CZM

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

OFCM

OFFICE OF THE FEDERAL COORDINATOR FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

National Hurricane Operations Plan

COASTAL ZONE
INFORMATION CENTER

FCM-P12-1989

ington, DC
1989

QC
851
.U485
1989

U.S. Dept of Commerce / NOAA / NWS

AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

THE FEDERAL COMMITTEE FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH (FCMSSR)

DR. WILLIAM E. EVANS, Chairman
Department of Commerce

MR. EWEN M. WILSON
Department of Agriculture

DR. GEORGE P. MILLBURN
Department of Defense

VACANT
Department of Energy

DR. WAYNE N. MARCHANT
Department of Interior

DR. LISLE A. ROSE
Department of State

MR. NEAL A. BLAKE
Department of Transportation

MR. DAVID TORNQUIST
Office of Management and Budget

MR. ROBERT H. MORRIS
Federal Emergency Management Agency

DR. LENNARD A. FISK
National Aeronautics and Space Administration

DR. ROBERT W. CORELL
National Science Foundation

MR. WILLIAM G. LAYNOR
National Transportion Safety Board

DR. DENWOOD F. ROSS
U.S. Nuclear Regulatory Commission

MR. H. MATTHEW BILLS
Environmental Protection Agency

MR. ROBERT L. CARNAHAN
Federal Coordinator for Meteorology

DR. JAMES A. ALMAZAN, Executive Secretary
Office of the Federal Coordinator for
Meteorological Services and Supporting Research

THE INTERDEPARTMENTAL COMMITTEE FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH (ICMSSR)

MR. ROBERT L. CARNAHAN, Chairman
Federal Coordinator

DR. NORTON D. STROMMEN
Department of Agriculture

DR. RONALD D. McPHERSON
Department of Commerce

COL TED S. CRESS, USAF
Department of Defense

DR. HARRY MOSES
Department of Energy

MR. LEWIS T. MOORE
Department of Interior

DR. LISLE A. ROSE
Department of State

MR. RICHARD J. HEUWINKEL
Federal Aviation Administration
Department of Transportation

MR. NEAL THAYER
U.S. Coast Guard
Department of Transportation

MR. FRANCIS A. SCHIERMEIER
Environmental Protection Agency

MR. ROBERT T. JASKE
Federal Emergency Management Agency

DR. SHELBY TILFORD
National Aeronautics and Space Administration

DR. RICHARD S. GREENFIELD
National Science Foundation

MR. JAMES C. McLEAN, JR
National Transportation Safety Board

MR. ROBERT A. KORNASIEWICZ
U.S. Nuclear Regulatory Commission

MR. DAVID TORNQUIST
Office of Management and Budget

DR. JAMES A. ALMAZAN, Executive Secretary
Office of the Federal Coordinator for
Meteorological Services and Supporting Research

FEDERAL COORDINATOR
FOR
METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH

11426 Rockville Pike, Suite 300
Rockville, Maryland 20852

NATIONAL HURRICANE OPERATIONS PLAN

QC851 .U485 1989
1787566
APR 10 1997

U.S. DEPARTMENT OF COMMERCE NOAA
COASTAL SERVICES CENTER
2234 SOUTH HOBSON AVENUE
CHARLESTON, SC 29405-2413

FCM-P12-1989
April 1989
Washington, D.C.

Property of CSC Library

CHANGE AND REVIEW LOG

Use this page to record changes and notices of reviews.

Change Number	Page Numbers	Date Posted	Initial
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Changes are indicated by a vertical line in the margin next to the change.

Review Date	Comments	Initial

FOREWORD

This publication is the 27th edition of the National Hurricane Operations Plan (NHOP). It reflects the procedures and agreements reached at the 43rd Interdepartmental Hurricane Conference (IHC), which was held at the U.S. Air Force Conference Center, Homestead Air Force Base, Florida, January 10-13, 1989. Details of the conference can be found in the minutes published by this office.

The conference is sponsored annually by the Working Group for Hurricanes and Winter Storms Operations, Committee for Basic Services of the Interdepartmental Committee for Meteorological Services and Supporting Research. It brings together the cognizant Federal agencies to reach agreement on items of mutual interest and concern related to hurricane forecasting and warning services. The host for the conference was Headquarters, Air Weather Service, Scott Air Force Base, Illinois.

The significant changes in content in this edition of the NHOP reflect the anticipated improvement in aerial reconnissance sensing of tropical cyclones resulting from the availability of the Improved Weather Reconnaissance System (IWRS). The first production article of the IRWS was installed on a 53rd Weather Reconnaissance Squadron aircraft 65-0966H in December, 1988. Additional systems are scheduled to be installed during 1989.

Robert L. Carnahan
Federal Coordinator for
Meteorological Services and
Supporting Reseach

NATIONAL HURRICANE OPERATIONS PLAN

TABLE OF CONTENTS

		Page
CHANGE AND REVIEW LOG		ii
FOREWORD		iii
TABLE OF CONTENTS		v
LIST OF FIGURES		viii
LIST OF TABLES		x
CHAPTER 1.	INTRODUCTION	
	1.1. General	1-1
	1.2. Scope	1-1
CHAPTER 2.	RESPONSIBILITIES OF COOPERATING FEDERAL AGENCIES	
	2.1. General	2-1
	2.2. DOC Responsibilities	2-1
	2.3. DOD Responsibilities	2-3
	2.4. DOT Responsibilities	2-4
	2.5. Annual Liaison with Other Nations	2-4
	2.6. Air Traffic Control/Flight Operations Coordination	2-4
CHAPTER 3.	GENERAL OPERATIONS AND PROCEDURES OF THE NATIONAL WEATHER SERVICE HURRICANE CENTERS	
	3.1. General	3-1
	3.2. Products	3-1
	3.3. Designation of Tropical and Subtropical Cyclones	3-5
	3.4. Transfer of Warning Responsibility	3-6
	3.5. Alternate Warning Responsibilities	3-11
	3.6. Abbreviated Communications Headings	3-11
CHAPTER 4.	NATIONAL WEATHER SERVICE PRODUCTS FOR THE DEPARTMENT OF DEFENSE	
	4.1. General	4-1
	4.2. Observations	4-1
	4.3. Marine Advisories	4-1

