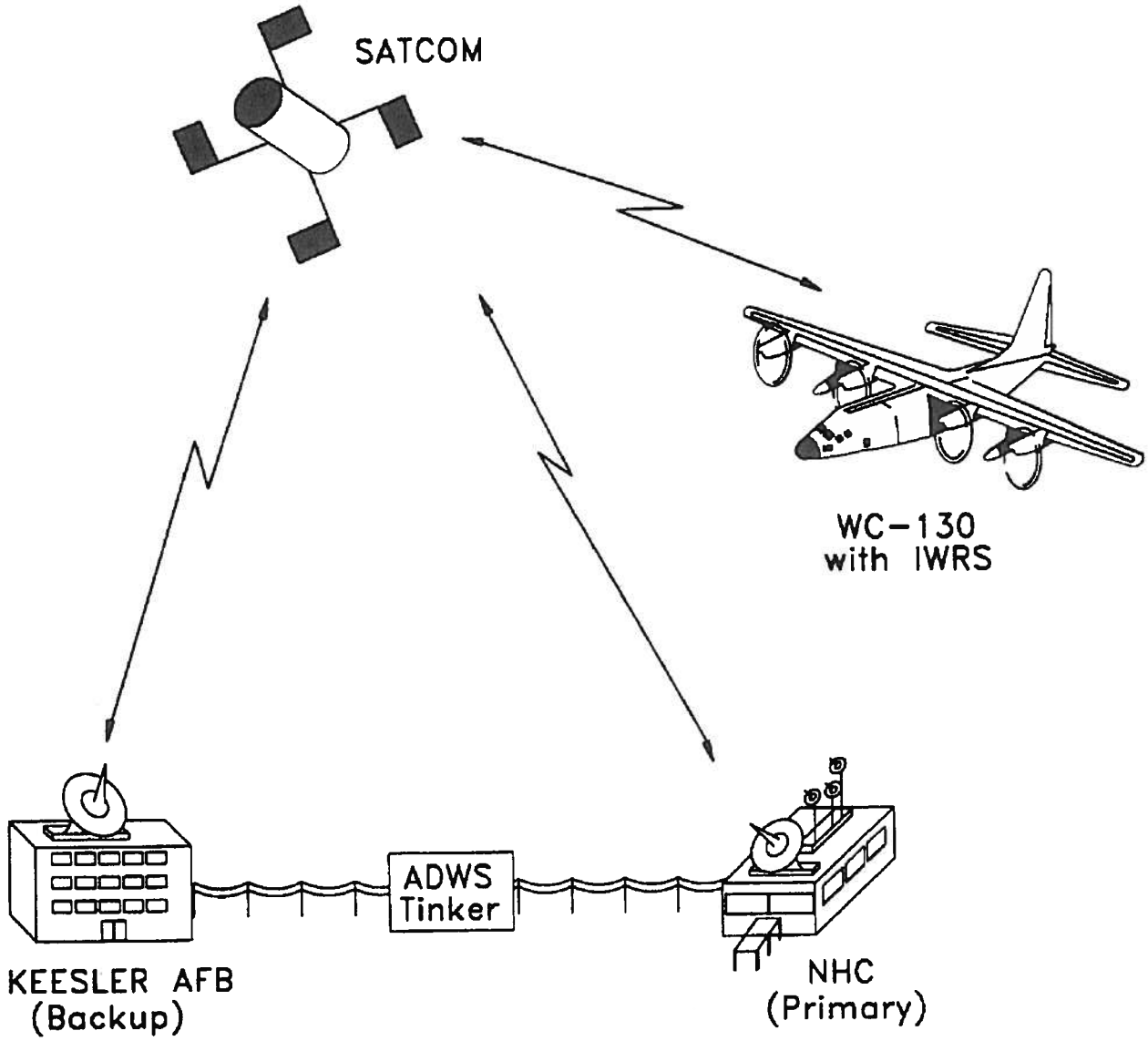

Figure 5-12. Schematic of aircraft-to-satellite data link for AFRES WC-130 aircraft

CHAPTER 6

SATELLITE SURVEILLANCE OF TROPICAL AND SUBTROPICAL CYCLONES

6.1. Satellites.

6.1.1. Geostationary Operational Environmental Satellite (GOES). Using modern 3-axis stabilization for orbit control, GOES-8 at 75°W and GOES-10 at 135°W support the operational two-GOES constellation. Independent imager and sounder instruments eliminate the need to time share, yielding an increase in spatial coverage of image and sounder data at more frequent scanning intervals. The new GOES also provides higher resolution and additional spectral channels than its predecessor, affording the hydrometeorological community improvements in detection, monitoring, and analysis of developing tropical cyclones. From 135°W and 75°W, routine GOES satellite data coverage is extensive, stretching from the central Pacific through the Americas to the eastern Atlantic, including the vital breeding grounds for tropical cyclones.

Routinely, GOES schedules provide two views of the CONUS (GOES-10 view is termed PACUS) every 30 minutes. More frequent interval scans can be employed to support NOAA's warning programs, including the tracking of tropical and subtropical cyclones. Government agencies and the private sector have access to digital data transmissions directly from NOAAPORT.

The current series of GOES satellites provide satellite data generated from full resolution, and imager and sounder data. Imagery at 1, 2, 4, and 8 km resolution is available for daytime and nighttime applications. The increased resolution of the satellite imagery is a vast improvement from previous satellites. Visible data are available at 1 and 2 km, "near infrared" (channel 2 data) as well as the infrared channels 4 and 5 are available at 4 km resolution, and water vapor (channel 3) is available at 8 km resolution. Channel 2 data are valuable for the detection of low clouds, fog, stratus, and surface hot spots; channel 5 data are useful for detecting volcanic ash in the atmosphere. The digital data may be enhanced to emphasize different features as desired. A suite of digital data and products is available to users in the National Weather Service (NWS), the National Environmental Satellite, Data, and Information Service (NESDIS), other Federal agencies, the academic community, and many private agencies, both national and international. These data are made available through NOAAPORT, RAMSDIS, the Internet, and other means such as local networks.

6.1.1.1. GOES-8. GOES-8 supporting a GOES-East station at 75°W, continues to serve NOAA operations including the TPC/NHC, other Federal agencies, and the private sector. Various imager channels at higher resolutions are being utilized to monitor the intensification and movement of tropical cyclones over the Atlantic Ocean and a portion of the East Pacific. In particular, greater detail in the imagery facilitates tropical cyclone monitoring and analysis, and the addition of the 3.9 micron channel to the GOES imager has vastly

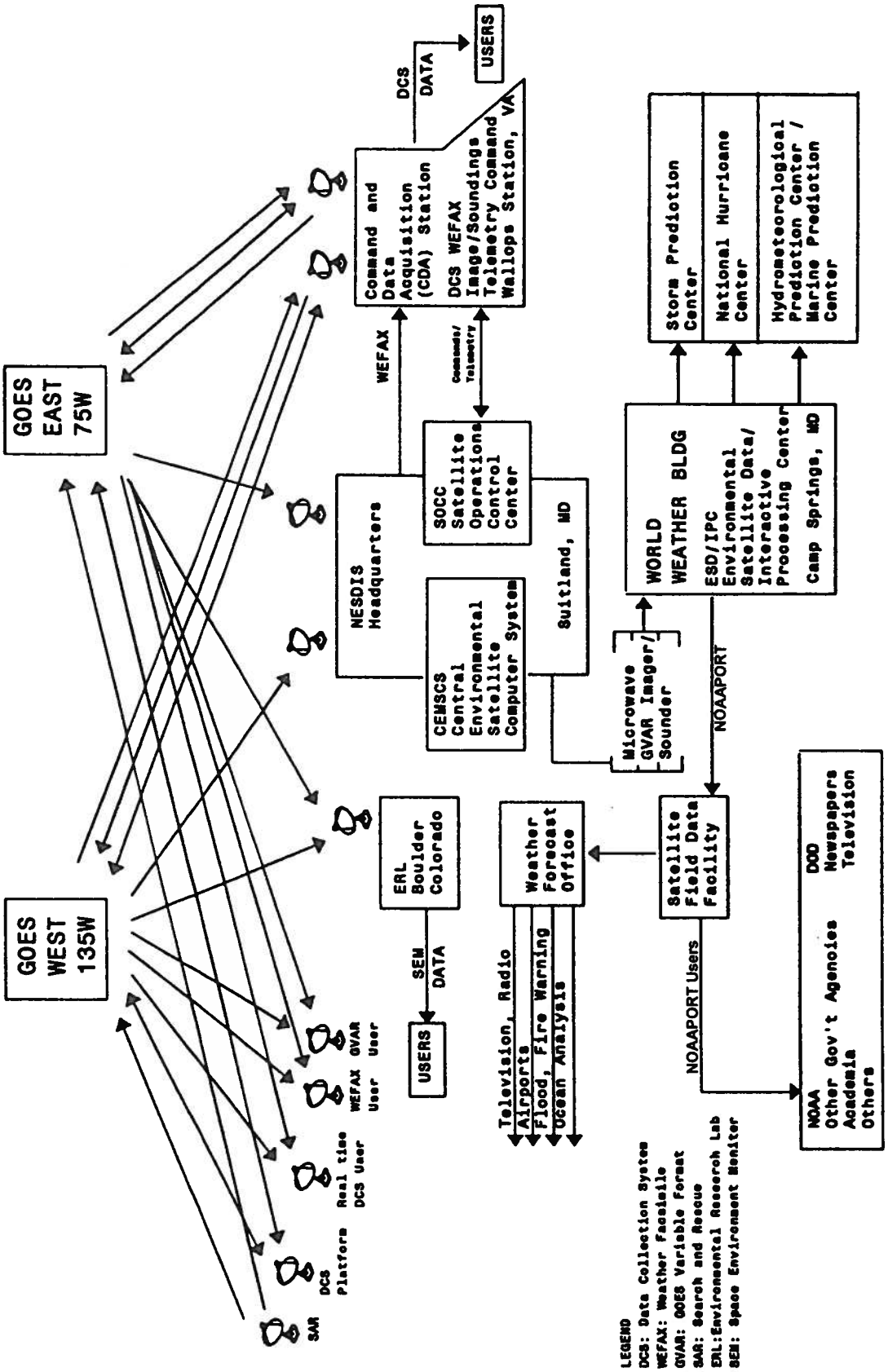

Figure 6-1. The GOES satellite system

improved the detection of low-level circulation centers at night to assist in storm positioning. Moisture retrievals from the GOES sounder, specifically four layers of derived precipitable water, are now being incorporated into NCEP's numerical models to improve model output. In addition, sounder data are being exploited to generate derived product imagery such as total precipitable water, atmospheric stability indices, and surface and cloud temperatures.

During the 1996 hurricane season, NESDIS instituted a specialized GOES-8 sounder schedule consisting of four sectors covering distinct areas of the Atlantic Ocean. Event driven, one of the four "hurricane" sounder sectors would be selected as "primary" by the TPC/NHC. The "primary" sector provides frequent scans over the area of interest to generate experimental sounder winds (identifies steering currents) and provide moisture and temperature retrievals. Sounder winds are made available to TPC/NHC as a forecasting tool by the Cooperative Institute for Mesoscale Meteorological Studies (CIMSS), University of Wisconsin. The same specialized "hurricane" sounder schedule will continue to be employed for the 1999 hurricane season.

6.1.1.2. GOES-9. GOES-9 has been replaced by GOES-10 as the operational satellite located at 135°W. GOES-9 is now in on-orbit storage standby if needed, but the satellite is severely degraded.

6.1.1.3. GOES-10. GOES-10, a clone of GOES-8, is the latest in the series of the current GOES program. GOES-10 was launched on April 24, 1997 and supports the GOES-West station at 135°W. The spacecraft carries the same specified imager and sounder instruments as GOES-8 and GOES-9. Due to the imminent failure of GOES-9, GOES-10 was declared operational in July 1998 and was moved to 135°W. The routine scanning mode of GOES-10 emulates GOES-9 operations, providing coverage of the Northern and Southern Hemisphere eastern Pacific Ocean as well as the western United States. The GOES-West satellite also supports the missions of both the TPC/NHC and the CPHC, and provides coverage of developing tropical cyclones over the East and Central Pacific. The DOD and other Federal agencies are also supported.

6.1.1.4. GOES-L. GOES-L (GOES-11 on orbit) is scheduled for launch in late spring 1999. GOES-L is also a clone of GOES-8 and will carry the same imager and instrumentation capability. GOES-L will be placed into on-orbit storage after initial checkout and will be available to replace GOES-8 or GOES-10 as required.

6.1.2. EUMETSAT Meteosat Geostationary Satellites. Meteosat-7 provides 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 NESDIS and NCEP at the NOAA Science Center (NSC) in Camp Springs, MD. They are also transmitted to the TPC and the Storm Prediction Center (SPC). Meteosat WEFAX data are also available and distributed on GOES-Tap circuits.

In December 1995, EUMETSAT, the program administrator, began encrypting digital Meteosat 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.

6.1.3. National Oceanic and Atmospheric Administration (NOAA) Polar-Orbiting Satellites. Two primary operational NOAA polar orbiting satellites, NOAA-14 and NOAA-15, 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 Weather Agency (AFWA), 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, AL, and Wallops, VA, acquire recorded global area coverage data, and then route the data to NESDIS computer facilities in Suitland, MD, where the data are processed and distributed to the NOAA, the DOD, and private communities. New ground equipment installed at various NWS regions including Kansas City and Miami (TPC), enable direct readout and data processing of AVHRR data from NOAA-14 and NOAA-15. The high resolution polar data and products generated at TPC complement other satellite data sources to support tropical mission objectives. Data from NOAA-12 remain available to APT and HRPT direct-readout users, but otherwise is not being utilized.

