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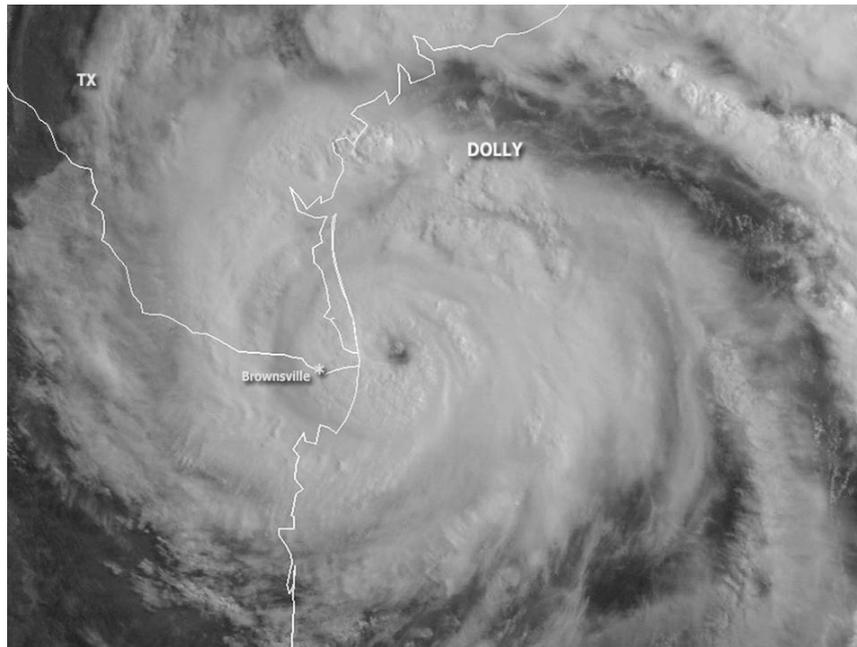
OFCM



OFFICE OF THE FEDERAL COORDINATOR FOR  
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

# National Hurricane Operations Plan

FCM-P12-2009



*Hurricane Dolly - 23 July 2008 - NOAA's GOES 12*

Washington, DC  
May 2009

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FOR  
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH**

8455 Colesville Road, Suite 1500  
Silver Spring, Maryland 20910  
301-427-2002  
[www.ofcm.gov](http://www.ofcm.gov)

**NATIONAL HURRICANE OPERATIONS PLAN**

FCM-P12-2009

Washington, D.C.  
May 2009

## CHANGE AND REVIEW LOG

Use this page to record changes and notices of reviews.

Change Number	Page Numbers	Date Posted	Initial
1			
2			
3			
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Changes are indicated by a vertical line in the margin next to the change or by shading and strikeouts.

Review Date	Comments	Initial

## FOREWORD

The Interdepartmental Hurricane Conference (IHC) is sponsored annually by the Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM) to provide a forum for the responsible Federal agencies, together with representatives from the user communities like emergency management, to review the Nation's hurricane forecast and warning program and to make recommendations on how to improve the program in the future. The major objective is to plan and prepare for the upcoming hurricane season. The 63<sup>rd</sup> IHC was held in St. Petersburg, Florida, March 2-5, 2009, and the new procedures, procedural changes, and agreements reached at the conference were incorporated into this publication—the 47<sup>th</sup> edition of the *National Hurricane Operations Plan* (NHOP).

At the 63<sup>rd</sup> IHC, there were 19 new actions items stemming from the meeting of the Working Group for Hurricane and Winter Storms Operations and Research. Of those, 12 items (mostly informational) will be closed through incorporation into the 2009 NHOP as approved recommendations and/or changes. Five items were informational in nature which did not require any action. Two items (plus four open actions from previous IHCs) will be worked through follow-on actions by the group. Detailed descriptions of the action items are available on the OFCM's web site at [http://www.ofcm.gov/homepage/text/spc\\_proj/ihc.html](http://www.ofcm.gov/homepage/text/spc_proj/ihc.html).

The following summarizes the 2008 tropical cyclone season:

- For the 2008 Atlantic hurricane season, there were 16 named storms. Eight of these storms became hurricanes, including five major hurricanes. This was above the long-term averages of 11, 6 and 2. Four of the five major hurricanes reached category 4 status, with the remaining major hurricane reaching category 3 status. Of note, Hurricanes Gustav and Ike struck the U. S. as Category 2 hurricanes, while Dolly struck as a Category 1. Gustav and Ike produced at least 40 and 29 tornadoes, respectively. Ike was the fourth costliest landfalling U. S. hurricane and its extratropical remains caused hurricane-force wind gusts and damage across the Ohio Valley.
- For the Eastern North Pacific, there were an above average number of tropical storms (16). However, there was a below average number of hurricanes (seven) and major hurricanes (two). One hurricane (Norbert) and one tropical storm (Julio) made landfall in Mexico—a near-average number of landfalls.
- The other tropical cyclone basins supported by the Central Pacific Hurricane Center and Joint Typhoon Warning Center had the following tropical cyclone activity in 2008 (25-year averages are noted in parenthesis): Central Pacific – 1 (5); Northwest Pacific – 27 (31); South Pacific – 8 (6); Arabian Sea and Bay of Bengal – 7 (5); South Indian Ocean and Australian Region – 21 (23).

The multiagency efforts—from both civilian and military organizations—that are part of the tropical cyclone forecast and warning system, once again provided outstanding support to their customers, helping to prevent loss of life and injuries and to reduce vulnerability to these devastating storms.

//SIGNED//

Samuel P. Williamson  
Federal Coordinator for Meteorological  
Services and Supporting Research



# NATIONAL HURRICANE OPERATIONS PLAN

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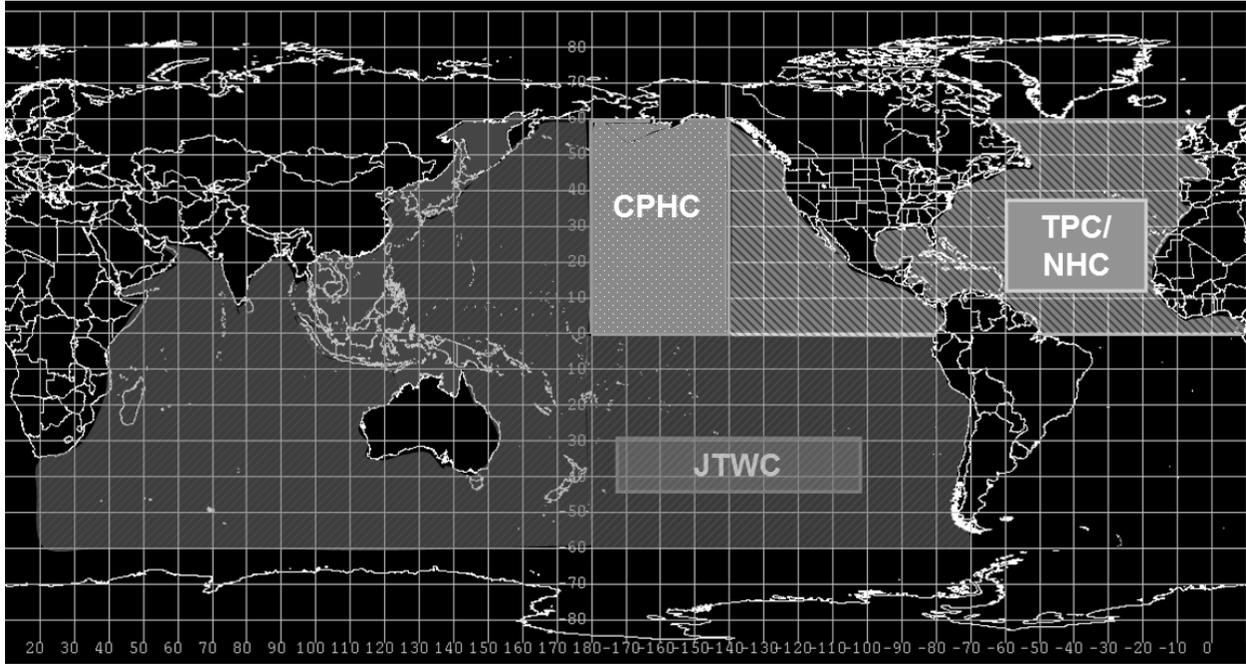


# CHAPTER 1

## 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 forecast and warning services. The bottom line—this interdepartmental cooperation achieves economy and efficiency in the provision of the tropical cyclone forecast and 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 forecast and 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 roles of individual agencies, participating in the tropical cyclone forecast and warning program 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.

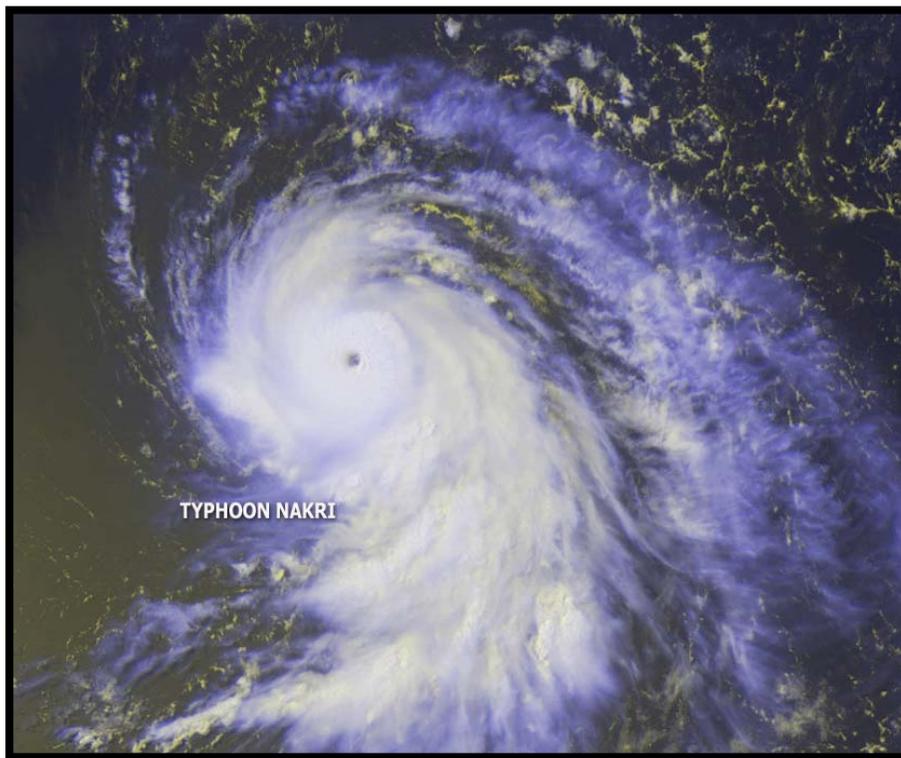


**Figure 1-1. Tropical Cyclone Forecast Centers' Areas of Responsibility**

## 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), the Department of Transportation (DOT), and the Department of Homeland Security (DHS)/U.S. Coast Guard (USCG) with the DOC brings to bear those 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.



**Figure 2-1. Typhoon Nakri, Northeast of the Philippines, May 29, 2008. Credit: NOAA**

### **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.

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

- 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 (NAVLANTMETOCEN), 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 Joint Typhoon Warning Center (JTWC), 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. In addition to the main Hawaiian Islands, CPHC also issues watches and warnings for Johnston Atoll, Midway, and the northwest Hawaiian Islands. The CPHC will consult with JTWC 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 Weather Forecast Office (WFO) Guam, using the tropical cyclone forecasts/advisories prepared by JTWC as guidance. WFO Guam issues watches and warnings for all tropical cyclones affecting the Territory of Guam, the Commonwealth of the Northern Marianas, the Republic of Palau, the Federated States of Micronesia, and the Republic of the Marshall Islands.

**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, and monitor and interpret DOC satellite imagery.
- 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.
- Provide surveillance support with fixes and/or intensity estimates to the Joint Typhoon Warning Center (JTWC), TPC/NHC, and CPHC through analysis of all available satellite imagery.

**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 NOAA Office of Marine and Aviation Operations (OMAO), 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 significant meteorological information on tropical and subtropical cyclones to the NWS in a timely manner.
- 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 F).

- 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 (e.g., additional upper-air observations).
- Provide weather reconnaissance data monitor services to evaluate and disseminate reconnaissance reports.
- Provide surveillance support with fixes and/or intensity estimates to the Central Pacific Hurricane Center through analysis of available satellite imagery. The support is provided by the 17th Operational Weather Squadron Meteorological Satellite Operations (SATOPS) Flight (17 OWS/WXJ), Joint Typhoon Warning Center, Pearl Harbor, HI, and is focused on the Indian Ocean and the Central, South, and Northwest Pacific Ocean.
- Western Pacific Ocean (north of the equator): Provide NWS with basic meteorological information, forecasts, and associated prognostic reasoning, concerning location, intensity, wind distribution, and forecast movement of tropical cyclones for the Northwest Pacific west of 180°. JTWC will consult with WFO 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.
- Initiate, monitor, and update satellite invest areas on the tropical cyclone satellite websites provided by the Fleet Numerical Meteorology and Oceanography Center (FNMOC) and the Naval Research Laboratory (NRL), Monterey, California. TPC/NHC and CPHC will coordinate with JTWC on the initiation of desired invest areas and will provide JTWC numbers for invest areas as required.
- Deploy, through the Naval Oceanographic Office (NAVOCEANO), drifting data buoys in support of Commander-in-Chief, Atlantic Fleet (CINCLANTFLT) requirements.

## **2.4. DOT and DHS 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 Department of Homeland Security (DHS) 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 selected 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.**

**2.5.1.** 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. Due to the international importance of this mission, the Air Force Reserve Command (AFRC) and TPC/NHC will jointly plan and execute this mission annually. The TPC/NHC will coordinate with the meteorological services in the countries to be visited.

**2.5.2.** This annual liaison trip is known as the Caribbean Hurricane Awareness Tour (CHAT). It takes place in the United States Southern and Northern Command's area of responsibility and supports its mission of promoting stability, collective security, and defending U.S. regional interests. The WC-130 aircraft flown by the 53rd Weather Reconnaissance Squadron (53<sup>rd</sup> WRS) "Hurricane Hunters" is the most visible symbol of this awareness program; it serves as an educational platform and as a media focus for both dignitaries and the local populace. Tours of the aircraft demonstrate the critical partnership between DOD and NOAA during the preparation of a tropical cyclone forecast. The CHAT increases public awareness of the hurricane threat and serves to recognize and strengthen national and international teamwork for storm warning and emergency response.

**2.5.3.** This diplomatic mission is unique in character and purpose. This joint AFRC and NOAA mission demonstrates the concerted U.S. effort to execute its hurricane program and is illustrates the importance the U.S. places on hurricane forecasting, tracking, and warning. The CHAT helps communicate the U.S. responsibilities in the region and it highlights the vital roles of NOAA and 53<sup>rd</sup> WRS. The media's role is to document the trip and promote the hurricane preparedness message, thus providing visibility to this important outreach activity both nationally and internationally.

**2.5.4.** The synergy created by all participants traveling together on the 53<sup>rd</sup> WRS WC-130 aircraft is essential to efficiently accomplishing the overall objectives of the mission while exercising fiscal responsibility. AFRC will fly the mission and issue invitational travel orders (ITO) on a noninterference, non-reimbursable basis for: the Director of the Tropical Prediction Center (TPC)/National Hurricane Center (NHC) of the National Weather Service (NWS) National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce (DOC); the NHC Hurricane Warning Program staff, NWS staff, other U.S. officials, and the media.

**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 electronic 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 the NOAA 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].

**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).

## CHAPTER 3

### GENERAL OPERATIONS AND PROCEDURES OF THE NATIONAL WEATHER SERVICE HURRICANE CENTERS

**3.1. General.** This chapter briefly 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). See Appendix A for a description of local National Weather Service (NWS) office products which support the tropical cyclone forecast and warning program. Additional details of the products, including transmission times, can be found in National Weather Service Instruction 10-601, located at: <http://www.weather.gov/directives>.

### **3.2. Products.**

**3.2.1. Tropical Weather Outlook (TWO).** TPC/NHC and CPHC prepare the TWO during their respective tropical cyclone seasons. The outlook covers tropical and subtropical waters and discusses areas of disturbed weather and the potential for tropical cyclone development during the next 48 hours.

**3.2.2. Tropical Cyclone Public Advisories (TCP).** The TCP is the primary tropical cyclone information product issued to the public. The TPC/NHC, the CPHC, and WFO Guam issue TCPs. The following pertains to the tropical storm/hurricane/typhoon watches and warnings contained in the TCP:

- **TPC/NHC.** TPC/NHC issues tropical storm/hurricane watches/warnings for the Atlantic, Pacific, and Gulf of Mexico coasts of the continental United States, the US Virgin Islands, and Puerto Rico. TPC/NHC issues watches when conditions along the coast are expected within 36 hours. TPC/NHC issues warnings when conditions along the coast are expected within 24 hours.
- **CPHC and WFO Guam.** CPHC and WFO Guam issues tropical storm/hurricane/typhoon watches/warnings for the islands of Hawaii, northwest Hawaiian Islands, Johnston Atoll, Guam, Northern Mariana Islands and selected points in the Micronesian countries. CPHC and WFO Guam issue watches when conditions along the coast are expected within 48 hours. CPHC and WFO Guam issue warnings when conditions are possible along the coast within 36 hours.

**3.2.3. Tropical Cyclone Forecast/Advisories (TCM).** NHC/TPC and CPHC will prepare TCMs for all tropical cyclones within their area of responsibility. See Section 4.3 for content and format of the advisories. The TCM provides critical tropical cyclone watch, warning, and forecast information for the protection of life and property.

Note: In the Western Pacific, tropical cyclone forecasts/advisories are issued by the JTWC. Appendix C provides a listing of the abbreviated communications headings and titles for JTWC products. Information on the broadcast of tropical cyclone information to coastal and high-seas shipping can be found in Chapter 9, Marine Weather Broadcasts.

**3.2.4. Tropical Cyclone Discussions (TCD).** NHC/TPC and CPHC issue TCDs to

explain forecaster's reasoning behind analysis and forecast of the tropical cyclone.

**3.2.5. Tropical Cyclone Updates (TCU).** The TCU is an event-driven product which provides users with timely, succinct information on significant changes to tropical cyclone conditions. TCUs are issued to inform users of unexpected changes in a tropical cyclone, such as to convey a significant change in the intensity, and/or to alert users a special advisory is about to be issued. The TCU may also be used to announce changes to international watches or warnings made by other countries, and to cancel U.S. watches or warnings. A TCU should only be used to issue a U.S. watch or warning if that TCU precedes a special advisory that will contain the same watch/warning information, and indicates the special advisory will be issued shortly.

**3.2.6. Tropical Cyclone Position Estimates (TCE).** This product ensures a continuous flow of information regarding the center location of a tropical cyclone when it nears the coast and thus provides up to date location information to emergency managers and other public officials. The TCE is a brief alphanumeric product containing information derived from WSR-88D radar or appropriate satellite data about tropical cyclone positions near coasts in latitude/longitude coordinates, distance, and direction from a well known point.

**3.2.7. Graphical Tropical Cyclone Surface Wind Speed Probabilities.** This graphical product portrays probabilistic surface wind speed information which will help users prepare for the potential of tropical storm or hurricane conditions. This product shows probabilities for three wind speed thresholds: 34, 50 and 64 knots. It provides cumulative probabilities through each 12 hour interval (e.g. 0 -12 hours, 0- 24 hours, etc.) from 0 through 120 hours. They are available in graphical forms in a static and an animated display. These wind speed probabilities are based on the track, intensity, and wind structure uncertainties in the official forecasts from the tropical cyclone centers.

**3.2.8. Tropical Cyclone Surface Wind Speed Probabilities Text Product (PWS).** This product portrays probabilistic wind speed information helping users prepare for the potential of tropical storm or hurricane conditions.

The probabilities in this product are statistically based on the errors in the official track and intensity forecasts issued during the past five years by TPC/NHC and CPHC. Variability in tropical cyclone wind structure is also incorporated. New probability values are computed for each new official forecast issued by TPC/NHC or CPHC.

The first section of the product provides categorical maximum wind speed (intensity) probabilities at standard forecast hours (12, 24, 36, 48, 72, 96, and 120) for various intensity stages (dissipated, tropical depression, tropical storm and hurricane) and for the five categories on the Saffir-Simpson Hurricane Scale. These probabilities apply to the maximum sustained surface wind associated with the cyclone, and not to winds that could occur at specific locations.

Probabilities for specific locations are provided in the second section for sustained wind speeds equal to or exceeding three wind speed thresholds: 34, 50 and 64 knots. Two types of probability values are provided in this table: individual period and cumulative. Individual period probabilities are provided for each of the following time intervals: 0-12 hours, 12-24 hours, 24-

36 hours, 36-48 hours, 48-72 hours, 72-96 hours, and 96-120 hours. These individual period probabilities indicate the chance that the particular wind speed will *start* during each individual period at each location. Cumulative probabilities are produced for the following time periods: 0-12 hours, 0-24 hours, 0-36 hours, 0-48 hours, 0-72 hours, 0-96 hours, and 0-120 hours. These cumulative probabilities indicate the overall chance the particular wind speed will occur at each location during the period between hour 0 and the forecast hour.

**3.2.9. Tropical Cyclone Watch Warning Product (TCV).** The TCV summarizes all new, continued, and cancelled tropical cyclone watches and warnings issued by the TPC/NHC for the U.S. Atlantic and Gulf coast, southern California coast, Puerto Rico, and U.S. Virgin Islands. The CPHC will issue a TCV for the main islands of the State of Hawaii. The product is issued each time a U. S. tropical cyclone watch and/or warning is issued, continued, or discontinued for all Atlantic, portions of the North East Pacific, and the North Central Pacific Ocean basin tropical cyclones.

**3.2.10. Hydrometeorological Prediction Center (HPC) Public Advisories (TCP).** The National Centers for Environmental Prediction's HPC issues public advisories after TPC/NHC discontinues its advisories on subtropical and tropical cyclones that have moved inland in the United States or Mexico, but still pose a threat of heavy rain and flash floods in the conterminous United States or Mexico. Content will refer to the decaying system's position, intensity, general forecast trends, highlight impacts which occurred and are expected to occur (usually in relation to heavy rain/flooding and tornadoes), and indicate when the next summary will be issued. A table at the end of the message will provide forecast latitude and longitude of the remnant low.

**3.2.11. Other Tropical Cyclone Products.** Several other tropical cyclone related products are issued to support the tropical cyclone forecast and warning program. Refer to NWS Instruction 10-601, located at <http://www.weather.gov/directives>, for further details on these products, which include:

- Satellite Interpretation Message (SIM).
- Tropical Weather Discussion (TWD).
- Tropical Weather Summary (TWS).
- Tropical Cyclone Summary – Fixes (TCS).
- Tropical Cyclone Danger Area Graphic
- Aviation Tropical Cyclone Advisory (TCA)
- Tropical Cyclone Reports (TCR)
- Tropical Cyclone Track and Watch/Warning Graphic
- Cumulative Wind Distribution
- Tropical Cyclone Wind Field Graphic
- Maximum Wind Speed Probability Table
- Tropical Cyclone Storm Surge Probabilities

### **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 intensity, it shall be named and the depression number dropped. The depression number will not be used again until the following year. Give tropical cyclones a name in the first advisory after intensifying to 34 knots (39 mph) or greater. In the Western Pacific, WFO Guam will use the JTWC cyclone number for all non-named systems. For RSMC Tokyo named systems, WFO Guam will use the RSMC Tokyo name with the associated JTWC number in parentheses.

The following rules apply for tropical cyclones passing from one basin to another: Retain the name if a tropical cyclone passes from one basin into another basin as a tropical cyclone; i.e., advisories are continuous. An unnamed tropical depression will also retain its number (e.g. Tropical Depression Six-E remains Tropical Depression Six-E) if it crosses into another area of responsibility. For unnamed tropical depressions moving from west to east across 180°, CPHC will use the associated Joint Typhoon Warning Center's (JTWC) number and indicate JTWC in parentheses following the number. For named systems, CPHC will use the associated RSMC Tokyo name and provide the associated JTWC number in parentheses.

Within a basin, if the remnant of a tropical cyclone redevelops into a tropical cyclone, it is assigned its original number or name. If the remnants of a former tropical cyclone regenerate in a new basin, the regenerated tropical cyclone will be given a new designation.

**3.3.1.1. Atlantic Basin.** Depression numbers, ONE, TWO, THREE, will be assigned by the TPC/NHC after advising the Naval Atlantic Meteorology and Oceanography Center (NAVLANTMETOCEN) 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 JTWC, Pearl Harbor, HI. 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 JTWC.

**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.** A single list of numbers and names will be used for all tropical and subtropical cyclones. Therefore, numbering of subtropical depressions

will follow the same procedure as tropical depressions. For example, if the first subtropical depression follows the first tropical depression, the subtropical depression will be given the designation SUBTROPICAL DEPRESSION TWO. If a subtropical depression becomes a subtropical storm, it receives the next available name in the tropical cyclone naming sequence.

### **3.3.2. Numbering and Naming of Tropical and Subtropical Cyclones.**

**3.3.2.1. Numbering and Naming Tropical Cyclones.** Tropical cyclone centers will number tropical depressions in their areas of responsibility. The centers will number tropical depressions consecutively beginning each season with the spelled out number “ONE.” In the north Pacific, for ease in differentiation, tropical depression numbers, assigned by NHC or CPHC, will include the suffix “E” for eastern (east of 140°W longitude) or “C,” for central (180° to 140°W longitude) respectively, after the number. In both the Atlantic and Pacific, once the depression reaches tropical storm intensity, name it and drop the depression number. The depression number will not be used again until the following year. Give tropical cyclones a name in the first advisory after intensifying to 34 knots (39 mph) or greater. In the Western Pacific, WFO Guam will use the JTWC cyclone number for all non-named systems. For RSMC Tokyo named systems, WFO Guam will use the RSMC Tokyo name with the associated JTWC number in parentheses.

The following rules apply for tropical cyclones passing from one basin to another: Retain the name if a tropical cyclone passes from one basin into another basin as a tropical cyclone; i.e. advisories are continuous. An unnamed tropical depression will also retain its number (e.g. Tropical Depression Six-E remains Tropical Depression Six-E) if it crosses into another area of responsibility. For unnamed tropical depressions moving from west to east across 180°, CPHC will use the associated Joint Typhoon Warning Center’s (JTWC) number and indicate JTWC in parentheses following the number. For named systems, CPHC will use the RSMC Tokyo name and provide the associated JTWC number in parentheses.

Within a basin, if the remnant of a tropical cyclone redevelops into a tropical cyclone, it is assigned its original number or name. If the remnants of a former tropical cyclone regenerate in a new basin, the regenerated tropical cyclone will be given a new designation.

**3.3.2.2. Numbering and Naming Subtropical Storms.** A single list of numbers and names will be used for all tropical and subtropical cyclones. Therefore, numbering of subtropical depressions will follow the same procedure as tropical depressions. For example, if the first subtropical depression follows the first tropical depression, the subtropical depression will be given the designation SUBTROPICAL DEPRESSION TWO. If a subtropical depression becomes a subtropical storm, it receives the next available name in the tropical cyclone naming sequence.