CHAPTER 5. AIRCRAFT RECONNAISSANCE
5.1. General 5-1
5.2. Responsibilities 5-1
5.3. Control of Aircraft 5-2
5.4. Reconnaissance Requirements 5-2
5.5. Reconnaissance Planning and Flight Notification 5-7
5.6. Reconnaissance Effectiveness Criteria ... 5-15
5.7. Aerial Reconnaissance Weather Encoding, Reporting, and Coordination 5-16
5.8. Operational Flight Patterns 5-19
5.9. Aircraft Reconnaissance Communications .. 5-24

CHAPTER 6. SATELLITE SURVEILLANCE OF TROPICAL AND SUBTROPICAL CYCLONES
6.1. Satellites 6-1
6.2. National Weather Service Support 6-1
6.3. NESDIS Synoptic Analyis Branch 6-4
6.4. AFGWC Support and the Defense Meteorological Satellite Program 6-5
6.5. Satellites and Satellite Data Availability for the Current Hurricane Season 6-5
6.6. Current Intensity and Tropical Classification Number 6-5

CHAPTER 7. SURFACE RADAR REPORTING
7.1. General 7-1
7.2. Procedures 7-1
7.3. Special Provisions 7-2

CHAPTER 8. NATIONAL DATA BUOY CENTER REPORTING STATIONS
8.1. General 8-1
8.2. Requests for Drifting Buoy Deployment ... 8-1
8.3. Communications 8-2

CHAPTER 9. MARINE WEATHER BROADCASTS
9.1. General 9-1
9.2. Broadcast Procedures 9-1

CHAPTER 10. PUBLICITY
10.1. News Media Releases 10-1
10.2. Distribution 10-1

APPENDIX A. ABBREVIATIONS A-1

APPENDIX B. GLOSSARY B-1

APPENDIX C. BIBLIOGRAPHY OF OFFICIAL INTERAGENCY AGREEMENTS C-1

APPENDIX D. DISTRIBUTION D-1

APPENDIX E. SAFFIR-SIMPSON HURRICANE SCALE E-1

APPENDIX F. PHONETIC PRONUNCIATION LISTING F-1

APPENDIX G. RECCO, MINOB, AND TEMP DROP CODES, TABLES, AND REGULATIONS G-1

APPENDIX H. TELEPHONE AND TELETYPE LISTING H-1

LIST OF FIGURES

Figure		Page
1-1.	Tropical cyclone forecast centers' areas of responsibility.	1-2
2-1.	Hurricane Gilbert, September 13, 1988, 2131 UTC.	2-6
4-1.	Marine advisory format.	4-3
4-2.	Hurricane Joan, October 22, 1988, 0601 UTC.	4-4
5-1.	Form 3--Vortex data message.	5-5
5-2.	Form 4--Supplementary vortex data message.	5-6
5-3.	Form 1--NHOP coordinated request for aircraft reconnaissance.	5-8
5-4.	USAF WC-130 weather reconnaissance aircraft equipped with the Improved Weather Reconnaissance System.	5-13
5-5.	Form 2--Tropical cyclone plan of the day format.	5-14
5-6.	Form 5--Mission evaluation form.	5-17
5-7.	Flight patterns ALPHA and modified ALPHA.	5-20
5-8.	Recommended pattern ALPHA execution.	5-21
5-9.	Flight pattern DELTA.	5-23
5-10.	Schematic of aircraft to satellite data link for NOAA P-3 aircraft.	5-26
5-11.	Schematic of aircraft to satellite data link for USAF WC-130 aircraft.	5-29
6-1.	GOES central data distribution system.	6-4
6-2.	Sample satellite tropical disturbance summary.	6-6

6-3. Center fix data form and message format (satellite). 6-7

8-1. A drifting data buoy. 8-4

8-2. Drifting data buoy deployment patterns. 8-4

8-3. NDBC buoy locations. 8-5

8-4. C-MAN sites. 8-7

G-1. Reconnaissance code recording form. G-2

G-2. Sample MINOB message. G-6

LIST OF TABLES

Table		Page
3-1.	Watch and warning break points.	3-4
3-2.	Atlantic tropical cyclone names.	3-7
3-3.	Eastern Pacific tropical cyclone names.	3-8
3-4.	Central Pacific tropical cyclone names.	3-9
3-5.	Western Pacific tropical cyclone names.	3-10
5-1.	Vortex data message entry explanation.	5-9
5-2.	Surface pressure as a function of 850-hPa height.	5-22
5-3.	ASDL data transmission schedule.	5-28
6-1.	Satellite and satellite data availability for the current hurricane season.	6-2
6-2.	Communications headings for satellite tropical disturbance summaries.	6-8
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.	6-8
7-1.	Participating radar stations.	7-3
8-1.	Data buoy locations and configuration.	8-3
8-2.	C-MAN sites.	8-5
8-3.	Code forms for moored data buoys, C-MAN stations, and drifting buoys.	8-8
9-1.	Marine tropical cyclone forecast broadcast stations.	9-1
G-1.	Reconnaissance code tables.	G-3
G-2.	Reconnaissance code regulations.	G-5
G-3.	MINOB message format and breakdown.	G-7
G-4.	TEMP DROP code breakdown.	G-8