6.1.3.1. NOAA-K/NOAA-15. NOAA-K/NOAA-15 is in full operational use except for the data from the Advanced Microwave Sounding Unit (AMSU), and it replaced NOAA-12 as one of the operational POES. The type of data and products provided will be the same as the current operational polar orbiting satellite, NOAA-14, except for the addition of the AMSU and an AVHRR shortwave channel at 1.6 microns. New sounder-based derived products will include rain rate, total precipitable water, and surface winds over water.

6.2.3.2. NOAA-L. NOAA-L (NOAA-16 on orbit) is scheduled to be launched around the end of 1999.

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 include:

- 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 for prescribed oceanic regions at the times indicated in Table 6-1. 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 Satellite Analysis Branch (SAB). The SAB operates 24 hours a day to provide satellite support to the HPC/MPC, TPC, CPHC, and other worldwide users. SAB coordinates, as conditions warrant, four times per day with TPC and CPHC, relaying pertinent information on tropical cyclone development, including location, tracking, and intensity analysis. A Satellite Weather Bulletin for the Indian Ocean and West Pacific Ocean, providing current position and current intensity of tropical cyclones, is also disseminated four times per day at the times indicated in Table 6-1. 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 6-1. For numerical model input and forecasting applications, data from high density cloud motion wind vectors, high density water vapor wind vectors, four layers of derived precipitable water from sounder moisture retrievals, and tropical rainfall estimates are provided to HPC and TPC. Telephone numbers for the SAB are located in Appendix H.

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 Weather Agency (AFWA) 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. AFWA readouts will augment NESDIS surveillance for the North Atlantic and Eastern Pacific. AFWA will, resources permitting, transmit twice daily teletype bulletins, describing the location and intensity classification of the system, using format shown in Figure 6-2 to the TPC/NHC on organized disturbances evident at the tropical classification of one point five (T-1.5) or higher. AFWA 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. AFWA will maintain the capability to provide surveillance support cited in para 6.4.1 to the CPHC. 15th Operations Support Squadron will provide fix and intensity information to the CPHC on systems upon request.

Table 6-1. Communications headings for satellite tropical weather discussion summaries

WMO HEADING	TIME ISSUED	OCEANIC AREA	TYPE OF DATA
TCIO11 KWBC	2200 UTC	Indian Ocean	IR Night
TCIO10 KWBC	1000 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
WWUSX KWBC	0400, 1000, 1600, 2200 UTC	Indian	VIS/IR
WWUSX KWBC	0400, 1000, 1600, 2200 UTC	Western Pacific (north and south)	VIS/IR

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

A CYCLONE DESIGNATOR	A.	Designator of tropical cyclone category including name/number. When a cloud system has not yet been designated by name/number enter TROPICAL DISTURBANCE. Sample entry: TROPICAL STORM AMY (15)
B DATE/TIME (Z) OF FIX	B.	Date and nodal crossing time in Zulu; round time to nearest minute. Sample entry: 252303Z.
C LATITUDE OF POSITION	C.	Latitude to nearest tenth of degree (N or S), followed by checksum. Sample entry: 29.9N/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 4.5/4.5/D1.0/25HRS (252305Z)
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 6.4 DEG EAST OF NADIR
I GALE WIND RADIUS ANALYSIS	I.	Experimental gale wind (34kt) radius boundary utilizing image mapped SSM/I ocean surface wind speed algorithm estimates. Sample Entry: Gale Wind Radius Anal-Boundary Compass Points

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

Figure 6-2. Center fix data form and message format (satellite)

6.5. Satellites and Satellite Data Availability for the Current Hurricane Season.

Table 6-2 lists satellite capabilities for the current hurricane season.

Table 6-2. Satellite and satellite data availability for the current hurricane season

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
GOES-8 at 75°W GOES-10 at 135°W GOES-9 (stored on-orbit) GOES-L (to be stored on-orbit)	Multispectral Imager and Sounder	Every 30 min, in Routine Scan Mode, provides 3 sectors with prescribed coverages: Northern Hemisphere (NH) or Extended NH; CONUS or PACUS; 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. Quantitative precipitation estimates for the continental U.S. and Puerto Rico; high density cloud and water vapor motion wind vectors; and experimental visible and sounder winds. 7. Operational moisture sounder data (precipitable water) in four levels for inclusion in NCEP numerical models. Other sounder products including gradient winds, vertical temperature and moisture profiles, mid-level winds, and derived product imagery (precipitable water, lifted index, and surface skin temperature). 8. Tropical storm monitoring and derivation of intensity analysis. Also produce tropical rainfall potential (TRaP) estimates for landfalling tropical cylones.

Table 6-2. Satellite and satellite data availability for the current hurricane season (continued)

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
METEOSAT-6	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 and derivation of intensity analysis.
NOAA-14	AVHRR GAC and LAC (recorded) HRPT and APT (direct) RTOVS	0313D[1]/1513A[2]	1. 1 km resolution HRPT and Local Area Coverage (LAC) data. 2. 4 km resolution APT and Global Area Coverage (GAC) data.
NOAA-15	same as NOAA-14 plus AMSU data	0732D/1932A	3. Mapped imagery. 4. Unmapped imagery (all data types) at DMSP sites.
NOAA-12	APT and HRPT only	0544D/1744A	5. Sea-surface temperature analysis. 6. Soundings. 7. Moisture profiles. 8. Remapped GAC sectors. 9. Sounding-derived products--total precipitable water, rain rate, and surface winds under sounding (NOAA-15).

[1] D - descending

[2] A - ascending

Table 6-2. Satellite and satellite data availability for the current hurricane season (continued)

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
DMSP F-11	OLS Imagery (recorded and direct), SSM/I, SSM/T-1, SSM/T-2 moisture sounder (direct)(150GHZ channels non-functional)	0730D/1930A	1. 0.3 nm (regional) and 1.5 nm (global) resolution (visual and infrared) imagery available via stored data recovery through AFWA. 2. Regional coverage at 0.3 nm and 1.5 nm resolution (visual and infrared) imagery available from numerous DOD tactical terminals. 3. SSM/T-1, SSM/T-2, SSM/I data transmitted to NESDIS and FNMOC from AFWA.
DMSP F-12	OLS Imagery (recorded and direct), SSM/I (non-functional), SSM/T-1 (non-functional), SSM/T-2 (recorded and direct)	0900D/2100A	
DMSP F-13	OLS Imagery (recorded and direct), SSM/I, SSM/T-1	0549D/1749A	
DMSP F-14	OLS Imagery (recorded and direct), SSM/I, SSM/T-1 (inop) SSM/T-2	0845D/2045A	

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 of 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 6-3. 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) Weather Surveillance Radar-1988 Doppler (WSR-88D) facilities. Participating radar sites are listed in Table 7-1.

7.2. The WSR-88D. The WSR-88D is a computerized radar data collection and processing system. The design and implementation of the WSR-88D was a joint effort of the DOD, NWS, and FAA, and the utilization of the radar continues to be governed by a triagency agreement. The WSR-88D is a 750 kilowatt, S-band (10 cm), coherent radar, with a nominal beam width of 1 degree. The maximum data ranges are 248 nm (reflectivity) and 124 nm (velocity). Radar scanning strategies are selectable, using predetermined volume coverage patterns (VCP). The VCP selected depends upon which weather phenomena are under surveillance. Once collected, the radar data are processed automatically at the radar site by a suite of algorithms which provide graphical products for forecaster use. TPC/NHC, as an external user, obtains these products through a dial-up connection. CPHC controls and operates four WSR-88Ds in Hawaii and obtains the products directly.

7.3. Procedures. In order to perform radar center-fixing and obtain other diagnostic information, TPC/NHC must obtain radar products from WSR-88D sites in the area of landfall. As a tropical cyclone approaches, software commands must be issued at the site, using the Unit Control Position (UCP), in order for TPC/NHC to obtain the necessary products. To facilitate this process, TPC/NHC, in cooperation with the Operational Support Facility (OSF), has developed an operations plan for use during tropical cyclone events (see Appendix H for details). The plan is also available via facsimile from the OSF hotline at 1-800-643-3363. A formal agreement between the NWS and DOD on the use of the plan at DOD facilities is pending.

7.3.1. Radar Observation Requirements, WSR-88D. Chief among the requirements is the appropriate display of hurricane-force winds. The WSR-88D, with default settings, will not display winds greater than 64 kt. Changes must be made at the radar site in order to deal effectively with hurricane conditions; the procedures are detailed in Appendix H, "WSR-88D Operations Plan for Tropical Cyclone Events." The physical characteristics of the tropical cyclone are best represented by use of the precipitation mode, usually VCP 11 or 21, depending upon range. Radar characteristics of hurricanes are given in *Federal Meteorological Handbook No. 11 (FMH-11), Part B*, "Doppler Radar Theory and Meteorology," Chapter 9. Further discussion of product usage appears in *FMH-11, Part D*, "Unit Description and Operational Applications." A recommended product list appears in *FMH-11, Part D*, Chapter 4, Table 4-1 (Application versus Product).

Table 7-1. Participating radar stations[1]

LOCATION	RADAR TYPE	LATITUDE	LONGITUDE
	NATIONAL WEATHER SERVICE RADARS		
	U.S. Gulf and Atlantic Coasts		
Albany, NY	WSR-88D	42°35' N	74°04' W
Atlanta, GA	WSR-88D	33°22' N	84°34' W
Baton Rouge, LA	WSR-88D	30°20' N	89°49' W
Binghamton, NY	WSR-88D	42°12' N	75°59' W
Birmingham, AL	WSR-88D	33°10' N	86°46' W
Boston, MA	WSR-88D	41°57' N	71°08' W
Brownsville, TX	WSR-88D	25°55' N	97°25' W
Caribou, ME	WSR-88D	46°02' N	67°48' W
Charleston, SC	WSR-88D	32°33' N	80°47' W
Columbia, SC	WSR-88D	32°39' N	81°03' W
Corpus Christi, TX	WSR-88D	27°47' N	97°31' W
Ft. Worth, TX	WSR-88D	32°34' N	97°18' W
Greer, SC	WSR-88D	34°53' N	82°13' 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 Orleans, LA	WSR-88D	30°20' N	89°50' 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
Raleigh/Durham, NC	WSR-88D	35°40' N	78°29' W
Roanoke, VA	WSR-88D	37°01' N	80°16' W
San Antonio, TX	WSR-88D	30°43' N	97°23' 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
Wakefield, VA	WSR-88D	36°59' N	77°00' W
Wilmington, NC	WSR-88D	33°59' N	78°26' W

[1]The criterion for selection is that the radar site lie within approximately 124 nm (maximum velocity range) of the coastline.

Table 7-1. Participating radar stations (continued)

NATIONAL WEATHER SERVICE RADARS

U.S. Southwest

Phoenix, AZ	WSR-88D	33°17' N	111°40' W
San Diego, CA	WSR-88D	33°49' N	117°38' W
Tucson, AZ	WSR-88D	31°57' N	110°54' W
Yuma, AZ	WSR-88D	32°40' N	114°37' W

FAA RADARS

Molokai, HI	WSR-88D	21°08'N	157°11'W
Kohala, HI	WSR-88D	20°06'N	155°45'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

DEPARTMENT OF DEFENSE

U.S. Gulf and Atlantic Coasts

Dover AFB, DE	WSR-88D	38°50'N	75°26'W
Eglin AFB, FL	WSR-88D	30°34'N	85°55'W
Fort Hood, TX	WSR-88D	30°43'N	97°23'W
Fort Polk, LA	WSR-88D	31°09'N	92°58'W
Fort Rucker, AL	WSR-88D	31°28'N	85°28'W
Maxwell AFB, AL	WSR-88D	32°32'N	85°47'W
Moody AFB, GA	WSR-88D	30°33'N	83°00'W
Robins AFB, GA	WSR-88D	32°40'N	83°21'W

(NHC has dial-in access to the above DOD sites.)

7.3.2. Central Region Report. The following fix definitions and criteria are used in reporting WSR-88D tropical cyclone radar observations:

- If the central region of a storm is defined by an identifiable circular, or nearly circular, wall cloud with an echo-free center, the fix (the geometric center) is reported as an "**EYE.**"

- If the central region is recognizable, but not well defined by a wall cloud (as in the case of a tropical storm) , 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, and will be classified as either "good," "fair," or "poor." If an eye is present, 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." Note that a partial eyewall may be the result of excessive range from the radar or represent the true structure of the system. Doppler velocities will, in general, increase confidence in the center position, and if available, should always be examined prior to establishing a fix.

7.3.3. Transmission of Radar Reports. When the tropical cyclone is within 200 nm of a WSR-88D and the center fix is considered reliable, the appropriate tropical cyclone warning center (TPC/NHC or CPHC) may issue a tropical cyclone position estimate (AFOS category TCE) between 2-hourly intermediate advisories. Note that although the issuance of this product depends upon the quality of the radar fix, other data sources such as aircraft reconnaissance may be blended with the radar estimate to obtain a position. Thus, a radar position established on one particular radar may appear to disagree with the TCE position but has, in fact, been taken into consideration.