**3.3.2.3. Numbering Advisories and Tropical/Subtropical Cyclone Discussions.** Tropical and subtropical cyclone advisories and discussions in the Atlantic and the Pacific will be numbered similarly. Number scheduled and special advisories and TCDs consecutively beginning with the number 1 (not spelled out) for each new tropical or subtropical cyclone, and continue through the duration of the cyclone. In situations where only TCMs and

TCDs are being written (tropical cyclones in the eastern Pacific not threatening land) and at a later time a public advisory is required, the public advisory number will match the corresponding TCM. In both the Atlantic and the Pacific, intermediate advisories and TCDs will retain the advisory number of the scheduled or special advisory they update and append an alphabetic designator (e.g., “HURRICANE ALLISON INTERMEDIATE ADVISORY NUMBER 20A”).

**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)/WFO Guam.** When a tropical or subtropical cyclone crosses 180° from east to west, the coordinated transfer of warning responsibility from CPHC to JTWC will be made and the appropriate advisory issued. At the same time, the CPHC will coordinate with the RSMC, Tokyo and WFO Guam 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 JTWC to CPHC will be made. 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.

**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	Fleet Numerical Meteorology and Oceanography Center (FLENUMETOCEN), Monterey, CA
WFO Guam	CPHC

**3.5.2. Notification.** The NAVLANTMETOCEN, Norfolk, and JTWC, 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. JTWC will advise CPHC, TPC/NHC, and WFO Guam of impending or actual transfer of JTWC responsibilities. In the event of a CARCAH operational failure, direct communication is authorized between the 53 WRS and the forecast facility. Contact 53 WRS at DSN 597-2409/228-377-2409 or through the Keesler AFB Command Post at DSN 597-4330/208-377-4330 (ask for the 53 WRS).

**Table 3-1. Atlantic Tropical Cyclone Names**

<p><b>2009</b>            ANA            BILL            CLAUDETTE claw-DET            DANNY            ERIKA ERR-ree-ka            FRED            GRACE            HENRI ahn-REE            IDA            JOAQUIN            KATE            LARRY            MINDY            NICHOLAS NIK-o-las            ODETTE o-DET            PETER            ROSE            SAM            TERESA te-REE-sa            VICTOR VIC-ter            WANDA</p>	<p><b>2010</b>            ALEX            BONNIE            COLIN            DANIELLE dan-YELL            EARL            FIONA            GASTON            HERMINE her-MEEN            IGOR e-GOR            JULIA            KARL            LISA LEE-sa            MATTHEW            NICOLE ni-COLE            OTTO            PAULA            RICHARD RICH-erd            SHARY SHA-ree            TOMAS to-MAS            VIRGINIE vir-JIN-ee            WALTER</p>	<p><b>2011</b>            ARLENE            BRET            CINDY            DON            EMILY            FRANKLIN            GERT            HARVEY            IRENE            JOSE ho-ZAY            KATIA ka-TEE-ah            LEE            MARIA ma-REE-ah            NATE            OPHELIA o-FEEL-ya            PHILIPPE fe-leep            RINA            STAN            TAMMY            VINCE            WHITNEY</p>
<p><b>2012</b>            ALBERTO al-BAIR-toe            BERYL BER-ril            CHRIS            DEBBY            ERNESTO er-NES-toe            FLORENCE            GORDON            HELENE he-LEEN            ISAAC EYE-zak            JOYCE            KIRK            LESLIE            MICHAEL MIKE-el            NADINE nay-DEEN            OSCAR            PATTY            RAFAEL ra-fa-EL            SANDY            TONY            VALERIE            WILLIAM</p>	<p><b>2013</b>            ANDREA            BARRY            CHANTAL shan-TAHL            DORIAN            ERIN AIR-in            FERNAND            GABRIELLE ga-bree-EL            HUMBERTO oom-BAIR-to            INGRID            JERRY            KAREN            LORENZO            MELISSA            NESTOR            OLGA            PABLO PA-blow            REBEKAH            SEBASTIEN say-BAS-tyan            TANYA TAHN-ya            VAN            WENDY</p>	<p><b>2014</b>            ARTHUR            BERTHA BUR-tha            CRISTOBAL            DOLLY            EDOUARD eh-DWARD            FAY            GONZALO            HANNA            ISAIAS JO-ze-feen            KYLE            LAURA            MARCO            NANA            OMAR            PAULETTE            RENE re-NAY            SALLY            TEDDY            VICKY            WILFRED</p>

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

**Table 3-2. Eastern Pacific Tropical Cyclone Names**

<p><b>2009</b>            ANDRES ahn DRASE            BLANCA BLAHN kah            CARLOS            DOLORES            ENRIQUE anh REE kay            FELICIA fa LEE sha            GUILLERMO gee YER mo            HILDA            IGNACIO eeg NAH cio            JIMENA he MAY na            KEVIN            LINDA            MARTY            NORA            OLAF OH lah f            PATRICIA            RICK            SANDRA            TERRY            VIVIAN            WALDO            XINA ZEE nah            YORK            ZELDA ZEL dah</p>	<p><b>2010</b>            AGATHA            BLAS            CELIA            DARBY            ESTELLE            FRANK            GEORGETTE            HOWARD            ISIS            JAVIER            KAY            LESTER            MADELINE            NEWTON            ORLENE            PAINE            ROSLYN            SEYMOUR            TINA            VIRGIL            WINIFRED            XAVIER            YOLANDA yo LAHN da            ZEKE</p>	<p><b>2011</b>            ADRIAN            BEATRIZ BEE a triz            CALVIN            DORA            EUGENE            FERNANDA fer NAN dah            GREG            HILARY            IRWIN            JOVA Ho vah            KENNETH            LIDIA            MAX            NORMA            OTIS            PILAR            RAMON rah MONE            SELMA            TODD            VERONICA            WILEY            XINA ZEE nah            YORK            ZELDA ZEL dah</p>
<p><b>2012</b>            ALETTA a LET ah            BUD            CARLOTTA            DANIEL            EMILIA ee MILL ya            FABIO FAH bee o            GILMA GIL mah            HECTOR            ILEANA ill ay AH nah            JOHN            KRISTY            LANE            MIRIAM            NORMAN            OLIVIA            PAUL            ROSA            SERGIO SIR gee oh            TARA            VICENTE vee CEN tay            WILLA            XAVIER ZAY vier            YOLANDA yo LAHN da            ZEKE</p>	<p><b>2013</b>            ALVIN            BARBARA            COSME COS may            DALILA            ERICK            FLOSSIE            GIL            HENRIETTE hen ree ETT            IVO            JULIETTE            KIKO KEE ko            LORENA low RAY na            MANUEL mahn WELL            NARDA            OCTAVE AHK tave            PRISCILLA            RAYMOND            SONIA SONE yah            TICO TEE koh            VELMA            WALLIS            XINA ZEE nah            YORK            ZELDA ZEL dah</p>	<p><b>2014</b>            AMANDA            BORIS            CRISTINA            DOUGLAS            ELIDA ELL ee dah            FAUSTO FOW sto            GENEVIEVE            HERNAN her NAHN            ISELLE ee SELL            JULIO HOO lee o            KARINA            LOWELL            MARIE            NORBERT            ODILE oh DEAL            POLO            RACHEL            SIMON            TRUDY            VANCE            WINNIE            XAVIER ZAY vier            YOLANDA yo LAHN da            ZEKE</p>

**Table 3-3. Central Pacific Tropical Cyclone Names**

<b>COLUMN 1</b>		<b>COLUMN 2</b>	
<b>Name</b>	<b>Pronunciation</b>	<b>Name</b>	<b>Pronunciation</b>
AKONI	ah-KOH-nee	AKA	AH-kah
EMA	EH-mah	EKEKA	eh-KEH-kak
HONE	HOH-neh	HENE	HEH-neh
IONA	ee-OH-nah	IOLANA	ee-OH-lah-nah
KELI	KEH-lee	KEONI	keh-ON-nee
LALA	LAH-lah	LINO	LEE-noh
MOKE	MOH-keh	MELE	MEH-leh
NOLO	NOH-loh	NONA	NOH-nah
OLANA	Oh-LAH-nah	OLIWA	oh-LEE-vah
PENA	PEH-nah	PAMA	PAH-mah
ULANA	oo-LAH-nah	UPANA	oo-PAH-nah
WALE	WAH-leh	WENE	WEH-neh
<b>COLUMN 3</b>		<b>COLUMN 4</b>	
<b>Name</b>	<b>Pronunciation</b>	<b>Name</b>	<b>Pronunciation</b>
ALIKA	ah-LEE-kah	ANA	AH-nah
ELE	EH-leh	ELA	EH-lah
HUKO	HOO-koh	HALOLA	hah-LOH-lah
IOPA	ee-OH-pah	IUNE	ee-OO-neh
KIKA	KEE-kah	KILO	KEE-lo
LANA	LAH-nah	LOKE	LOH-keh
MAKA	MAH-kah	MALIA	mah-LEE-ah
NEKI	NEH-kee	NIALA	nee-AH-lah
OMEKA	oh-MEH-kah	OHO	OH-hoh
PEWA	PEH-vah	PALI	PAH-lee
UNALA	oo-NAH-lah	ULIKA	oo-LEE-kah
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 3-4. International Tropical Cyclone Names  
for the Northwest Pacific and South China Sea**

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

NOTE: The official international name list was 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.

**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 communications procedures governed by the World Meteorological Organization (WMO). 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: WTNT61 KNHC 180400.

**Table 3-5. Summary of Products and their Associated WMO Header**

<b>PRODUCT TITLE</b>	<b>WMO HEADER</b>
<b>Tropical Weather Outlook</b>	
Atlantic Basin	ABNT20 KNHC
Eastern Pacific	ABPZ20 KNHC
Central Pacific	ACPN50 PHFO
<b>Tropical Weather Discussion</b>	
Atlantic Basin	AXNT20 KNHC
Eastern Pacific	AXPZ20 KNHC
<b>Tropical/Subtropical Cyclone Public Advisory</b>	
Atlantic Basin	WTNT31-35 KNHC
Eastern Pacific	WTPZ31-35 KNHC
Central Pacific	WTPA31-35 PHFO
Western Pacific	WTPQ31-35 PGUM
<b>Tropical Cyclone Surface Wind Speed Probabilities Text Product</b>	
Atlantic Basin	FONT11-15 KNHC
Eastern Pacific	FOPZ11-15 KNHC
Central Pacific	FOPA11-15 PHFO
<b>Tropical/Subtropical Cyclone Forecast/Advisory</b>	
Atlantic Basin	WTNT21-25 KNHC
Eastern Pacific	WTPZ21-25 KNHC
Central Pacific	WTPA21-25 PHFO
<b>Tropical Cyclone Discussion</b>	
Atlantic Basin	WTNT41-45 KNHC
Eastern Pacific	WTPZ41-45 KNHC
Central Pacific	WTPA41-45 PHFO
<b>Tropical Cyclone Valid Time Event Code Product</b>	
Atlantic Basin	WTNT81-85 KNHC
Eastern Pacific	WTPZ81-85 KNHC
Central Pacific	WTPA81-85 PHFO
<b>Tropical Cyclone Position Estimate</b>	
Atlantic Basin	WTNT51-55 KNHC
Eastern Pacific	WTPZ51-55 KNHC
Central Pacific	WTPA51-55 PHFO
Western North Pacific	WTPQ51-55 PGUM
<b>Tropical Cyclone Update</b>	
Atlantic Basin	WTNT61-65 KNHC
Eastern Pacific	WTPZ61-65 KNHC
Central Pacific	WTPA61-65 PHFO

**Table 3-5 (continued). Summary of Products and their Associated WMO Header**

<b>PRODUCT TITLE</b>	<b>WMO HEADER</b>
<b>Tropical Weather Summary</b>	
Atlantic Basin	ABNT30 KNHC
Eastern Pacific	ABPZ30 KNHC
Central Pacific	ACPN60 PHFO
<b>Tropical Cyclone Position and Intensity from Satellite Data</b>	
South Central Pacific 120W	TXPS40 PHFO
North Central Pacific 140W - 180	TXPN40 PHFO
<b>Satellite Interpretation Message</b>	
Hawaiian Islands	ATHW40 PHFO
West Pacific (Guam)	ATPQ40 PGUM
<b>Satellite-Derived Rainfall</b>	
Eastern Caribbean	TCCA21 KNHC
Central Caribbean	TCCA22 KNHC
Western Caribbean	TCCA23 KNHC
<b>Aviation Tropical Cyclone Advisory Message</b>	
Atlantic Basin	FKNT21-25 KNHC
Eastern Pacific	FKPZ21-25 KNHC
Central Pacific	FKPA21-25 PHFO
<b>Tropical Cyclone Summary - Fixes</b>	
South Central Pacific 120W	TXPS41-45 PHFO
North Central Pacific 140W - 180	TXPN41-45 PHFO

Note: Refer to Appendix C for abbreviated communications headers and titles for the products for which JTWC is responsible.

### **3.7. Hurricane Liaison Team (HLT).**

**3.7.1. National Weather Service (NWS) Responsibilities.** The NWS supports the HLT through use of Tropical Prediction Center (TPC) meteorologists, Weather Forecast Office (WFO) personnel (typically warning coordination meteorologists and service hydrologists), and River Forecast Center (RFC) hydrologists. Eastern and Southern Region Headquarters will maintain a list of their available HLT candidates.

After HLT deactivation, the HPC will assume the briefing duties provided the remnants of the tropical cyclone remain a threat to inland areas. TPC and HPC will coordinate prior to the transfer. During the inland event HPC will coordinate with the appropriate WFOs and RFCs and when needed, hydrologists from the RFCs will provide hydrological briefings.

**3.7.2. Activation.** The HLT may be activated when a tropical cyclone in the Atlantic, Gulf of Mexico, Caribbean or eastern Pacific threatens the United States or its territories, and the Director or Deputy Director of TPC deems HLT assistance is required. TPC makes the request for activation by contacting the Federal Emergency Management Agency (FEMA) Operations Center (FOC). Upon FEMA's approval, the FOC will activate the HLT. The TPC Director or Deputy Director will contact the appropriate NWS Regional Director requesting meteorological and/or hydrologic support. NWS personnel should arrive at TPC within 24 hours. The HLT will

remain active until the hurricane threat has passed, at which time HLT operations will be terminated by FEMA. However, if the storm moves inland and if significant rainfall is expected, the HLT may remain activated.

If the HLT is deactivated, the HPC will assume the briefing duties provided the remnants of the tropical cyclone remain a threat to inland areas. TPC and HPC will coordinate prior to the transfer. During the inland event, HPC will coordinate with the appropriate WFOs and RFCs and, when needed, hydrologists from the RFCs will provide hydrological briefings.

**3.7.3. Training.** Completing NWS/FEMA's distance learning training module, Community Hurricane Preparedness, is required by HLT members. The module can be taken via the Internet at: <http://meted.ucar.edu/hurricane/chp/index.htm>. Other training opportunities are strongly encouraged. They are: FEMA's "Introduction to Hurricane Preparedness" conducted at TPC for emergency managers and NWS personnel, and FEMA's annual HLT training session held at TPC.

**3.7.4. Meteorological Duties.** The HLT meteorologist will:

- Establish and maintain contact with the impacted WFOs, RFCs, and the HPC.
- Facilitate participation of the impacted NWS offices in conference calls, briefings, and in preparation and distribution of graphics.
- Provide meteorological interpretations on National Hurricane Center advisories (NHC), WFO hurricane local statements, HURREVAC products, and storm surge forecasts for federal, state and local agencies on request.
- Provide storm briefings via video/audio teleconferences for federal, state and local organizations.
- Respond to meteorology-related incoming calls from federal, state, and local emergency managers, and as appropriate, refer meteorologic inquiries to the local WFO.

**3.7.5. Hydrologic Duties.** The HLT hydrologist will:

- Establish and maintain contact with the impacted local WFOs, RFCs, and the HPC.
- Facilitate participation of the impacted NWS offices in conference calls, briefings, and in preparation and distribution of graphics.
- Provide hydrologic interpretation on NHC advisories, WFO hurricane local statements, and WFO and RFC hydrologic products for federal, state and local agencies on request.
- Provide technical support for RFC lead during hydrologic portion of video teleconference. In absence of the RFC, lead the hydrologic portion of the video teleconference.

- Respond to hydrology-related incoming calls from federal, state, and local emergency managers and as appropriate, refer hydrologic inquiries to the local WFO

## 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 Weather Product Management and Distribution System (WPMDS) at the Air Force Weather Agency (AFWA), Offutt AFB, NE, 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 (WFO) 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.

**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. The forecast will contain 12, 24, 36, 48, 72, 96, and 120-hour tropical cyclone forecast positions. A code string is appended at the end of the line "NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL." This is the Automated Tropical Cyclone Forecasting (ATCF) System Storm Identification Character String recognized by the WMO for tracking and verification of tropical cyclones. The ATCF <Storm ID> is three spaces after "FL" and uses the following format:

**NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL BBCCYYYY**  
where:

**BB = Ocean Basin**

- AL** - North Atlantic basin...north of the Equator
- SL** - South Atlantic basin...south of the Equator
- EP** - North East Pacific basin...eastward of 140°W
- CP** - North Central Pacific basin...between the Dateline and 140°W
- WP** - North West Pacific basin...westward of the Dateline
- IO** - North Indian Ocean basin...north of the Equator between 40°E and 100°E
- SH** - South Pacific Ocean Basin and South Indian Ocean basin

**CC = Cyclone Number**

Numbers 01 through 49 are reserved for tropical and subtropical cyclones. A cyclone number is assigned to each tropical or subtropical cyclone in each basin as it develops. The numbers are assigned in chronological order.

Numbers 50 through 79 are reserved for internal use by operational forecast centers.

Numbers 80 through 89 are reserved for training, exercises and testing.

Numbers 90 through 99 are reserved for tropical disturbances which have the potential to become tropical or subtropical cyclones. Although not required, the 90's should be assigned sequentially and reused throughout the calendar year.

**YYYY = Four-digit year**

This is the calendar year for the Northern Hemisphere. For the Southern Hemisphere, the year begins July 1, with calendar year plus one.

Note: Tropical cyclone public advisories issued by the TPC/NHC, CPHC, and WFO Guam will contain appropriate information as shown in the example in Figure 4-2.

**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.

**4.3.3.2. Numbering of Tropical Cyclone Forecast/Advisories.** All tropical cyclone forecast/advisories will be numbered sequentially; for example,

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

WTNT25 KNHC 230300  
TCMAT5

HURRICANE ISIDORE FORECAST/ADVISORY NUMBER 28  
NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL AL102002  
0300Z MON SEP 23 2002

A HURRICANE WARNING REMAINS IN EFFECT ALONG THE GULF OF MEXICO AND  
CARIBBEAN COASTS OF THE YUCATAN PENINSULA FROM CAMPECHE NORTH AND  
EASTWARD TO TULUM...INCLUDING THE ISLAND OF COZUMEL.

HURRICANE CENTER LOCATED NEAR 20.8N 89.5W AT 23/0300Z  
POSITION ACCURATE WITHIN 20 NM

PRESENT MOVEMENT TOWARD THE SOUTHWEST OR 220 DEGREES AT 4 KT

ESTIMATED MINIMUM CENTRAL PRESSURE 950 MB  
MAX SUSTAINED WINDS 90 KT WITH GUSTS TO 110 KT.  
64 KT..... 45NE 25SE 25SW 45NW.  
50 KT..... 75NE 50SE 50SW 75NW.  
34 KT.....200NE 130SE 100SW 150NW.  
12 FT SEAS..300NE 200SE 150SW 300NW.  
WINDS AND SEAS VARY GREATLY IN EACH QUADRANT. RADII IN NAUTICAL  
MILES ARE THE LARGEST RADII EXPECTED ANYWHERE IN THAT QUADRANT.

REPEAT...CENTER LOCATED NEAR 20.8N 89.5W AT 23/0300Z  
AT 23/0000Z CENTER WAS LOCATED NEAR 21.0N 89.4W

FORECAST VALID 23/1200Z 20.7N 90.3W  
MAX WIND 80 KT...GUSTS 100 KT.  
64 KT... 40NE 20SE 25SW 40NW.  
50 KT... 60NE 40SE 40SW 60NW.  
34 KT...180NE 60SE 60SW 150NW.

FORECAST VALID 24/0000Z 21.0N 91.0W  
MAX WIND 95 KT...GUSTS 115 KT.  
64 KT... 45NE 25SE 25SW 45NW.  
50 KT... 75NE 50SE 50SW 75NW.  
34 KT...200NE 150SE 100SW 150NW.

FORECAST VALID 24/1200Z 21.8N 92.0W  
MAX WIND 115 KT...GUSTS 140 KT.  
64 KT... 60NE 45SE 45SW 60NW.  
50 KT...100NE 75SE 75SW 100NW.  
34 KT...200NE 150SE 125SW 180NW.

FORECAST VALID 25/0000Z 22.8N 92.5W  
MAX WIND 125 KT...GUSTS 155 KT.  
50 KT...100NE 100SE 75SW 100NW.  
34 KT...200NE 200SE 150SW 200NW.

FORECAST VALID 26/0000Z 25.0N 93.0W  
MAX WIND 125 KT...GUSTS 155 KT.  
50 KT...100NE 100SE 75SW 100NW.  
34 KT...200NE 200SE 150SW 200NW.

EXTENDED OUTLOOK. NOTE...ERRORS FOR TRACK HAVE AVERAGED NEAR 275 NM  
ON DAY 4 AND 375 NM ON DAY 5...AND FOR INTENSITY NEAR 20 KT EACH DAY

OUTLOOK VALID 27/0000Z 22.8N 92.5W  
MAX WIND 100 KT...GUSTS 120 KT.

OUTLOOK VALID 28/0000Z 25.0N 93.0W  
MAX WIND 90 KT...GUSTS 110 KT.

REQUEST FOR 3 HOURLY SHIP REPORTS WITHIN 300 MILES OF 20.8N 89.5W

NEXT ADVISORY AT 23/0900Z

FORECASTER PASCH

\$\$  
NNNN

**Figure 4-1. Tropical Cyclone Forecast/Advisory Format**

WTNT34 KNHC 260359  
MIATCPAT4

BULLETIN

TROPICAL STORM DEBBY ADVISORY NUMBER 18  
NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL AL042006  
1100 PM AST FRI AUG 25 2006

...DEBBY BARELY HANGING ON AS A TROPICAL STORM...

AT 1100 PM AST...0300 UTC...THE CENTER OF TROPICAL STORM DEBBY WAS  
LOCATED NEAR LATITUDE 25.2 NORTH...LONGITUDE 45.6 WEST OR ABOUT 1400  
MILES...2255 KM...SOUTHWEST OF THE AZORES.

DEBBY IS MOVING TOWARD THE WEST-NORTHWEST NEAR 14 MPH...22 KM/HR...  
AND A TURN TO THE NORTHWEST AND THEN NORTH-NORTHWEST IS EXPECTED  
DURING THE NEXT DAY OR TWO.

MAXIMUM SUSTAINED WINDS ARE NEAR 40 MPH...65 KM/HR...WITH HIGHER  
GUSTS. LITTLE CHANGE IN STRENGTH IS FORECAST DURING THE NEXT 24  
HOURS.

TROPICAL STORM FORCE WINDS EXTEND OUTWARD UP TO 105 MILES...165 KM  
FROM THE CENTER.

ESTIMATED MINIMUM CENTRAL PRESSURE IS 1008 MB...29.77 INCHES.

...SUMMARY OF 1100 PM AST INFORMATION...

LOCATION...25.2N 45.6W  
MAXIMUM SUSTAINED WINDS...40 MPH  
PRESENT MOVEMENT... WEST-NORTHWEST OR 295 DEGREES AT 14 MPH  
MINIMUM CENTRAL PRESSURE...1008 MB

THE NEXT ADVISORY WILL BE ISSUED BY THE NATIONAL HURRICANE CENTER AT 500 AM AST.

\$\$  
FORECASTER NAME

**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 F), DOC has identified a requirement for, and the Department of Defense (DOD) maintains aircraft to support, up to five sorties per day. Requirements exceeding five sorties will be accomplished on a "resources-permitting" basis. 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:

**5.2.1.1.** Providing operational aircraft for vortex fixes and data, synoptic surveillance missions, and investigative flights in response to DOC needs (see Figure 5-1).

**5.2.1.2.** 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:

**5.2.2.1.** Provide synoptic surveillance soundings (see Figure 5-2).

**5.2.2.2.** Augment AFRC aircraft reconnaissance when DOC needs exceed the capabilities of DOD resources (see Figure 5-3).

**5.2.2.3.** Assume responsibility for hurricane reconnaissance over foreign airspace that may be restricted for military operations.

**5.2.2.4.** Conduct research flights.



**Figure 5-1. WC-130J 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. Procedures for the expeditious handling of reconnaissance aircraft are documented in paragraph 5.5.4, Aircraft Operations—Pre-mission Coordination and paragraph 5.5.5, Aircraft Operations—Mission Execution..

**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, 850 hPa, or 700 hPa height.
- Minimum 700, 850 or 925 hPa height, if available.
- Wind data (continuous observations along the flight track) for surface and flight level.
- SFMR surface wind.
- High density three-dimensional Doppler radial velocities of the tropical cyclone core circulation.
- Temperature at flight level.
- SFMR rain rate.
- 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.

#### **5.4.2.9. Core Doppler Radar.**

- Horizontal resolution along aircraft track: 1.5 km
- Radar beam width: 3 degrees.
- Radar radial resolution (gate length): 150 m.
- Error in radar radial velocity: 1 m/s.
- Range: 50 km.

[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 UTC time, aircraft latitude, longitude, static pressure, geopotential height, extrapolated sea level pressure or DValue, air temperature, dew point temperature, flight-level (FL) wind direction, FL wind speed, peak 10-second (10-s) average FL wind speed, peak 10-s average surface wind speed from the stepped frequency microwave radiometer (SFMR), SFMR-derived

rain rate, and quality control flags. Except for the peak values noted above, all data provided in HDOB messages are 30-second averages, regardless of the interval at which the HDOB messages are reported. See Appendix G for HDOB message formats. 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 immediately contact Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) to determine data requirements for the remainder of the mission.

**5.4.4. Synoptic Surveillance Data Requirements.** When required, TPC/NHC will request sounding data on the periphery of systems approaching the United States. TPC/NHC will provide specific tracks including control points, control times and dropwindsonde frequency allocations to CARCAH for coordination with the reconnaissance units.

**5.4.5. Core Doppler Radar Requirements.** When required, TPC/NHC and the Environmental Modeling Center (EMC) will coordinate to request high-density three-dimensional Doppler radial velocities in the tropical cyclone core for potential storms impacting the United States, including Puerto Rico and the Virgin Islands. EMC, TPC/NHC, and HRD will coordinate to provide specific flight plans to CARCAH for coordination with the reconnaissance units.

**5.4.6. Required Frequency and Content of Observations.** Observation requirements are summarized in Table 5-1. Deviations to these requirements will be coordinated through CARCAH. The Vortex message format and information are shown in Figure 5-4, Figure 5-5, and Table 5-2. Other data message formats and code breakdowns can be found in Appendix G.