CHAPTER 1

INTRODUCTION

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

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

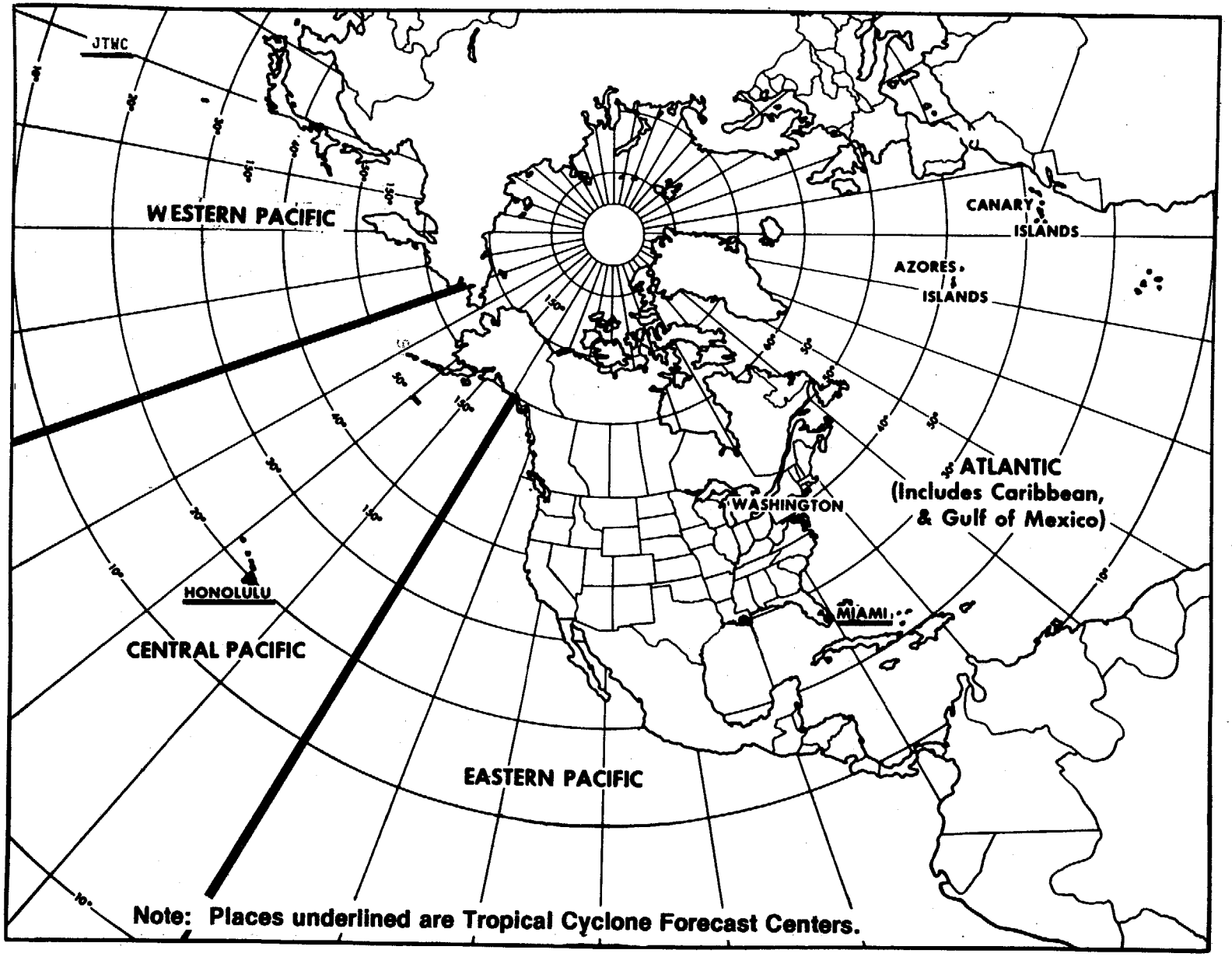


Figure 1-1. Tropical cyclone forecast centers' areas of responsibity.

CHAPTER 2

RESPONSIBILITIES OF COOPERATING FEDERAL AGENCIES

2.1. General. The Department of Commerce (DOC) 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 necessary preparedness actions are undertaken to minimize loss of life and destruction of property. The joint participation by the Department of Defense (DOD) and the Department of Transportation (DOT) with the Department of Commerce brings to bear those limited and expensive Federal resources considered essential for storm detection and accurate forecasting. This cooperative effort has proven to be a cost effective, highly responsive endeavor to meet national requirements for tropical cyclone warning information.

2.2. DOC Responsibilities. The DOC will

2.2.1. Provide timely dissemination of forecasts, warnings, and all significant information regarding tropical and subtropical cyclones to appropriate agencies, general public, and marine and aviation interests.

2.2.2. Through the National Weather Service (NWS), provide the following additional support services to the DOD:

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

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

2.2.2.3. Provide facilities, administrative support, and dissemination of weather observation data for Operating Location G (OL-G), 7th Weather Wing (7WW) as agreed to by DOC and DOD.

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

2.2.2.4.1. Atlantic Ocean (north of the equator including the Caribbean Sea and Gulf of Mexico)--advisories are the responsibility of the Director, NHC, Miami, FL. The NHC will consult with the Naval Eastern Oceanography Center, 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.

2.2.2.4.2. Eastern Pacific Ocean (north of the equator and east of 140°W)--advisories are the responsibility of the Director, NHC. The NHC will consult with the Naval Western Oceanography Center (NAVWESTOCEANCEN), 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.