In the case of communications failure and/or an event that prevents the TPC/NHC from obtaining the necessary radar data, the local National Weather Service Office may be called upon to estimate the radar position and render a qualitative assessment of the circulation. Other radar facilities not having weather transmission capability, but wishing to provide information deemed important, should call the nearest National Weather Service Office or the TPC/NHC.

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, in the coastal and offshore areas of the Atlantic and Pacific Oceans, and in the Great Lakes. 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 network in the Gulf of Mexico and along the southeast U.S. coast. The operational status and measurement capability of stations can be obtained from NDBC Program Management Division, Building 1100, Stennis Space Center, MS 39529-6000, phone 228-688-1720, or on-line via NDBC's Internet home page at http://www.ndbc.noaa.gov.

8.1.2. Data Acquisition. Moored buoy and C-MAN stations routinely acquire, store, and transmit data every hour; a few selected stations report every half hour. Data obtained operationally include sea-level pressure, wind speed and direction, peak wind, and air temperature. Sea-surface temperature and wave spectra data are measured by all moored buoys and a limited number of C-MAN stations. Relative humidity is also measured at several stations.

8.1.3. Drifting Buoys. If funding permits, a limited number of NDBC wind speed and direction (WSD) drifting buoys may be available in 1999 for strategic deployment in advance of storms. WSDs measure sea-level pressure, wind speed and direction, air temperature, and sea-surface temperature (Figure 8-5). Asynoptic reports are collected through Polar Orbiting Environmental Satellites (POES) and distributed in near-real time.

8.2. Requests for Drifting Buoy Deployment. If funding permits in 1999, NDBC will maintain a very small inventory of drifting buoys for rapid response deployment ahead of tropical cyclones. If such a mission is required, the Department of Commerce (DOC), through the National Oceanic and Atmospheric Administration (NOAA), will initiate a request through the Office of the Federal Coordinator for Meteorology (OFCM). The request for support will then be sent to the 53rd Weather Reconnaissance Squadron (53 WRS) through HQ Air Force Reserve Command (AFRC). For deployments in advance of a U.S. land-threatening hurricane, a 36- to 48-hour notification is required. All requests will include specific information, regarding onloading base, accompanying technicians, desired pickup times, offload points, reimbursement funding, and other pertinent data.

Table 8-1. Moored buoy locations and configurations

SITE	STATION ID	LOCATION	HULL SIZE (m)	ANEMOMETER HEIGHT (m)
GULF OF MEXICO	42001	25.9°N 89.7°W	10	10
	42002	25.9°N 93.6°W	10	10
	42003	25.9°N 85.9°W	10	10
	42007[1]	30.1°N 88.8°W	3	5
	42019[1]	27.9°N 95.4°W	3	5
	42020[1]	26.9°N 96.7°W	3	5
	42035[1]	29.2°N 94.4°W	3	5
	42036[1]	28.5°N 84.5°W	3	5
	42039[1]	28.8°N 86.0°W	3	5
	42040[1]	29.2°N 88.3°W	3	5
ATLANTIC OCEAN	41001	34.7°N 72.6°W	6	5
	41002	32.3°N 75.2°W	6	5
	41004[1]	32.5°N 79.1°W	3	5
	41008	31.4°N 80.9°W	3	5
	41009[1]	28.5°N 80.2°W	3	5
	41010[1]	28.9°N 78.5°W	6	5
	44004	38.5°N 70.7°W	6	5
	44005	42.9°N 68.9°W	6	5
	44007[1]	43.5°N 70.1°W	3	5
	44008	40.5°N 69.4°W	3	5
	44009	38.5°N 74.7°W	3	5
	44011[1]	41.1°N 66.6°W	6	5
	44013[1]	42.4°N 70.7°W	3	5
	44014[1]	36.6°N 74.8°W	3	5
	44025[1]	40.3°N 73.2°W	3	5
PACIFIC OCEAN (SOUTH OF 45°N)	46002	42.5°N 130.4°W	6	5
	46006	40.9°N 137.5°W	6	5
	46011[1]	34.9°N 120.9°W	3	5
	46012[1]	37.4°N 122.7°W	3	5
	46013[1]	38.2°N 123.3°W	3	5
	46014[1]	39.2°N 124.0°W	3	5
	46022[1]	40.8°N 124.5°W	3	5
	46023[1]	34.7°N 121.0°W	3	5
	46025[1]	33.8°N 119.1°W	3	5
	46026[1]	37.8°N 122.8°W	3	5
	46027[1]	41.9°N 124.4°W	3	5
	46028[1]	35.7°N 121.9°W	3	5
	46030[1]	40.4°N 124.5°W	3	5
	46042[1]	36.8°N 122.4°W	3	5
	46045[1]	33.8°N 118.4°W	3	5
	46050[1]	44.6°N 124.5°W	3	5
	46053[1]	34.2°N 119.8°W	3	5
	46054[1]	34.3°N 120.4°W	10	10
	46059[1]	38.0°N 130.0°W	6	5
	46062[1]	35.1°N 121.0°W	10	10
	46063[1]	34.3°N 120.7°W	6	5
	51001	23.4°N 162.3°W	6	6
	51002	17.2°N 157.8°W	6	6
	51003	19.1°N 160.8°W	6	6
	51004	17.4°N 152.5°W	6	5
	51028[1]	0.0°N 152.5°W	3	5

[1]Temporary site established with other special funding.

Table 8-2. C-MAN sites

SITE	STATION ID	LOCATION	STATION NAME
GULF OF MEXICO	BURL1	28.9°N 89.4°W	Southwest Pass, LA
	CDRF1[1]	29.1°N 83.0°W	Cedar Key, FL
	CSBF1	29.7°N 85.4°W	Cape San Blas, FL
	DPIA1	30.3°N 88.1°W	Dauphin Island, AL
	DRYF1[1]	24.6°N 82.9°W	Dry Tortugas, FL
	GDIL1	29.3°N 90.0°W	Grand Isle, LA
	KTNF1[1]	29.8°N 83.6°W	Keaton Beach, FL
	LONF1[1]	24.8°N 80.9°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
ATLANTIC OCEAN	ALSN6	40.5°N 73.8°W	Ambrose Light, NY
	BUZM3	41.4°N 71.0°W	Buzzards Bay, MA
	CHLV2	36.9°N 75.7°W	Chesapeake Light, VA
	CLKN7	34.6°N 76.5°W	Cape Lookout, NC
	DSLN7	35.2°N 75.3°W	Diamond Shoals, NC
	DUCN7	36.2°N 75.8°W	Duck Pier, 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
	SANF1[1]	24.5°N 81.9°W	Sand Key, FL
	SAUF1	29.9°N 81.3°W	St. Augustine, FL
	SMKF1	24.6°N 81.1°W	Sombrero Key, FL
	SPGF1	26.7°N 79.0°W	Settlement Point, GBI
	TPLM2	38.9°N 76.4°W	Thomas Point, MD
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 with other special funding.

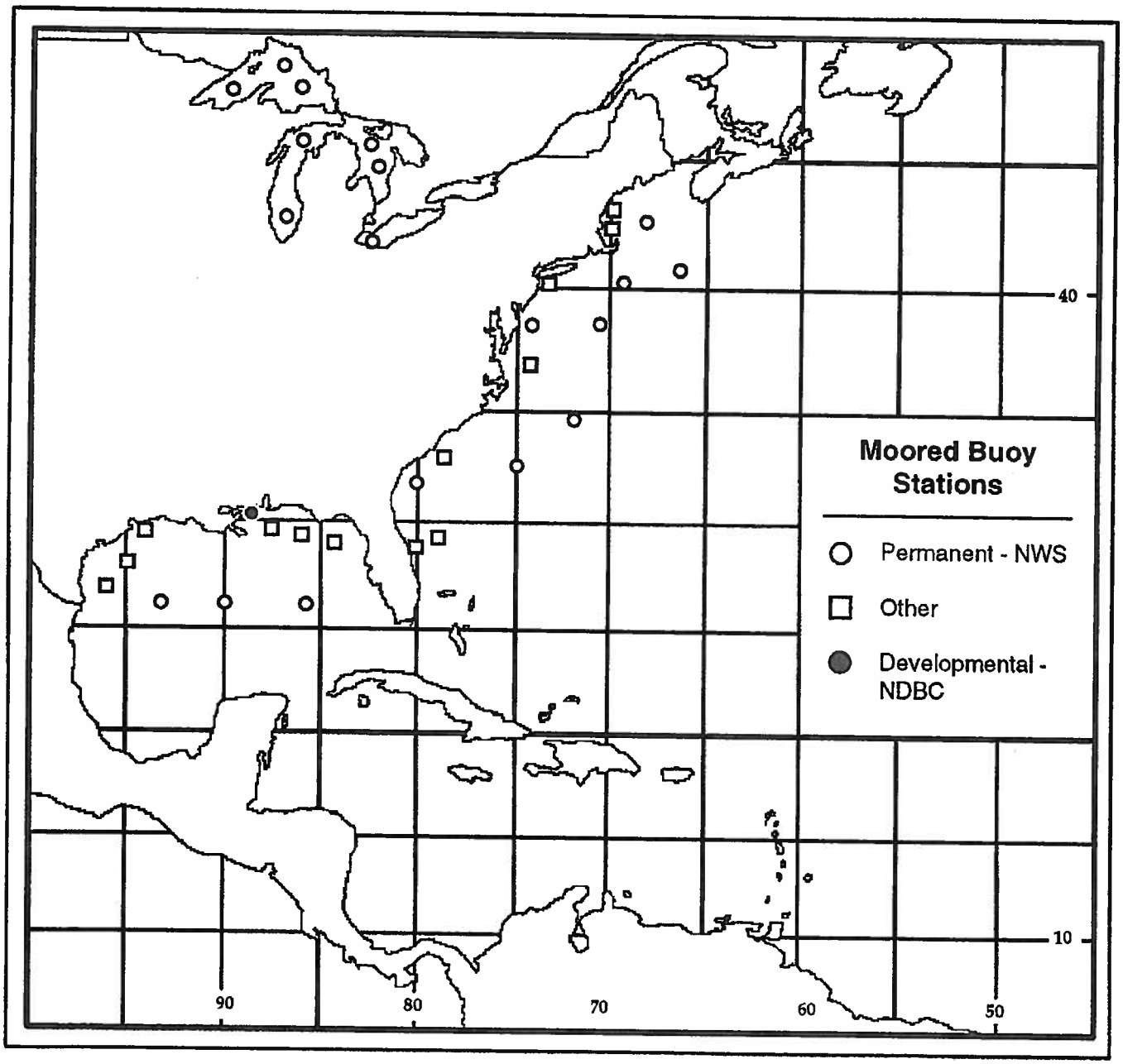

Figure 8-1. NDBC moored buoys in the Atlantic Ocean, the Gulf of Mexico, and the Great Lakes