**Table 5-1. Requirements for Aircraft Reconnaissance Data**

	RECCO Section 1 plus 4ddff and 9VTTT as applicable	Vortex Data Message (VDM)	Vertical Data WMO Temp Drop Code (FM37-VII)	High Density Observation (HDOB)
En route	Approx. every 30 minutes over water not to exceed 200 nm	NA	Every 400 nm over water	30-sec interval
Invest area	At major turn turnpoints. Also, every 15 minutes if HDOBs are <i>INOP</i> .	After closing a circulation	NA	30-sec interval
Fix pattern	End points of Alpha pattern legs.  When necessary with radar fix information.	Each fix.	Each tasked fix at or above 850 mb. Intermediate fixes and eyewall modules as requested.	30-sec interval

**5.4.7. WP-3D Configuration.** The minimum operational configuration of the WP-3D will include the stepped frequency microwave radiometer (SFMR), Doppler radar and the advanced vertical atmospheric profiling system (AVAPS).

DATE		SCHEDULED FIX TIME	AIRCRAFT NUMBER	ARWO
WX MISSION IDENTIFICATION			STORM NUMBER IDENTIFIER	OB
VORTEX DATA MESSAGE				
A			DATE AND TIME OF FIX	
B	DEG	MIN N S	LATITUDE OF VORTEX FIX	
	DEG	MIN E W	LONGITUDE OF VORTEX FIX	
C			MINIMUM HEIGHT AT STANDARD LEVEL	
D			ESTIMATE OF MAXIMUM SURFACE WIND OBSERVED	
E			BEARING AND RANGE FROM CENTER OF MAXIMUM SURFACE WIND	
F			MAXIMUM FLIGHT LEVEL WIND NEAR CENTER	
G			BEARING AND RANGE FROM CENTER OF MAXIMUM FLIGHT LEVEL WIND	
H			MINIMUM SEA LEVEL PRESSURE COMPUTED FROM DROPSONDE OR EXTRAPOLATED FROM FLIGHT LEVEL. IF EXTRAPOLATED, CLARIFY IN REMARKS.	
I			MAXIMUM FLIGHT LEVEL TEMP/PRESSURE ALTITUDE OUTSIDE EYE	
J			MAXIMUM FLIGHT LEVEL TEMP/PRESSURE ALTITUDE INSIDE EYE	
K			DEWPOINT TEMP/SEA SURFACE TEMP INSIDE EYE	
L			EYE CHARACTER: Closed wall, poorly defined, open SW, etc.	
M			EYE SHAPE/ORIENTATION/DIAMETER. <b>CODE EYE SHAPE AS:</b> C -Circular; CO - Concentric; E- Elliptical. <b>TRANSMIT ORIENTATION OF MAJOR AXIS IN TENS OF DEGREE</b> (i.e., 01-010 to 190; 17-170 to 350). <b>TRANSMIT DIAMETER IN NAUTICAL MILES.</b> Examples: C8 - Circular eye 8 miles in diameter. EO9/15/5 - Elliptical eye, major axis 090-270, length of major axis 15 NM, length of minor axis 5NM. CO8-14 - Concentric eye, diameter inner eye 8 NM, outer eye 14 NM.	
N			FIX DETERMINED BY/FIX LEVEL. <b>FIX DETERMINED BY:</b> 1 - Penetration; 2 - Radar; 3 - Wind; 4 - Pressure; 5 - Temperature. <b>FIX LEVEL:</b> 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; 5 - 500 mb; 4 - 400 mb; 3 - 300 mb; 2 - 200 mb; NA - Other.	
O			NAVIGATION FIX ACCURACY/METEOROLOGICAL ACCURACY	
P	REMARKS			
	MAX FL WIND _____ KT _____ QUAD _____ Z			
	MAX OUTBOUND FL WIND _____ KT _____ QUAD _____ Z			
	SLP EXTRAP FROM (Below 1500 FT/ 925 MB/ 850 MB/ DROPSONDE)			
	SFC CNTR _____ / _____ NM FROM FL CNTR			
MAX FL TEMP _____ C _____ / _____ NM FROM FL CNTR				
SURFACE WIND OBSERVED VISUALLY				
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.				

**Figure 5-4. Vortex Data Message Worksheet**

**Table 5-2. Vortex Data Message Entry Explanation**

<b>DATA ITEM</b>	<b>ENTRY</b>
Mission Identifier	As determined in Chapter 5, paragraph 5.7.6.
Storm Identifier	As determined in Chapter 4, paragraph 4.3.3.
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 FL center in Remarks; 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. When SFMR surface wind data are unavailable, the surface wind is determined visually.
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. All winds reported should be 10-s averages.
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.

**Table 5-2 (continued). Vortex Data Message Entry Explanation**

DATA ITEM	ENTRY
J (JULIET)	<p>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 Remarks, including bearing and distance from the flight level center.</p> <p>PRESSURE ALT--Pressure altitude data (meters) are taken at the same location as the maximum temperature data reported in item JULIET.</p>
K (KILO)	<p>Dewpoint temperature/sea surface temperatures are collected at the same location as the maximum temperature reported in item JULIET. Enter NA if not observed.</p>
L (LIMA)	<p>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.</p>
M (MIKE)	<p>Self explanatory. Report only if item LIMA is reported, otherwise enter NA.</p>
N (NOVEMBER)	<p>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.</p> <p>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.</p>
O (OSCAR)	<p>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>
P (PAPA)	<p>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 maximum flight-level wind observed on the outbound leg following the center fix just obtained, if it is higher than the inbound maximum reported in item F. Include time of observation and the relative quadrant of the storm of the qualifying outbound max wind. If, after the transmission of the vortex message but prior to the aircraft reaching the cross-leg turn point, a higher qualifying outbound wind is observed, then the vortex message will be amended with the higher outbound wind reported. If the outbound max FL wind becomes the new overall max FL wind, then consolidate the two max FL wind remarks into one remark; (4) the method of deriving the central SLP when extrapolated; and (5) the bearing and range of the surface center and/or maximum flight level temperature if not within 5 nm of the flight level center.</p>

```

URNT12 KNHC 072030
VORTEX DATA MESSAGE AL092008
A. 07/20:09:20Z
B. 21 deg 01 min N
   074 deg 26 min W
C. 700 mb 2624 m
D. 90 kt
E. 045 deg 13 nm
F. 147 deg 106 kt
G. 047 deg 016 nm
H. 945 mb
I. 10 C/ 3045 m
J. 16 C/ 3057 m
K. 13 C/ NA
L. CLOSED WALL
M. CO16-48
N. 12345/7
O. 0.02 / 1 nm
P. AF307 0909A IKE      OB 11
MAX FL WIND 107 KT NW QUAD 18:21:10 Z

```

**Figure 5-5. Example Vortex Data Message (VDM) for the WC-130J**

## **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, 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.

**5.5.1.3.1.** 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.

**NHOP COORDINATED REQUEST FOR AIRCRAFT RECONNAISSANCE**

\_\_\_ Original  
\_\_\_ Amendment  
(Check One)

**I. ATLANTIC REQUIREMENTS**

STORM NAME	FIX OR ON		FLIGHT	FCST	NHC
DEPRESSION #	STATION		PATTERN	MVMT	PRIORITY
SUSPECT AREA	TIME	COORDINATES			

---

---

---

GULF STREAM \_\_\_\_\_

SUCCEEDING DAY OUTLOOK \_\_\_\_\_

REMARKS \_\_\_\_\_

---

---

**II. PACIFIC REQUIREMENTS**

STORM NAME	FIX OR ON		FLIGHT	FCST	NHC
DEPRESSION #	STATION		PATTERN	MVMT	PRIORITY
SUSPECT AREA	TIME	COORDINATES			

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SUCCEEDING DAY OUTLOOK \_\_\_\_\_

REMARKS \_\_\_\_\_

---

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**III. DISTRIBUTION**

- A. TO CARCAH BY 1630Z OR AMEND AT ANY TIME
- B. Date \_\_\_\_\_ Time \_\_\_\_\_ FCSTR INITIAL \_\_\_\_\_
- C. 53 WRS \_\_\_\_\_ AOC \_\_\_\_\_ Other \_\_\_\_\_

**Figure 5-6. NHOP Coordinated Request for Aircraft Reconnaissance**

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

NOUS42 KNHC \_\_\_\_\_ (DATE/UTC TIME)  
 WEATHER RECONNAISSANCE FLIGHTS  
 CARCAH, TPC/NATIONAL HURRICANE CENTER, MIAMI, FL  
 \_\_\_\_\_ (LOCAL TIME) \_\_\_\_ (TIME ZONE) \_\_\_\_ (DAY) \_\_\_\_ (MONTH/DATE), \_\_\_\_ (YEAR)  
 SUBJECT: THE TROPICAL CYCLONE PLAN OF THE DAY (TCPOD)  
 VALID \_\_\_\_\_Z (MONTH) TO \_\_\_\_\_Z (MONTH) (YEAR)  
 TCPOD NUMBER.....(YR)- \_\_\_\_\_

**I. ATLANTIC REQUIREMENTS**

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

FLIGHT ONE (NHC PRIORITY, if applicable)

TEAL or NOAA \_\_\_\_\_ (number)

- |           |                        |
|-----------|------------------------|
| A. _____Z | FIX/INVEST TIME        |
| B. _____  | MISSION IDENTIFIER     |
| C. _____Z | DEPARTURE TIME         |
| D. _____  | FORECAST POSITION      |
| E. _____Z | TIME ON STATION        |
| F. _____  | ALTITUDE(S) ON STATION |
| G. _____  | 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. PACIFIC REQUIREMENTS (Same as in ATLANTIC)**

**Figure 5-7. Tropical Cyclone Plan of the Day Format**

- 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.

- Up to two synoptic surveillance missions per 24-hour period for potentially landfalling storms.

**5.5.1.3.2.** In the Eastern Pacific, reconnaissance missions may be tasked when necessary to carry out warning responsibilities.

**5.5.1.3.3.** 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.

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

## **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.

**5.5.2.5. NOAA WP-3D Availability.** At least one WP-3D will be operationally configured (per paragraph 5.4.7) and available to respond to requirements within 24 hours from June 1<sup>st</sup> through November 30<sup>th</sup> annually. A second P-3 with the same operational configuration will be available each hurricane season from July 15<sup>th</sup> to September 30<sup>th</sup>. When maintenance and programmatic considerations permit, the second aircraft could be made available until November 30<sup>th</sup> also. The frequency of flights when two aircraft are available and with present staffing shall be every twelve hours.

### **5.5.3. Reconnaissance Tropical Cyclone Plan of the Day.**

**5.5.3.1. Preparation.** 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.

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

**5.5.3.1.2.** The TCPOD will list all DOC and DOD required tropical and subtropical cyclone operational reconnaissance. Research missions will be listed in remarks when available by transmission time.

**5.5.3.1.3.** 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, which 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 1830 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 AWIPS users and “NOUS42 KNHC” for AWDS users. The TCPOD can be accessed via the Internet at the Tropical Prediction Center/National Hurricane Center homepage at [www.nhc.noaa.gov](http://www.nhc.noaa.gov), then click on aircraft reconnaissance and then on Plan of the Day.]

### **5.5.4. Aircraft Operations—Pre-mission Coordination.**

#### **5.5.4.1. Federal Aviation Administration (FAA) Coordination.**

**5.5.4.1.1. Responsibilities.** The Air Traffic Control System Command Center (ATCSCC) and Air Route Traffic Control Centers (ARTCC) are responsible for coordination in support of the NHOP.

#### **5.5.4.1.2. ATCSCC Procedures.**

- Review the NOAA/National Hurricane Center Aircraft Reconnaissance TCPOD at <http://www.nhc.noaa.gov/reconlist.shtml>, by 1200 Eastern Time.
- Activate the Hurricane Desk or the Crisis Management Center, when required.
- Prepare a public Flow Evaluation Area (FEA) based on the latitude/longitude points specified in the TCPOD when a mission is scheduled to be flown. The

FEA naming convention is the three-letter identifier of the primary ARTCC and the two (2) digits of the mission aircraft call sign (ex. ZNY71 or with multiple aircraft in the same FEA ZNY71/42). Modify the FEA when requested by the primary ARTCC.

- Designate a primary ARTCC when the Operations Area includes multiple ARTCCs.
- Coordinate, as necessary, with the Air Force Reserve Command's 53rd Weather Reconnaissance Squadron (53 WRS), the National Oceanic and Atmospheric Administration Aircraft Operations Center (NOAA AOC), the National Aeronautics and Space Administration (NASA), the Naval Research Laboratory (NRL), and the affected ARTCCs.
- Discuss the mission profile with the unit's operations center or aircraft commander approximately two (2) hours prior to the flight departure time. The unit's operations center or aircraft commander will initiate the discussion. This discussion will include, at a minimum, the flight time, geographic location, flight track, and altitudes (AGL). Modify the FEA as required and coordinate with the impacted ARTCCs.
- Assist ARTCCs with traffic flow priorities if the hurricane reconnaissance flight will impact air traffic. If required, ensure the hurricane reconnaissance flight receives priority for the specified period of time.
- Conduct hurricane and customer conferences, as required.

#### **5.5.4.1.3. ARTCC Procedures.**

- Coordinate with all impacted military facilities (ex. FACSFAC) and entities within their area of operations and responsibility to ensure all offshore airspace that is released to the military is protected for NHOP flights, when required.
- Coordinate with all impacted terminal facilities.
- If mission profile changes, coordinate with ATCSCC for FEA modifications.
- Prepare a Notice to Airmen (NOTAM) based on the latitude/longitude points specified in the TCPOD and update as required.
- Assign each aircraft the designated reserved NORAD transponder code associated with that call sign.

**5.5.4.2. Flight Operations Coordination (Aircraft and Unmanned Aerial Systems (UAS)).** Normally notification to the ATCSCC of planned reconnaissance or buoy deployment flights by the 53 WRS and NOAA aircraft is accomplished through the TCPOD (1 June through 30 November). If for any reason a flight is planned that was not included in the TCPOD, then these units operations centers will notify the ATCSCC National Operations

Manager (NOM) or International Operations Manager (IOM) directly at (703) 904-4525 prior to the scheduled time of departure.

When flights are scheduled on the TCPOD, the operations centers for the units flying those missions will contact the NOM for coordination. This call should happen as soon as practical after the TCPOD is published to enable the NOM to coordinate and activate their hurricane operations. NASA, NRL, or any other agency planning operations into or around the forecast or actual storm location will notify the ATCSCC NOM at (703) 904-4525 and the Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) at (305) 229-4474, as soon as possible prior to an NHOP reconnaissance, surveillance, or research mission.

All missions must provide the following information:

- Mission call sign.
- Departure point and estimated time of departure.
- Approximate route to be flown.
- Requested AGL or MSL altitude(s).
- Any special requests.

The following aircraft call signs will be used:

- 53 WRS – “TEAL 70 through 79”
- NOAA AOC – “NOAA 42 through 44”; and “NOAA 49”
- NASA – “NASA ##”
- NRL – “WARLOCK 587”

Each aircraft will have a designated reserved NORAD transponder code associated with that call sign. This code is assigned by ARTCC.

**5.5.4.3. Flight Plan Filing Procedures.** Flight plans for reconnaissance and research flights must be filed with the FAA as soon as practicable before departure time. Include delay time in the Route portion of the International Flight Plan. This will keep the IFR flight plan active throughout the delay. Due to limited information that is displayed on controller screens, it is recommended that only the following remarks be included in the “Other Information” block: “EET” to FIR boundaries, “STS” with storm delay information, and “RMK/MDCN” diplomatic clearance information.

**5.5.4.4. Mission Coordination.** The aircraft commander or operations center must contact the NOM at (703) 904-4525 or (703) 708-5140/5144 approximately 2 hours prior to scheduled takeoff time, or as soon as possible. If required, the NOM or the IOM initiates a conference call with all ATC and military facilities affected by the flight operations area to ensure flight information and proposed operations area information is up to date.

**5.5.4.5. Mission Cancellation.** When a mission is cancelled or delayed, the unit flying the mission must notify the NOM/IOM as soon as possible.

## **5.5.5. Aircraft Operations—Mission Execution**

### **5.5.5.1. NHOP Missions (Surface to FL150).**

**5.5.5.1.1. Priority Handling.** When requested by the aircrew, ATC will provide TEAL and NOAA aircraft priority handling. The aircraft commander will only ask for priority handling when necessary to accomplish the mission.

**5.5.5.1.2. Operations Area.** Missions will be flown 100 percent under IFR criteria, and the IFR clearance will remain active throughout the flight. Even though rules for flying in Controlled and Uncontrolled Airspace are different, aircrews will not differentiate between these two while in the Operations Area and will follow normal Controlled Airspace procedures or procedures specified in this section. Regardless of the Designated Class of airspace (A through G), the following rules apply.

**5.5.5.1.3. IFR Procedures and Clearance.** ATC facilities will provide Air Traffic Control Services to all participating aircraft in the area of operations. All aircraft operating in this area will file their flight plan and fly according to IFR procedures. 53WRS crews will not conduct flight operations under the military provisions of "Due Regard" or declare "Operational" in FAA controlled or uncontrolled airspace. However, this does not preclude the aircraft commander from exercising their authority in the interest of safety or during an aircraft emergency.

**5.5.5.1.4. Altitude Assignment (AGL).** Authorized aircraft may request to operate at a single altitude or within a block of altitudes defined by radar altitude (AGL). Multiple aircraft may operate in the same vicinity but at different altitudes at the same time.

- **Operations in Controlled Airspace.** ATC will assign an altitude or a block of altitudes and provide standard vertical separation between all participating and all other known aircraft. ATC will use the following phraseology; "Teal 70 maintain block (altitude) through (altitude)."

- **Operations in Uncontrolled Airspace.** ATC can neither assign altitudes in, nor provide separation between aircraft in uncontrolled airspace, but will issue safety alerts. While in uncontrolled airspace, aircrews will advise ATC of their planned altitudes. Aircrews are responsible for maintaining their own separation from the surface of the sea, obstacles, and oil platforms while operating below the Minimum IFR Altitude (MIA).

**NOTE:** When an aircrew requests a block altitude that includes altitudes outside of controlled airspace, ATC will assign the altitudes that are in controlled airspace and clear the aircraft to exit controlled airspace.

**EXAMPLE:** Teal 70 requests the block altitude surface to FL100. The airspace below FL055 is uncontrolled. ATC will clear Teal 70, "Teal 70, maintain block flight level 055 through flight

level 100, cleared to exit controlled airspace.”

**5.5.5.1.5. Delay Area.** This area is defined as an area of airspace at and below FL150 with a radius of 150 nm around a set of center coordinates. This airspace excludes the terminal areas (as shown on the NHOP operational maps) until radio contact is established with the ATC facility controlling the terminal airspace. If not in radar contact within the area as shown on the NHOP Operational Maps, the aircrew will make position reports in relation to designated navigational aids as requested by ATC along the coast, and will be allowed flight up to the coast, traffic permitting. When several aircraft are participating in NHOP missions they may have different center coordinates or delay areas. Any changes to the operating area will be coordinated with ATC.

**5.5.5.1.6. Communications.** The aircrew maintains communications with only the primary ARTCC. Normally UHF or VHF radios will be used for communications with ATC, when within range. When out of UHF or VHF range, use Satellite Phone to communicate directly to ATC Centers. IFR aircraft flying in airspace under the control of FAA facilities are required to maintain continuous two-way communications with ATC even while flying in class F or G designated airspace. Due to quick ATC clearance approvals needed by the aircrew to maintain safety and execute the mission, direct contact with the ARTCC is required. Crews will make hourly “ops normal” calls to the primary ARTCC if not in radar contact, and no radio transmissions have been made within the previous hour. Relaying clearance requests through AIRINC, other aircraft, or SATCOM Data Link is not desired as this will delay receiving updated clearances or requests.

**5.5.5.1.7. Backup ARTCC Communications Procedures.** *The 53 WRS, CARCAH, NOAA, NASA, and NRL operation centers are responsible for ensuring that air traffic clearances and messages relayed by them to/from the FAA are relayed in an accurate manner. Only use this method when the aircraft is unable to directly contact ATC to request a revised or en route clearance.*

- *TEAL aircraft will send their requests by SATCOM data link to the 53 WRS operations center. The operations center will print this message and fax it directly to the primary ARTCC Missions Desk providing mission clearance. The operations center will also phone the Mission Desk. The ARTCC will issue a revised clearance. The 53 WRS operations center will transmit the approval via SATCOM back to the aircraft.*

- *53 WRS and NOAA flights may also request that a clearance be relayed through CARCAH.*

**5.5.5.1.8. Air Traffic Control (ATC).** The FAA will provide ATC services between Participating Aircraft, Non-Participating instrument flight rules (IFR) aircraft and known Visual Flight Rule (VFR) aircraft to the 53 WRS, NOAA, NASA, and NRL aircraft operating in the area of interest. Aircraft not following IFR or operating in Class G airspace may be operating near or in the storm environment; therefore, adherence to ATC clearances is mandatory for safety.

- It is understood by the FAA, the 53 WRS, and NOAA AOC that

there is no practical method at this time to provide separation from any nonparticipating aircraft that is flying VFR, flying in Class G airspace, not in radar contact, not squawking, and/or not in communication with ATC. Aircrews must use “see and avoid” and TCAS to avoid these aircraft when possible.

- If Air Traffic Advisory Service knows that an aircraft is operating VFR or is operating in uncontrolled airspace in the Area of Operations, then ATC will inform all Participating Aircraft so the Participating Aircraft can contact the Non-Participating Aircraft to de-conflict routing.

- Coordination for aircraft operations will be at the ARTCC level. The ATC Military Operations desk will coordinate with all agencies for flight operations in Warning Areas, Special Use Airspace (SUA), and Approach Control airspace.

**5.5.5.1.9. Participating Aircraft.** During the aircraft commander’s or UAS operator’s mission call to the NOM, the NOM or the IOM will advise them whenever more than one Participating Aircraft will be in the area of interest at the same time and must brief the other aircraft’s call sign and mission information. If CARCAH is aware that there will be another aircraft or UAS in the operations area then they must also advise the affected flight crew. The following actions will be taken by the aircrews to de-conflict operations and enhance situational awareness with the other Participating Aircraft:

- Set 29.92 (inches Hg) in at least one pressure altimeter.
- Contact the other Participating Aircraft and confirm (as a minimum) the other aircraft’s pressure altitude, geographic position, true heading, and operating Altitude or Block Altitude (AGL).
- Crews will not fly within 2,000 feet (vertical) of other participants operating in the same area of interest without concurrence of the other Participating Aircraft.
- While in uncontrolled airspace TEAL and NOAA aircraft may use the same block altitudes and will provide separation from each other and any weather instrument being released. To maintain separation, these aircraft use separate altitudes and airplane-to-airplane communication to maintain situational awareness of the other aircraft’s location in addition to using air-to-air TACAN, and TCAS.
- The following frequencies will be used for airplane-to-airplane communications and coordination unless otherwise directed by ATC:

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

**5.5.5.1.10. UAS Operations.** When a UAS requires a block altitude conflicting with a Participating Aircraft then the Participating Aircraft will coordinate with each other and then coordinate with ATC for altitude changes. If both aircraft require the same block altitude then contact CARCAH to determine which mission has priority.

**5.5.5.1.11. Weather Dropsonde Instrument Release.** The aircraft commander is the sole responsible party for all dropsonde releases or sensor activations. Aircraft commanders will ensure coordination with other Participating Aircraft prior to release or activation. (Examples of weather instruments are dropwindsondes and *oceanographic profilers (OP)*).

**5.5.5.2. Buoy Deployment Mission (Surface to FL050).** Regardless of the Designated Class of airspace (A through G) the following rules apply.

**5.5.5.2.1. Flight Plan.** A normal IFR flight plan will be filed for this mission. The coordinates for some of the planned deployments may need to be changed while en route to adjust to the forecast track of the storm. The aircraft routing will not be altered by ATC because the buoys must exit the aircraft in a specified order and they cannot be rearranged in flight.

**5.5.5.2.2. IFR Procedures and Clearance.** It is preferred that these missions be filed and flown using IFR procedures in either controlled or uncontrolled airspace. However, with the concurrence of the aircraft commander, they may be flown VFR. If this change is made en route, then ATC flight following and traffic advisories will be requested by the aircrew, and any changes to the route of flight must be relayed to ATC by the aircrew.

**5.5.5.2.3. Altitude.** These missions will be flown from 1000' AGL up to FL050. Aircrews are responsible for maintaining their own clearance from the surface of the sea, obstacles, and oil platforms while operating below the Minimum IFR Altitude (MIA).

**5.5.5.2.4. Communications.** Normally use UHF or VHF radios for communications with ATC when within range. If out of range, then use the procedures for SATCOM relay through TEAL operations (ref. Communications paragraph under 5.5.5.1.6. above).

**5.5.5.2.5. Participating Aircraft.** If there are two or more TEAL aircraft deploying buoys in the same area at the same time, then they can accept MARSA operations with each other and must relay that to ATC. This will not cancel their IFR clearance but will allow ATC to no longer be responsible for providing aircraft separation between TEAL aircraft. The TEAL aircraft must be in communication with each other and have operating TCAS on at least one of the aircraft. At least one of these aircraft will have SATCOM data relay capability on board.

**5.5.5.2.6. Priority Handling.** ATC will provide TEAL aircraft priority handling to and from the deployment area only when specifically requested by the aircrew. The aircraft commander will only ask for priority handling when necessary to accomplish the mission.

**5.5.5.3. High Altitude Synoptic Track Missions.**

**5.5.5.3.1. Flight Plan.** A normal IFR flight plan will be filed for this mission. An Altitude Reservation (ALTRAV) request is not required.

**5.5.5.3.2. NOTAM.** A NOTAM will be submitted by the 53 WRS, NOAA AOC, NASA, or NRL for any High Altitude Synoptic Track mission that will be releasing weather instruments. The NOTAM must contain coordinates for all releases. Submit NOTAM request per Appendix D procedures.

**5.5.5.3.3. Priority Handling.** ATC must provide priority handling during Synoptic Track Missions only when specifically requested by the aircrew.

**5.5.5.3.4. Release of Dropsondes.** During NHOP missions and when operationally feasible, dropsonde instrument releases from FL 190 or higher and sensor activation must be coordinated with the appropriate ARTCC/CERAP (Center En Route Approach Control) by advising of a pending drop or sensor activation about 10 minutes prior to the event when in direct radio contact with ATC. When ATC has radar contact with the aircraft, they will notify the aircrew of any traffic below them that might be affected. The aircraft commander is solely responsible for release of the instrument after clearing the area by all means available.

- When contact with ATC is via ARINC, event coordination must be included with the position report prior to the point where the action will take place, unless all instrument release points have been previously relayed to the affected ATC center(s). Example: “TEAL 100, SLATN at 1215, FL290 block 310, estimating FLANN at 1250, CHAMP next; Weather instrument release at FLANN.” Contact between participating aircraft must be made using the frequencies listed in paragraph 5.5.5.1.9., last bullet.

- During NHOP missions, commencing five (5) minutes prior to release from FL190 or higher, the aircrew will broadcast in the blind on radio frequencies 121.5 MHZ and 243.0 MHZ to advise any traffic in the area of the impending drop. Pilots must not make these broadcasts if they will interfere with routine ATC communications, such as in the vicinity of an ATC facility. The aircraft commander is responsible for determining the content and duration of a broadcast, concerning the release or sensor activation.

## **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 ½ 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 ½ 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 the 250 nm of the specific coordinates by the scheduled time plus 2 hours or is unable to provide meaningful data.

#### **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/OPC deadline for synoptic analysis.

- **MISSED.** When the requirements listed 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 requirements tasked by TPC/NHC and CPHC and missions accomplished.

### **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 fixes, using all observed vortex fix information, each time the aircraft penetrates the center.