2.2.2.4.3. Central Pacific Ocean (north of the equator between 140°W and 180°)--advisories are the responsibility of the Director, Central Pacific Hurricane Center (CPHC), Honolulu, HI. The CPHC will consult with the NAVWESTOCEANCEN and Detachment 4, 20th Weather Squadron, Hickam AFB, HI, prior to issuing initial and final advisories and prior to issuing any advisory that indicates a significant change in forecast of intensity or track from the previous advisory. Exchange of information is encouraged on subsequent warnings when significant changes are made or otherwise required.

2.2.3. Through the NWS, 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 to issue to interested agencies.

2.2.4. Through the National Environmental Satellite, Data, and Information Service 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 research and development satellite and DOD operational satellite data for NWS operational use. Comply with NHC and CPHC satellite data requirements.

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

2.2.6. Through the National Oceanic and Atmospheric Administration (NOAA) Office of Aircraft Operations (OAO), provide weather reconnaissance flights as specified in Chapter 5, unless relieved of these responsibilities by the Administrator of NOAA.

2.3. DOD Responsibilities. The DOD will

2.3.1. Provide NWS with timely dissemination of significant information received regarding tropical and subtropical cyclones.

2.3.2. Provide NHC and CPHC current DOD requirements for tropical and subtropical cyclone advisories.

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

2.3.4. Provide at NHC a 24-hr aircraft operation interface--Chief, Aerial Reconnaissance Coordinator, All Hurricanes.

2.3.5. Designate OL-G, 7WW as the liaison to NHC and the military point of contact for NHC to request special DOD observations in support of this plan, i.e., Defense Meteorological Satellite Program (DMSP) fixes, additional upper-air observations, etc.

2.3.6. Provide broadcast facilities of radio station NAM for tropical storm and hurricane forecasts and warnings.

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

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

2.3.9. Provide, through Air Force Global Weather Central, Offutt AFB, NE, surveillance support and fixes and/or intensity

estimates to all United States tropical cyclone warning agencies through analysis of satellite imagery obtained primarily from the DMSP system.

2.4. DOT Responsibilities. The DOT will

2.4.1. Provide NWS with timely dissemination of significant information received regarding tropical and subtropical cyclones.

2.4.2. Provide, through the Federal Aviation Administration, air traffic control, communications, and flight assistance services.

2.4.3. Provide the following through the U.S. Coast Guard:

- Personnel, vessel, and communication support to the NDBC for development, deployment, and operation of moored enviromental data buoy systems;
- Surface observations to NWS from its coastal facilities and vessels;
- Communications circuits for relay of weather observations to NWS in selected areas;
- Primary guard Automated Digital Network support to OL-G, 7WW; and
- Coastal broadcast facilities at selected locations for tropical storm or hurricane forecasts and warnings.

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

2.6. Air Traffic Control/Flight Operations Coordination. The operations officers of the principal flying units, the Assistant Manager for Traffic Management, Traffic Management Branch, Air Traffic Control Command Center, Central Flow Control Facility, Washington, D.C., and the assistant managers for traffic management or assistant manager for military operations, as appropriate, at key air route traffic control centers (ARTCC) will maintain a close working relationship on a continuing basis to ensure mission success under actual tropical storm conditions. This will involve visits to each other's

facilities, familiarization flights, and telephone and teletype communications to improve the understanding of each other's requirements and capabilities.

2.6.1. The 53rd Weather Reconnaissance Squadron, the 815th Weather Operations Flight, and OAO operations officers will maintain a close working relationship with the Air Traffic Control Command Center, Central Flow Control Facility, and the appropriate 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

2.6.1.1. Request the assistance of the appropriate ARTCC/FACSFAC in support of the National Hurricane Operations Plan.

2.6.1.2. Provide the current operations officer's name and telephone number to the appropriate ARTCC and FACSFAC.

2.6.1.3. Publish the unit's telephone numbers (Federal Telephone System (FTS)/Automated Voice Network (AUTOVON (AV))/ Commercial) and teletype address code for Service B (Appendix H).