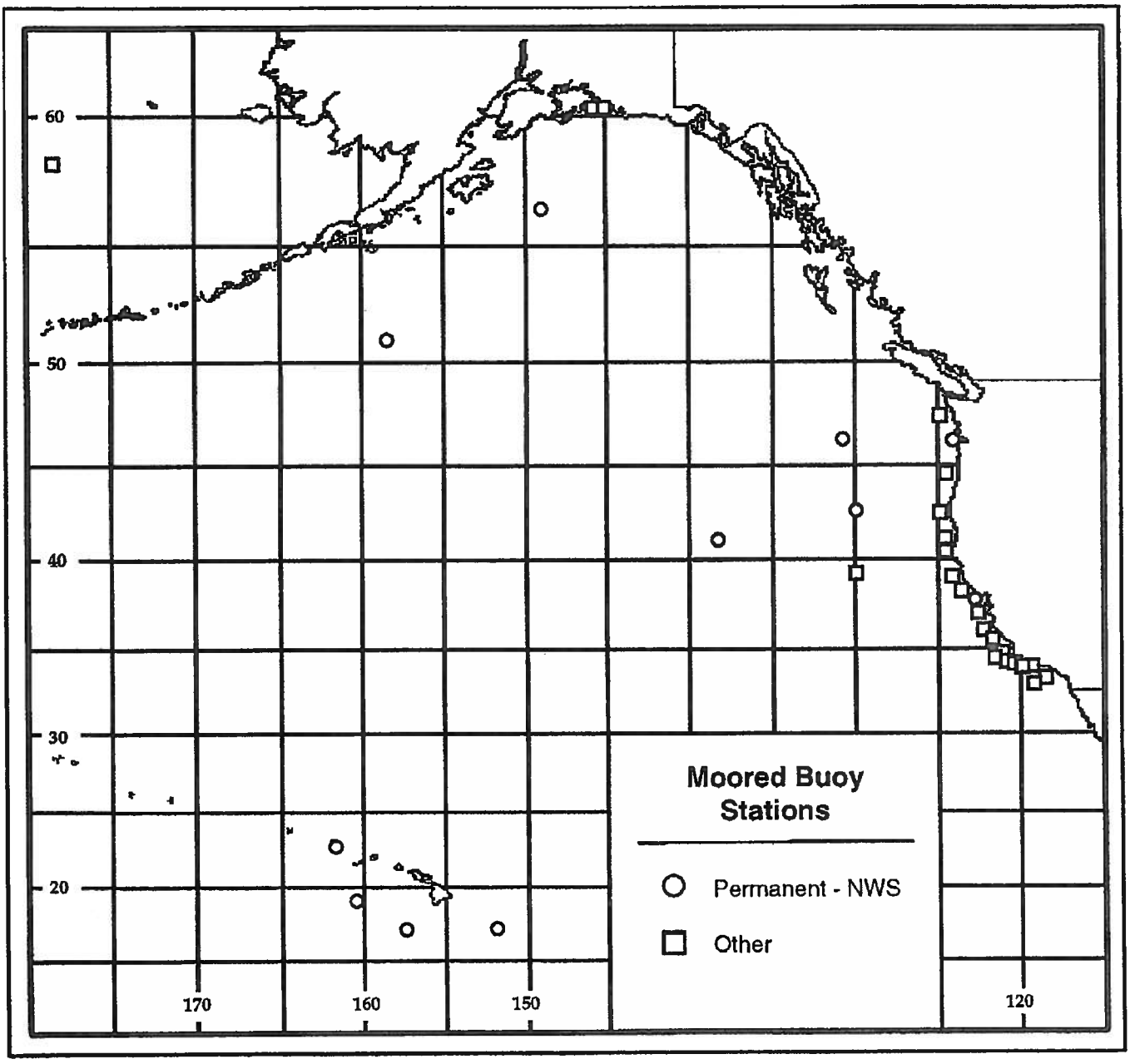

Figure 8-2. NDBC moored buoys in the Pacific Ocean

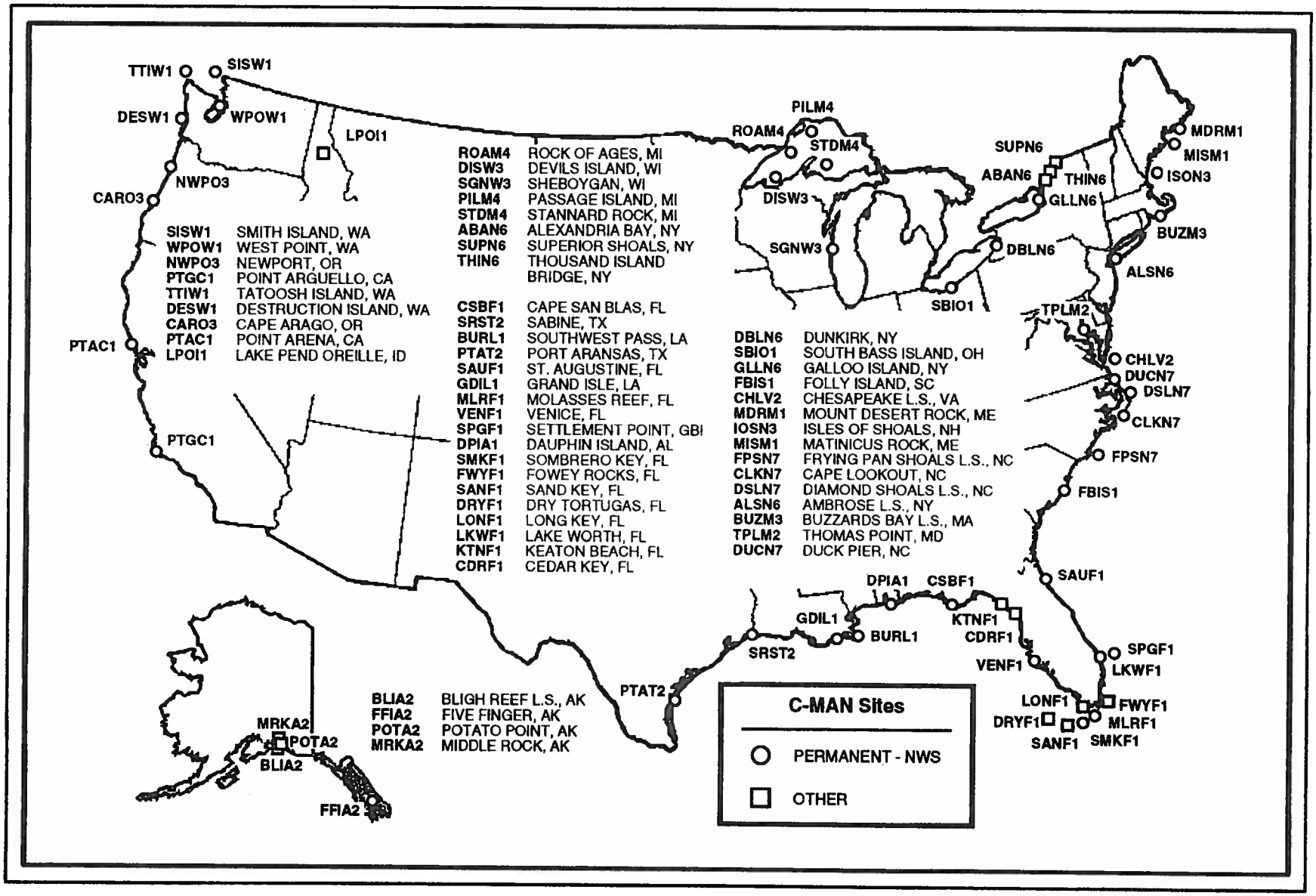

Figure 8-3. C-MAN stations in the coastal U.S.

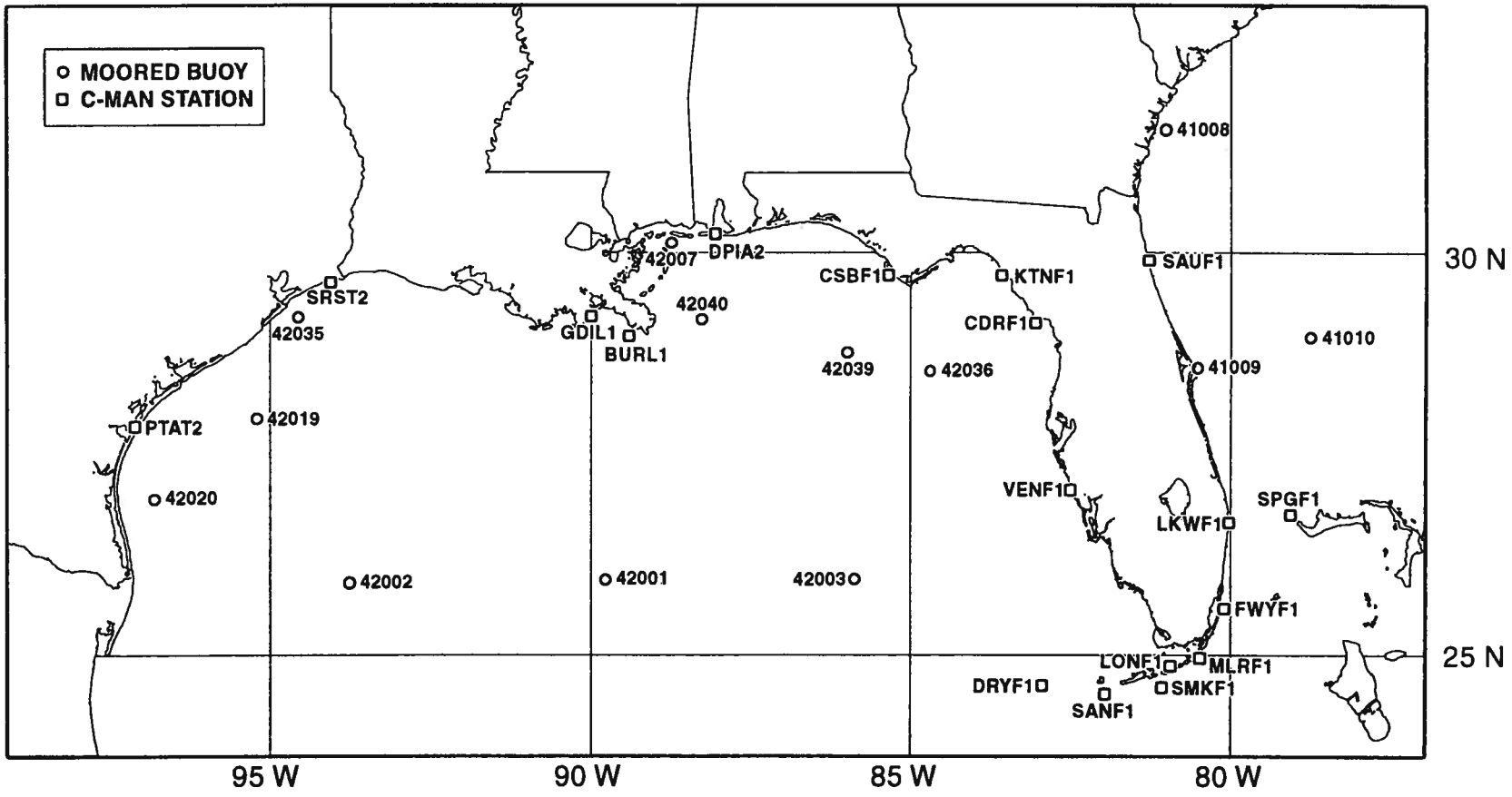

Figure 8-4. NDBC planned and current Gulf of Mexico moored buoy network

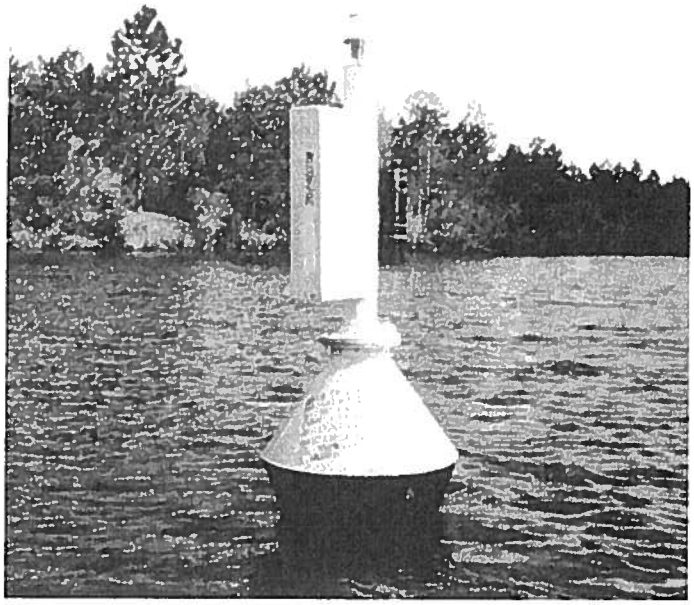

Figure 8-5. A wind speed and direction (WSD) drifting buoy

8.2.1. Tropical Prediction Center/National Hurricane Center (TPC/NHC). TPC/NHC 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 14 hours prior to the event via the TCPOD.

8.2.2. Deployment Buoys. DOC may request the deployment of up to four drifting buoys between 185 and 333 km (100 and 180 nm) from the storm center, depending on the dynamics of the storm system. DOC will ensure the buoys and mission-related DOC personnel are available for pickup by AFRC 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 before 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 ultrahigh frequency communications via the Geostationary Operational Environmental Satellite (GOES) to the National Environmental Satellite, Data, and Information Service (NESDIS) and then are relayed to the NWS Telecommunications Gateway (NWSTG) for processing and dissemination. Moored buoy observations are formatted into the World Meteorological Organization (WMO) FM 13-IX SHIP code. The SHIP code is defined in Federal Meteorological Handbook No. 2, Surface Synoptic Codes. C-MAN measurements are formatted into C-MAN code, which is very similar to the WMO FM 12-IX SYNOP code. 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. Drifting buoy data are telemetered through the NOAA polar orbiting satellites to the U.S. Argos Global Processing Center, Largo, MD. Service Argos processes and formats the data into the WMO FM 18 BUOY code defined in the WMO *Manual on Codes*, Volume I. The messages are then routed to the NWSTG for distribution.