**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. Radar fixes may be reported in a vortex data message using available observed information or as a remark appended to a RECCO observation taken at fix time. The remark stating the type of radar fix and quality of the radar presentation is in accordance with Chapter 7, paragraph 7.3.2; e.g., RADAR CENTER FIX 21.5N 83.0W, POOR RADAR PRESENTATION, NAV ACCURACY 5NM.

**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.

**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.

<b>MISSION EVALUATION FORM</b>			
MEMORANDUM FOR: OL-A, 53WRS/CARCAH			
FROM: _____ (Director, NHC, CPHC) _____,			
SUBJECT: Mission _____ Evaluation (Mission Identifier)			
<u>PUBLISHED REQUIREMENTS:</u>			
Permission Coordinates (As Updated Prior to TKO) _____ N _____ W			
Flight Pattern _____			
Mission Requirements Times _____			
<u>RECONNAISSANCE MISSION PERFORMANCE:</u>			
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
<u>OVERALL MISSION EVALUATION:</u>			
OUTSTANDING _____			
UNSATISFACTORY _____ FOR:			
COMPLETENESS _____ TIMELINESS _____ ACCURACY _____			
EQUIPMENT _____ PROCEDURES _____ OTHER _____			
<u>REMARKS:</u> (Brief but specific)			
_____ FORECASTER'S SIGNATURE			

**Figure 5-8. Mission Evaluation Form**

**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. Table 5-3 summarizes elements of the mission identifier:

**5.7.7. Storm Identifier <Storm ID>.** To facilitate the automatic ingest into the TPC/NHC, CPHC, and DOD tropical cyclone forecast computing systems, the storm identifier will be added 3 spaces after the Vortex Data Message title (see Figure 5-5) in the following format: **Vortex Data Message BBCCYYYY**. For the definition of BBCCYYYY, see Chapter 4, paragraph 4.3.3., page 4-2.

**Table 5-3. Elements of the Mission Identifier**

AGENCY/ AIRCRAFT	Mission Storm System Indicator			
Agency + Aircraft Number <sup>12</sup>	Sequential number of mission in this storm	Two-digit depression number or two letter identifier if not a depression or greater <sup>3</sup>	Location A, E, C, or W <sup>4</sup>	Storm name or mission type (i.e., CYCLONE or INVEST)
<b>-EXAMPLES-</b>				
AF306 0201C CYCLONE		USAF aircraft 306 on the second mission on tropical depression number 1 in the Central Pacific. Invest or fix as specified in the TCPOD.		
AF307 0403E CARLOS		USAF aircraft 307 on the fourth mission on tropical depression 3 which formed in the Eastern Pacific and acquired the name Carlos.		
NOAA2 01BBA INVEST		NOAA aircraft 42RF on the first mission to investigate the second suspect area in the Atlantic, Gulf of Mexico or Caribbean.		
NOAA3 WX01A AGNES		NOAA aircraft 43RF on a non-tasked mission into AGNES.		

**5.7.8. Observation Numbering and Content.** Air Force aircraft movement information (i.e., departure time and location, and ETA's to locations) will not be included in observation remarks. That information should be passed to CARCAH via SATCOM administrative messages. The mission identifier will be the first mandatory remark followed by the observation number. All observations (RECCO, vortex, dropsonde) from the first to the last will be numbered sequentially. HDOBs will be automatically numbered 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 use the CARCAH-assigned mission identifier, will be numbered OB 01, and will include the time of diversion.

-EXAMPLE-

RMK AF306 01BBA INVEST OB 01 DPTD AF306 WXWXA AT 05/1235Z

**5.7.9 Corrections to Observations.** A correction indicator should be appended to the

<sup>1</sup> AF plus last 3 digits of tail number

<sup>2</sup> NOAA, plus last digit of aircraft registration number

<sup>3</sup> The letters CC should not be used in an invest identifier

<sup>4</sup> A=Atlantic, Caribbean, or Gulf of Mexico; E=Eastern Pacific; C=Central Pacific; W=Western Pacific

WMO abbreviated header after the date/time group and to any lines containing the mission identifier and observation number within corrected aircraft messages. This includes the first remark line in a RECCO, Item P in a vortex data, each of the 61616 lines in a sonde TEMP DROP code, and the second line in an HDOB data message. The first corrected message will have an indicator of CCA; subsequent corrections will have indicators of CCB, CCC, etc. Examples of corrected observations are in Table 5-4 below:

**Table 5-4. Examples of Corrected Observations**

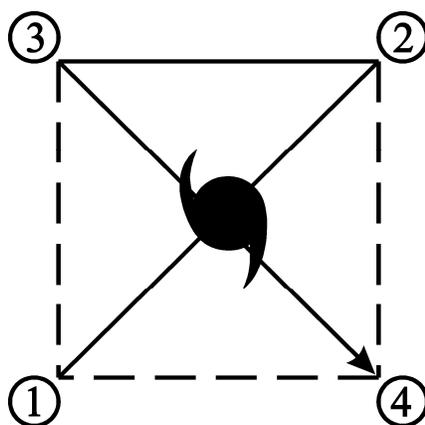
EXAMPLES	
URNT11 KNHC 111629 CCA 97779 16264 51286 90000 30400 09054 11071 /3136 40545 RMK AF303 2709A IKE OB 01 CCA	Correction for RECCO message OB 01 from the AF303 02709A IKE mission.
URNT12 KNHC 130552 CCB VORTEX DATA MESSAGE AL092008 A. 13/04:47:20Z B. 28 deg 52 min N 094 deg 37 min W . . . P. AF301 3509A IKE OB 02 CCB MAX FL WIND 103 KT NE QUAD 04:30:40 Z CORRECTED FOR TIME IN ITEM A	Second correction for vortex data message OB 02 from the AF301 3509A IKE mission.
UZNT13 KWBC 080739 CCA XXAA 58062 99300 70760 11606 99/// // // // 00956 25616 09512 . . . 61616 NOAA9 1109A IKE OB 03 CCA 62626 0629 LST WND 894 AEV 20704 CORRECTED RPT DLM WND 08509 0071 82 = XXBB 58068 99300 70760 11606 00/// // // // 11007 26217 22977 24010 . . . 61616 NOAA9 1109A IKE OB 03 CCA 62626 0629 LST WND 894 AEV 20704 CORRECTED RPT DLM WND 08509 0071 82 =	Correction for sonde TEMP DROP code message OB 03 from the NOAA9 1109A IKE mission.

**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 850 hPa or above. The dropsonde will be released at the flight-level center coordinates (item BRAVO of the vortex data message). For fixes when dropsonde-measured SLP is not available, an extrapolated SLP will be computed and reported.

**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. Note: The depicted pattern may be converted to a mirror image if entry is made from a different direction.

- 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.

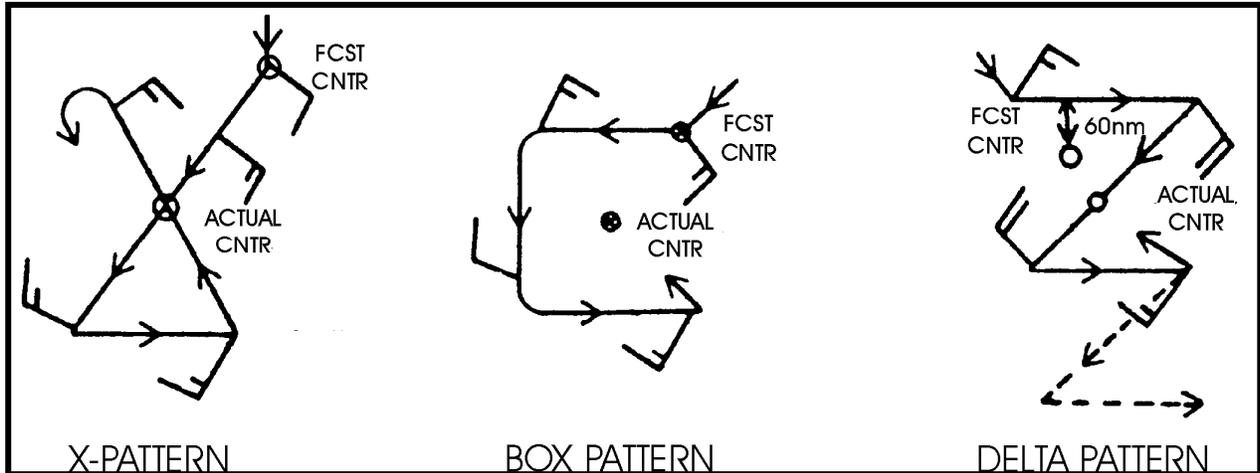
- On the Box pattern, the aircraft is flown on cardinal headings around the suspected center. The track resembles three sides of a square.

- 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.

**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 Table 5-1.

**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.



**Figure 5-10. Suggested Patterns for Investigative Missions**

**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) or commercial SATCOM. Figures 5-11 and 5-12 depict the ASDL and AFSATCOM communications links. The NOAA G-IV will normally transmit WMO Temp Drop messages via commercial SATCOM. Flight meteorologists should contact CARCAH following the first fix, and periodically throughout the mission.

**5.9.2. Backup Air-to-Ground Communications.** *The weather reconnaissance crew may relay weather data via SATPHONE or HF phone 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. Specific radio procedures and terminology will comply with Allied Communications Publication 125, Standard Telephone and Radio Procedures.*

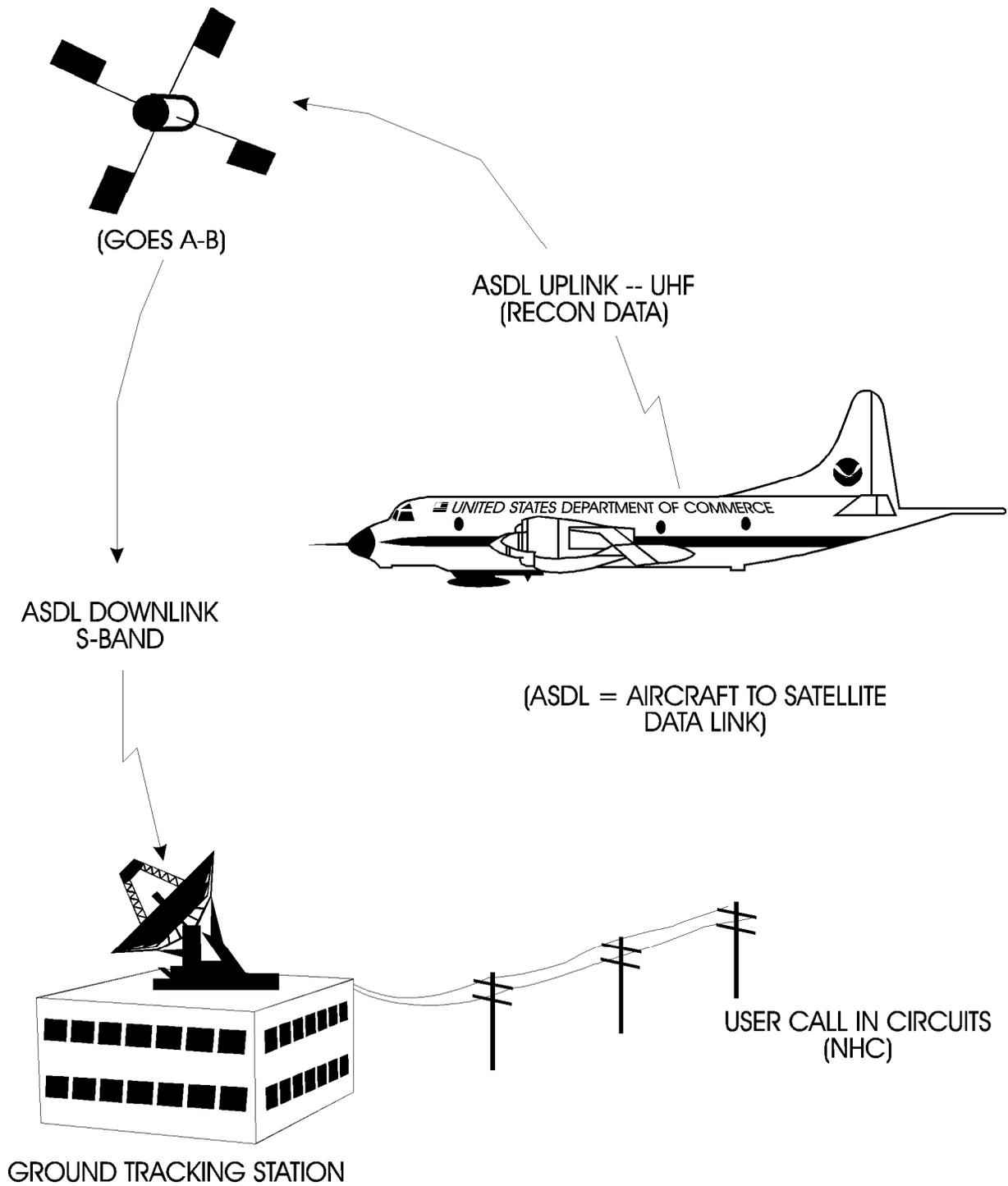
**5.9.3. Aircraft-to-Satellite Data Link (ASDL) Equipped Aircraft.** Aircraft equipped with ASDL have the option to utilize the ASDL system. Prior to the beginning of the hurricane season, each ASDL-equipped aircraft will perform a ground or airborne test of the equipment and data ground handling procedures to determine the equipment reliability, transmission errors, and time lapse between transmission of the data from the aircraft and receipt of the data by the hurricane forecaster. Test data will be forwarded to the Chairman, Working Group for Hurricane and Winter Storms Operations and Research.

**5.9.4. Backup CARCAH Procedures.** Satellite ground stations, which are used to receive and process data from AFRC reconnaissance aircraft, are installed at CARCAH and the 53 WRS. The 53 WRS ground station has a similar configuration and communications capability as the satellite ground station installed at CARCAH (located within TPC/NHC), except that the CARCAH ground station has additional capability to stream data using serial RS-232 communications to TPC/NHC local servers. The ground station at the 53 WRS can fully transmit data using SATCOM and land line to the CARCAH ground station. Both ground stations can send data to AFWA's Weather Product Management and Distribution System (WPMDS)—WPMDS then relays all AFRC/53 WRS reconnaissance data to the NWS Gateway for world-wide distribution. In the event that backup procedures are required due to severe communications failures, severe weather conditions, or other extreme events affecting TPC/NHC, all CARCAH responsibility will be transferred to the 53 WRS to ensure reconnaissance service is uninterrupted.

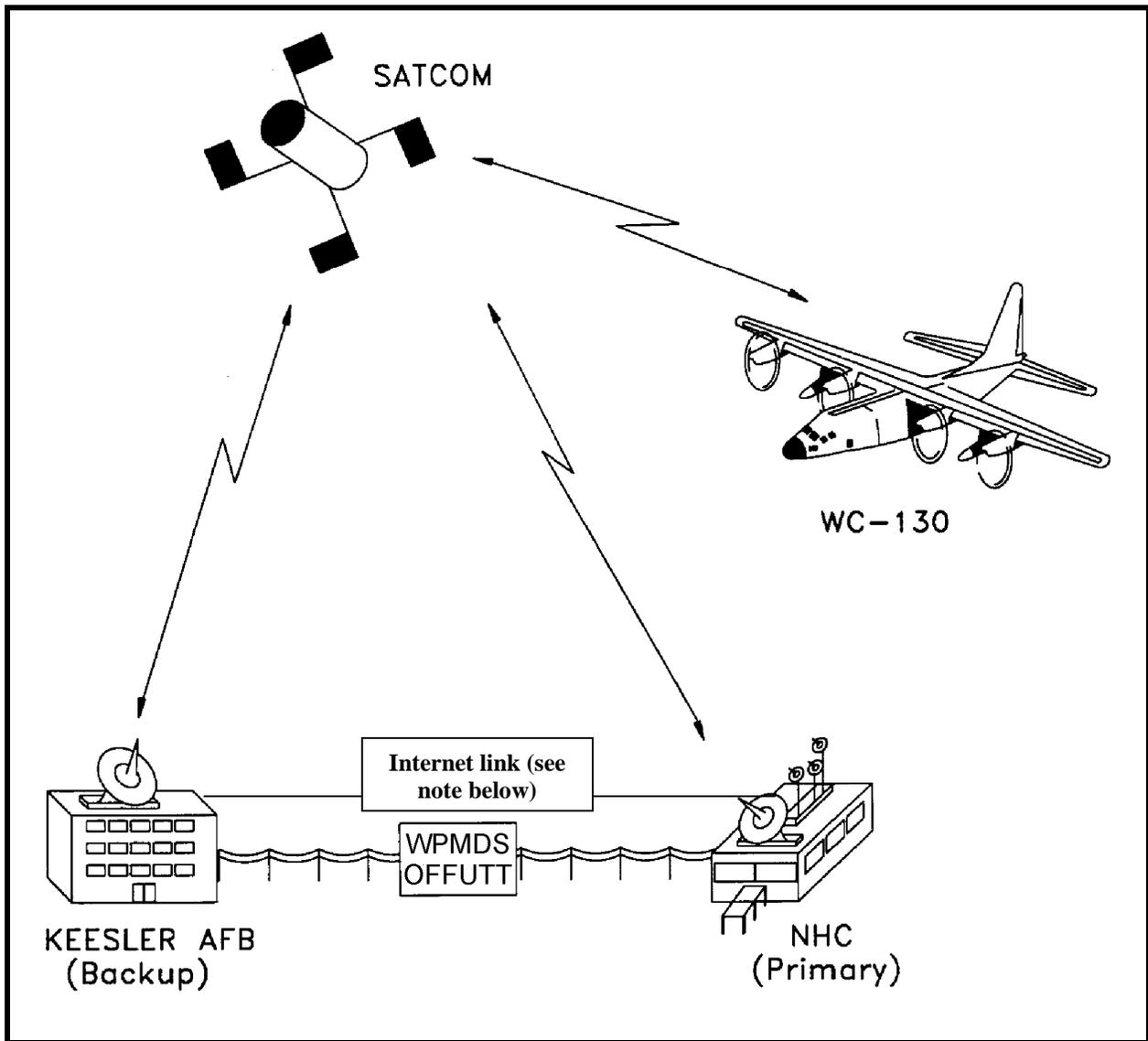
**5.9.4.1.** *Satellite antenna communications failure at NHC: CARCAH will coordinate with the 53 WRS to have a temporary operator man the ground station located at the backup site. The Alternate CARCAH backup site ground station will be configured to relay aircraft data to the CARCAH ground station. If the outage at CARCAH is expected to be temporary, the 53WRS will provide operators to man the Alternate CARCAH ground station. For long-term outages, CARCAH will send operators to the 53 WRS, and those operators will ensure the aircraft data are transmitted to the WPMDS, NWS servers, and external users via the NWS Gateway.*

**5.9.4.2.** In the event communications lines between the 53 WRS and NHC are severed, the ground station at the 53 WRS will be configured to transmit data directly to the WPMDS. The current version of ground station software does not have the capability to directly send data to HPC (NHC's COOP backup site); consequently, all data or observations will need to be accessed from the WPMDS or obtained from the NWS Gateway.

**5.9.4.3.** TPC/NHC emergency backup plan: In the event that TPC/NHC activates the HPC COOP backup plan, the designated CARCAH individual will deploy to the 53WRS to operate the ground station system. The HPC COOP site will obtain the reconnaissance data through either the WPMDS or the NWS Gateway.



**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 AFRC WC-130 Aircraft**

Note: A new Internet link from Keesler AFB to TPC/NHC is operational beginning in the 2008 storm season. All observation types can be passed directly to TPC/NHC without going through Offutt.

## 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-12 at 75°W and GOES-11 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 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, each GOES schedule provides two views of the CONUS (GOES-11 view is termed PACUS) every 15 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 NOAAAPORT, from NOAA's Environmental Satellite Processing Center (ESPC), or directly from GOES.

The current series of GOES satellites provide satellite data generated from full resolution imager and sounder data. Imagery at 1, 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 km, "shortwave" 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 on GOES-11 and 4 km resolution on GOES-12. Channel 2 data are valuable for the detection of low clouds, fog, stratus, and surface hot spots; channel 5 data, available on GOES-11, in combination with data from channels 2 and/or 4 are useful for detecting volcanic ash in the atmosphere. On GOES-12, channel 6 is a 13.3  $\mu\text{m}$  band at 8 km that is useful in the detection of CO<sub>2</sub>. Channel 6 improves the measurement of the height of clouds and volcanic ash, thus improving computer model forecasts and ash warnings to the aviation community. The digital data may be enhanced to emphasize different features as desired. A suite of digital data and environmental 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 NOAAAPORT, from ESPC, the Internet, and other means such as local networks.

**6.1.1.1. GOES-12.** GOES-12, launched July 23, 2001, supports the GOES-East station at 75°W and serves NOAA operations, to include 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 use of the GOES imager channel 2 has vastly improved the detection of low-level circulation centers at night to assist in storm positioning. Retrievals from the GOES sounder are 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, surface temperatures and cloud heights.

During the 1996 hurricane season, NESDIS instituted a specialized GOES-East sounder schedule consisting of four sectors covering distinct areas of the Atlantic Ocean. Of the four sounder sectors, the CONUS sector is scanned every hour and covers the northern Gulf of Mexico and the east coast of the United States. During routine scanning operations, of the other 3 sounder sectors (the Gulf of Mexico, North Atlantic, and the East Caribbean) the Gulf of Mexico sector is designated as the "primary OCONUS" (off CONUS) sector and is scanned 4 times in a 6 hour period, while the other two sectors are only scanned once in every 6 hour period. Event driven, this "primary OCONUS" sounder sector can be changed by the TPC/NHC. The "primary" OCONUS sector provides frequent scans over the area of interest to generate vertical profiles of temperature and moisture, and additional derived environmental products such as atmospheric winds.

**6.1.1.2. GOES-11.** GOES-11 was launched on May 3, 2000, and supports the GOES-West station at 135°W. The routine scanning mode of GOES-11 provides 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.

During the 2008 Central Pacific hurricane season, NESDIS instituted a specialized GOES-West sounder schedule consisting of additional Hawaii sectors. During routine operation, the GOES-West sounder scans two Hawaii and four North Pacific sectors. To aid in the surveillance and input of additional sounder data into hurricane models, the Central Pacific Hurricane Sector (CPHC) can request the alternate GOES-West sounder schedule that replaced two North Pacific sectors with two Hawaii sectors, allowing for four Hawaii sector scans and two North Pacific sector scans in a six-hour period.

**6.1.1.3. GOES-13.** GOES-13 was launched on May 24, 2006. GOES-13 carries the same imager and instrumentation capabilities as GOES-12. GOES-13 is stored on orbit at 105°W until required to replace either of the older operational satellites.

**6.1.1.4. GOES-10.** GOES-10 was launched on April 25, 1997. GOES-10 was used as the primary GOES-West satellite until it was replaced by GOES-11 on June 21, 2006, due to the low fuel reserves on GOES-10. In 2007, NOAA signed an agreement with several countries in South America to use GOES-10 for operations. Since then, GOES-10 has been operating as the primary satellite covering South America and its adjacent waters. During an emergency outage of GOES-12 in December 2007, NOAA switched GOES-East operations to GOES-10. GOES-10 imager and sounder are similar to GOES-11, with a 5 channel imager with a 12 micron channel and 8 km water vapor channel, and a 19 channel imager at 10 km. In 2009,

the GOES-10 sounder was powered off due to an irreversible anomaly to the sounder filter wheel.

(NOTE: For GOES imager/sounding schedules go to <http://www.ssd.noaa.gov/PS/SATS/>)

**6.1.2. EUMETSAT Meteosat Geostationary Satellites.** Meteosat-9, launched December 21, 2005, replaced Meteosat-8 on April 11, 2007, and provides vital coverage of developing tropical waves off the African Coast and eastern Atlantic Ocean. Conventionally, the full disk IR, visible (VIS), and water vapor imagery have a 3 km resolution whereas a specialized VIS sector provides a maximum 1 km resolution. This visible sector has a limited scan, and will shift from the West Indian Ocean to the East Atlantic Ocean from 14:00 UTC to 01:00 UTC every day during hurricane season. This shift will ensure interests monitoring for tropical activity in the North Indian Ocean (Meteo-France) as well as the East Atlantic (TPC) will be satisfied. The digital data are transmitted to NESDIS and NCEP at the NOAA Science Center (NSC) in Camp Springs, MD, every 15 minutes. They are also available to the TPC and the Storm Prediction Center (SPC) through an encrypted DOMestic SATellite (DOMSAT) relay and through direct transmission from ESPC.

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. non-government users are allowed access via a domestic satellite to non-encrypted Meteosat data 4 times per day at synoptic times; at other times, the data are encrypted. Hence, if quarter-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 (NOAA/DOD and other U.S. government agencies are registered).

**6.1.3. MTSAT-1R.** The Multifunctional Transport Satellite-1 Replacement (MTSAT-1R) was launched for the Japanese Meteorological Agency (JMA) on February 26, 2005. MTSAT-1R is located at 140° East, covering the West Pacific Ocean, East Asia, and the East Indian Ocean. MTSAT-1R is similar to GOES as it carries a 5-channel imager (one visible channel at 1 km plus four IR channels at 5 km, to include a new low-light IR channel). MTSAT-1R provides imagery for the Northern Hemisphere every 30 minutes, and JMA makes the data available to 27 countries and territories in the region. Data from MTSAT-1R is available to CONUS users via the DOMSAT or directly from ESPC and available to Pacific OCONUS users directly via downlinks in Hawaii and Guam.

**6.1.4. Initial Joint Polar System (IJPS).** Two primary operational polar orbiting satellites, NOAA's NOAA-19 and EUMETSAT's MetOp-A, provide image coverage four times a day over a respective area in 6 spectral channels (however only 5 channels can be supported at one time; channel switching is used to support the 6th channel). These satellites cross the U.S. twice per day at 12-hour intervals for each geographical area near the Equatorial crossing times listed in Table 6-1. NOAA-19 and MetOp-A provide the same capabilities as previous NOAA satellites, except that the Advanced Microwave Sounding Unit-B (AMSU-B) sensor flown aboard NOAA-17 and previous polar orbiters has been replaced by the Microwave Humidity Sounder (MHS) on NOAA-19. Data are available via direct readout—high-resolution picture transmission (HRPT) or automatic picture transmission (APT)—or via central processing. Data

from the Advanced Very High Resolution Radiometer (AVHRR) on NOAA-19 and the corresponding Visible Infrared Imaging Radiometer (VIIRS) on board MetOp-A 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, AK, and Wallops, VA, acquire recorded global area coverage data sub-sampled to a 4 km spatial resolution, 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. Ground equipment installed at various NWS regions including Kansas City, Miami (TPC), and Monterey enable direct readout and data processing of 1.1 km resolution AVHRR and VIIRS data from NOAA-19 and MetOp-A. The high resolution polar data and products generated at TPC complement other satellite data sources to support tropical mission objectives.

## **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 I.

**6.2.2. Products.** Satellite-related products are listed in Table 3-5, “Summary of Products and their Associated WMO Header.”

**6.2.2.1. Tropical Weather Discussions.** TPC/NHC issues these discussions four times a day based on satellite imagery, meteorological analysis, weather observations and radar. They describe significant features 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.

**6.2.2.2. Satellite Interpretation Messages.** CPHC issues these discussions four times a day to describe synoptic features and significant weather areas in the vicinity of the Hawaiian Islands. WFO Guam issues these discussions two times a day to describe synoptic features and significant weather over the Micronesian waters.