2.6.2. The Air Traffic Control 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

2.6.2.1. Provide the current names and telephone numbers of points of contact to the flying units.

2.6.2.2. Publish telephone numbers (FTS/AV/Commercial) and teletype code for Service B (Appendix H).

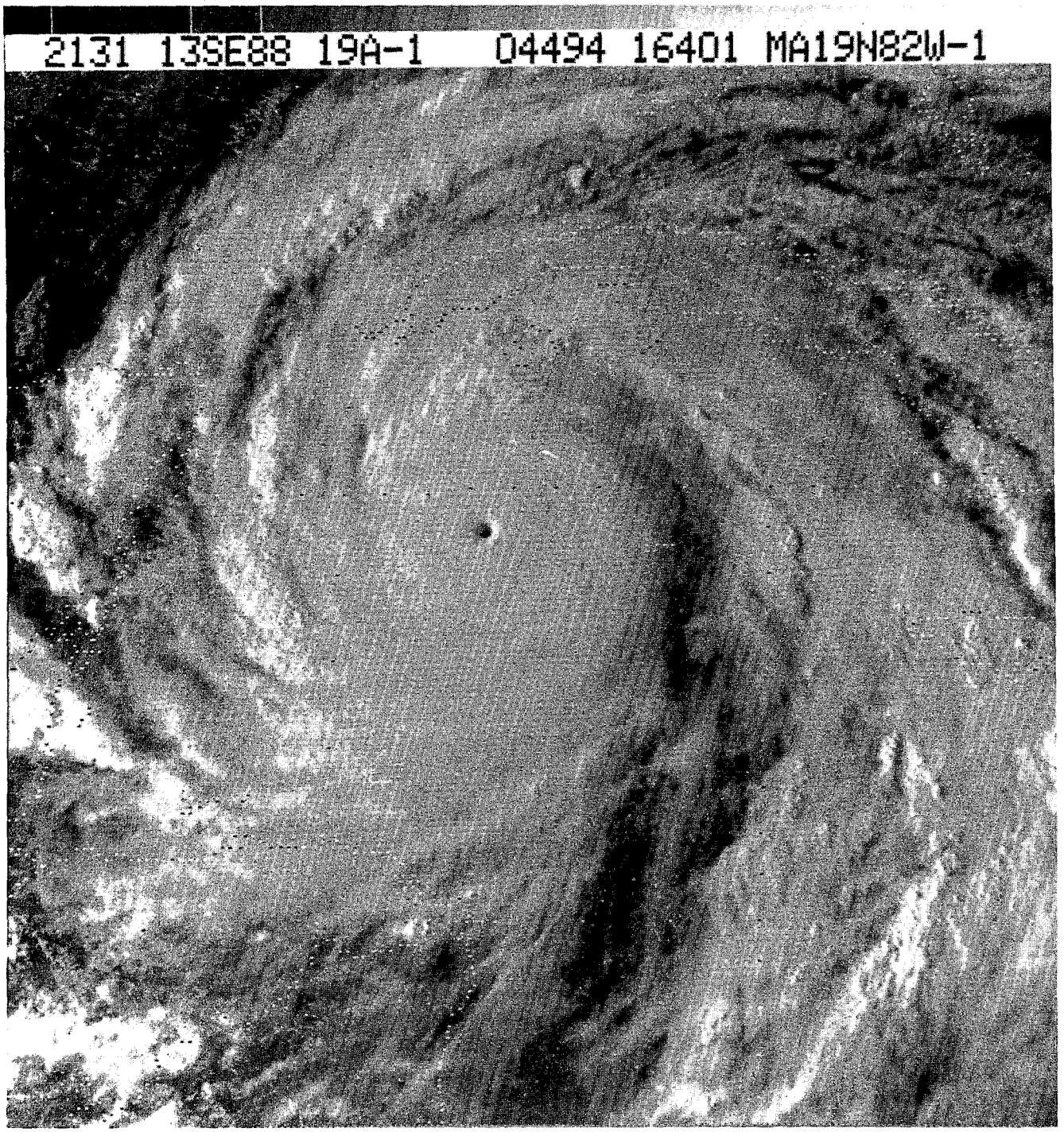


Figure 2-1. Hurricane Gilbert, September 13, 1988, 2131 UTC.

CHAPTER 3

GENERAL OPERATIONS AND PROCEDURES OF THE NATIONAL WEATHER SERVICE HURRICANE CENTERS

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

3.2. Products.

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

3.2.2. Tropical Cyclone Discussion.

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

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

3.2.3. Public Advisories. Public advisories are issued by the NHC for all tropical cyclones in the Atlantic. In the Eastern Pacific, public advisories are issued by NHC for tropical cyclones that are expected to affect land within 48 hr. In the Central Pacific, public advisories are issued by CPHC for all tropical cyclones within the area of responsibility.

Scheduled public advisories are issued at the same time scheduled marine advisories are issued. However, when NHC is issuing advisories every three hours in the Atlantic, the 0400 UTC public advisory will be issued at 0230 UTC to ensure that the latest information is available for the heavily-watched evening local news shows. Watch and warning break points are listed in Table 3-1. [Note: Public advisories use statute miles for distance and miles per hour for speed. Nautical miles and knots may be added at the discretion of the centers.]

3.2.4. Marine Advisories. Marine advisories are issued by the NHC and the CPHC. See Section 4.3 for content and format of the advisories. Marine advisories will be transmitted to high-seas shipping according to the details found in Worldwide Marine Weather Broadcasts, jointly published by the U.S. Navy and National Weather Service. In the Atlantic, these advisories should be distributed 30 min before their effective times of 0400, 1000, 1600, and 2200 UTC. In the Pacific the advisories are scheduled for 0300, 0900, 1500, and 2100 UTC for position times of 0000, 0600, 1200, and 1800 UTC, respectively. Pacific advisories should be transmitted 15 min before the effective time.

3.2.5. Probability of Hurricane/Tropical Storm Conditions.

3.2.5.1. The probability of the storm center passing within 50 mi to the right or 75 mi to the left of specific forecast points within 24, 36, 48, and 72 hr is included in the public advisories for all named storms in the Atlantic, Caribbean, and the Gulf of Mexico. Probabilities may also be included for yet to be named storms that are developing rapidly near a coastline, dependent upon NHC assessment. Probabilities will not be included on intermediate public advisories. The probabilities, which are based on the official forecast track, will be issued when the 72-hr forecast position approaches the coast and will continue until the hurricane or tropical storm has made landfall and is not expected to reemerge over water. For storms forecast to paralled the coast, the maximum value over water points will be included. The NHC retains the right to discontinue issuance of probabilities earlier if other factors arise, such as difficulties with evacuation orders.

3.2.5.2. The probabilities will be computed shortly after synoptic times for the periods 0-24, 24-36, 36-48, and 48-72 hr. A total probability for the next 72 hr will be shown in the last column and represents a total of all forecast periods. If the probability of a storm hitting a coastal location within 48 hr is needed, add the 0-24, 24-36, and the 36-48 hr probabilities. If the probability for a location is less than one percent, an "X" will be indicated in the table.