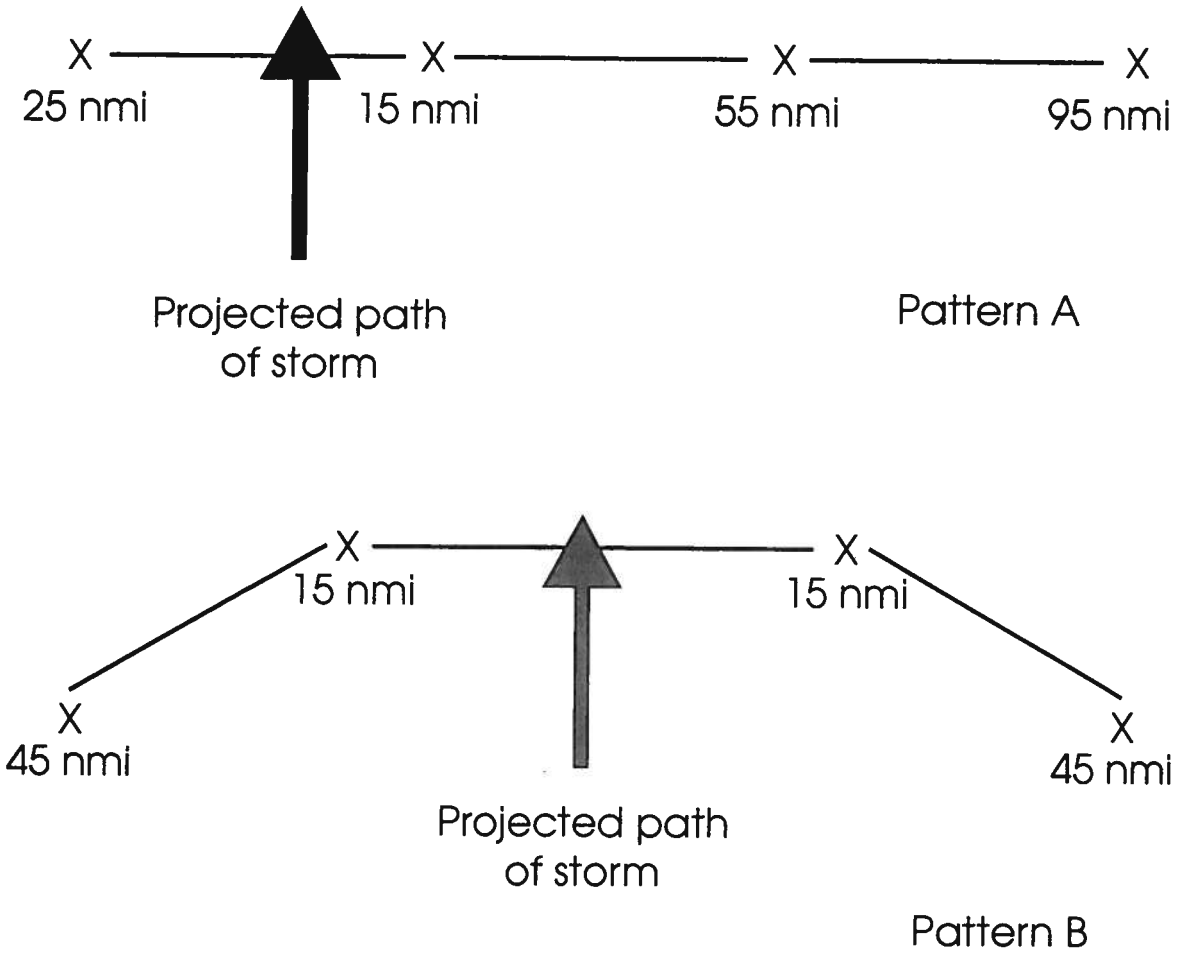

Figure 8-6. Drifting data buoy deployment patterns

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

FORM	CODE
FM 13-IX (SHIP) REPORT OF SYNOPTIC SURFACE OBSERVATION FROM A SEA STATION (AUTOMATIC WEATHER STATION)	$M_iM_iM_jM_j$ $A_1b_wn_bn_bn_b$ YYGGi_w 99$L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ i_ri_x/// /ddff 1s_nTTT (2$s_nT_dT_dT_d$) 4PPPP 5appp 9GGgg 22200 Q$s_sT_wT_wT_w$ 1$P_{wa}P_{wa}H_{wa}H_{wa}$ 70 $H_{wa}H_{wa}H_{wa}$ 8$s_wT_bT_bT_b$ 333 912ff (00fff) 555 11fff 22fff (3GGgg 4ddf_mf_m) (6$G_cG_cg_cg_c$ $d_1d_1d_1f_1f_1f_1$ $d_6d_6d_6f_6f_6f_6$) $d_2d_2d_2f_2f_2f_2$ $d_3d_3d_3f_3f_3f_3$ $d_4d_4d_4f_4f_4f_4$ $d_5d_5d_5f_5f_5f_5$
U.S. NATIONAL (C-MAN LAND STATION) MODIFIED FM 12-IX	CMAN YYGGi_w XXXXn_t i_Ri_xhVV Nddff (00fff) 1s_nTTT 2$s_nT_dT_dT_d$ 4PPPP 5appp 6RRRt_R 9GGgg 222// 0$s_nT_wT_wT_w$ 1$_{wa}P_{wa}P_{wa}H_{wa}H_{wa}$ 70$H_{wa}H_{wa}H_{wa}$ 333 912ff (00fff) 444 1$P_{av}P_{av}P_{av}$/ 555 11fff 22fff (3GGgg) (4dd$f_mf_mf_m$) (6$G_cG_cg_cg_c$ $d_1d_1d_1f_1f_1f_1$ $d_6d_6d_6f_6f_6f_6$) $d_2d_2d_2f_2f_2f_2$ (TIDE1111) $d_3d_3d_3f_3f_3f_3$ $d_4d_4d_4f_4f_4f_4$ $d_5d_5d_5f_5f_5f_5$
FM 18 BUOY REPORT OF A DRIFTING BUOY OBSERVATION	Section 0: ZZYY $Q_cL_aL_aL_aL_aL_a$ $A_1b_wn_bn_bn_b$ $L_0L_0L_0L_0L_0L_0$ YYMMJ (6Q_1Q_t//) GGggi_w Section 1: 111Q_dQ_x Oddff ((2$s_nT_dT_dT_d$) (3$P_oP_oP_oP_o$) or (1s_nTTT) (29UUU)) (4PPPP) (5appp) Section 2: 222Q_dQ_x (0$S_nT_wT_wT_w$) (20$P_{wa}P_{wa}P_{wa}$) (1$P_{wa}P_{wa}H_{wa}H_{wa}$) (21$H_{wa}H_{wa}H_{wa}$) Section 3: 333$Q_{d1}Q_{d2}$ (8887k_2 $2z_0z_0z_0z_0$ $3T_0T_0T_0T_0$ $4S_0S_0S_0S$ .... $2z_nz_nz_nz_n$ $3T_nT_nT_nT_n$ $4S_nS_nS_nS_n$) (66$k_6$9k_3 $2z_0z_0z_0z_0$ $d_0d_0c_0c_0c_0$ .... $2z_nz_nz_nz_n$ $d_nd_nc_nc_nc_n$) Section 4: 444 (($Q_cL_aL_aL_aL_aL_a$ (7$V_BV_Bd_Bd_B$) (1$Q_pQ_2Q_{tw}Q_4$) $L_0L_0L_0L_0L_0L_0$) (8$V_iV_iV_iV_i$) or (2Q_nQ_L//) (YYMMJ GGgg/)) (9$i_dZ_dZ_dZ_dZ_d$)

CHAPTER 9

MARINE WEATHER BROADCASTS

9.1. General. The Department of Transportation's United States Coast Guard (USCG) broadcasts forecast products that include information on tropical cyclones issued by the National Hurricane Center and the Central Pacific Hurricane Center. The broadcast of these products supports the U.S. participation in the Global Maritime Distress and Safety System, which provides the communications support to the International Maritime Organization's (IMO) global search and rescue plan.

9.2. Global Maritime Distress and Safety System (GMDSS). The goals of GMDSS are to provide more effective and efficient emergency and safety communications, and to disseminate maritime safety information to all ships on the world's oceans regardless of location or atmospheric conditions. These goals are defined in the International Convention for the Safety of Life at Sea (SOLAS) 1974, as amended in 1988. GMDSS is based upon a combination of satellite and terrestrial radio services and has changed international distress communications from being primarily ship-to-ship based to ship-to-shore (rescue coordination center) based. GMDSS provides for automatic distress alerting and locating, and requires ships to receive broadcasts of maritime safety information which could prevent a distress from happening in the first place. GMDSS consists of many separate systems which are being implemented in a coordinated and agreed-upon manner. The NWS participates directly in the GMDSS by preparing weather forecasts and warnings for broadcast via two primary GMDSS systems--NAVTEX and Inmarsat-C SafetyNET.

9.2.1. NAVTEX. NAVTEX is an international, automated system for instantly distributing maritime navigational warnings, weather forecasts and warnings, search and rescue notices, and similar information to ships. It has been designated by the IMO as the primary means for transmitting coastal urgent marine safety information to ships worldwide. NAVTEX is broadcast from the USCG facilities listed in Table 9.1. Coverage is reasonably continuous along the east, west, and Gulf coasts of the United States, as well as the area around Kodiak, Alaska, Guam, and Puerto Rico. Typical NAVTEX transmissions range from 200-400 nm.

9.2.2. SafetyNET. Satellite systems operated by the International Mobile Satellite Organization (Inmarsat) are an important element of the GMDSS. Inmarsat-C provides ship/shore, shore/ship, and ship/ship store-and-forward data and telex messaging; the capability for sending preformatted messages to a rescue coordination center; and the SafetyNET service. The Inmarsat-C SafetyNET service is a satellite-based worldwide maritime safety information broadcast service of high seas weather warnings, navigational warnings, radionavigation warnings, ice reports and warnings generated by USCG-conducted International Ice Patrol, and other information not provided by NAVTEX.

9.3. Coastal Maritime Safety Broadcasts. In addition to NAVTEX, the USCG and other government agencies broadcast maritime safety information, using a variety of different radio systems to ensure coverage of different ocean areas for which the United States has responsibility and to ensure all ships of every size and nationality can receive this vital safety information.

9.3.1. VHF Marine Radio. The USCG broadcasts nearshore and storm warnings of interest to the mariner on VHF channel 22A (157.1 MHz) following an initial call on the distress, safety, and calling channel 16 (156.8 MHz). Broadcasts are made from over 200 sites, covering the coastal areas of the U.S., including the Great Lakes, major inland waterways, Puerto Rico, Alaska, Hawaii, and Guam. All ships in U.S. waters over 20 meters in length are required to monitor VHF channel 16 and must have radios capable of tuning to the VHF simplex channel 22A. Typical coverage is 25 nm offshore.

9.3.2. Medium Frequency Radiotelephone (Voice). The USCG broadcasts offshore forecasts and storm warnings of interest to mariners on 2670 kHz, after first being announced on the distress, safety, and calling frequency 2182 kHz.

9.3.3. NOAA Weather Radio. The NOAA Weather Radio network continually broadcasts coastal and marine forecasts on frequencies near 162 MHz. Recorded voice broadcasts are in the process of transitioning to voice synthesis. The network provides near-continuous coverage of the coastal U.S., Great Lakes, Hawaii, Guam, and the populated Alaska coastline. Typical coverage is 25 nm offshore.

9.4. High Seas Broadcasts. NWS high seas weather forecasts and warnings are also available on the following high frequency (HF) broadcasts.

9.4.1. HF Radiotelephone (Voice). Weather forecasts and warnings for the high seas are broadcast over scheduled HF radiotelephone channels from USCG communications stations using a very distinctive and recognizable computer-synthesized voice. Limited offshore forecasts are also available.

9.4.2. HF Radiofacsimile. The USCG broadcasts NWS high seas weather maps from five communications stations--Boston, MA (NMF); Point Reyes, CA (NMC); New Orleans, LA (NMG), Honolulu, HI (KVM-70) (a DOD station); and Kodiak, AK (NOJ). Limited satellite imagery, sea surface temperature maps, and text forecasts are also available.

9.4.3. HF Radiotelex (HF SITOR). High seas forecasts in text format, recognized by the GMDSS, are broadcast over scheduled GMDSS HF narrow-band direct printing channels from USCG communications stations. Limited offshore forecasts are also available.

9.4.4. WWV, WWVH HF Voice (Time Tick). Atlantic high seas warnings are broadcast at 7 and 8 minutes past the hour over WWV (Boulder, CO) on the following HF frequencies: 2.5, 5, 10, 15, and 20 MHz; Pacific high seas warnings are broadcast at 9 minutes past the hour. Pacific high seas warnings are broadcast from 48-51 minutes past the hour over WWVH (Honolulu, HI) at 2.5, 5, 10, and 15 MHz. These are the National Institute of Standards and Technology (NIST) standard time/frequency broadcasts.

9.5. Additional Information. Further information concerning these broadcasts can be found at the following Internet sites--http://www.navcen.uscg.mil/marcomms/marcomms.htm and http://weather.noaa.gov/fax/marine.shtml. In addition, NIMA Publication 117 contains detailed information on USCG radio schedules. This publication is available from your local National Ocean Service chart agent; it can also be ordered by calling 1-800-638-8972 or 301-436-8301 or by visiting the Internet site at http://chartmaker.ncd.noaa.gov. The cost is $18.10.