**6.3 NESDIS Satellite Analysis Branch (SAB).** The SAB operates 24 hours a day to provide satellite support to the HPC/OPC, TPC, CPHC, JTWC, and other worldwide users. In addition to providing high quality imagery from geostationary and polar-orbiting satellites and coordinating the execution of GOES Rapid Scan Operations (RSO) requests, SAB provides pertinent information on global tropical cyclone development, including location and intensity analysis based on the Dvorak technique (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. In addition, estimates of cumulative rainfall expected over coastal areas derived using the Tropical Rainfall Potential (TRaP) methodology are provided for tropical storms within 24 hours of landfall and posted to a web site in support of CPHC, HPC, TPC, forecast offices in U.S. territories, and international customers. Telephone numbers for the SAB are located in Appendix H.

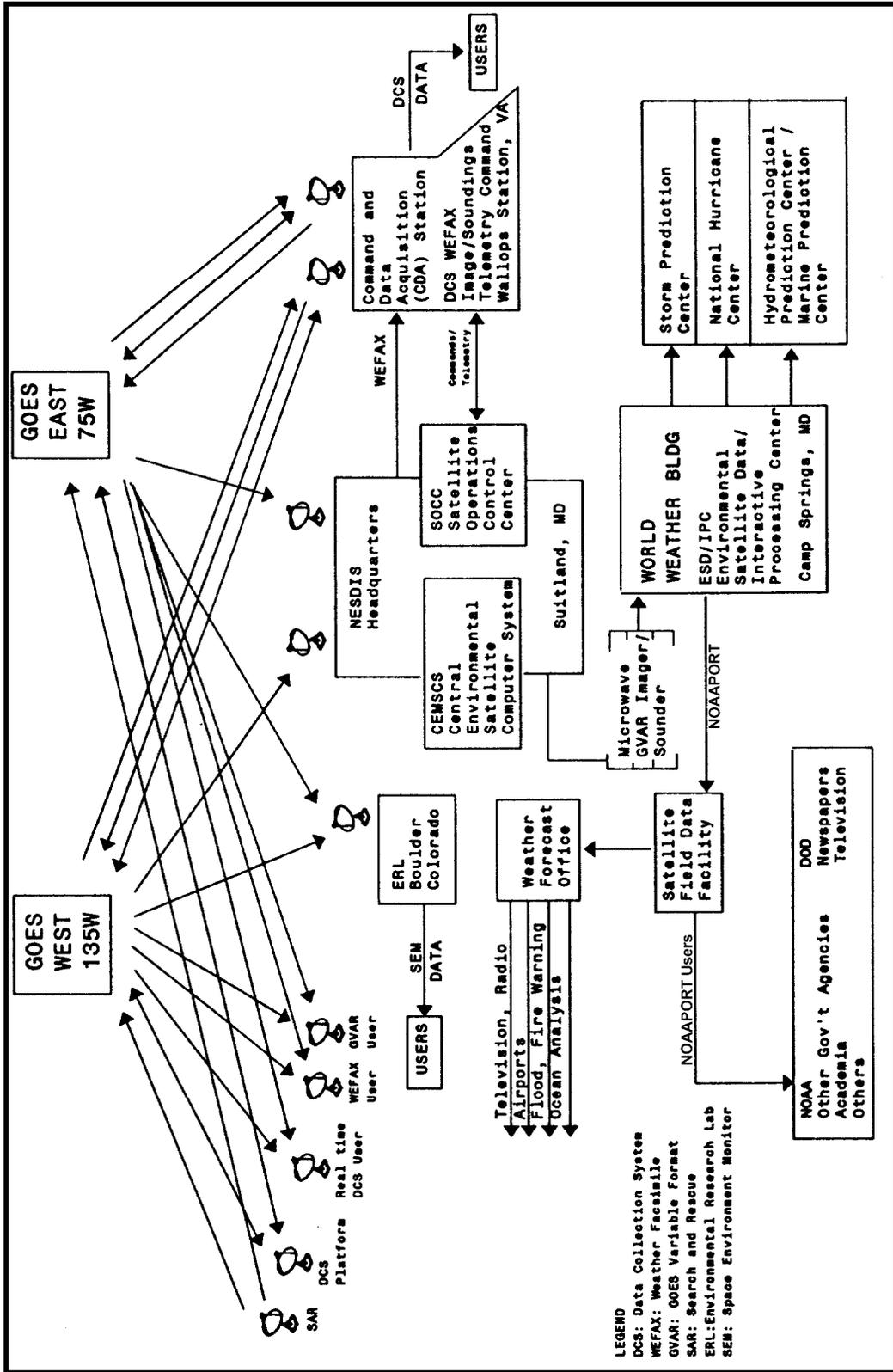


Figure 6-1. The GOES Satellite System

**Table 6-1. Communications Headings for SAB Dvorak Analysis Products**

WMO HEADING	OCEANIC AREA	TYPE OF DATA
TXPN20-29 KNES	North West Pacific Ocean west of 180°	VIS/IR
TXPS20-29 KNES	South Pacific Ocean east of 135°E	VIS/IR
TXIO20-29 KNES	North Indian Ocean	VIS/IR
TXXS20-29 KNES	South Indian Ocean west of 135°E	VIS/IR

**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 distributed to the Air Force's Operational Weather Squadrons (OWS) and the Navy's Fleet Numerical Meteorology and Oceanography Center (FNMOC) at Monterey, CA. Satellite data covering the Central Pacific area are received at or shipped to the 17th OWS Meteorological Satellite Operations (SATOPS) Flight (17 OWS/WXJ), Joint Typhoon Warning Center, Pearl Harbor, HI. The 17 OWS/WXJ uses all available meteorological satellite data when providing fix and or intensity information to Central Pacific Hurricane Center forecasters.

**6.4.1. Central Pacific Surveillance.** The 17 OWS/WXJ (JTWC Satellite Operations) will provide, resources permitting, fix and intensity information to the CPHC on systems upon request.

**6.5. Satellites and Satellite Data Availability for the Current Hurricane Season.** Table 6-2 lists satellite capabilities for the current hurricane season.

**6.6. Current Intensity and Tropical Classification Number.** The current intensity (C.I.) number relates directly to the intensity of the storm. The empirical relationship between the C.I. number and a storm's wind speed is shown in Table 6-3. The C.I. number is the 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 6-2. Satellite and Satellite Data Availability for the Current Hurricane Season**

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
<p>GOES-10 at 60°W (supporting South America)</p> <p>GOES-11 at 135°W</p> <p>GOES-12 at 75°W</p> <p>GOES-13 (on-orbit storage at 105°W)</p>	<p>Multispectral Imager and Sounder</p> <p>5 Channels for Imager</p> <p>19 Channels for Sounder (not operational for GOES-10)</p>	<p>GOES-10 is providing 15 minute imager data and hourly sounder data covering South America</p> <p>GOES-11 and GOES-12: 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).</p>	<ol style="list-style-type: none"> <li>1. 1, 2, 4, and 8 km resolution visible standard sectors.</li> <li>2. 4 km equivalent resolution IR sectors.</li> <li>3. Equivalent and full resolution IR enhanced imagery.</li> <li>4. Full disk IR every 3 hours.</li> <li>5. 8 km water vapor sectors.(4 km on GOES-12)</li> <li>6. Quantitative precipitation estimates; high density cloud and water vapor motion wind vectors; and experimental visible and sounder winds.</li> <li>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).</li> <li>8. Tropical storm monitoring and derivation of intensity analysis.</li> <li>9. Volcanic ash monitoring and dissemination of Volcanic Ash Advisory Statements.</li> <li>10. Daily northern hemisphere snow cover analysis.</li> <li>11. Twice daily fire and smoke analysis over specific areas within CONUS.</li> </ol>

**Table 6-2 (continued). Satellite and Satellite Data Availability for the Current Hurricane Season**

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
METEOSAT-9	Multi-spectral Spin-Scan Radiometer (SEVIRI) and High Resolution Visible (HRV)	SEVIRI: Full disk image every 15 minutes.  HRV: Sector scan to move with local noon.	<ol style="list-style-type: none"> <li>1. 1 km resolution digital VIS imagery (HRV); 3 km resolution digital IR imagery (SEVIRI).</li> <li>2. 3 km resolution VIS and IR WEFAX imagery.</li> <li>3. 3 km water vapor imagery.</li> <li>4. Tropical storm monitoring and derivation of intensity analysis.</li> <li>5. Volcanic ash detection and analysis.</li> </ol>
MTSAT-1R	Multi-band imager (Visible plus 4 IR channels)	Hourly Full disk and two Northern Hemisphere scans per hour, with special “quadrant” scans four per hour.	<ol style="list-style-type: none"> <li>1. 1 km resolution digital VIS imagery</li> <li>2. 5 km resolution digital IR imagery and water vapor</li> <li>4. Tropical storm monitoring and derivation of intensity analysis.</li> <li>5. Volcanic ash detection and analysis</li> </ol>
TRMM (NASA Tropical Rainfall Measuring Mission)	85 and 37 GHz Microwave	Fluctuates from 30°N to 30°S	<ol style="list-style-type: none"> <li>1. 15 km resolution microwave coverage of the tropics from 30°S to 30°N.</li> <li>2. Microwave analysis of 85 and 37 GHz radiance composited passes.</li> <li>3. Brightness temperature products of the 85 and 37 GHz horizontal and vertical polarization. Derived rain-rate products.</li> </ol>
MetOp-A  NOAA-19	AVHRR; GAC and LAC (recorded); HRPT (direct); AMSU-A; AMSU-B (N-17); MHS (N-18); HIRS  VIIRS 1 km global	0931D <sup>1</sup> /209A <sup>2</sup>  0156D/1356A	<ol style="list-style-type: none"> <li>1. 1 km resolution HRPT and Local Area Coverage (LAC) data.</li> <li>2. 4 km resolution APT and Global Area Coverage (GAC) data.</li> <li>3. Mapped imagery.</li> <li>4. Unmapped imagery (all data types) at DMSP sites.</li> <li>5. Sea-surface temperature analysis.</li> <li>6. Soundings.</li> <li>7. Moisture profiles.</li> <li>8. Remapped GAC sectors.</li> <li>9. Sounding-derived products--total precipitable water, rain rate, and surface winds under sounding</li> <li>10. Daily northern hemisphere snow cover analysis.</li> <li>11. Twice daily fire and smoke analysis over specific areas within CONUS.</li> </ol>

<sup>1</sup> D - descending

<sup>2</sup> A - ascending

**Table 6-2 (continued). Satellite and Satellite Data Availability for the Current Hurricane Season**

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
DMSP F-13	OLS Imagery (recorded and direct), SSM/I, SSM/T-1	0624D <sup>1</sup> /1824A <sup>2</sup>	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, and SSM/IS data transmitted to NESDIS and FNMOC from AFWA.
DMSP F-14	OLS Imagery (recorded and direct), SSM/I, SSM/T-1 (inop), SSM/T-2	0424D/1624A	
DMSP F-15	OLS Imagery (recorded and direct), SSM/I, SSM/T-1, SSM/T-2	0617D/1817A	
DMSP F-16	OLS Imagery (recorded and direct), SSM/IS	0732D/1932A	
DMSP F-17	OLS Imagery (recorded and direct), SSM/IS	0528D/1728A	
		Note: Times are accurate to +/- 5 minutes	

<sup>1</sup> D - descending

<sup>2</sup> A - ascending

**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 (SLP)**

C.I. NUMBER	MAXIMUM WIND SPEED	T-NUMBER	MINIMUM SLP (Atlantic)	MINIMUM SLP (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, Wash., 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 tri-agency agreement. The WSR-88D is an 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), although velocity data out to 162 nm can be obtained from radars using “super-resolution.” Radar scanning strategies are selectable, using predetermined volume coverage patterns (VCPs). The VCP in use depends upon which weather phenomena are under surveillance. Once the radar data has been collected, it is 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 network connection. CPHC obtains products directly from four WSR-88Ds in Hawaii operated by the NWS Weather Forecast Office in Honolulu.

**7.3. Procedures.** As a tropical cyclone approaches, TPC/NHC uses the WSR-88D to perform radar center-fixing and to obtain other diagnostic information. Therefore, it is important to optimize WSR-88D performance for tropical cyclones and to allow other users, especially the TPC/NHC, access to radar products in the area of landfall. Most of the changes must be issued through the Master System Control Function (MSCF), Radar Product Generator (RPG) Human Computer Interface (HCI). To facilitate this process, TPC/NHC in cooperation with the Radar Operations Center (ROC) has developed an operations plan for use during tropical cyclone events. The current WSR-88D Tropical Cyclone Operations Plan is available as a sub-link to the National Hurricane Operations Plan on the OFCM web site at <http://www.ofcm.gov/homepage/text/pubs.htm>. It is also available via fax from the ROC Hotline (1-800-643-3363).

**7.3.1. Radar Observation Requirements, WSR-88D.** Chief among the requirements is the appropriate display of hurricane-force winds. Changes must be made at the radar site, guided by the WSR-88D Tropical Cyclone Operations Plan, in order to deal effectively with hurricane conditions. The physical characteristics of the tropical cyclone are best represented by use of the precipitation mode. Choice of VCP may significantly enhance (or degrade) collection of velocity data. (See WSR-88D Tropical Cyclone Operations Plan for further information.) Radar characteristics of hurricanes are given in Federal Meteorological Handbook Number 11 (FMH-11), Part B, 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, Application versus Product Table 4-3.

**Table 7-1. Participating Radar Stations<sup>1</sup>**

<b>National Weather Service Radars: U.S. Gulf and Atlantic Coasts</b>			
<b>Location</b>	<b>Radar Type</b>	<b>Latitude</b>	<b>Longitude</b>
Albany, NY	WSR-88D	42°35' N	74°04' W
Atlanta, GA	WSR-88D	33°22' N	84°34' 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
Brandon/Jackson, MS	WSR-88D	32°17' N	89°59' 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
Huntsville/Hytop, AL	WSR-88D	34°56' N	86°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/Baton Rouge, 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

<sup>1</sup>The criterion for selection is that the radar site is located within approximately 124 n mi (legacy maximum velocity range) of the coastline.

**Table 7-1 (continued). Participating Radar Stations**

<b>National Weather Service Radars: U.S. Southwest</b>			
<b>Location</b>	<b>Radar Type</b>	<b>Latitude</b>	<b>Longitude</b>
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
<b>FAA Radars</b>			
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
<b>Department of Defense Radars</b>			
Andersen AFB, Guam	WSR-88D	13°27'N	144°49' E
Columbus AFB, MS	WSR-88D	33°54'N	88°20' W
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

**7.3.2. Central Region Report.** The following fix definitions and criteria are used in reporting 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 n mi 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 (AWIPS 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 based on a 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 the event that TPC/NHC cannot obtain the necessary radar data, the local NWS Weather Forecast Office may be called upon to estimate the radar position and render qualitative assessment of the circulation.

Other radar facilities not having weather transmission capability but wishing to provide information deemed important, should call the nearest NWS Weather Forecast Office or the TPC/NHC.

## CHAPTER 8

### NATIONAL DATA BUOY CAPABILITIES AND REQUIREMENTS

#### 8.1. General.

**8.1.1. Automated Reporting Stations.** The National Data Buoy Center (NDBC) maintains automated reporting stations in the coastal and deep ocean areas of the Gulf of Mexico, the Atlantic and Pacific Oceans, and in the Great Lakes. These data acquisition systems collect real-time meteorological and oceanographic measurements for operational and research purposes. Moored buoys are deployed in the Southern Gulf of Mexico, the Caribbean and the Atlantic Ocean east of the Lesser Antilles for the primary purpose of supporting National Hurricane Center operations. NDBC also quality controls and releases meteorological data from the National Ocean Service Water Level Observing Network and from moorings and coastal stations operated by cooperating Regional Ocean Observing Systems. The NDBC website at [www.ndbc.noaa.gov](http://www.ndbc.noaa.gov) provides locations, latest operating status, and site-specific information for NDBC stations and provides links to details on partner organization stations. Specific questions may be addressed to NDBC Data Management and Communications Branch, Stennis Space Center, Mississippi 39529-6000, phone 228-688-2835.

**8.1.2. Data Acquisition.** Moored buoy and C-MAN stations routinely acquire, store, and transmit data every hour; a few selected stations report more frequently. 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 measured at several stations. Ocean currents and salinity are measured at a few coastal stations.

NDBC acquires, encodes, and distributes data from partner organizations via NWS dissemination systems. Data from partner organizations pass through NDBC data quality control procedures prior to NWS dissemination. Frequency and timeliness of transmissions from these stations varies by organization.

#### **8.1.3. Drifting Buoys.**

**8.1.3.1. NDBC.** NDBC is capable of acquiring, preparing, and deploying drifting buoys; however, an operational drifting buoy requirement has not been identified or funded.

**8.1.3.2. Navy.** Since 1998, the Naval Oceanographic Office (NAVOCEANO) has deployed meteorological drifting buoys to report surface meteorological and oceanographic measurements, for operational purposes, as tropical systems move through data sparse regions tracking toward the U.S. East Coast. Additionally, Navy drifting buoys have been deployed in the Intertropical Convergence Zone (ITCZ). The drifting buoy measurements, which are available to tropical forecasters, provide invaluable input for defining tropical storm movement and intensity, improve forecast model initialization, and give tropical forecasters a much better sense of storm characteristics and track as they approach the fleet concentration areas of Jacksonville, FL, and Norfolk, VA. Drifting buoys typically have a life span of 1 to 2 years, and

the data are available through the NAVOCEANO homepage and through standard World Meteorological Organization (WMO) data sources.

NAVOCEANO acquires, prepares, and deploys drifting meteorological buoys based on operational requirements identified by Commander-in-Chief, Atlantic Fleet (CINCLANTFLT). Currently, CINCLANTFLT has identified the Navy's drifting buoy support as a standing requirement to support fleet safety, assist in fleet sortie decisions, and enhance tropical weather preparedness.

**8.2. Requests for Drifting Buoy Deployment.** Drifting buoy deployments should be coordinated through the Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA). Deployments will be requested through the Office of the Federal Coordinator for Meteorology (OFCM) to HQ Air Force Reserve Command (AFRC). Deployments in advance of a U.S. land-threatening hurricane require a 36- to 48-hour notification.

**8.2.1. CARCAH.** CARCAH will issue, through the Tropical Cyclone Plan of the Day (TCPOD), an alert or outlook for drifting buoy deployment 48 hours before the planned deployment. Hard tasking for the deployment will be issued via the TCPOD 16 hours, plus flying time to the deployment location, before the event.

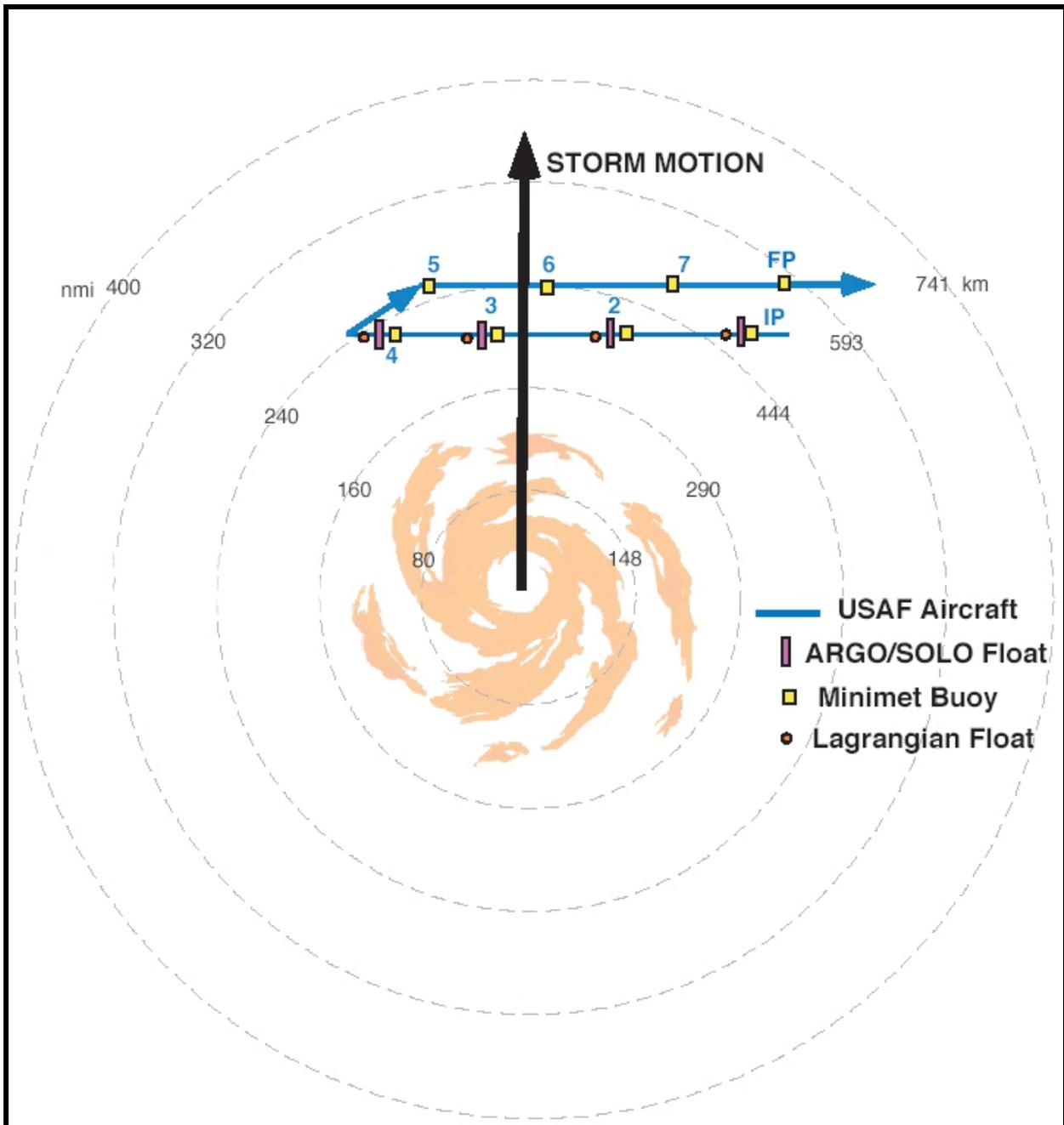
**8.2.2. Deployment of Buoys.** DOC may request the deployment of a drifting buoy and subsurface float array with up to 40 elements at a distance of 200 to 400 nm from the storm center, depending on the dynamics of the storm system. DOC will ensure the buoys and mission-related DOC personnel are delivered to AFRC. 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.
- Availability of aircraft and *Loadmasters (LM)* certified for buoy deployment.

**8.2.3. Deployment Position.** The final deployment position will be provided before the flight crew briefing. An example of a possible buoy and float deployment pattern from the recent CLBAST Experiment is shown in Figure 8-1.

**8.3. Communications.** Moored buoy and C-MAN data are transmitted via NOAA Geostationary Operational Environmental Satellite (GOES) to the National Environmental Satellite, Data, and Information Service (NESDIS) or via the Iridium satellite communication system and then are relayed to the NWS Telecommunications Gateway (NWSTG) for processing and dissemination. Data from partner organizations acquired by NDBC are relayed to the NWSTG for processing and dissemination. Moored buoy observations are formatted into the World Meteorological Organization (WMO) FM13 SHIP code. C-MAN and other partner organization coastal station data are formatted into C-MAN code, which is very similar to the WMO FM12 SYNOP code. Drifting buoys transmit data via NOAA's Polar Orbiting Environmental Satellites (POES) to the U.S. Argos Global Processing Center, Largo, MD.

Service Argos processes and formats the data into WMO FM18 BUOY code. The messages are then routed to the NWSTG for distribution. The formats for WMO encoded messages may be found in the WMO Manual on Codes Volume One, WMO-No. 306.



**Figure 8-1. Example Buoy and Float Deployment Pattern**



## CHAPTER 9

### MARINE WEATHER BROADCASTS

**9.1. General.** The National Weather Service and the Department of Homeland Security's United States Coast Guard (USCG) broadcast 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. 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. 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 12 USCG stations. 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 Inmarsat Ltd. 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 have largely been supplanted by a synthesized voice. The network provides near-continuous coverage of the coastal U.S., Great Lakes, Hawaii, Guam, Commonwealth of the Northern Mariana Islands, 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 high seas and offshore areas are broadcast over scheduled HF single sideband (SSB) radiotelephone channels from USCG communications stations using a very distinctive and recognizable computer-synthesized voice.

**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 and other marine broadcasts, including schedules, frequencies, and links to products can be found at:

- [www.nws.noaa.gov/om/marine/home.htm](http://www.nws.noaa.gov/om/marine/home.htm)
- [www.navcen.uscg.gov/marcomms/](http://www.navcen.uscg.gov/marcomms/)

In addition, the National Geospatial-Intelligence Agency (NGA), Publication 117, Radionavigational Aids (<http://www.nga.mil/portal/site/maritime>), contains detailed information on maritime safety information broadcasts within the U.S. and worldwide.



## 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  
1100 Balch Boulevard  
Stennis Space Center, MS 39522-3001
- HQ Air Force Reserve Command (AFRC/PA)  
Robins AFB, GA 31093
- Joint Staff Weather Officer  
The Joint Chiefs of Staff (J3/DDGO-ROD)  
Pentagon Room 2D-921G  
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

### LOCAL NATIONAL WEATHER SERVICE (NWS) OFFICE PRODUCTS

**A.1. General.** This appendix briefly describes some of the products issued by local National Weather Service (NWS) offices which support the tropical cyclone forecast and warning program. Additional details of all the products can be found in National Weather Service Instruction 10-601, located at <http://www.weather.gov/directives>.

**A.2. Products.**

**A.2.1. Hurricane/Typhoon Local Statements (HLS).** WFOs with coastal county responsibilities and selected inland WFOs will issue these products which are very specific and designed to inform media, local decision makers, and the public on present and anticipated storm effects in their county warning area (CWA) and adjacent coastal waters. HLSs will add localized details to tropical cyclone center’s advisory releases and should not conflict with or repeat advisory information not directly applicable to the local office’s CWA.

Coastal WFOs are defined as those having at least one county with significant tidal influences. Those are:

EASTERN REGION	SOUTHERN REGION	WESTERN REGION	PACIFIC REGION
Caribou, ME Portland, ME Boston, MA New York City, NY Philadelphia, PA Baltimore, MD/ Washington, DC Wakefield, VA Newport/ Morehead City, NC Wilmington, NC Charleston, SC	Brownsville, TX Corpus Christi, TX Houston/Galveston, TX Lake Charles, LA New Orleans, LA Mobile, AL Tallahassee, FL Tampa Bay, FL Miami, FL Key West, FL Melbourne, FL Jacksonville, FL San Juan, PR	San Diego, CA Los Angeles/ Oxnard, CA	Honolulu, HI Guam WSO Pago Pago, American Samoa

**A.2.2. Extreme Wind Warning (EWW).** Short duration warnings are issued by WFOs to protect lives and property. WFO forecasters issue short duration EWW products to provide the public with advance notice of the onset of extreme tropical cyclone winds, usually associated with the eyewall of a major (category 3 or higher) tropical cyclone. Extreme Wind Warnings inform the public of the need to take immediate shelter in an interior portion of a well-built structure due to the onset of extreme tropical cyclone winds.