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

Brownsville, TX	West Palm Beach, FL
Corpus Christi, TX	Fort Pierce, FL
Port O'Connor, TX	Cocoa Beach, FL
Galveston, TX	Daytona Beach, FL
Port Arthur, TX	Jacksonville, FL
New Iberia, LA	Savannah, GA
New Orleans, LA	Myrtle Beach, SC
Buras, LA	Charleston, SC
Gulfport, MS	Wilmington, NC
Mobile, AL	Cape Hatteras, NC
Pensacola, FL	Ocean City, MD
Panama City, FL	Atlantic City, NJ
Apalachicola, FL	Norfolk, VA
St. Marks, FL	New York City, NY
Cedar Key, FL	Montauk Point, NY
Tampa, FL	Providence, RI
Venice, FL	Nantucket, MA
Fort Myers, FL	Hyannis, MA
Marco Island, FL	Boston, MA
Key West, FL	Portland, ME
Marathon, FL	Bar Harbor, ME
Miami, FL	Eastport, ME
29°N 85°W	28°N 93°W
29°N 87°W	28°N 95°W
28°N 89°W	27°N 96°W
28°N 91°W	25°N 97°W

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

3.2.7. Atlantic and Gulf of Mexico Tropical Cyclone Position Estimates. The NHC may also issue hourly tropical cyclone position estimates when the tropical cyclone is under effective surveillance and within 200 nmi of land-based radar. These estimates, when issued, will be prepared a short time before each hour except at hours when advisories are issued. Position estimates disseminated to the public, DOD, and other Federal agencies will provide geographical positions in latitude and longitude and also by distance and direction from a well-known point.

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

Table 3-1. Watch and warning break points.

1.	Brownsville, TX	48.	Vero Beach, FL
2.	Port Mansfield, TX	49.	Sebastian Inlet, FL
3.	Baffin Bay, TX	50.	Cocoa Beach, FL
4.	Corpus Chisti, TX	51.	Titusville, FL
5.	Port Aransas, TX	52.	New Smyrna, FL
6.	Port O'Connor, TX	53.	St. Augustine, Fl
7.	Matagorda, TX	54.	Fernandina Beach, FL
8.	Freeport, TX	55.	Brunswick (Atlamaha Sound), GA
9.	High Island, TX	56.	Savannah, GA
10.	Port Arthur, TX	57.	Edisto Beach, SC
11.	Sabine Pass, TX	58.	Cape Romain, SC
12.	Cameron, LA	59.	Little River Inlet, SC
13.	Morgan City, LA	60.	Cape Fear, NC
14.	Grand Isle, LA	61.	Topsail Beach, NC
15.	Mouth of Mississippi River, LA	62.	Bogue Inlet, NC
16.	Mouth of Pearl River, LA	63.	Cape Lookout, NC
17.	Gulfport, MS	64.	Ocracoke Inlet, NC
18.	Mobile, AL	65.	Cape Hatteras, NC
19.	Pensocola, FL	66.	Oregon Inlet, NC
20.	Fort Walton, FL	67.	Albemarle Sound, NC
21.	Panama City, FL	68.	Virginia Beach, VA
22.	Apalachicola, FL	69.	Cape Charles, VA
23.	St. Marks, FL	70.	North Chesapeake Bay, MD
24.	Aucilla River, FL	71.	South Chesapeake Bay, MD
25.	Steinhatchee River, FL	72.	Chincoteague, VA
26.	Suwannee River, FL	73.	Cape Henlopen, DE
27.	Cedar Key, FL	74.	Fenwick Island, DE
28.	Yankeetown, FL	75.	Cape May, NJ
29.	Bay Port, FL	76.	Brigatine, NJ
30.	Anclote Key, FL	77.	Sandy Hook, NJ
31.	Long Boat Key, FL	78.	Manasquan, NJ
32.	Venice, FL	79.	Fire Island, LI, NY
33.	Boca Grande, FL	80.	Montauk Point, LI, NY
34.	Fort Myers, FL	81.	Port Jefferson Harbor, LI, NY
35.	Bonita Beach, FL	82.	New Haven, CT
36.	Everglades City, FL	83.	Watch Hill, RI
37.	Flamingo, FL	84.	Point Judith, RI
38.	Seven Mile Bridge, FL	85.	Woods Hole, MA
39.	Craig Key, FL	86.	Chatham, MA
40.	Key Largo, FL	87.	Plymouth, MA
41.	Hallandale, FL	88.	Gloucester, MA
42.	Deerfield Beach, FL	89.	Merrimack River, MA
43.	Boyton Beach, FL	90.	Portsmouth, NH
44.	Lake Worth, FL	91.	Portland, ME
45.	Jupiter Inlet, FL	92.	Rockland, ME
46.	Stuart, FL	93.	Bar Harbor, ME
47.	Fort Pierce, FL	94.	Eastport, ME

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

3.2.10. Satellite Tropical Disturbance Summary. These are issued twice a day by the CPHC to describe significant weather in the tropical regions of the Central Pacific. World Meteorological Organization contractions are used.

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

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

3.2.13. Tropical Disturbance Rainfall Estimates. As required, the NHC issues satellite based rainfall estimates for tropical disturbances and tropical cyclones within 36 hr of expected landfall for the Caribbean, the Bahamas, and both coasts of Mexico.

3.3. <u>Designation of Tropical and Subtropical Cyclones</u>.

3.3.1. Numbering of Depressions. Each depression will be assigned a number that will be retained throughout the life of the cyclone. This depression number will not, however, be disseminated on advisories after a depression is named as a tropical storm or hurricane. For each hurricane center's area, numbering will begin with ONE at the start of each calendar year. When forecast responsibility is passed from one warning center to another, the assigned number will be retained.