Table 9-1. U.S. NAVTEX Stations

STATION IDENTIFIERS	LOCATION
NMF	Boston, MA
NMN	Chesapeake, VA
NMA	Miami, FL
NMR	San Juan, PR
NMG	New Orleans, LA
NMC	Point Reyes, CA
NMC	Cambria, CA
NMC	Astoria, WA
NOJ	Kodiak, AL
NMO	Honolulu, HI
NRV	Guam

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 Command (AFRC/PA)
  Robins AFB, GA 31093

- The Joint Chiefs of Staff (J3/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	Automatic Digital Weather Switch
AFB	Air Force Base
AFMEDS	Air Force Meteorological Data System (replaced COMEDS)
AFOS	Automation of Field Operations and Services
AFRC	Air Force Reserve Command
AFSATCOM	Air Force Satellite Communications System
AIM	Airman's Information Manual
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
APUP	Associated Principal User Processor (WSR-88D)
ASDL	Aircraft-to-Satellite Data Link
ATC	Air Traffic Control
ATCSCC	Air Traffic Control System Command Center
AVHRR	Advanced Very High Resolution Radiometer
AWN	Automated Weather Network

-C-

CARCAH	Chief, Aerial Reconnaissance Coordination, All Hurricanes
CARF	Central Altitude Reservation Function
C.I.	Current Intensity
C-MAN	Coastal-Marine Automated Network
COM	Commercial (telephone)
CONUS	Continental United States
CPHC	Central Pacific Hurricane Center
°C	degree/degrees Celsius

-D-

DA	Daylight Ascending
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
DROP	dropsonde/dropwindsonde
DSN	Defense Switched Network (formerly AUTOVON)
DTG	date/time group

-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
FNMOC	Fleet Numerical Meteorology and Oceanography Center (USN)
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
HDOB	High Density Observation
HF	High Frequency
hPa	hectopascal/hectopascals
h	hour/hours
HNL	Honolulu (CPHC)
HPC	Hydrometeorological Prediction Center (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
KNHC	ICAO identifier for the Tropical Prediction Center/National Hurricane Center, Miami, FL
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
MOU	Memorandum of Understanding
MPC	Marine Prediction Center (NCEP)
mph	mile/miles per hour
MVMT	movement

-N-

NAPUP	Non-associated Principal User Processor (WSR-88D)
NASA	National Aeronautics and Space Administration
NAVLANTMETOCCEN	Naval Atlantic Meteorology and Oceanography Center
NAVLANTMETOCDET	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 Centers 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
nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration
NOM	National Operations Manager (FAA)
NSC	NOAA Science Center
NSTL	National Space Technology Laboratories (NASA)
NWS	National Weather Service

-O-

OAC	Oceanic Aircraft Coordinator (USN)
OB	observation
OFCM	Office of the Federal Coordinator for Meteorological Services and Supporting Research
OSF	Operational Support Facility (WSR-88D)
OSS	Operations Support Squadron (USAF)

-P-

PA	Public Affairs
PANC	ICAO identifier for Anchorage, AK
PCN	Position Confidence Number
PHNL	ICAO identifier for Honolulu, HI
POD	Plan of the Day
POES	Polar Orbiting Environmental Satellite
PRF	pulse repetition frequency (WSR-88D)

-R-

RECCO	Reconnaissance Code
RECON	reconnaissance
REQT	requested
RPS	routine product set (WSR-88D)
RSMC	Regional/Specialized Meteorological Center (WMO)

-S-

SAB	Synoptic Analysis Branch
SFC	surface
SFDF	Satellite Field Distribution Facility
SLP	Sea Level Pressure
SSM/I	Mission Sensor Microwave Imager (DMSP)
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)
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-

UCP	unit control position (WSR-88D)
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
VCP	volume coverage pattern (WSR-88D)
VDM	Vortex Data Message
VDUC	VAS Data Utilization Center
VIS	Visible
VISSR	Visible and Infrared Spin Scan Radiometer
VMI	velocity measurement increment (WSR-88D)
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-88D	Weather Surveillance Radar-1988 Doppler
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.

Air Traffic Control System Command Center (ATCSCC). The facility responsible for the real-time command, control, and oversight of air traffic activity within the National Airspace System. The ATCSCC is a 24 hour a day, 7 day a week operation.

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.

Controlled Airspace. An airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification.

a. Controlled airspace is a generic term that covers Class A, Class B, Class C, Class D, and Class E airspace.

b. Controlled airspace is also that airspace within which all aircraft operators are subject to certain pilot qualifications, operating rules, and equipment requirements in FAR Part 91 (for specific operating requirements, please refer to FAR Part 91). For IFR operations in any class of controlled airspace, a pilot must file an IFR flight plan and receive an appropriate ATC clearance. Each Class B, Class C, and Class D airspace area designated for an airport contains at least one primary airport around which the

airspace is designated (for specific designations and descriptions of the airspace classes, please refer to FAR Part 71).

c. Controlled airspace in the United States is designated as follows:

CLASS A: Generally, that airspace from 18,000 feet MSL up to and including FL 600, including the airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous States and Alaska. Unless otherwise authorized, all persons must operate their aircraft under IFR.

CLASS B: Generally, that airspace from the surface to 10,000 feet MSL surrounding the nations's busiest airports in terms of airport operations or passenger enplanements. The configuration of each Class B airspace area is individually tailored and consists of a surface area and two or more layers (some Class B airspaces areas resemble upside-down wedding cakes), and is designed to contain all published instrument procedures once an aircraft enters the airspace. An ATC clearance is required for all aircraft to operate in the area, and all aircraft that are so cleared receive separation services within the airspace. The cloud clearance requirement for VFR operations is "clear of clouds."

CLASS C: Generally, that airspace from the surface to 4,000 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and that have a certain number of IFR operations or passenger enplanements. Although the configuration of each Class C area is individually tailored, the airspace usually consists of a surface area with a 5 nautical mile (NM) radius, an outer circle with a 10 NM radius that extends from 1,200 feet to 4,000 feet above the airport elevation and an outer area. Each person must establish two-way radio communications with the ATC facility providing air traffic services prior to entering the airspace and thereafter maintain those communications while within the airspace. VFR aircraft are only separated from IFR aircraft within the airspace. (See OUTER AREA).

CLASS D: Generally, that airspace from the surface to 2,500 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower. The configuration of each Class D airspace area is individually tailored and when instrument procedures are published, the airspace will normally be designed to contain the procedures. Arrival extensions for instrument approach procedures may be Class D or Class E airspace. Unless otherwise authorized, each person must establish two-way radio communications with the ATC facility providing air traffic services prior to entering the airspace and thereafter maintain those communications while in the airspace. No separation services are provided to VFR aircraft.

CLASS E: Generally, if the airspace is not Class A, Class B, Class C, or Class D, and it is controlled airspace, it is Class E airspace. Class E airspace extends upward from either the surface or a designated altitude to the overlying or adjacent controlled airspace. When designated as a surface area, the airspace will be configured to contain all instrument

procedures. Also in this class are Federal airways, airspace beginning at either 700 or 1,200 AGL used to transition to/from the terminal or en route environment, en route domestic, and offshore airspace areas designated below 18,000 feet MSL. Unless designated at a lower altitude, Class E airspace begins at 14,500 MSL over the United States, including that airspace overlying the waters within 12 nautical miles of the 48 contiguous States and Alaska, up to, but not including 18,000 MSL, and the airspace above FL 600.

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. An airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification. (*Note: Controlled airspace is a generic term which covers Air Traffic Service airspace Classes A, B, C, D, and E*).

-M-

Major Hurricane. A "major" hurricane is one that is classified as a Category 3 or higher.

Micronesia. An area defined by the Commonwealth of the Northern Marianas Islands, the Republic of Palau, the Federated States of Micronesia, and the Republic of the Marshall Islands.

Miles. The term "miles" used in this plan refers to nautical miles (nm) 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 Operations Manager. Supervisor in charge of the overall operation of the Air Traffic Control System Command Center.

-P-

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.

Super Typhoon. A "super" typhoon is one that is classified as having winds of 130 kts (150 mph) or greater.

Sustained Surface Wind. The 1-minute averaged wind at the 10-meter elevation with an unobstructed exposure.

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-

Traffic Management Specialist. ATCSCC personnel responsible for the active management of traffic throughout the National Airspace System.

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.

-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 Command (AFRC) and the National Oceanic and Atmospheric Administration (NOAA), dated May 4, 1992; Letter of Agreement (LOA) between the AFRC, Federal Aviation Administration (FAA) and NOAA, dated February 16, 1996; and a Letter of Agreement (LOA) between the AFRC and NOAA Corps Air Operations, dated August 3, 1993. The purpose of these MOAs and LOAs is to establish policies, principles, and procedures under which the FAA, AFRC and NOAA Corps will provide aircraft weather reconnaissance to NOAA.

MEMORANDUM OF AGREEMENT

BETWEEN

THE UNITED STATES AIR FORCE RESERVE

AND

THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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

1. REFERENCES:

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

b. National Hurricane Operations Plan (NHOP)

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

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

4. GENERAL PROVISION:

a. AFRES agrees:

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

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

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

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

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

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

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

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

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

FOR THE UNITED STATES
AIR FORCE RESERVE

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

Date 16 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
Distribution List

APPENDIX D

SAFFIR-SIMPSON HURRICANE SCALE

Saffir/Simpson Hurricane Scale (SSHS). A scale ranging from one to five based on the hurricane's present intensity. This can be used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane. This scale may be used in public hurricane releases although the SSHS may not be applicable for all geographical areas; e.g., Hawaii and Guam. In practice, sustained surface wind speed (1-minute average) is the parameter that determines the category since storm surge is strongly dependent on the slope of the continental shelf.

ONE. Winds 74-95 mph (64-82 kts). No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage.

TWO. Winds 96-110 mph (83-95 kts). Some roofing material, door, and window damage of buildings. Considerable damage to vegetation and mobile homes. Flooding damages piers, and small craft in unprotected anchorages break moorings.

THREE. Winds 111-130 mph (96-113 kts). Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures with larger structures damaged by floating debris. Terrain may be flooded well inland.

FOUR. Winds 131-155 mph (114-135 kts). More extensive curtainwall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland.

FIVE. Winds greater than 155 mph (>135 kts). Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required.

Note 1: A "major" hurricane is one that is classified as a Category 3 or higher.

APPENDIX E

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 F

SEA-LEVEL PRESSURE EXTRAPOLATION TABLES

Table F-1. Surface pressure as a function of 925 hPa heights and temperatures

	925 hPa Temperature (°C)								
Heights	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 F-2. 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 F-3. 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.

APPENDIX G

RECCO, HDOB, MINOB, AND TEMP DROP

CODES, TABLES, AND REGULATIONS

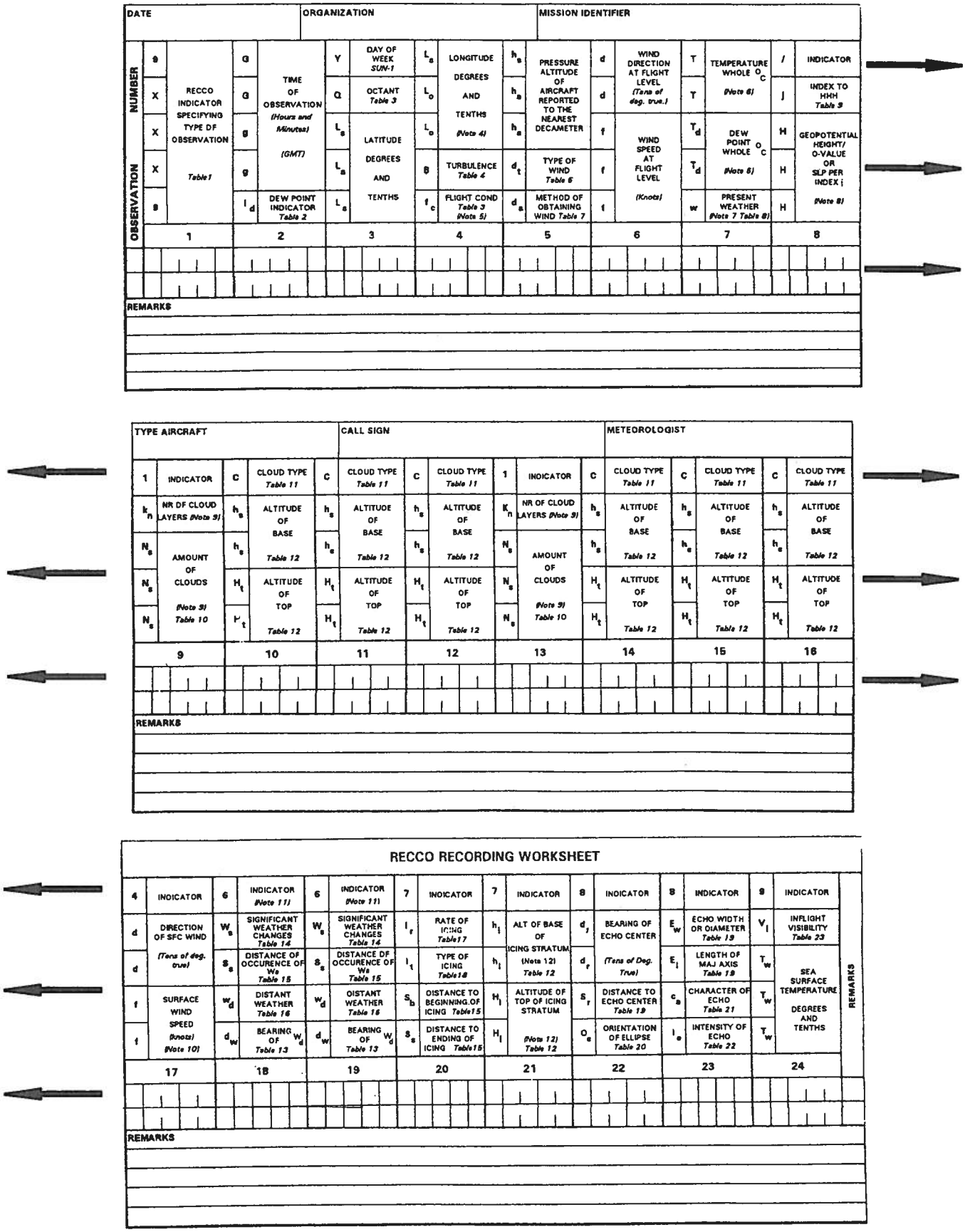

Figure G-1. Reconnaissance code recording form

Table G-1. Reconnaissance code tables

TABLE 1 XXX

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

0 Sea level pressure in whole millibars (thousands fig if any omitted)
1 Altitude 200 mb surface in geopotential decameters (thousands fig if any omitted)
2 Altitude 850 mb surface in geopotential meters (thousands fig omitted)
3 Altitude 700 mb surface in geopotential meters (thousands fig omitted)
4 Altitude 500 mb surface in geopotential decameters
5 Altitude 400 mb surface in geopotential decameters
6 Altitude 300 mb surface in geopotential decameters
7 Altitude 250 mb surface in geopotential decameters (thousands fig if any omitted)
8 D - Value in geopotential decameters; if negative 500 is added to HHH
9 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 $h_s h_s H_t H_t h_i h_i H_i H_i$

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-1. Reconnaissance code tables (continued)

TABLE 16 w_d

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

TABLE 17 I_r

7 Light
8 Moderate
9 Severe
/ Unknown or contrails

TABLE 18 I_t

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

TABLE 19 S_r, E_w, E_l

0 0NM	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$_a$L$_a$L$_a$ L$_o$L$_o$L$_o$Bf$_c$ h$_a$h$_a$h$_a$d$_t$d$_a$

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

SECTION TWO (ADDITIONAL)

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

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

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

SECTION THREE (INTERMEDIATE)

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

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

Table G-2. Reconnaissance code regulations

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

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

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

1-minute data interval

```
SXXX50 KNHC 040952
AF967 1017A OPAL HDOB 39
  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
                                .
                                .
                                .
```

2-minute data interval

Figure G-2. HDOB Description and Sample 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.