**A.2.3. Post-Tropical Cyclone Reports (PSH).** The PSH is the primary WFO post tropical cyclone product issued to the public to report and document local tropical cyclone impacts. The PSH product is intended to provide the NHC, NWS Headquarters, the media, the public, and emergency management officials with a record of peak tropical cyclone conditions. This data is then used to formulate other post-event reports, news articles and historical records.

## APPENDIX B

### DEFINING POINTS FOR TROPICAL CYCLONE WATCHES/WARNINGS

The coastal areas placed under tropical storm and hurricane/typhoon watches and warnings are described through the use of "breakpoints" or geographical positions. The primary breakpoints are defined below.

<p style="text-align: center;"><b><u>Mexico</u></b></p> <p>La Pesca, MX      23.76°N      97.78°W            Rio San Fernando, MX   25.00°N      97.60°W</p>	<p style="text-align: center;"><b><u>Lake Charles, LA</u></b></p> <p>High Island, TX   29.54°N      94.39°W            Sabine Pass, TX      29.69°N      93.84°W            Cameron, LA      29.78°N      93.30°W            Intracoastal City, LA   29.62°N      92.04°W            Morgan City, LA      29.48°N      91.29°W</p>
<p style="text-align: center;"><b><u>Brownsville, TX</u></b></p> <p>Mouth of the Rio                Grand River      25.96°N      97.15°W            Port Mansfield, TX      26.60°N      97.29°W            Baffin Bay, TX      27.29°N      97.37°W</p>	<p style="text-align: center;"><b><u>New Orleans, LA</u></b></p> <p>Morgan City, LA      29.48°N      91.29°W            Lake Maurepas, LA      30.25°N      90.50°W            Grand Isle, LA      29.25°N      89.96°W            Mouth of Mississippi                River, LA      29.12°N      89.10°W            Mouth of Pearl                River, LA      30.15°N      89.60°W            Lake Maurepas, LA      30.25°N      90.50°W            Pascagoula, MS      30.35°N      88.55°W            MS/AL Border      30.40°N      88.40°W</p>
<p style="text-align: center;"><b><u>Corpus Christi, TX</u></b></p> <p>Baffin Bay, TX      27.29°N      97.37°W            North Entrance of the                Padre Island                National Seashore      27.47°N      97.29°W            Port Aransas, TX      27.83°N      97.07°W            Port O'Connor, TX      28.39°N      96.41°W</p>	<p style="text-align: center;"><b><u>Mobile, AL</u></b></p> <p>MS/AL Border      30.40°N      88.40°W            AL/FL Border      30.27°N      87.55°W            Destin, FL      30.39°N      86.50°W</p>
<p style="text-align: center;"><b><u>Houston, TX</u></b></p> <p>Port O'Connor, TX      28.39°N      96.41°W            Matagorda, TX      28.63°N      95.93°W            Sargent, TX      28.77°N      95.60°W            Freeport, TX      28.93°N      95.33°W            San Luis Pass, TX      29.07°N      95.13°W            Point Bolivar, TX      29.38°N      94.76°W            High Island, TX   29.54°N      94.39°W</p>	<p style="text-align: center;"><b><u>Tallahassee, FL</u></b></p> <p>Destin, FL      30.39°N      86.50°W            Walton/Bay                County Line, FL      30.28°N      85.98°W            Panama City, FL      30.12°N      85.70°W            Mexico Beach, FL      29.93°N      85.39°W            Indian Pass, FL      29.68°N      85.27°W            Apalachicola, FL      29.73°N      84.99°W            Ochlockonee River, FL   29.96°N      84.38°W            St. Marks, FL      30.10°N      84.20°W            Aucilla River, FL      30.04°N      83.92°W            Keaton Beach, FL      29.82°N      83.59°W            Steinhatchee River, FL   29.67°N      83.40°W            Suwanee River, FL      29.30°N      83.17°W</p>

<b><u>Tampa Bay, FL</u></b>			<b><u>Melbourne, FL</u></b>		
Suwanee River, FL	29.30°N	83.17°W	Jupiter Inlet, FL	26.95°N	80.07°W
Yankeetown, FL	29.03°N	82.75°W	Stuart, FL	27.21°N	80.18°W
Chassahowitzka, FL	28.70°N	82.65°W	Fort Pierce, FL	27.46°N	80.28°W
Aripeka, FL	28.43°N	82.66°W	Vero Beach, FL	27.65°N	80.35°W
Anclote Key, FL	28.18°N	82.85°W	Sebastian Inlet, FL	27.83°N	80.43°W
Tarpon Springs, FL	28.15°N	82.79°W	Cocoa Beach, FL	28.32°N	80.61°W
Anna Maria Island, FL	27.53°N	82.73°W	Volusia/Brevard		
Middle of Longboat			County Line, FL	28.79°N	80.73°W
Key, FL	27.39°N	82.64°W	New Smyrna Beach, FL	29.03°N	80.89°W
Englewood, FL	26.94°N	82.37°W	Flagler Beach, FL	29.47°N	81.12°W
Boca Grande, FL	26.75°N	82.26°W			
Bonita Beach, FL	26.32°N	81.84°W			
<b><u>Miami, FL (Gulf)</u></b>			<b><u>Jacksonville, FL</u></b>		
Bonita Beach, FL	26.33°N	81.84°W	Flagler Beach, FL	29.47°N	81.12°W
Chokoloskee, FL	25.78°N	81.38°W	St. Augustine, FL	29.88°N	81.27°W
East Cape Sable, FL	25.12°N	81.08°W	Fernandina Beach, FL	30.66°N	81.44°W
Flamingo, FL	25.14°N	80.93°W	Altamaha Sound, GA	31.29°N	81.29°W
<b><u>Key West, FL (Gulf)</u></b>			<b><u>Charleston, SC</u></b>		
Flamingo, FL	25.14°N	80.93°W	Altamaha Sound, GA	31.29°N	81.29°W
Dry Tortugas, FL	24.66°N	82.86°W	Savannah River, GA	32.03°N	80.86°W
Key West, FL	24.55°N	81.81°W	Edisto Beach, SC	32.49°N	80.32°W
Seven Mile Bridge, FL	24.70°N	81.15°W	South Santee River, SC	33.12°N	79.27°W
Craig Key, FL	24.83°N	80.77°W			
Card Sound Bridge, FL	25.29°N	80.37°W			
Ocean Reef, FL	25.33°N	80.26°W			
<b><u>Miami, FL (Atlantic)</u></b>			<b><u>Wilmington, NC</u></b>		
Ocean Reef, FL	25.33°N	80.26°W	South Santee River, SC	33.12°N	79.27°W
Golden Beach, FL	25.97°N	80.12°W	Murrells Inlet, SC	33.56°N	79.01°W
Hallandale Beach, FL	25.99°N	80.12°W	Little River Inlet, SC	33.85°N	78.55°W
Deerfield Beach, FL	26.32°N	80.07°W	Cape Fear, NC	33.84°N	77.96°W
Boca Raton, FL	26.36°N	80.07°W	Surf City, NC	34.44°N	77.52°W
Jupiter Inlet, FL	26.95°N	80.07°W			

<b><u>Morehead City, NC</u></b>			<b><u>Mt. Holly, NJ</u></b>		
Surf City, NC	34.44°N	77.52°W	Cape Henlopen, DE	38.80°N	75.09°W
New River Inlet, NC	34.53°N	77.34°W	Cape May, NJ	38.94°N	74.90°W
Bogue Inlet, NC	34.64°N	77.11°W	Great Egg Inlet, NJ	39.29°N	74.54°W
Cape Lookout, NC	34.60°N	76.53°W	Little Egg Inlet, NJ	39.49°N	74.31°W
Ocracoke Inlet, NC	35.06°N	76.00°W	Manasquan Inlet, NJ	40.10°N	74.03°W
Cape Hatteras, NC	35.22°N	75.53°W	Delaware Bay North/ South of Slaughter Beach, DE to	38.91°N	75.30°W
Oregon Inlet, NC	35.77°N	75.53°W	Sandy Hook, NJ	40.46°N	74.00°W
(The inclusion of Pamlico and Albemarle Sounds should be on a case-by-case basis).					
5 miles north of Duck, NC					
	36.23°N	75.77°W			
<b><u>Wakefield, VA</u></b>			<b><u>New York City, NY</u></b>		
5 miles north of Duck, NC			Sandy Hook, NJ	40.46°N	74.00°W
	36.23°N	75.77°W	Fire Island Inlet, LI, NY	40.63°N	73.31°W
NC/VA State Line	36.55°N	75.87°W	Moriches Inlet, LI, NY	40.77°N	72.75°W
Cape Charles Light, VA	37.12°N	75.90°W	Montauk Point, LI, NY	41.07°N	71.86°W
Parramore Island, VA	37.52°N	75.64°W	Port Jefferson Harbor, LI, NY	40.96°N	73.08°W
Chincoteague, VA	37.93°N	75.32°W	New Haven, CT	41.30°N	72.91°W
Chesapeake Bay, New Point Comfort, VA	37.30°N	76.28°W	Watch Hill, RI	41.31°N	71.86°W
Chesapeake Bay, Windmill Point, VA	37.61°N	76.28°W			
Chesapeake Bay, Smith Point, VA	37.89°N	76.24°W			
<b><u>Sterling, VA</u></b>			<b><u>Boston, MA</u></b>		
Chesapeake Bay, Smith Point, VA	37.89°N	76.24°W	Block Island, RI	41.16°N	71.56°W
Tidal Potomac, Cobb Island, MD	38.26°N	76.84°W	Martha's Vineyard, MA	41.38°N	70.63°W
Tidal Potomac, Indian Head, MD	38.61°N	77.15°W	Nantucket, MA	41.27°N	70.04°W
Tidal Potomac, Key Bridge, MD	38.89°N	77.07°W	(The inclusion of the above points should be on a case-by-case basis).		
Chesapeake Bay, Drum Point, MD	39.32°N	76.42°W	Watch Hill, RI	41.31°N	71.86°W
Chesapeake Bay, North Beach, MD	38.70°N	76.53°W	Point Judith, RI	41.35°N	71.49°W
Chesapeake Bay, Sandy Point, MD	39.02°N	76.40°W	Westport, MA	41.50°N	71.11°W
Chesapeake Bay, Pooles Island, MD	39.29°N	76.27°W	Woods Hole, MA	41.52°N	70.68°W
			Chatham, MA	41.67°N	69.95°W
			Sagamore Beach, MA	41.80°N	70.53°W
			Plymouth, MA	41.98°N	70.65°W
			Provincetown, MA	42.06°N	70.25°W
			Hull, MA	42.30°N	70.91°W
			Gloucester, MA	42.58°N	70.66°W
			Merrimack River, MA	42.84°N	70.82°W

<b><u>Portland, ME</u></b>			<b><u>Caribou, ME</u></b>		
Merrimack River, MA	42.84°N	70.82°W	Stonington, ME	44.16°N	68.64°W
Portsmouth, NH	43.05°N	70.72°W	Bar Harbor, ME	44.39°N	68.20°W
Cape Elizabeth, ME	43.56°N	70.19°W	Eastport, ME	44.92°N	67.00°W
Port Clyde, ME	43.92°N	69.25°W			
Stonington, ME	44.16°N	68.64°W			
<b>California Breakpoints</b>					
<b><u>San Diego, CA</u></b>			<b><u>Los Angeles/Oxnard, CA</u></b>		
Mouth of the Tijuana River, CA	32.53°N	117.12°W	Mouth of San Gabriel River, CA	33.75°N	118.11°W
San Mateo Point, CA	33.38°N	117.60°W	Point Mugu, CA	34.11°N	119.12°W
Mouth of San Gabriel River, CA	33.75°N	118.11°W	Point Conception, CA	34.45°N	120.45°W
<b>Central Pacific Hurricane Center Breakpoints</b>					
<b><u>Honolulu, HI</u></b>					
Northwest Hawaiian Islands Nihoa	23.05°N	161.92°W			
French Frigate Shoals	23.86°N	166.27°W			
Maro Reef	25.33°N	170.50°W			
Lisianski	26.08°N	174.00°W			
Pearl and Hermes Atoll	27.83°N	175.83°W			
Midway	28.02°N	177.37°W			
Kure Atoll	28.42°N	178.33°W			

For graphical representations of the breakpoints, see [http://www.nhc.noaa.gov/breakpoints\\_graphics.shtml](http://www.nhc.noaa.gov/breakpoints_graphics.shtml).

## APPENDIX C

### JOINT TYPHOON WARNING CENTER (JTWC) BULLETINS

Below are the abbreviated communications headers and titles for the products for which JTWC is responsible. A brief description of each product, to include scheduled transmission times, is available [http://metocph.nmci.navy.mil/jtwc/menu/jtwc\\_dis.html](http://metocph.nmci.navy.mil/jtwc/menu/jtwc_dis.html).

ABIO 10 PGTW	Significant Weather Advisory, Indian Ocean
ABPW 10 PGTW	Significant Weather Advisory, Western Pacific Ocean
WTPN 21-26 PGTW	Tropical Cyclone Formation Alert, Northwest Pacific Ocean
WTPN 31-36 PGTW	Tropical Cyclone Warning, Northwest Pacific Ocean
WDPN 31-36 PGTW	Prognostic Reasoning Bulletin, Northwest Pacific Ocean
WTIO 21-25 PGTW	Tropical Cyclone Formation Alert, North Indian Ocean
WTIO 31-35 PGTW	Tropical Cyclone Warning, North Indian Ocean
WTPS 21-25 PGTW	Tropical Cyclone Formation Alert, Southwest Pacific Ocean
WTPS 31-35 PGTW	Tropical Cyclone Warning, Southwest Pacific Ocean
WTXS 21-26 PGTW	Tropical Cyclone Formation Alert, South Indian Ocean
WTXS 31-36 PGTW	Tropical Cyclone Warning, South Indian Ocean
WTPN 21-25 PHNC	Tropical Cyclone Formation Alert, Northeast Pacific Ocean
WTPN 31-35 PHNC	Tropical Cyclone Warning, Northeast Pacific Ocean
FKPN 31-35 PHNC	Prognostic Reasoning Bulletin, Northeast Pacific Ocean
WTPS 21-25 PHNC	Tropical Cyclone Formation Alert, Southeast Pacific Ocean
WTPS 31-35 PHNC	Tropical Cyclone Warning, Southeast Pacific Ocean
TPPN 10-19 PGTW	Tropical Cyclone Position and Intensity, Northwest Pacific Ocean
TPIO 10-19 PGTW	Tropical Cyclone Position and Intensity, North Indian Ocean
TPPS 10-19 PGTW	Tropical Cyclone Position and Intensity, Southwest Pacific Ocean
TPXS 10-19 PGTW	Tropical Cyclone Position and Intensity, Southern Indian Ocean
TPPZ 01-05 PGTW	Tropical Cyclone Position and Intensity, Central North Pacific Ocean



## APPENDIX D

### FORMAT FOR NHOP/NWSOP FLIGHT INFORMATION FOR INTERNATIONAL AND DOMESTIC NOTAM ISSUANCE

Flight information shall be sent to the NOTAM office via facsimile for dissemination as an International and Domestic NOTAM in the following format (Note: The request is made for a domestic NOTAM which will then automatically makes its way into the international NOTAM system):

#### Header

#### **Request a Domestic NOTAM be Issued**

- A. Affected Center(s). This field will include all affected ARTCCs in 3-letter identifier format; e.g., ZNY, ZOA, ZAN. Synoptic track flights will probably utilize more than one ARTCC, and any adjacent ARTCC should be included when the flight track is within 100 miles of the adjacent center's airspace. Flights that are flying in the storm environment will utilize the ARTCC whose airspace is mostly affected.
- B. Start Time (YYMMDDZZZZ). For example, 0006011600. This time would correspond to the entry time on a reconnaissance track or time at the storm fix latitude/longitude.
- C. Ending Time (YYMMDDZZZZ). This would be the completion time of reconnaissance track or the time exiting the storm environment.
- E.\* Text. This field is free form and should include the following information: route of flight for the mission portion (latitude/longitude, fixes, airways), type of activity (laser, dropsonde, etc.), frequency/location of deployment, broadcast frequencies, any other pertinent information that may concern other flights. Include a unit/agency phone number and point of contact for possible questions.
- F. Lower Altitude (during mission). Use "Surface" since the dropsonde is the "reason" for the NOTAM as much or more so than the aircraft altitude.
- G. Upper Altitude (during mission). For example, FL450.

If only one altitude is to be used, then F and G may be combined. If altitude is going to vary throughout the mission, utilize "see text" and the information can be inserted there and the altitudes may be explained in field E.

\* Note that there is no paragraph "D". It is reserved for FAA use.

#### NOTES:

1. Only ICAO approved contractions may be used.
2. Using this format will help ensure timely and accurate information dissemination.



## APPENDIX E

### SAFFIR-SIMPSON HURRICANE SCALE

Saffir/Simpson Hurricane Scale (SSHS). The SSHS is a scale ranging from one to five based on the hurricane's present intensity. 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). Additional details regarding the SSHS can be found at: <http://www.nhc.noaa.gov/aboutsshs.shtml>.



## **APPENDIX F**

### **OFFICIAL INTERAGENCY AGREEMENTS**

The following enclosure is the Memorandum of Agreement (MOA) between the Air Force Reserve Command (AFRC) and the National Oceanic and Atmospheric Administration (NOAA), October 12, 2000. The purpose of this agreement is to establish policies, principles, and procedures under which the AFRC and NOAA provide aircraft weather reconnaissance and surveillance in support of NOAA's tropical cyclone forecast, warning, and research missions.



# MEMORANDUM OF AGREEMENT

## BETWEEN

### THE UNITED STATES AIR FORCE RESERVE COMMAND

## AND

### THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

**PURPOSE:** The National Oceanic and Atmospheric Administration (NOAA), an agency of the Department of Commerce, does not have the capability to fully support all operational requirements in support of tropical cyclone and winter storm aerial reconnaissance. This memorandum of agreement establishes policies, principles, and procedures under which the Air Force Reserve Command (AFRC) will provide aircraft weather reconnaissance support to NOAA. NOAA and AFRC enters into this agreement pursuant to its authority under 15 U.S.C. 313.

#### 1. REFERENCES:

- a. *National Hurricane Operations Plan (NHOP)*
- b. *National Winter Storms Operations Plan (NWSOP)*
- c. Department of Defense Appropriations Act, 2000

#### 2. BACKGROUND: The Air Force Reserve Command (AFRC) maintains 10 WC-130s to meet the Department of Commerce (DOC) aircraft reconnaissance requirements. AFRC will conduct up to five (5) sorties per day in support of NHOP requirements and up to two (2) sorties per day in support of NWSOP requirements. The Department of Defense (DOD), through AFRC, will bear all costs directly attributed to providing aircraft weather reconnaissance support. Support will be limited to the number of AFRC congressionally funded aircraft flying hours per year.

- a. Total flying hours used to support the weather reconnaissance mission are set annually in the DOD Appropriations Act. The 53rd Weather Reconnaissance Squadron (53 WRS) manages the flying hour program.
- b. The operational area for AFRC weather reconnaissance includes the Atlantic Ocean, Gulf of Mexico, the Caribbean Sea, and the North Pacific Ocean east of the international date line, as outlined in the NHOP and the NWSOP.
- c. The 53 WRS will be capable of operating from two (2) deployed locations, as well as from home station, simultaneously, supporting a maximum of five tropical cyclone

sorties per day or two winter storm sorties per day.

3. IMPLEMENTATION: Implementation details are contained in “GENERAL PROVISIONS.”
4. GENERAL PROVISIONS:
  - a. AFRC agrees:
    - 1) Within the limits of military capability, to meet NOAA’s requirements for aerial weather reconnaissance in accordance with the NHOP and NWSOP.
    - 2) To provide at the Tropical Prediction Center/National Hurricane Center (TPC/NHC) the staff and equipment required to support the mission of the Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH). CARCAH provides 24-hour telecon/aircraft SATCOM operational interface between NOAA/TPC/NHC and AFRC/53WRS for NHOP and NWSOP taskings. CARCAH is a subunit of and reports directly to the 53WRS.
  - b. NOAA agrees to promptly notify AFRC/53WRS of the requirements for tropical cyclone or winter storm mission taskings in accordance with the NHOP and the NWSOP. Tropical cyclone missions will be tasked by the Director, TPC/NHC. Winter storm missions will be tasked by the Director, National Centers for Environmental Prediction.
  - c. AFRC recognizes the obligation to support winter storm operations and associated research projects as delineated by the DOD Appropriations Act and the NWSOP. Support to research projects will be contingent upon aircraft availability.
5. MOBILIZATION: In times of national emergency or war, some or all AFRC/53WRS reconnaissance resources may not be available to fulfill DOC/NOAA needs.
6. EFFECTIVE AND TERMINATION DATES: This memorandum will become effective on the date signed by the last approving official. The parties will review this memorandum of agreement at least once every three years to determine whether it should be revised, amended, or cancelled. Amendments or revisions to this agreement require the mutual consents of the parties.

7. COORDINATION:

The agency contacts for coordination of the activities under this MOU are:

AOC: CAPT Robert W. Maxson, NOAA, Aircraft Operations Center, DOC, MacDill AFB, Florida; phone: (813) 828-3310 ext. 3001; fax: (813) 828-3266 E-mail [Bob.W.Maxson@NOAA.gov](mailto:Bob.W.Maxson@NOAA.gov)

Ms. Julie Robertson, (813) 828-3310 ext. 3010; fax: (813) 828-8923 E-mail  
[Julie.A.Robertson@NOAA.gov](mailto:Julie.A.Robertson@NOAA.gov)

AFRC:

HQ AFRC/DOOX  
DSN 497-1161; Commercial (228)327-1161

403 WG/XPL  
SSgt Clarence Hester Jr., Logistics Plans Manager  
Keesler AFB, MS  
DSN 597-3521; Commercial (228) 377-3521  
Fax DSN 597-4624; Commercial (228) 377-3521  
Email: [Clarence.Hester@keesler.af.mil](mailto:Clarence.Hester@keesler.af.mil)

53 WRS  
Lt Col Dennis L. Price, Director of Operation  
817 H Street, Keesler AFB, MS 39534  
DSN 597-8510; Commercial (228) 377-8510  
Fax DSN 597-1923; Commercial (228) 337-1923  
Email: [Dennis.Price@keesler.af.mil](mailto:Dennis.Price@keesler.af.mil)

## 8. RESOLUTION OF DISAGREEMENTS

Nothing herein is intended to conflict with current DOC or the NOAA Aircraft Operations Center directives. If the terms of this agreement are inconsistent with existing directives of either of the agencies entering into this agreement, then those portions of this agreement which are determined to be inconsistent shall be invalid, but the remaining terms and conditions not affected by the inconsistency shall remain in full force and effect. At the first opportunity for review of the agreement, all necessary changes will be accomplished either by an amendment to this agreement or by entering into a new agreement, whichever is deemed expedient to the interest of both parties.

Should disagreement arise on the interpretation of the provisions of this agreement, or amendments and/or revisions thereto, that cannot be resolved at the operating level, the area(s) of disagreement shall be stated in writing by each party and presented to the other party for consideration. If agreement on interpretation is not reached within thirty (30) days, the parties shall forward the written presentation of the disagreement to respective higher officials for appropriate resolution.

FOR THE UNITED STATES  
AIR FORCE RESERVE COMMAND



Date: 2 Oct 2000

FOR THE NATIONAL OCEANIC AND  
ATMOSPHERIC ADMINISTRATION

 Capt NOAA

Date: 10/12/2000

**APPENDIX G**  
**RECCO, HDOB, AND TEMP DROP**  
**CODES, TABLES, AND REGULATIONS**

DATE		ORGANIZATION				MISSION IDENTIFIER										
OBSERVATION NUMBER	9	RECCO INDICATOR SPECIFYING TYPE OF OBSERVATION <i>Table 1</i>	G	TIME OF OBSERVATION (Hours and Minutes)  (GMT)	Y	DAY OF WEEK SUN-1	L <sub>o</sub>	LONGITUDE DEGREES AND TENTHS <i>(Note 4)</i>	h <sub>a</sub>	PRESSURE ALTITUDE OF AIRCRAFT REPORTED TO THE NEAREST DECAMETER	d	WIND DIRECTION AT FLIGHT LEVEL <i>(Tens of deg. true.)</i>	T	TEMPERATURE WHOLE °C <i>(Note 6)</i>	/	INDICATOR INDEX TO WHH <i>Table 9</i>
	X		G		Q	OCTANT <i>Table 3</i>	L <sub>o</sub>		h <sub>a</sub>		d		T			
	X		G		L <sub>a</sub>	LATITUDE DEGREES AND TENTHS	L <sub>o</sub>		h <sub>a</sub>		f		T <sub>d</sub>		H	
	X		G		L <sub>a</sub>	B	TURBULENCE <i>Table 4</i>		d <sub>t</sub>		f		T <sub>d</sub>		H	
	9		I <sub>d</sub>		L <sub>a</sub>	f <sub>c</sub>	FLIGHT COND <i>Table 5</i>		d <sub>a</sub>		f		w		H	
		1	2		3		4		5		6		7		8	
REMARKS																

TYPE AIRCRAFT				CALL SIGN				METEOROLOGIST							
1	INDICATOR	C	CLOUD TYPE <i>Table 11</i>	C	CLOUD TYPE <i>Table 11</i>	C	CLOUD TYPE <i>Table 11</i>	1	INDICATOR	C	CLOUD TYPE <i>Table 11</i>	C	CLOUD TYPE <i>Table 11</i>	C	CLOUD TYPE <i>Table 11</i>
k <sub>n</sub>	NR OF CLOUD LAYERS <i>(Note 9)</i>	h <sub>a</sub>	ALTITUDE OF BASE	h <sub>a</sub>	ALTITUDE OF BASE	h <sub>a</sub>	ALTITUDE OF BASE	K <sub>n</sub>	NR OF CLOUD LAYERS <i>(Note 9)</i>	h <sub>a</sub>	ALTITUDE OF BASE	h <sub>a</sub>	ALTITUDE OF BASE	h <sub>a</sub>	ALTITUDE OF BASE
N <sub>a</sub>	AMOUNT OF CLOUDS <i>(Note 3)</i> <i>Table 10</i>	h <sub>a</sub>	<i>Table 12</i>	h <sub>a</sub>	<i>Table 12</i>	h <sub>a</sub>	<i>Table 12</i>	N <sub>a</sub>	AMOUNT OF CLOUDS <i>(Note 9)</i> <i>Table 10</i>	h <sub>a</sub>	<i>Table 12</i>	h <sub>a</sub>	<i>Table 12</i>	h <sub>a</sub>	<i>Table 12</i>
N <sub>a</sub>		H <sub>t</sub>	ALTITUDE OF TOP	H <sub>t</sub>	ALTITUDE OF TOP	H <sub>t</sub>	ALTITUDE OF TOP	N <sub>a</sub>		H <sub>t</sub>	ALTITUDE OF TOP	H <sub>t</sub>	ALTITUDE OF TOP	H <sub>t</sub>	ALTITUDE OF TOP
N <sub>a</sub>		H <sub>t</sub>	<i>Table 12</i>	H <sub>t</sub>	<i>Table 12</i>	H <sub>t</sub>	<i>Table 12</i>	N <sub>a</sub>		H <sub>t</sub>	<i>Table 12</i>	H <sub>t</sub>	<i>Table 12</i>	H <sub>t</sub>	<i>Table 12</i>
9		10		11		12		13		14		15		16	
REMARKS															