3.3.1.1. For the Atlantic, Caribbean, and Gulf of Mexico, depression numbers with the suffix A, e.g., ONE-A, TWO-A, THREE-A, will be assigned by the NHC after advising the Navy Eastern Oceanography Center, Norfolk.

3.3.1.2. For the Pacific east of 140°W, depression numbers, with the suffix E, e.g., ONE-E, TWO-E, THREE-E, will be assigned by the NHC after advising the Navy Western Oceanography Center (NAVWESTOCEANCEN), Pearl Harbor.

3.3.1.3. For the 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 after advising the NAVWESTOCEANCEN, Pearl Harbor.

3.3.2. Naming of Tropical Storms and Hurricanes.

3.3.2.1. Atlantic and Eastern Pacific. A different set of names will be used each year. After a set is used, it will drop to the end of the list to be used again in six years. Names of significant hurricanes will be retired and replaced. Lists of Atlantic and Eastern Pacific names are provided in Tables 3-2 and 3-3, respectively.

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

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

3.4. <u>Transfer of Warning Responsibility</u>.

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

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

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

Table 3-2. Atlantic Tropical Cyclone Names

1989	1990	1991	1992	1993	1994
ALLISON	ARTHUR	ANA	ANDREW	ARLENE	ALBERTO
BARRY	BERTHA	BOB	BONNIE	BRET	BERYL
CHANTAL	CESAR	CLAUDETTE	CHARLEY	CINDY	CHRIS
DEAN	DIANA	DANNY	DANIELLE	DENNIS	DEBBY
ERIN	EDOUARDQ	ERIKA	EARL	EMILY	ERNESTO
FELIX	FRAN	FABIAN	FRANCES	FLOYD	FLORENCE
GABRIELLE	GUSTAV	GLORIA	GEORGES	GERT	*
HUGO	HORRTENSE	HENRI	HERMINE	HARVEY	HELENE
IRIS	ISIDORE	ISABEL	IVAN	IRENE	ISSAC
JERRY	JOSEPHINE	JUAN	JEANNE	JOSE	*
KAREN	KLAUS	KATE	KARL	KATRINA	KEITH
LUIS	LILI	LARRY	LISA	LENNY	LESLIE
MARILYN	MARCO	MINDY	MITCH	MARIA	MICHAEL
NOEL	NANA	NICHOLAS	NICOLE	NATE	NADINE
OPAL	OMAR	ODETTE	OTTO	OPHELIA	OSCAR
PABLO	PALOMA	PETER	PAULA	PHILIPPE	PATTY
ROXANNE	RENE	ROSE	RICHARD	RITA	RAFAEL
SEBASTIEN	SALLY	SAM	SHARY	STAN	SANDY
TANYA	TEDDY	TERESA	TOMAS	TAMMY	TONY
VAN	VICKY	VICTOR	VIRGINIE	VINCE	VALERIE
WENDY	WILFRED	WANDA	WALTER	WILMA	WILLIAM

*Replacement names determined at the WMO Region IV meeting in April, 1989 will be inserted.

Table 3-3. Eastern Pacific tropical cyclone names.

1989	1990	1991	1992	1993	1994
ADOLPH	ALMA	ANDRES	AGATHA	ADRIAN	ALETTA
BARBARA	BORIS	BLANCA	BLAS	BEATRIZ	BUD
COSME	CRISTINA	CARLOS	CELIA	CALVIN	CARLOTTA
DALILIA	DOUGLAS	DELORES	DARBY	DORA	DANIEL
ERICK	ELIDA	ENRIQUE	ESTELLE	EUGENE	EMILIA
FLOSSIE	FAUSTO	FEFA	FRANK	FERNANDA	FABIO
GIL	GENEVIEVE	GUILLERMO	GEORGETTE	GREG	GILMA
HENRIETTE	HERNAN	HILDA	HOWARD	HILARY	HECTOR
ISMAEL	ISELLE	IGNACIO	ISIS	IRWIN	*
JULIETTE	JULIO	JIMENA	JAVIER	JOVA	JOHN
KIKO	KENNA	KEVIN	KAY	KNUT	KRISTY
LORENA	LOWELL	LINDA	LESTER	LIDIA	LANE
MANUEL	MARIE	MARTY	MADELINE	MAX	MIRIAM
NARDA	NORBERT	NORA	NEWTON	NORMA	NORMAN
OCTAVE	ODILE	OLAF	ORLENE	OTIS	OLIVIA
PRISCILLA	POLO	PAULINE	PAINE	PILAR	PAUL
RAYMOND	RACHEL	RICK	ROSLYN	RAMON	ROSA
SONIA	SIMON	SANDRA	SEYMOUR	SELMA	SERGIO
TICO	TRUDY	TERRY	TINA	TODD	TARA
VELMA	VANCE	VIVIAN	VIRGIL	VERONICA	VICENTE
WINNIE	WALLIS	WALDO	WINIFRED	WILEY	WILLA
XINA	XAVIER	XINA	XAVIER	XINA	XAVIER
YORK	YOLANDA	YORK	YOLANDA	YORK	YOLANDA
ZELDA	ZEKE	ZELDA	ZEKE	ZELDA	ZEKE

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

*Replacement name determined at the WMO Region IV meeting, April, 1989, will be inserted.

Table 3-4. Central Pacific tropical cyclone names.

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

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

Table 3-5. Western Pacific tropical cyclone names.

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

NOTE:

Names will be assigned in rotation, alphabetically. When the last name, ZACK, has been used the sequence will begin again with ANGELA.