MinOb messages are created automatically by the NOAA P-3 Research Aircraft Measurement System (RAMS). Each MinOb message contains one or more lines of flight level data. Each line consists of data parameters, averaged over an operator-selected sample interval (common settings are 30 seconds and 1 minute). The time interval for collecting lines in a block before forming a message for transmission is also selectable, typically 10 or 15 minutes. The message length is based on the operator's selection of sample interval and block length, but will never exceed 3300 characters (approximately 50 lines) due to satellite transmission protocol limits.

Each line is terminated with an ASCII <cr><cr><lf> sequence (Hex 0D 0D 0A). The line length is variable, depending on whether the optional Stepped Frequency Microwave Radiometer (SFMR) fields are included (see Table G-4 description). All fields are separated by at least one ASCII blank (Hex 20) as shown in the Table by a ␣ symbol.

```
URNT40 KWBC 261950
NOAA3 WX02A BONNIE
194030  3136 07758 6849 +0152 251053 +171 +106 251054 040 005
194100  3138 07758 6847 +0148 247053 +171 +102 249053 040 005
194130  3141 07758 6849 +0146 246053 +166 +106 247053 039 005
194200  3143 07758 6851 +0144 246054 +162 +111 246054 039 004
194230  3145 07758 6849 +0141 246053 +162 +112 246054 999 999
194300  3147 07558 6852 +0134 245053 +160 +114 245053 039 004
194330  3149 07759 6845 +0126 247052 +162 +110 247052 038 000
                              .
                              .
```

30-Second Data Interval (with optional SFMR data)

Note: Differences from the Air Force HDOB message include the following:

- Time code includes seconds, rather than a period to show 30-second mark
- Latitude and longitude hemispheres are denoted by a minus sign rather than an alphabetic character (N,S,E,W)
- Pressure altitudes and D-values are in feet
- D-value sign is explicit, rather than coded as a leading '5'
- Temperature and dewpoint signs are explicit, rather than making tenths odd/even
- There is no radar altitude or default status
- There may be SFMR data fields

Figure G-3. MinOb Description and Sample Message

Table G-4. NOAA MinOb Message Format

HHMMSS␣$L_aL_aL_a$mm␣$L_oL_oL_o$mm␣PPPPP␣±DDDD␣WWWSSS␣±TTT␣±ddd␣wwwsss␣*sss*␣rrr

HHMMSS	The time of the observation in hours, minutes and seconds (UTC). All averages (except peak wind) are centered around this time.
$L_aL_aL_a$mm	The latitude of the observation in degrees and minutes. A negative number signifies the Southern hemisphere. There may be leading blanks in the degree subfield; the minutes will always be a two digit numeric (zero filled as required).
$L_oL_oL_o$mm	The longitude of the observation in degrees and minutes. A negative number signifies the Eastern hemisphere. NOTE: This is opposite the normal convention. There may be leading blanks in the degree subfield; minutes will always be a two digit numeric.
PPPPP	The pressure altitude in feet. There may be leading blanks.
±DDDD	The D-value (Geopotential Altitude - Pressure Altitude) in feet. There will always be a leading sign (+ or -) followed by four numeric characters (leading zeros if required)
WWW	The wind direction in degrees, with 0 being true North, increasing clockwise. There will always be three numeric characters, with leading zeros if required.
SSS	The wind speed in knots. There will always be three numeric characters, with leading zeros if required.
±TTT	The air temperature in degrees and tenths Celsius. There will always be a leading sign (+ or -) followed by three numeric characters (leading zeros if required). For example, 5.3 C would be coded +053.
±ddd	The dewpoint temperature, encoded the same way as air temperature.
www	The direction of the peak wind during this interval (30 sec, 1 min, etc.). The peak wind is defined as the maximum 10 second average wind. Format is the same as wind direction above.
sss	The speed of the peak wind in knots. Format is the same as wind speed above.
sss	The wind speed at the surface in knots, as measured by the Stepped Frequency Microwave Radiometer (SFMR). This is an optional field new for 1999, and may be omitted depending on the version of software being run. If omitted, the rain rate field will also be omitted, and the <cr><cr><lf> sequence will occur immediately after the peak wind speed field (no trailing blank). When present, there will be three numeric characters, with leading zeros if required. If the SFMR wind can not be calculated during the sample interval, it (and the rain rate) will be coded as 999.
rrr	The rain rate in mm/hr, as measured by the SFMR. When present (see SFMR wind speed discussion above), there will be three numeric characters, with leading zeros if required. If rain rate can not be calculated it will be coded as 999.

Table G-5. 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. See Figure G-3 for an example TEMP DROP message for tropical cyclone operations.

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

SECTION 9 51515 (through 59595) Code groups to be developed regionally.

SECTION 10 61616 (through 69696) Code groups to be developed nationally.

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 = 700 mb, 5 = 500 mb, etc. If flight level is above a standard surface, for example 495, report a 5 for 500 mb in the I_d group.

Note the following clarification was approved at the 52d IHC: I_d will specify in hundreds of mb (Part A) or tens of mb (Part C) the highest mandatory isobaric level for which the wind is reported. For example, in Part A, I_d = 7 indicates 700 mb, but in Part C, I_d = 7 indicates 70 mb. I_d = 0 refers to the 1000 mb level. The surface wind group should always be present.

(1) The wind group shall be omitted at all levels above the level specified by I_d, except as noted in (3) and (4) below.

(2) The wind group shall be present at all levels at and below the level specified by I_d. At levels below that specified by I_d for which the wind is missing, encode the wind group as "/////."

(3) When the highest mandatory level for which the wind is reported is 250 mb, encode I_d as 2. If other information is available above 250 mb, encode the 200 mb wind group as "/////."

(4) When the highest mandatory level for which the wind is reported is 150 mb, encode I_d as 1. If other information is available above 150 mb, encode the 100 mb wind group as "/////."

(5) When no winds are reported for any level, encode I_d as "/," encode the surface wind group as "/////," and omit all wind groups above the surface.

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

$h_1h_1h_1$ 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.

$h_nh_nh_n$

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

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

D_oD_o 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_1D_1
D_nD_n

d_od_o 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.
d_1d_1
d_nd_n

$f_of_of_o$ Wind speed in knots. Hundreds digit is sum of hundreds digit of speed and unit digit of direction, i.e. 29<u>5</u>° at <u>1</u>25 kts encoded as 29<u>6</u>25. (Notes 1&2)
$f_1f_1f_1$
$f_nf_nf_n$

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. 29<u>5</u>° at <u>1</u>25 kts encoded as 29<u>6</u>25.

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 millibars.

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. 29<u>5</u>° at <u>1</u>25 kts encoded as 29<u>6</u>25.

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".

77999 Indicator that maximum wind data have not been observed.

SECTION 10 - NATIONAL PRACTICES

61616 Mission identifier followed by the observation number. (e.g., 61616 NOAA9 0403A CLAUDETTE OB 01)

62626 Remarks (e.g., EYEWALL, SST28.2, SFC WND AT 7M)

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 7 31313 $s_ir_ar_as_as_a$ 8GGgg

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

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

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

SECTION 10 61616 Repeat national practice encoded in Part A.
62626 Repeat national practice encoded in Part A.

PART B

SECTION - 1 IDENTIFICATION AND POSITION

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

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

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

SECTION 6 - DATA FOR SIGNIFICANT WIND LEVELS

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

SECTION 7 - SOUNDING SYSTEM INDICATION

31313 Data on sounding system.

s_r Identifies solar and infrared radiation correction. Always report as zero--no correction.
$r_e r_e$ Identifies dropsonde/sounding system used. Always report as "96"--descending radiosonde.
$s_e s_e$ Identifies tracking technique/status of system used. Reported as "00" or "08."
"0" - Aircraft system has no windfinding capability.
"8" - Automatic satellite navigation.

8 Indicator for time of observation.
GG Actual time of dropsonde launch to the nearest whole hour UTC.
gg Actual time of dropsonde launch in minutes UTC.

SECTION 9 - ADDITIONAL DATA GROUPS

$101A_{df}\ A_{df}$ 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.

FIGURE G-4. EXAMPLE TEMP DROP MESSAGE FOR TROPICAL CYCLONE OPERATIONS

UZNT13 KWBC 141910
XXAA 64193 99272 70775 08077 99017 27657 11003 00146 26456 07505 92829 20844
03501 85557 16659 00000 70183 07260 ///// 50587 08156 23007 40757 19166 22014
30965 34964 17018 25089 45163 20234 579// 88999 77999
61616 NOAA9 0403A CLAUDETTE OB 01
62626 EYEWALL, SST28.2, SFC WIND AT 7M

XXBB 6419/ 99272 70775 08077 00017 27657 11956 22837 22872 17650 33832 16063
44789 12444 55704 07458 66692 06867 77658 04062 88640 03070 99598 00956 11588
01363 22578 02336 33559 04327 44528 06350 55520 06961 66513 07347 77492 08759
88482 09957 99460 11759 11410 17957 22401 18966 33393 20162 44381 21569 55361
24364 66353 25570 77318 31359 88302 34564 99238 47962 11192 605//
21212 00017 11003 11435 22512 22419 20510 33397 22014 44330 16017 55292 18017
66270 16521 77192 19014
31313 09608 81833
61616 NOAA9 0403A CLAUDETTE OB 01
62626 EYEWALL, SST28.2, SFC WIND AT 7M
NNNN

APPENDIX H

WSR-88D OPERATIONS PLAN FOR TROPICAL CYCLONE EVENTS

The following procedures are used to modify WSR-88D operations in support of the tropical cyclone warning system:

At the Unit Control Position (UCP):

1. Operational mode--precipitation mode. Either **VCP 11** (14 elevations in 5 minutes) **or VCP 21** (9 elevations in 6 minutes). VCP 21 will cause less wear on antenna gearing, and offers reduced potential for loadshedding. For convection within 80 nm of the radar, VCP 11 offers denser vertical resolution above tilt 5 and is thus preferred for close-in cases and overpasses.

2. Velocity data levels (display levels) for the 8-data level products should be set to display hurricane-force winds. Note that default settings, which display a maximum of 64 kt, will be exceeded by even a minimal category one hurricane.

UCP commands:	**SE, WXMAN1, VE** (enter appropriate menu)		
then	**D, 5**	<--display Table 5 first	
then	**M**	(modify Table 5)	
		suggested values are -100, -80	
then	**E**	(save edits)	
then	**D, 7**	<-- now display Table 7	
	M	(modify Table 7)	
		suggested values are -135, -115	
then	**E**	(save edits)	

This modifies the 8-level products ONLY. The routine 16-level products are not affected. By entering the negative values above, corresponding positive values are automatically supplied. Table 5 will be used if the velocity increment is 1 kt (0.97 kt or 0.5 m/s) while Table 7 will be used if the velocity increment is increased to 2 kt (1.94 kt or 1 m/s). See paragraph 3 below.

Note: These are good initial settings for pre-event preparedness. As the hurricane comes into radar range, examine the velocities in the eyewall. Settings (as time allows) may be adjusted by 5 or 10 kt increments to produce a clean maximum (a 'bulls-eye') in the area of the velocity maximum. This velocity maximum is usually found on the right side of the eyewall (right side defined as standing behind the hurricane and looking forward along the direction of motion).

3. If velocities are expected to exceed 124 kt, increase the velocity increment from 1 to 2 kt.

UCP commands:	**RD, PR**	(turn off auto pulse repetition frequency (PRF))
	V	(display current VCP)
	V, 1.94	(switch velocity measurement increment (VMI) of current VCP)
	E	(save edits)
	RD, DO, 0	(download modified VCP)
	RD, PR	(turn on auto PRF)

Note: If the velocity increment is 1 kt, Table 5 above applies; if the velocity increment is 2 kt, Table 7 above applies.

4. Allow <u>non-associated Principal User Processors (NAPUP)</u> (e.g. TPC/NHC) access to:

   a. 8-data level Velocity product (product #24).

   b. 0.54 nm Composite Reflectivity product (product #37).

These may be added to the Generation and Distribution Control list, Adaptation list 'A,' with a 'Y' in the NAPUP column. (Note: SRM, product #56, should already appear with a 'Y' for NAPUP.