RECCO RECORDING WORKSHEET															
4	INDICATOR	6	INDICATOR <i>(Note 11)</i>	6	INDICATOR <i>(Note 11)</i>	7	INDICATOR	7	INDICATOR	8	INDICATOR	8	INDICATOR	9	INDICATOR
d	DIRECTION OF SFC WIND <i>(Tens of deg. true)</i>	W <sub>s</sub>	SIGNIFICANT WEATHER CHANGES <i>Table 14</i>	W <sub>s</sub>	SIGNIFICANT WEATHER CHANGES <i>Table 14</i>	I <sub>r</sub>	RATE OF ICING <i>Table 17</i>	h <sub>i</sub>	ALT OF BASE OF ICING STRATUM <i>(Note 12)</i> <i>Table 12</i>	d <sub>r</sub>	BEARING OF ECHO CENTER <i>(Tens of Deg. True)</i>	E <sub>w</sub>	ECHO WIDTH OR DIAMETER <i>Table 19</i>	V <sub>i</sub>	INFLIGHT VISIBILITY <i>Table 23</i>
d		S <sub>s</sub>	DISTANCE OF OCCURRENCE OF W <sub>s</sub> <i>Table 15</i>	S <sub>s</sub>	DISTANCE OF OCCURRENCE OF W <sub>s</sub> <i>Table 15</i>	I <sub>t</sub>	TYPE OF ICING <i>Table 18</i>	h <sub>i</sub>		d <sub>r</sub>		E <sub>i</sub>	LENGTH OF MAJ AXIS <i>Table 19</i>	T <sub>w</sub>	SEA SURFACE TEMPERATURE DEGREES AND TENTHS
f	SURFACE WIND SPEED <i>(Note 10)</i>	w <sub>d</sub>	DISTANT WEATHER <i>Table 16</i>	w <sub>d</sub>	DISTANT WEATHER <i>Table 16</i>	S <sub>b</sub>	DISTANCE TO BEGINNING OF ICING <i>Table 15</i>	H <sub>i</sub>	ALTITUDE OF TOP OF ICING STRATUM <i>(Note 12)</i> <i>Table 12</i>	S <sub>r</sub>	DISTANCE TO ECHO CENTER <i>Table 19</i>	C <sub>e</sub>	CHARACTER OF ECHO <i>Table 21</i>	T <sub>w</sub>	
f		d <sub>w</sub>	BEARING OF W <sub>d</sub> <i>Table 13</i>	d <sub>w</sub>	BEARING OF W <sub>d</sub> <i>Table 13</i>	S <sub>e</sub>	DISTANCE TO ENDING OF ICING <i>Table 15</i>	H <sub>i</sub>		O <sub>e</sub>	ORIENTATION OF ELLIPSE <i>Table 20</i>	I <sub>e</sub>	INTENSITY OF ECHO <i>Table 22</i>	T <sub>w</sub>	
17		18		19		20		21		22		23		24	
REMARKS															

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<sub>d</sub>

- 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    | <u>Northern</u> |
| 1 90° W - 180° | <u>Northern</u> |
| 2 180° - 90° E | <u>Northern</u> |
| 3 90° - 0° E   | <u>Northern</u> |
| 4 Not Used     |                 |
| 5 0° - 90° W   | <u>Southern</u> |
| 6 90° W - 180° | <u>Southern</u> |
| 7 180° - 90° E | <u>Southern</u> |
| 8 90° - 0° E   | <u>Southern</u> |

**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<sub>c</sub>

- 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<sub>t</sub>

- 0 Spot of Wind
- 1 Average wind
- / No wind reported

**TABLE 7** d<sub>a</sub>

- 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<sub>s</sub>

- 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 Altopcumulus (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<sub>s</sub>h<sub>s</sub>H<sub>t</sub>H<sub>t</sub>h<sub>i</sub>h<sub>i</sub>H<sub>i</sub>H<sub>i</sub>

- |                           |  |
|---------------------------|--|
| 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<sub>w</sub>

- |             |  |                  |
|-------------|--|------------------|
| 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<sub>s</sub>

- 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<sub>b</sub>S<sub>e</sub>S<sub>s</sub>

- 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<sub>s</sub>)

## Table G-1 (continued). Reconnaissance Code Tables

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 GGgg<sub>d</sub> YQL<sub>a</sub>L<sub>a</sub>L<sub>a</sub> L<sub>o</sub>L<sub>o</sub>L<sub>o</sub>Bf<sub>c</sub> h<sub>a</sub>h<sub>a</sub>h<sub>a</sub>d<sub>t</sub>d<sub>a</sub>

ddfff TTT<sub>d</sub>T<sub>d</sub><sup>w</sup> /jHHH

SECTION TWO (ADDITIONAL)

1k<sub>n</sub>N<sub>s</sub>N<sub>s</sub>N<sub>s</sub> Ch<sub>s</sub>h<sub>s</sub>H<sub>t</sub>H<sub>t</sub> ..... 4ddff

6W<sub>s</sub>S<sub>s</sub>W<sub>d</sub>d<sub>w</sub> 7I<sub>r</sub>I<sub>t</sub>S<sub>b</sub>S<sub>e</sub> 7h<sub>i</sub>h<sub>i</sub>H<sub>i</sub>H<sub>i</sub> 8d<sub>r</sub>d<sub>r</sub>S<sub>r</sub>O<sub>e</sub>

8E<sub>w</sub>E<sub>i</sub>c<sub>e</sub>i<sub>e</sub> 9V<sub>i</sub>T<sub>w</sub>T<sub>w</sub>T<sub>w</sub>

SECTION THREE (INTERMEDIATE)

9XXX9 GGgg<sub>d</sub> YQL<sub>a</sub>L<sub>a</sub>L<sub>a</sub> L<sub>o</sub>L<sub>o</sub>L<sub>o</sub>Bf<sub>c</sub> h<sub>a</sub>h<sub>a</sub>h<sub>a</sub>d<sub>t</sub>d<sub>a</sub>

ddfff TTT<sub>d</sub>T<sub>d</sub><sup>w</sup> /jHHH

**Table G-2. Reconnaissance Code Regulations**

<p>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.</p> <p>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.</p> <p>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."</p> <p>4. The hundreds digit of longitude is omitted for longitudes from 100° to 180°.</p> <p>5. Describe conditions along the route of flight actually experienced at flight level by aircraft.</p> <p>6. TT, T<sub>d</sub>T<sub>d</sub>. 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<sub>d</sub>. Missing or unknown temperatures are reported as //. When the dew point is colder than -49.4°C, Code T<sub>d</sub>T<sub>d</sub> as // and report the actual value as a plain language remark - e.g. "DEW POINT NEG 52°C".</p> <p>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.</p>	<p>8. When j is reported as a /, HHH is encoded as ///.</p> <p>9. If the number of cloud layers reported exceeds 3, k<sub>n</sub> 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.</p> <p>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."</p> <p>11. Significant weather changes which have occurred since the last observation along the track are reported for W<sub>s</sub>.</p> <p>12. When aircraft encounters icing in level flight, the height at which the icing occurred will be reported for h<sub>i</sub>h<sub>i</sub>. The H<sub>i</sub>H<sub>i</sub> will be reported as //.</p>
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## THE HDOB MESSAGE

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The HDOB message is used to transmit High-Density/High-Accuracy (HD/HA) meteorological data from hurricane reconnaissance aircraft. These are created automatically by the system software. Each message consists of a communications header line (Table G-3), a mission/ob identifier line (Table G-4), and 20 lines of HD/HA data (Table G-5).

Within an HDOB message, the time interval (resolution) between individual HD/HA observations can be set by the operator to be 30, 60, or 120 seconds. However, regardless of the time resolution of the HD/HA data, the meteorological parameters in the HDOB message always represent 30-second averages along the flight track (except for certain peak values as noted in Table G-5).

The nominal time of each HD/HA record is the midpoint of the 30-second averaging interval. This means that an HD/HA record at time  $t$  will include data measured at time  $t+15$  seconds. For purposes of determining peak flight-level and SFMR winds, the encoding interval begins 15 seconds after the nominal time of the last HD/HA record and ends 15 seconds after the nominal time of the record being encoded.

A sample HDOB message is given below (message begins with URNT15...):

```

0           1           2           3           4           5           6           7
01234567890123456789012345678901234567890123456789012345678901234567890
-----
URNT15 KNHC 281426
AF302 1712A KATRINA           HDOB 41 20050928
142030 2608N 08756W 7093 03047 9333 +192 +134 133083 089 080 999 00
142100 2609N 08755W 7091 03054 9330 +166 +146 133106 115 103 999 00
142130 2610N 08754W 7058 03040 9295 +134 +134 135121 124 111 999 00
142200 2611N 08753W 7037 03060 9291 +124 +124 138129 136 122 999 00
.
.
.
142230 2612N 08752W 7010 03057 9282 +102 +102 141153 166 148 999 00
142300 2612N 08751W 7042 03010 9293 +088 +083 133159 164 147 999 00
142330 2613N 08750W 6999 03064 9279 +088 +088 138158 161 144 999 00
142400 2614N 08749W 7005 03046 9281 +080 +080 138155 158 142 999 00
142430 2614N 08748W 6998 03048 9278 +078 +078 138151 153 137 999 00
142500 2615N 08747W 7002 03048 9279 +084 +084 140146 148 133 999 00
$$

```

---

**Figure G-2. HDOB Description and Sample Message**



**Table G-5. HD/HA Data Line Format for HDOB Messages**

0	1	2	3	4	5	6	7
01234567890123456789012345678901234567890123456789012345678901234567890							
-----							
<b>hhmmss</b>	<b>LLLLH</b>	<b>NNNNH</b>	<b>PPPP</b>	<b>GGGGG</b>	<b>XXXX</b>	<b>sTTT</b>	<b>sddd</b>
142230	2612N	08752W	7010	03057	9282	+102	+102
						141153	166 148 999 00

**hhmmss:** Observation time, in hours, minutes and seconds (UTC). The observation time is the midpoint of the 30-s averaging interval used for the record's meteorological data.

**LLLLH:** The latitude of the aircraft at the observation time in degrees (LL) and minutes (LL). The hemisphere (H) is given as either N or S.

**NNNNH:** The longitude of the aircraft at the observation time, in degrees (NNN) and minutes (NN). The hemisphere (H) is given as either E or W.

**PPPP:** Aircraft static air pressure, in tenths of mb with decimal omitted, at the observation time. If pressure is equal to or greater than 1000 mb the leading 1 is dropped.

**GGGGG:** Aircraft geopotential height, in meters, at the observation time.

**XXXX:** Extrapolated surface pressure or D-value (30-s average). Encoded as extrapolated surface pressure if aircraft static pressure is 550.0 mb or greater (i.e., flight altitudes at or below 550 mb). Format for extrapolated surface pressure is the same as for static pressure. For flight altitudes higher than 550 mb, **XXXX** is encoded as the D-value, in meters. Negative D-values are encoded by adding 5000 to the D-value.

**s:** Sign of the temperature or dew point (+ or -).

**sTTT:** The air temperature in degrees and tenths Celsius, decimal omitted (30-s average).

**sddd:** The dew point temperature, in degrees and tenths Celsius, decimal omitted (30-s average).

**www:** Wind direction in degrees (30-s average). North winds are coded as 000. 999 indicates missing value.

**SSS:** Wind speed, in kt (30-s average). 999 indicates missing value.

**MMM:** Peak 10-second average wind speed occurring within the encoding interval, in kt. 999 indicates missing value.

**KKK:** Peak 10-second average surface wind speed occurring within the encoding interval from the Stepped Frequency Microwave Radiometer (SFMR), in kt. 999 indicates missing value.

**ppp:** SFMR-derived rain rate, in  $\text{mm hr}^{-1}$ , evaluated over the 10-s interval chosen for KKK. 999 indicates missing value.

**FF:** Quality control flags.

First column indicates status of positional variables as follows:

- 0 All parameters of nominal accuracy
- 1 Lat/lon questionable
- 2 Geopotential altitude or static pressure questionable
- 3 Both lat/lon and GA/PS questionable

Second column indicates status of meteorological variables as follows:

- 0 All parameters of nominal accuracy
  - 1 T or TD questionable
  - 2 Flight-level winds questionable
  - 3 SFMR parameter(s) questionable
  - 4 T/TD and FL winds questionable
  - 5 T/TD and SFMR questionable
  - 6 FL winds and SFMR questionable
  - 9 T/TD, FL winds, and SFMR questionable
-

## Table G-6. TEMP DROP CODE

EXTRACT FROM: WMO-No. 306 MANUAL ON CODES

FM 37-X 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     $M_i M_i M_j M_j$      $YYGGI_d$      $99L_a L_a L_a$      $Q_c L_o L_o L_o L_o$      $MMM U_{L_a} U_{L_o}$

SECTION 2     $99P_o P_o P_o$      $T_o T_o T_{a0} D_o D_o$      $d_o d_o f_o f_o f_o$

$P_1 P_1 h_1 h_1 h_1$      $T_1 T_1 T_{a1} D_1 D_1$      $d_1 d_1 f_1 f_1 f_1$

$P_n P_n h_n h_n h_n$      $T_n T_n T_{an} D_n D_n$      $d_n d_n f_n f_n f_n$

SECTION 3     $88P_t P_t P_t$      $T_t T_t T_{at} D_t D_t$      $d_t d_t f_t f_t f_t$   
or  
88999

SECTION 4     $77P_m P_m P_m$      $d_m d_m f_m f_m f_m$      $(4v_b v_b v_a v_a)$   
or  
 $66P_m P_m P_m$      $d_m d_m f_m f_m f_m$      $(4v_b v_b v_a v_a)$   
or  
77999

SECTION 10    31313

51515     $101A_{df} A_{df}$      $0P_n P_n P'_n P'_n$   
or

$101A_{df} A_{df}$      $P_n P_n h_n h_n h_n$   
61616

62626

#### PART B

SECTION 1     $M_i M_i M_j M_j$      $YYGG8$      $99L_a L_a L_a$      $Q_c L_o L_o L_o$      $MMM U_{L_a} U_{L_o}$

SECTION 5     $n_o n_o P_o P_o P_o$      $T_o T_o T_{a0} D_o D_o$

$n_1 n_1 P_1 P_1 P_1$      $T_1 T_1 T_{a1} D_1 D_1$

$n_n n_n P_n P_n P_n$      $T_n T_n T_{an} D_n D_n$

SECTION 6    21212     $n_o n_o P_o P_o P_o$      $d_o d_o f_o f_o f_o$

$n_1 n_1 P_1 P_1 P_1 \quad d_1 d_1 f_1 f_1 f_1$   
 $n_n n_n P_n P_n P_n \quad d_n d_n f_n f_n f_n$   
 SECTION 7    31313     $s_r r_a s_a s_a \quad 8GGgg$   
 SECTION 9    51515     $101A_{df} A_{df} \quad \text{or}$   
 $101A_{df} A_{df} \quad 0P_n P_n P'_n P'_n \quad \text{or}$   
 $101A_{df} A_{df} \quad P_n P_n h_n h_n h_n$   
 SECTION 10    61616  
                   62626

**PART ALPHA (A)**

**IDENTIFICATION LETTERS:  $M_j M_j$**

Identifier:  $M_j M_j$  - Identifier for Part A of the report.

**DATE/TIME GROUP:  $YYGGI_d$**

Identifier: **YY** - Date group

Identifier: **GG** - Time group

Identifier: **I<sub>d</sub>** - The highest mandatory level for which wind is available.

**LATTITUDE:  $99L_a L_a L_a$**

Identifier: **99** – Indicator for data on position follows.

Identifier:  $L_a L_a L_a$  – Latitude in tenths of degrees

**LONGITUDE:  $Q_c L_o L_o L_o$**

Identifier: **Q<sub>c</sub>** – The octant of the globe.

Identifier:  $L_o L_o L_o$  – Longitude in tenths of degrees

**MARSDEN SQUARE:  $MMMU_{ia} U_{io}$**

Identifier: **MMM** - Marsden square.

Identifier:  $U_{ia} U_{io}$  – Units digits in the reported latitude and longitude.

**SEA LEVEL PRESSURE:  $99P_0 P_0 P_0 \quad T_0 T_0 T_0 D_0 D_0 \quad d_0 d_0 f_0 f_0$**

Identifier: **99** – Indicator for data at the surface level follows

Identifier:  $P_0 P_0 P_0$  – Indicator for pressure of specified levels in whole millibars (thousands digit omitted)

Identifier:  $T_0 T_0 T_0$  – Tens and digits of air temperature (not rounded off) in degrees Celsius, at specified levels beginning with surface.

Identifier:  $D_0 D_0$  – Dewpoint depression at standard isobaric surfaces beginning with surface level.

**NOTE**

When the depression is 4.9C or less encode the units and tenths digits of the depression. Encode depressions of 5.0 through 5.4C as 50. Encode depressions of 5.5C through 5.9C as 56. Dew point

depressions of 6.0 and above are encoded in tens and units with 50 added. Dew point depressions for relative humidities less than 20% are encoded as 80. When air temperature is below -40C report  $D_n D_n$  as //.

Identifier:  $d_o d_o$  – 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.

Identifier:  $f_o f_o$  – Wind speed in knots. Hundreds digit is sum of speed and unit digit of direction, i.e. 295° at 125 knots encoded as 29625.

NOTE: 1. When flight level is just above a standard surface and in the operator's best meteorological judgment, 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 /////.

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

#### STANDARD ISOBARIC SURFACES : $P_1 P_1 h_1 h_1 h_1 T_1 T_1 T_1 D_1 D_1 d_1 d_1 f_1 f_1$

Identifier:  $P_1 P_1$  – Pressure of standard isobaric surfaces in units of tens of millibars.

(1000 mbs = 00, 925mbs = 92, 850mbs = 85, 700mbs = 70, 500mbs = 50, 400mbs = 40, 300mbs = 30, 250mbs = 25).

Identifier:  $h_1 h_1 h_1$  – Heights of the standard pressure level in geopotential meters or decameters above the surface. Encoded in decameters at and above 500mbs omitting, if necessary, the thousands or tens of thousands digits. Add 500 to hhh for negative 1000mb or 925mb heights. Report 1000mb group as 00// ///// ///// when pressure is less than 950mbs.

Identifier:  $T_1 T_1 T_1 D_1 D_1$  – Same temperature/dew point encoding procedures apply to all levels.

Identifier :  $d_1 d_1 f_1 f_1$  – Same wind encoding procedures apply to all levels.

#### DATA FOR TROPOPAUSE LEVELS: 88 $P_t P_t P_t T_t T_t T_t D_t D_t d_t d_t f_t f_t$

Identifier: 88 – Indicator for Tropopause level follows

Identifier:  $P_t P_t P_t$  – Pressure at the tropopause level reported in whole millibars. Report 88 $P_n P_n P_n$  as 88999 when tropopause is not observed.

Identifier:  $T_t T_t T_t D_t D_t$  – Same temperature/ dew point encoding procedures apply.

Identifier:  $d_t d_t f_t f_t$  – Same wind encoding procedures apply.

#### MAXIMUM WIND DATA: 77 $P_n P_n P_n d_n d_n f_n f_n 4v_b v_b v_a v_a$

Identifier: 77 – Indicator that data for maximum wind level and for vertical wind shear follow when max wind does not coincide at flight. If the maximum wind level coincides with flight level encode as 66

Identifier:  $P_n P_n P_n$  – Pressure at maximum wind level in whole millibars.

Identifier:  $d_n d_n f_n f_n$  - Same wind encoding procedures apply.

#### VERTICAL WIND SHEAR DATA: 4 $v_b v_b v_a v_a$

Identifier: 4 – Data for vertical wind shear follow.

Identifier:  $v_b v_b$  – Absolute value of vector difference between max wind and wind 3000 feet BELOW the level of max wind, reported to the nearest knot. Use “//” if missing and a 4 is reported. A vector difference of 99 knots or more is reported with the code figure “99”.

Identifier:  $v_a v_a$  – Absolute value of vector difference between max wind and wind 3000 feet above the level of max wind, reported to the nearest knot. Use “/” if missing and a 4 is reported. A vector difference of 99 knots or more is reported with the code figure “99”.

### **SOUNDING SYSTEM INDICATION, RADIOSONDE/ SYSTEM STATUS, LAUNCH TIME:**

**31313**  $s_r r_a r_a s_a s_a$  **8GGgg**

Identifier:  $s_r r_a r_a s_a s_a$  - Sounding system indicator, radiosonde/ system status:  $s_a r_a r_a s_a s_a$

Identifier:  $s_a$  - Solar and infrared radiation correction ( **0** – no correction)

Identifier:  $r_a r_a$  – Radiosonde/sounding system used ( **96** – Descending radiosonde)

Identifier:  $s_a s_a$  – Tracking technique/status of system used ( **08** – Automatic satellite navigation)

Identifier: **8GGgg** – Launch time

Identifier: **8** – Indicator group

Identifier: **GG** – Time in hours

Identifier: **gg** – Time in minutes

### **ADDITIONAL DATA GROUPS: 51515 101XX 0P<sub>n</sub>P<sub>n</sub>P<sub>n</sub>P<sub>n</sub>**

Identifier: **51515** – Additional data in regional code follow

Identifier: **10166** – Geopotential data are doubtful between the following levels 0P<sub>n</sub>P<sub>n</sub>P<sub>n</sub>P<sub>n</sub>. This code figure is used only when geopotential data are doubtful from one level to another.

Identifier: **10167** – Temperature data are doubtful between the following levels 0P<sub>n</sub>P<sub>n</sub>P<sub>n</sub>P<sub>n</sub>. This code figure shall be reported when only the 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.

Identifier: **10190** – Extrapolated altitude data follows:

When the sounding begins within 25mbs below a standard surface, the height of the surface is reported in the format **10190 P<sub>n</sub>P<sub>n</sub>h<sub>n</sub>h<sub>n</sub>h<sub>n</sub>**. 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 A and B as 1019030966.

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 also at the end of Part A and Part B of the code in the format as **10190 P<sub>n</sub>P<sub>n</sub>h<sub>n</sub>h<sub>n</sub>h<sub>n</sub>**.

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.

Identifier: **10191** – Extrapolated surface pressure precedes. Extrapolated surface pressure is only reported when the termination occurs between 850mbs and the surface. Surface pressure is reported in Part A as 99P<sub>0</sub>P<sub>0</sub>P<sub>0</sub> //// and in Part B as 00P<sub>0</sub>P<sub>0</sub>P<sub>0</sub> ////. When surface pressure is extrapolated the 10191 group is the last additional data group reported in Part B.

### **AIRCRAFT AND MISSION IDENTIFICATION: 61616 AFXXX XXXXX XXXXX OB X**

Identifier: **61616** – Aircraft and mission identification data follows.

Identifier: **AFXXX** – The identifier AF for U.S. Air Force and the last three digits of the aircraft’s tail number.

Identifier: **XXXXX XXXXX** – The identifier for the type of mission being flown.

If a training mission the mission identifier is **WXWXA TRAIN**. The fifth letter “A” is the only character that could possibly change. The “A” defining that the flight originated in the Atlantic basin. The letter “C” identifies the Central Pacific area and the letter “E” identifies the Eastern Pacific.

If an operational storm mission: the first two numbers Identifier the number of times an aircraft has flown this system and the second two numbers Identifier the system number. The last character

again identifies the basin flown. The name of the storm would replace TRAIN.  
EXAMPLE: AF968 0204A MARIE – Aircraft number 50968, this was the second flight into this system and the system was the fourth of the season. The system reached tropical storm strength and was named MARIE.

Identifier: **OB 14** – The observation (both vertical and horizontal) number as transmitted from the aircraft.

#### **NATIONALLY DEVELOPED CODES: 62626**

Identifier: **62626** – This is the remarks section. Only the remarks EYE, EYEWALL XXX, MXWNBND XXX, or RAINBAND will be used. If the remarks EYEWALL is used it will be followed by the radian from the eye center to the sonde. Example: If the sonde is released in the NE quad of the storm, the value codes is 045.

Identifier: **REL XXXXNXXXXXW hhmss** – Release location of the sonde and the release time.

Identifier: **SPG XXXXNXXXXXW hhmss** - Impact location of the sonde based on its last GPS position and the splash time.

Identifier: **SPL XXXXNXXXXXW hhm** - Impact location of the sonde based on its last GPS position and the splash time. (SPL has less precision than SPG and may be removed in the next version of the NHOP).

Identifier: **LAST WND XXX** - Height of the last reported wind. If a surface wind is reported the Last Wind remark is omitted. XXX will never be less than 13 meters

Identifier: **MBL WND dddff** - The mean boundary level wind. The mean wind in the lowest 500 meters of the sounding

Identifier: **AEV XXXXX** - This is the software version being used for the sounding.

Identifier: **DLM WND dddff bbbttt** - The Deep Layer Mean wind. It is the average wind over the depth of the sounding. Where dddff is the wind averaged from the first to the last available wind (these would correspond to the first and last significant levels for wind); ttt is the pressure at the top of the layer, and bbb is the pressure at the bottom of the layer (in whole mbs, with thousands digit omitted).

Identifier: **WL150 dddff zzz** - Average wind over the lowest available 150 m of the wind sounding. Where dddff is the mean wind over the 150 m layer centered at zzz m.

#### **PART ALPHA (B)**

#### **DATA FOR SIGNIFICANT TEMPERATURE AND RELATIVE HUMIDITY LEVELS SIGNIFICANT ISOBARIC LEVELS:**

**n<sub>0</sub>n<sub>0</sub>P<sub>0</sub>P<sub>0</sub>P<sub>0</sub> T<sub>0</sub>T<sub>0</sub>T<sub>0</sub>D<sub>0</sub>D<sub>0</sub>**

#### **IDENTIFICATION LETTERS: M<sub>J</sub>M<sub>J</sub>**

Identifier: **M<sub>J</sub>M<sub>J</sub>** - Identifier for Part B of the report.

#### **DATE/TIME GROUP: YYGG8**

Identifier: **YY** - Date group

Identifier: **GG** - Time group

Identifier: **8** - Indicator for the use of satellite navigation for windfinding.

**LATTITUDE: 99L<sub>a</sub>L<sub>a</sub>L<sub>a</sub>** (Same as Part A)

**LONGITUDE: QcL<sub>0</sub>L<sub>0</sub>L<sub>0</sub>L<sub>0</sub>** (Same as Part A)

**MARSDEN SQUARE: MMMU<sub>1a</sub>U<sub>1o</sub>** (Same as Part A)

**SEA LEVEL PRESSURE: n<sub>0</sub>n<sub>0</sub>P<sub>0</sub>P<sub>0</sub>P<sub>0</sub> T<sub>0</sub>T<sub>0</sub>T<sub>0</sub>D<sub>0</sub>D<sub>0</sub>**

Identifier: **nono** – Indicator for number of level starting with surface level. Only surface will be numbered as “00”.

Identifier: **P<sub>0</sub>P<sub>0</sub>P<sub>0</sub>** – Indicator for pressure of specified levels in whole millibars (thousands digit omitted)

Identifier: **T<sub>0</sub>T<sub>0</sub>T<sub>0</sub>** – Tens and digits of air temperature (not rounded off) in degrees Celsius, at specified levels beginning with surface.

Identifier: **D<sub>0</sub>D<sub>0</sub>** – Dewpoint depression at standard isobaric surfaces beginning with surface level. Encoded the

same as Part A.

**FOR STORM DROPS ONLY.** If SLP is less than 950mb encode the 1000mb group as 00/// //// // //. When the SLP is between 950mb and 999mb encode 1000mb as 00PoPoPo //// // (500 meters are added to height below surface).