UCP commands: **AD, WXMAN1, G, A**

then **M, 9** (modify line 9)

SLICE	GEN	AUT ARC	AUT STO	STO TIM	NA PUP	
-2.0	1	0	1	60	Y	(con't)

then **M, 22** (modify line 22)

SLICE	GEN	AUT ARC	AUT STO	STO TIM	NA PUP
	1	0	1	60	Y

then **E** (save edits)
G, R, A (replace current list with copy of changes)
G, E (save edits)

5. Make certain that Archive II is active.

6. If range-folding is obscuring velocities beyond about 70-80 nm, shown in extreme cases as a solid purple band surrounding the 'good' velocities, auto-PRF is not working effectively. Consider turning auto PRF **off**. Auto PRF uses only the 4 highest PRFs (5 through 8). To alleviate the purple band problem and extend the range of usable velocities, set PRF to PRF #4.

UCP commands:	**RD, PR**	(turn off auto PRF)
	F1	(return to main menu)
	V	(enter VCP menu)
	S, 94	(set Rmax to 94 nm)
	E	(save edits)
then	**F1**	(return to main menu)
	RD, DO, 0	(down load the modified VCP)

To return to normal: **RD, PR** (turn auto PRF back on)

7. Applications terminal, associated PUPs (APUP):

a. Suggested minimum routine product set (RPS) lists follow these instructions. Sites may wish to add Mesocyclone (M), Tornadic Vortex Signature (TVS), Storm Tracking (STI), and Echo Tops (ET) to the list. Storm Relative Velocity products (SRM, SRR) should be generated as One-Time Requests, with storm motion determined by the forecaster. The system software may not be able to produce a useful motion due to the rotation of the tropical cyclone. One-Hour Precip (looped) can also be useful in finding the tropical cyclone center in poorly defined cases.

b. Initiate a local product archive (Archive IV). This will copy the PUP database onto the optical disk for later assessment. This record has proven to be extremely useful even if Archive II is also running and can become crucial if Archive II fails.

*Most important here, for both APUPs and NAPUPs, is the **8-data level velocity product**, and, in the event of velocities exceeding 124 knots, changing the **velocity increment from 1 to 2 knots**.*

The advantage of using the 8-level velocity product is that the location of strong hurricane force winds can be displayed, while leaving the standard 16-level velocity product (-64 kt to +64 kt) for display of surrounding areas. The data resolution (i.e., "width" of the display levels) is maintained to aid identification of mesocyclones which may occur in rainbands.

Note that the key 8-level velocity product and the 0.54 nm composite reflectivity product are not available to non-associated users (e.g. TPC) by default, although some stations may already have granted access. These products can be made available to NAPUPs by inserting them into the Generation and Distribution Control list. Ideally, this amendment to the distribution list would be done in anticipation of an event, so that everything is ready to go should a hurricane approach. Again, local Unit Radar Coordinator approval should be sought as necessary--in advance--so that the change can be made operationally as the need arises.

Additional note: For improved WSR-88D algorithm performance during tropical cyclone events, the Threshold Pattern Vector (TPV) adaptable parameter for the Mesocyclone algorithm should be reduced to improve detection of small diameter features. From the main menu:

UCP commands: **AD, ******, M, ******, M** (display the mesoscale adaptable parameter menu)

change **TPV** (page forward to page 2) to **6**

then **E** (save edits)

The default Z-R relationship does not perform well in tropical cyclones. Change the default Z-R ($300R^{1.4}$) to the tropical Z-R, ($250R^{1.2}$) to provide better precipitation estimates.

From the main menu:

UCP commands: **AD,******, M, ******, Z** (display Z-R parameters)

then change **CZM** to **250**

and change **CZP** to **1.2**

then **E** (save edits)

Table H-1. Suggested minimum WSR-88D RPS lists for tropical cyclones.

Tropical cyclone range > 124 nm

Product	Elevation angle	Data resolution	Data levels
Base Reflectivity	0.5°	1.1 nm	16
	1.5	1.1 nm	16
	0.5	0.54 nm	16
	1.5	0.54 nm	16
	2.4	0.54 nm	16
	3.4	0.54 nm	16
Base velocity	0.5	0.54 nm	16
	1.5	0.54 nm	16
	2.4	0.54 nm	16
	0.5	0.54 nm	**8**
Composite Reflectivity		0.54 nm	16
VIL, Storm Total Precip			

Tropical cyclone range 62 - 124 nm

Product	Elevation angle	Data resolution	Data levels
Base Reflectivity	0.5°	1.1 nm	16
	0.5	0.54 nm	16
	1.5	0.54 nm	16
	2.4	0.54 nm	16
	3.4	0.54 nm	16
	6.0	0.54 nm	16
Base velocity	0.5	0.54 nm	16
	1.5	0.54 nm	16
Product	Elevation angle	Data resolution	Data levels
Base Velocity (con't)	2.4	0.54 nm	16
	3.4	0.54 nm	16
	0.5	0.54 nm	8
Composite Reflectivity		0.54 nm	16
VIL, Storm Total Precip			

Tropical cyclone range > 32 - 62 nm

Product	Elevation angle	Data resolution	Data levels
Base Reflectivity	0.5°	1.1 nm	16
	0.5	0.54 nm	16
	1.5	0.54 nm	16
	2.4	0.54 nm	16
	4.3	0.54 nm	16
	6.0	0.54 nm	16
Base velocity	0.5	0.54/0.27 nm	16
	1.5	0.54/0.27 nm	16
	2.4	0.54 nm	16
	4.3	0.54 nm	16
	0.5	0.54 nm	8
Composite Reflectivity		0.54 nm	16
VIL, Storm Total Precip			

Tropical cyclone range 0 - 32 nm

Product	Elevation angle	Data resolution	Data levels
Base Reflectivity	0.5°	1.1 nm	16
	0.5	0.54 nm	16
	1.5	0.54 nm	16
	2.4	0.54 nm	16
	3.4	0.54 nm	16
	6.0	0.54 nm	16
	9.9	0.54 nm	16
Product	Elevation angle	Data resolution	Data levels
Base velocity	0.5	0.54/0.27/0.13 nm	16
	1.5	0.54/0.27 nm	16
	2.4	0.54 nm	16
	0.5	0.54 nm	8
	1.5	0.54 nm	8
Composite Reflectivity		0.54 nm	16
VIL, Storm Total Precip			

APPENDIX I

TELEPHONE AND TELETYPE LISTING

DEPARTMENT OF COMMERCE

AGENCY	LOCATION	TTY[1]	TELEPHONE
Alternate NHC (NCEP, HPC)	Camp Springs, MD	B	COM 301-763-8201
AOC	Tampa Bay, FL		COM 813-828-3310
CPHC - Forecaster and Warning Desk - Admin - Dir/Coord - Operations	Honolulu, HI	B	COM 808-973-5284 COM 808-973-5270 COM 808-973-5272 FAX 808-973-5281
CPHC Satellite Coordinator	Honolulu, HI	B	COM 808-973-5285
NWSO Tiyan, Guam Forecast Warning Desk	Tiyan, Guam		COM 671-471-7398
NDBC - Data Systems Division	SSC, MS		COM 601-688-1720
NESDIS SAB	Camp Springs, MD	B	COM 301-763-8444
NHC	Miami, FL	AB	COM 305-229-4470
TAFB Lead Forecaster (TPC/NHC)	Miami, FL	AB	COM 305-229-4425
Hydrometeorological Prediction Center (HPC)	Camp Springs, MD	B	COM 301-763-8096
NCEP Senior Duty Met (Data QC)	Camp Springs, MD	B	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] A AFMEDS
B AFOS

AGENCY	LOCATION	TTY	TELEPHONE	
AFGWC	Offutt AFB, NE	B	COM DSN	402-294-2586 271-2586
CARCAH OLA, 53 WRS	Miami, FL	AB	COM DSN	305-229-4474 434-3420
FACSFAC VACAPES OAC	Oceana, VA		COM DSN	804-433-1233 433-1233
FACSFAC Roosevelt Roads	Roosevelt Roads, PR		COM DSN	787-865-7007 831-7007/5202/5203
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		787-253-4567	
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 613-957-6390
ARU OPS (24 HRS) (ATCSCC OF CANADA)	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

APPENDIX J

DISTRIBUTION

DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Administration Office, Aircraft Operations Center (AOC)	20
Assistant Administrator for Satellite and Information Services (E)	2
Director, National Climatic Data Center (E/CC)	2
Chief, Library and Information Services Division (E/OC4)	4
Chief, Satellite Services Division (E/SP2)	1
Chief, Library Division MASC (MC5)	2
Assistant Administrator for Ocean Svcs and Coastal Zone Management (N)	1
Director, Office of Public Affairs, NOAA (PA)	2
Assistant Administrator for Oceanic and Atmospheric Research (R)	1
Director, Environmental Research Laboratories (R/E/FS)	4
Chief, International Programs (R/E/FS7)	2
Director, AOML Hurricane Research Division (R/E/AO)	5
Director, Program Development and Coordination Staff (R/PDC)	2
Assistant Administrator for Weather (W)	1
Director, National Data Buoy Center (W/DB)	6
Director, National Centers for Environmental Prediction (W/NP)	1
Director, Central Operations (W/NP1)	2
Director, Environmental Modeling Center (W/NP2)	1
Deputy Director, Environmental Modeling Center (W/NP2x1)	1
Director, Hydrometeorological Prediction Center (W/NP3)	2
Director, Marine Prediction Center (W/NP4)	2
Director, Tropical Prediction Center (W/NP8)	20
Director, Office of Hydrology (W/OH)	1
Director, Office of Meteorology (W/OM)	1
Chief, International Activities Division (W/IA)	1
Chief, Hydrometeorological Services Core (W/OM12)	20
Director, NWS Eastern Region (W/ER)	50
Director, NWS Central Region (W/CR)	16
Director, NWS Southern Region (W/SR)	56
Director, NWS Western Region (W/WR)	15
Director, NWS Pacific Region (W/PR)	15
NOAA Budget Officer, Office of Management and Budget	1

DEPARTMENT OF DEFENSE

OFFICE OF THE JOINT CHIEFS OF STAFF

Joint Staff/J3/ROD 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
USSOUTHCOM	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 AFWA/XO	6
HQ AFCCC/TECH LIBRARY (DOL)	1
HQ PACAF/DOW	6
HQ USSTRATCOM/J-3615	2
HQ USAFE/DOOW	2
15 OSS/OSW	1
45 SPW/XP and SE	4
24 WS/CC	1
45 WS/CC	3
46 WS/CC	2
78 OSS/OSW	1
325 OSS/OSW	1
3395 TCHTG/TTKO	2
Phillips Laboratory/GPAS	1
SM-ALC/LHFBB	2

Det 13, 1st Weather Group	2

AFRC

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

DEPARTMENT OF THE ARMY

HQ Department of the Army/DAMI- POI	2
Topographic Engineering Center	1
COE/CEWES-CD-P	1
607th Weather Squadron	1

DEPARTMENT OF THE NAVY

Commandant of the Marine Corps (DCS/Aviation)	12
Oceanographer of the Navy	2
NAVMETOCCOM	5
Commanding Officer, NAVOCEANO (N2513)	75
Commanding Officer, NAVLANTMETOCCEN	2
NAVPACMETOCCEN West/JTWC, Guam	2
NAVLANTMETOCFAC Jacksonville	1
NAVTRAMETOCFAC Pensacola	1
CINCLANTFLT (N37)	2
CINCPACFLT (N3WX)	1
COMTHIRDFLT	1
COMFITMATAEWWINGLANT, NAS Oceana, VA	1
Commander, Naval Air Warfare Center, Weapons Division	2
Office of Naval Research (Code 1122MM)	2
NRL, Stennis Space Center, MS	1
NRL, Atmospheric Division, Monterey, CA	2
OPTEVFOR (Code 314)	1
Coastal System Station (Code 05W)	1
AFWTF, Roosevelt Roads, PR	1

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

Air Traffic Plans and Requirements Service ATR-1	1
Air Traffic Program Management Director ATZ-1	1
Air Traffic Operations ATO-1	1

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	
AAL-500 Anchorage	1
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	3
Honolulu ARTCC	3
Houston ARTCC	3
Jacksonville ARTCC	3
Los Angeles ARTCC	2
Memphis ARTCC	1
Miami ARTCC	3
New York ARTCC	3
Oakland ARTCC	2
San Juan ARTCC	3
Seattle ARTCC	2
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
San Juan AIFSS	2

U.S. COAST GUARD

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
Commanding Officer, USCG Reserve Training Center	1

DEPARTMENT OF AGRICULTURE

World Agriculture Outlook Board	1

DEPARTMENT OF ENERGY

Office of Emergency Management	1
Office of Biological and Environmental Research	1

DEPARTMENT OF INTERIOR

Bureau of Reclamation, Office of Liaison Engineering and Research	1

DEPARTMENT OF STATE

Office of Advanced Technology	1

NATIONAL SCIENCE FOUNDATION

Director, Meteorology Program	1
Director, Atmospheric Sciences Division	1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Goddard Space Flight Center, Code 912	1
Director, Atmospheric Sciences Division	1

FEDERAL EMERGENCY MANAGEMENT AGENCY

FEMA, Mitigation Directorate	1
FEMA Region I	1
FEMA Region IV	1

OTHER U.S.

General Services Administration, Federal Information Center	1
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	3
GTE Government Systems	1
Larkin Associates	1
Nash C. Roberts, Jr. Consultants, New Orleans, LA	1
Hurricane and Weather Specialists, Inc., Valrico, FL	1

GOVERNMENT OF CANADA

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