**DATA FOR SIGNIFICANT WIND LEVELS: n<sub>0</sub>n<sub>0</sub>P<sub>0</sub>P<sub>0</sub>P<sub>0</sub> d<sub>0</sub>d<sub>0</sub>f<sub>0</sub>f<sub>0</sub>**

Identifier: **n<sub>0</sub>n<sub>0</sub>** – Number of level starting with surface level. Only surface will be numbered as “00”.

Identifier: **P<sub>0</sub>P<sub>0</sub>P<sub>0</sub>** – Pressure at specified levels in whole millibars.

Identifier: **d<sub>0</sub>d<sub>0</sub>** – 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.

Identifier: **f<sub>0</sub>f<sub>0</sub>f<sub>0</sub>** – Wind speed in knots. Hundreds digit is sum of speed and unit digit of direction, i.e. 295° at 125 knots encoded as 29625.

Same notes in Part A apply.

**31313, 51515, 61616, 62626** – Repeated from Part A.

**FIGURE G-3. EXAMPLE TEMP DROP MESSAGE FOR TROPICAL CYCLONES**

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```
UZNT13 KNHC 080839
XXAA 58088 99192 70803 04590 99964 21676 20581 00814 //// //
92359 20476 22611 85085 18876 24614 88999 77999
31313 09608 80747
51515 10190 70752
61616 AF302 0617A PALOMA OB 16
62626 EYEWALL 225 SPL 1925N08021W 0750 MBL WND 22112 AEV 20800 DL
M WND 23107 964833 WL150 21611 079 REL 1920N08030W 074700 SPG 192
6N08021W 075012 =
XXBB 58088 99192 70803 04590 00964 21676 11850 18876 22811 18476
33760 19677 44739 21077 55719 23261 66701 11430
21212 00964 20581 11963 20585 22960 20604 33958 21120 44955 21626
55949 22107 66939 22621 77933 22614 88917 22611 99900 23099 11874
23604 22867 24098 33864 24100 44859 24117 55850 24614 66701 26123
31313 09608 80747
51515 10190 70752
61616 AF302 0617A PALOMA OB 16
62626 EYEWALL 225 SPL 1925N08021W 0750 MBL WND 22112 AEV 20800 DL
M WND 23107 964833 WL150 21611 079 REL 1920N08030W 074700 SPG 192
6N08021W 075012 =
```

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## **APPENDIX H**

### **WSR-88D OPERATIONS PLAN FOR TROPICAL CYCLONE EVENTS**

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 NWS Weather Forecast Office, Melbourne, and the NEXRAD Radar Operations Center (ROC), has developed an operations plan for use during tropical cyclone events.

The latest addition can be found on the OFCM web site at:

**<http://www.ofcm.gov/homepage/text/pubs.htm>**



## APPENDIX I

### TELEPHONE LISTING

AGENCY	LOCATION	TELEPHONE
<b>Department of Commerce</b>		
Alternate NHC (NCEP, HPC)	Camp Springs, MD	COM 301-763-8201
AOC	Tampa Bay, FL	COM 813-828-3310
CPHC Forecaster and Warning Desk Admin Director Operations Satellite Coordinator	Honolulu, HI	COM 808-973-5284 COM 808-973-5270 COM 808-973-5272 FAX 808-973-5281 COM 808-973-5285
WFO Guam	Tiyan, Guam	COM 671-472-0950/1/2
NDBC - Operations Branch	Stennis Space Center, MS	COM 228-688-7720
NESDIS Satellite Analysis Branch	Camp Springs, MD	COM 301-763-8444
NHC	Miami, FL	COM 305-229-4415
TAFB Lead Forecaster (TPC/NHC)	Miami, FL	COM 305-229-4425
Hydrometeorological Prediction Center (HPC)	Camp Springs, MD	COM 301-763-8201
NCEP Senior Duty Met (Data QC)	Camp Springs, MD	COM 301-763-8298
NWS Hydrometeorological Services Core (Headquarters)	Silver Spring, MD	COM 301-713-1858, ext. 108 FAX 301-713-1520
<b>Interdepartmental</b>		
OFCM	Silver Spring, MD	COM 301-427-2002 DSN 851-1460
<b>Department of Defense</b>		
AFWA	Offutt AFB, NE	COM 402-294-7264 DSN 271-7264
CARCAH OLA, 53d WRS	Miami, FL	COM 305-229-4474 DSN 434-3420
FACSFAC VACAPES OAC	Oceana, VA	COM 804-433-1233 DSN 433-1233
FACSFAC Roosevelt Roads	Roosevelt Roads, PR	COM 787-865-7007 DSN 831-7007/5202/5203
17 OWS/WXJ (Satellite Analyst)	Pearl Harbor, HI	COM 787-865-7007 DSN 471-3533
325 OSS/OSW (SE Air Defense Sector/WE)	Tyndall AFB, FL	COM 904-283-2845 DSN 523-2845
Keesler AFB Command Post	Keesler AFB, MS	COM 228-377-4330 DSN 597-4330
NAVLANTMETOCEN	Norfolk, VA	COM 757-444-7583/7750 DSN 564-7583/7750
JTWC (Typhoon Duty Officer)	Pearl Harbor, HI	COM 808-474-2320
Fleet Numerical Meteorology & Oceanography Center (FNMOC) (Alternate JTWC)	Monterey, CA	COM 831-656-4325 DSN 878-4325
53 WRS/DO	Keesler AFB, MS	COM 228-377-2409 DSN 597-2409
53 WRS (Office)	Keesler AFB, MS	COM 228-377-3207 DSN 597-3207
53 WRS (Alternate CARCAH)	Keesler AFB, MS	COM 228-377-9060 DSN 597-9060

**Department of Transportation/Federal Aviation Administration**

ARTCC PHONE DIRECTORY				
	ARTCC ID	TMU	ADMINISTRATION	WATCH DESK OPERATIONS MANAGER
ANCHORAGE	ZAN	907-269-1108	907-269-1137	907-269-1103
ALBUQUERQUE	ZAB	505-856-4547	505-856-4601	505-856-4500
CHICAGO	ZAU	630-906-8445	630-906-8221	630-906-8341
BOSTON	ZBW	603-879-6666	603-879-6633	603-879-6655
WASHINGTON	ZDC	703-771-3471	703-771-3440/1	703-771-3470
DENVER	ZDV	303-651-4540	303-651-4101	303-651-4248
FT. WORTH	ZFW	817-858-7520	817-858-7500	817-858-7503
HOUSTON	ZHU	281-230-5530	281-230-5600	281-230-5560
INDIANAPOLIS	ZID	317-247-2267	317-247-2231	317-247-2242
JACKSONVILLE	ZJX	904-549-1570	904-549-1501	904-549-1537
KANSAS CITY	ZKC	913-254-8502	913-254-8403	913-791-8500
LOS ANGELES	ZLA	661-265-8250	661-265-8215	661-265-8205
SALT LAKE CITY	ZLC	801-320-2580	801-320-2501	801-320-2560
MIAMI	ZMA	305-716-1736	305-716-1500	305-716-1588
MEMPHIS	ZME	901-368-8250	901-368-8103	901-368-8234
MINNEAPOLIS	ZMP	651-463-5517	651-463-5510	651-463-5580
NEW YORK	ZNY	631-468-1010	631-468-1001	631-468-5959
OAKLAND	ZOA	510-745-3812	510-745-3000	510-745-3331
CLEVELAND	ZOB	440-774-0319	440-774-0320	440-774-0426
SEATTLE	ZSE	253-351-3525	253-351-3500	253-351-3520
ATLANTA	ZTL	770-210-7697	770-210-7600/3	770-210-7622
HONOLULU	HNL	N/A	808-840-6100	808-840-6201
SAN JUAN	SJU		787-253-8707	787-253-8664/5
TORONTO	YYZ		905-676-4590/1/2	Note: TMO - Traffic Management Officer Area Manager - Watch Supervisor ARTCC - Air Route Traffic Control Center Canadian ACC - Area Control Centre
MONTREAL	YUL		514-633-3211	
MONCTON	YOM		506-867-7176	
WINNIPEG	YWG		204-983-8337	
EDMONTON	YEG		780-890-8304/5	
GANDER	YQX		709-651-5225	
VANCOUVER	YVR		604-775-9601/6	

<b>Department of Transportation/Federal Aviation Administration (continued)</b>	
Air Traffic Tactical Operations (ATT-100)	COM 703-904-4403
Air Traffic Management Service	COM 703-904-4401
Air Traffic Control System Command Center (ATT 2)	800-333-4286
Central Altitude Reservation Function (CARF)	COM 703-904-4427 DSN 725-3331/725-3333
National NOTAM Office	COM 703-904-4557
ATCSCC National Operations Manager (NOM)	COM 703-904-4525/703-904-4953 800-333-4286 MILITARY USE ONLY
<b>Canadian OFCF (ARU)</b>	
Admin Hours	COM 613-998-6583
Teleconference	COM 613-954-7425 COM 613-957-6390
ARU Ops (24 Hours) (ATCSCC of Canada)	COM 613-957-6343 COM 613-992-9740 COM 613-992-7940 COM 613-992-9751
ARU Fax	COM 613-957-6412
<b>Center Weather Service Units (CWSU) in FAA Coastal Facilities</b>	
Boston ARTCC	COM 603-879-6698
New York ARTCC	COM 631-468-1083
Washington ARTCC	COM 703-771-3480
Jacksonville ARTCC	COM 904-549-1839
Miami ARTCC	COM 305-716-1635
Houston ARTCC	COM 281-230-5676
Los Angeles ARTCC	COM 661-265-8258
Oakland ARTCC	COM 510-745-3457
Seattle ARTCC	COM 253-351-3741
Anchorage ARTCC	COM 907-269-1145



## APPENDIX J

### GEOGRAPHICAL DEFINING POINTS AND PHONETIC PRONUNCIATIONS

Abaco	AB-a-KO	Escondido	es-cond-dee-dow
Abreojos	aahbray-oh-hoes	Eugenia	ayuh-hen-yuh
Amalie	a-MAHL-ye	Exuma	ek-SOO-ma
Angel	aan-hel		
Anguilla	ang-GWIL-a	Flores	FLO-rish
Antigua	an-TEE-ga	Fort de France	for-de-FRAHCS
Arena	aah-ray-nah		
Arista	ah-ree-staa	Galera	gaa-lehra
Aruba	ah-ROO-ba	Grenada	gre-NAY-dah
Antilles	an-TILL-leez	Guadaloupe	GWAH-deh-loop
Azores	uh-ZOHRZ	Guasave	gwaa-saa-ve
		Guaymas	gwhy-maahs
Bahia	ba-e-yuh		
Ballenas	ba-yaynas	Huatulco	whaa-tool-coe
Barahona	ba-ra-HO-na		
Barbados	bar-BAY-dohz	Islas	eeslas
Barbuda	bar-BOO-dah		
Barra	baa-rra	Jalisco	ha-lee-sco
Barranquilla	Bahr-rahn-KEE-yah	Juanico	whaa-nee-coe
Basse-Terre	baha-TER		
Bimini	BIM-I-ni	Lazaro	laasa-roe
Bonaire	ba-NAIR	Loreto	lo-ae-toe
Burros	bhoorroes	Leeward	LEE-werd
Cap	Haitien kahp ah-ee-SYAN	Manzanillo	manza-nee-oh
Caracas	kah-RAH-kahs	Maracaibo	mar-a-KYE-boh
Cardenas	car-denaass	Maracay	mah-rah-KYE
Caribbean	kar-a-BE-an	Marigot	ma-ree-GOH
Castries	KAS-tree	Mateo	muh-ta-yo
Cayman	kay-MAHN	Mayaguez	may-yah-GWAYS
Champerico	chaam-per-e-coe	Medano	may-daa-no
Charlotte		Melaque	may-laa-kay
Colima	coleema	Merida	MAY-re-thah
Corrientes	cor-re-ehn-tays	Mochis	mo-chees
Cozumel	koh-soo-MEL	Montego	mon-TEE-go
Curacao	koor-a-SOH	Montserrat	mont-se-RAT
Cuyutlan	coo-yootlaan	Mugu	muhgu
		Mulege	moo-lay-hay
Dominica	dom-I-NEE-ka		
Eleuthera	el-OO-thera	Nicaragua	nik-a-RAH-gwah

Ocho Rios	OH-cho REE-os	Tampico	tam-PEE-ko
Oranjestad	o-RAHN-yuh-stat	Tehuantepec	te-whaan-te-pec
		Tela	TAY-lah
Paramaribo	par-a-MAR-I-boh	Tobago	to-BAY-go
Parguera	par-GWER-a	Todos	todohs
Penasco	pen-yaas-co	Tomas	tow-maas
Pointe-a-Pitre	pwan-ta-PEE-tr	Tonala	ton-aahla
Ponce	PON-sa	Tosca	toesca
Port-au-Prince	port-oh-PRINS		
Punta	poonta	Vallarta	vah-yar-ta
Revillagigedo	ray-veeaheehaydo	Yavaros	yaa-vaa-roce
		Yucatan	yoo-ka-TAN
Saba	SAH-ba		
Sao Miguel	soun ME-gel	Zihuatanejo	zeeh-whaa-tanay-
Sipacate	see-paa-caa-tay	ho	
St Croix	ST croy		
St Lucia	ST LOO-she-a		
Soufriere	soo-free-AR		
Surinam	SOOR-I-nam		

## APPENDIX K

### ACRONYMS/ABBREVIATIONS

#### -A-

AB	Data type header for Tropical Weather Outlook
AFB	Air Force Base
AFRC	Air Force Reserve Command
AFSATCOM	Air Force Satellite Communications System
AFWA	Air Force Weather Agency
AIM	Airman's Information Manual
AMOS	Automated Meteorological Observing Station
AMSU	Advanced Microwave Sounding Unit
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
ATCT	Air Traffic Control Tower (FAA)
AVAPS	Advanced Vertical Atmospheric Profiling System
AVHRR	Advanced Very High Resolution Radiometer
AWIPS	Advanced Weather Interactive Processing System

#### -C-

CARCAH	Chief, Aerial Reconnaissance Coordination, All Hurricanes
CARF	Central Altitude Reservation Function
CERAP	Center En Route Approach (FAA)
CFW	Coastal Flood Watch/Warning
C.I.	Current Intensity
C-MAN	Coastal-Marine Automated Network
CMC	Crisis Management Center (FAA)
CNMI	Commonwealth of the Northern Mariana Islands
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
FEA	Flow Evaluation Area (FAA)
FL	flight level
FLT LVL	flight level
FMH	Federal Meteorological Handbook
FNMOC	Fleet Numerical Meteorology and Oceanography Center (USN)
FSM	Federated States of Micronesia
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
HLS	Hurricane Local Statement
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
IOM	International Operations Manager (FAA)
IR	Infrared
IWRS	Improved Weather Reconnaissance System

**-J-**

JTWC	Joint Typhoon Warning Center
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**-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  
MIA Minimum IFR Altitude  
min/MIN minute  
MHS Microwave Humidity Sounder  
MOU Memorandum of Understanding  
mph mile/miles per hour  
MTSAT-1R Japanese Geostationary Satellite  
MVMT movement

**-N-**

NAPUP Non-associated Principal User Processor (WSR-88D)  
NASA National Aeronautics and Space Administration  
NAVLANTMETOCCEN Naval Atlantic Meteorology and Oceanography Center  
NAVLANTMETOCDDET Naval Atlantic Meteorology and Oceanography Detachment  
NAVLANTMETOFCFAC Naval Atlantic Meteorology and Oceanography Facility  
NAVMETOCCOM Naval Meteorology and Oceanography Command  
NAVOCEANO Naval Oceanographic Office  
NAVPACMETOCCEN Naval Pacific Meteorology and Oceanography Center  
NAVTRAMETOFCFAC 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)  
NOTAM Notice to Airmen  
NRL Naval Research Laboratory  
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
OPC	Ocean Prediction Center (NCEP)
OSDPD	Office of Satellite Data Processing and Distribution (NESDIS)
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
PHFO	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
ROC	Radar Operations Center
RPS	routine product set (WSR-88D)
RSMC	Regional/Specialized Meteorological Center (WMO)

**-S-**

SAB	Satellite Analysis Branch
SFC	surface
SFDF	Satellite Field Distribution Facility
SLP	Sea Level Pressure
SPC	Storm Prediction Center (NCEP)
SSM/I	Special Sensor Microwave Imager (DMSP)
SSM/IS	Special Sensor Microwave Imager Sounder
SSM/T	Special Sensor Microwave Temperature Sounder
SST	Sea Surface Temperature
STMC	Supervisory Traffic Management Coordinator (FAA)
SVD	Supplementary Vortex Data

**-T-**

TAFB	Tropical Analysis Forecast Branch (TPC)
TCA	Aviation Tropical Cyclone Advisory
TCD	Tropical Cyclone Discussion
TCE	Tropical Cyclone Position Estimate
TCP	Tropical Cyclone Public Advisory

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
TRMM	Tropical Rainfall Measurement Mission
TPC	Tropical Prediction Center
TS	Thermal Smooth
TWO	Tropical Weather Outlook

-U-

UAS	Unmanned Aerial Systems
UAV	Unmanned Aerial Vehicle
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
VIIRS	Visible Infrared Imaging Radiometer
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
WFO	Weather Forecast Office
WMO	World Meteorological Organization
WND	wind
WO	Data type header for special tropical disturbance statements

WPMDS	Weather Product Management and Distribution System (Offutt AFB)
WRS	Weather Reconnaissance Squadron
WS	Weather Squadron
WSD	Wind Speed and Direction (data buoy)
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
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**-Z-**

Z	Zulu (UTC)
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## APPENDIX L

### 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 nation'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 airspace 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-**

**Extratropical cyclone.** A synoptic scale low pressure system whose primary energy source is baroclinic.

**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/Typhoon/Tropical Cyclone Season.** The portion of the year having a relatively high incidence of hurricanes/typhoons/tropical cyclones. The seasons for the specific areas are as follows (Note: tropical cyclones can occur during any month of the year in the Western Pacific.):

- |  |                       |
|--|-----------------------|
| • Atlantic, Caribbean,<br>and the Gulf of Mexico | June 1 to November 30 |
| • Eastern Pacific                                | May 15 to November 30 |
| • Central Pacific                                | June 1 to November 30 |
| • Western Pacific                                | July 1 to December 31 |

**Hurricane Warning Offices.** The designated hurricane warning offices follow:

- Tropical Prediction Center/National Hurricane Center, Miami, Florida
- Central Pacific Hurricane Center, Honolulu, Hawaii

**Hurricane/Typhoon Warning.** An announcement that sustained winds of 64 knots (74 mph or 119 km/hr) or higher are expected within the specified coastal area. TPC/NHC issues warnings when conditions along the coast are expected within 24 hours. CPHC and WFO Guam issue warnings when conditions are expected along the coast within 36 hours.

**Hurricane/Typhoon Watch.** An announcement that sustained winds of 64 knots (74 mph or 119 km/hr) or higher are possible within the specified coastal area. TPC/NHC issues watches when conditions along the coast are possible within 36 hours. CPHC and WFO Guam issue watches when conditions are possible along the coast within 48 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.

**Maximum 1-Min Sustained Surface Wind.** When applied to a particular weather system, refers to the highest 1-minute average wind (at an elevation on 10 meters with an unobstructed exposure) associated with that weather system at a particular point in time.

**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 non-frontal low pressure system that has characteristics of both tropical and extratropical cyclones. This system is typically an upper-level cold low with circulation extending to the surface layer and maximum sustained winds generally occurring at a radius of about 100 miles or more from the center. In comparison to tropical cyclones, such systems have a relatively broad zone of maximum winds that is located farther from the center, and typically have a less symmetric wind field and distribution of convection.

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

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

**Super Typhoon.** A "super" typhoon is one that is classified as having winds of 130 knots (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, non-frontal synoptic-scale cyclone, originating over tropical or subtropical waters, with organized deep convection and a closed surface wind circulation about a well-defined center.

**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.** An announcement that sustained winds of 34 to 63 knots (39 to 73 mph or 63 to 118 km/hr) are expected within the specified coastal area. TPC/NHC issues warnings when conditions along the coast are expected within 24 hours. CPHC and WFO Guam issue warnings when conditions are expected along the coast within 36 hours.

**Tropical Storm Watch.** An announcement that sustained winds of 34 to 63 knots (39 to 73 mph or 63 to 118 km/hr) are possible within the specified coastal area. TPC/NHC issues watches when conditions along the coast are possible within 36 hours. CPHC and WFO Guam issue watches when conditions are possible along the coast within 48 hours.

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

**Tropical Weather System.** A designation for one of a series of tropical weather anomalies. As such, it is the basic generic designation, which in successive stages of intensification, may be classified as a tropical disturbance, wave, depression, storm, or hurricane.

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

-U-

**Uncontrolled Airspace (Class G Airspace).** That portion of the airspace that has not been designated as Class A, Class B, Class C, Class D, or Class E and within which Air Traffic Control has neither the authority nor the responsibility for exercising control over air traffic.

-V-

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

-W-

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



## APPENDIX M

### 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, 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
Chief, Hydrologic Services Division (W/OS3)	1
Director, Office of Meteorology (W/OM)	1
Chief, International Activities Division (W/IA)	1
Chief, Marine and Coastal Weather Services (W/OS21)	10
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/DDGO-ROD 2

UNIFIED/SPECIFIED COMMANDS

USCENTCOM/CCJ3-OW 1  
USCINCPAC/J316 (ENV.GP) 1  
USCINCSO/SCJ3-SWO 1  
USEUCOM/EPOC-CCPD  
USJFCOM 1  
USSOCOM/SCSO-OC-M 1  
USSOUTHCOM/SCJ322 1  
USTRANSCOM/TCJ3 1

DEPARTMENT OF THE AIR FORCE

HQ USAF/A3O-W 3  
HQ ACC/DOW 34  
HQ AFMC/DOW 2  
HQ AFSPC/XOSW 5  
HQ AFSOC/DOW 1  
HQ AMC/A3W 10  
HQ AOC/XPPD 1  
HQ AETC/TTO 2  
HQ AETC/DOYW 10  
HQ AU/WE 1  
HQ AFWA/XO 6  
HQ PACAF/DOW 6  
HQ USAFE/DOW 2  
AFRL/VSB (AFMC) 1  
AFCCC (AFWA) 1  
AFCWC (AFWA) 1  
ANG/XOOSW 1  
MSD/AOW (AETC) 1  
OO-ALC/LHW 2  
3 WS/CC 1  
17 OWS/CC 1  
18 WS/CC 1  
25 OWS/CC 2  
26 OWS/CC 2  
28 OWS/CC 2  
36 OSS/OSW (PACAF) 1

45 WS/CC	3
45 SPW/XP and SE	4
46 WS/CC	2
88 WS/CC	1
78 OSS/OSW	1
325 OSS/OSW	1
335 TRS/UAO	2
607 WS/CC	1

AFRC

HQ USAF/REX	3
HQ AFRC/DOO	2
HQ AFRC/DOT/DOTA	2
HQ AFRC/DOVA	2
HQ 22AF/DOT/DOTA	2
403 WG/DO/XP	5
53 WRS/DOV	35
CARCAH (OL-A 53 WRS)	10

DEPARTMENT OF THE ARMY

HQ Department of the Army/DAMI- POB	2
Topographic Engineering Center	1
COE/CEWES-CD-P	1

DEPARTMENT OF THE NAVY

Commandant of the Marine Corps (DCS/Aviation)	12
Oceanographer of the Navy	2
NAVMETOCOM	5
Commanding Officer, NAVOCEANO (N2513)	1
Commanding Officer, NAVLANTMETOCEN	2
NAVPACMETOCEN/JTWC, Pearl Harbor, HI	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

DEPARTMENT OF TRANSPORTATION

## FEDERAL AVIATION ADMINISTRATION

Air Traffic System Requirements Service ARS-1	1
Air Traffic System Requirements Service/Weather ARW-1	1
Air Traffic Operations ATO-1	3
Air Traffic Operations ATO-110	1
Air Traffic Operations ATO-120	3
Air Traffic Resource Management Program ATX-100/ATX-400	2
Air Traffic Control System Command Center (ATCSCC) ATO-200	9
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
AMA-500, Oklahoma City, OK	1
AIA-100/AIA-200	3
AOP-4	1
APA-300	3
ARW-100/ARW-200	2
Houston AIFSS	3
Miami (QAS) AIFSS	2
New York AIFSS	1
San Juan AIFSS	2

## U.S. COAST GUARD

Commandant, USCG Headquarters (G-OPN-1)	2
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Commandant, USCG (G-OPF)	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, Seventh Coast Guard District	3
Commander, Eighth Coast Guard District	3
Commander, Ninth Coast Guard District	1
Commander, Eleventh Coast Guard District	1
Commander, Thirteenth Coast Guard District	1
Commander, Fourteenth Coast Guard District	2
Commander, Seventeenth Coast Guard District	1
Commanding Officer, USCG Air Station, Aquadilla, PR	1
Commanding Officer, USCG Air Station, Atlantic City, NJ	1
Commanding Officer, USCG Air Station, Cape Cod, MA	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, Houston, TX	1
Commanding Officer, USCG Air Station, Kapolei, HI	1
Commanding Officer, USCG Air Station, Kodiak, AK	1
Commanding Officer, USCG Air Station, Los Angeles, CA	1
Commanding Officer, USCG Air Station, McClellan AFB, CA	1
Commanding Officer, USCG Air Station, McKinleyville, CA	1
Commanding Officer, USCG Air Station, Mt. Clemens, MI	1
Commanding Officer, USCG Air Station, New Orleans, LA	1
Commanding Officer, USCG Air Station, North Bend, OR	1
Commanding Officer, USCG Air Station, Opa Locka, FL	1
Commanding Officer, USCG Air Station, Port Angeles, WA	1
Commanding Officer, USCG Air Station, San Diego, CA	1
Commanding Officer, USCG Air Station, San Francisco, CA	1
Commanding Officer, USCG Air Station, Savannah, GA	1
Commanding Officer, USCG Air Station, Sitka, AK	1
Commanding Officer, USCG Air Station, Traverse City, MI	1
Commanding Officer, USCG Air Station, Warrenton, OR	1
Commanding Officer, USCG Reserve Training Center	1

#### DEPARTMENT OF AGRICULTURE

World Agriculture Outlook Board	1
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#### 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

DEPARTMENT OF HOMELAND SECURITY/  
FEDERAL EMERGENCY MANAGEMENT AGENCY

FEMA, Mitigation Directorate 2

FEMA Region I 1

FEMA Region IV 2

FEMA Region IX 20

OTHER U.S.

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

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

Atmospheric Environment Service, Downsview, ON 1

Transport Canada, Monkton ACC 2

UNITED KINGDOM

Assistant Director, Head of Defense Services, Meteorological Office 1

MICRONESIA

Department of Homeland Security/Office of Civil Defense, Guam 2

Emergency Management Offices:

- Commonwealth of the Northern Mariana Islands (CNMI), Saipan 1
- Republic of Palau, Koror 1
- Republic of the Marshall Islands, Majuro 1
- Federated States of Micronesia (FSM), Pohnpei State, Colonia 1
- Federated States of Micronesia (FSM), Yap State, Colonia 1
- Federated States of Micronesia (FSM), Chuuk State, Weno Island 1
- Federated States of Micronesia (FSM), Kosrae State, Tofol 1