This entire list was updated at the 1989 Tropical Cyclone Conference.

3.5. Alternate Warning Responsibilities. In the event of impending or actual operational failure of a hurricane forecast center, responsibilities will be transferred to an alternate facility in accordance with existing directives and retained there until resumption of responsibility can be made. The NAVEASTOCEANCEN, Norfolk, will be advised by the NHC and Chief, Aerial Reconnaissance Coordinator, All Hurricanes (CARCAH) of impending or actual transfer of responsibility by the most rapid means available. Alternate facilities are as follows:

PRIMARY	ALTERNATE
NHC	National Meteorological Center, Meteorological Operations Division Washington, DC
CPHC	NHC
CARCAH*	Detachment 1, 7th Weather Wing, (Det 1, 7WW) Keesler AFB, MS

*In the event of the operational failure of CARCAH, direct communication is authorized between Det 1, 7WW and the forecast facility. Contact Det 1, 7WW at AUTOVON (AV) 868-2544/Commercial (COM) 601-377-2544 or through the Keesler AFB Command Post at AV 868-4330/COM 601-377-4330.

3.6. Abbreviated Communications Headings. Abbreviated communications headings are assigned to advisories on tropical and subtropical cyclones and other advisories based on depression numbers or storm name and standard communication procedures. [Note: an abbreviated heading consists of three groups with ONE space between the second and third groups. The first group contains a data type indicator (e.g., WT for hurricane), a geographical indicator (e.g., NT for North Atlantic and Caribbean), and a number. The second group contains a loction identifier of the message originator (e.g., KMIA for Miami). The third group is a date-time group in UTC. An example of a complete header is WTNT31 KMIA 180400.] Abbreviated communication headers for the areas of reponsibility follow:

3.6.1. Atlantic

ABNT20 KMIA	Tropical Weather Outlook
ABNT30 KMIA	Tropical Weather Summary (monthly)
WTNT41-45 KMIA	Tropical Cyclone Discussion

WTNT31-35 KMIA	Public Advisory
WTNT21-25 KMIA	Marine Advisory
WWNT21-25 KMIA	Marine Subtropical Storm Advisory
WWNT31-35 KMIA	Subtropical Storm Advisory
WTNT61 KMIA	Tropical Cyclone Update
WTNT51 KMIA	Tropical Cyclone Position Estimate
WONT41 KMIA	Special Tropical Disturbance Statement
WTXX90 KMIA	Tropical Cyclone Discussion for WMO Region IV Stations

3.6.2. Eastern and Central Pacific.

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

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

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

ABPA20 PHNL	Tropical Weather Outlook
ABPZ20 KMIA	Tropical Weather Outlook
WTPZ41-45 KMIA	Tropical Cyclone Discussion

WTPA41-45 PHNL	Tropical Cyclone Discussion
WTPZ51 KMIA	Tropical Cyclone Position Estimate
WTPA51 PHNL	Tropical Cyclone Position Estimate
WTPZ61 KMIA	Tropical Cyclone Update
WTPA61 PHNL	Tropical Cyclone Update
WOPZ41 KMIA	Special Tropical Disturbance Statement
WOPA41 PHNL	Special Tropical Disturbance Statement
WWPA21-25 PHNL	Marine Subtropical Storm Advisory
WWPZ21-25 KMIA	Marine Subtropical Storm Advisory
WWPA31-35 PHNL	Public Subtropical Storm Advisory
WWPZ31-35 KMIA	Public Subtropical Storm Advisory

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 responsibities. Mutually supportive relationships have developed over the years and have resulted into a mutual dependency. Due to the nature and distribution of DOD resources and operations, the DOD requires certain meteorological information beyond that available to the general public. Accordingly, the DOC provides DOD with special observations and advisories on tropical and subtropical storms threatening DOD resources or operations.

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

4.3. Marine Advisories.

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

4.3.2. Marine Advisory Issue Frequency. The first marine advisory will normally be issued when meteorological data indicate that a tropical or subtropical cyclone has formed. Subsequent advisories will be issued at 0400, 1000, 1600, and 2200 UTC from the NHC (0300, 0900, 1500, and 2100 UTC from the NHC (for the Eastern Pacific)) and CPHC. Advisories will continue to be issued until the system degenerates below depression level. In addition,

special advisories will be issued whenever the following criteria are met. Remarks stating the reason for the special advisory or the relocation will be mandatory in all special advisories or advisories that include a relocated position.

- Conditions require a hurricane or tropical storm watch or warning to be issued.
- A tropical depression becomes a tropical storm or vice versa.
- A tropical storm changes to a hurricane or vice versa.
- Conditions require initiation or upgrading of an existing coastal warning.
- A tornado threat develops or becomes non-existant.
- Any other circumstances causing the hurricane forecaster to believe other significant changes have occurred.

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

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

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

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

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

```
     MIATCMAT3
TTAAOO KMIA 251535
HURRICANE GLORIA MARINE ADVISORY NUMBER 34
NATIONAL WEATHER SERVICE MIAMI FL
1600Z WED SEP 25 1985

WATCH/WARNING SECTION*

HURRICANE CENTER LOCATED NEAR 27.1N 73.1W AT 25/1600Z
POSITION ACCURATE WITHIN 20 NAUTICAL MILES BASED ON AIR FORCE
RECONNAISSANCE AND SATELLITE.

PRESENT MOVEMENT TOWARD THE NORTHWEST OR 315 DEGREES AT 13 KT.

MAX SUSTAINED WINDS 130 KT WITH GUST TO 150 KT.
RADIUS OF 64 KT WINDS  75NE  50SE  50SW  75NW.
RADIUS OF 50 KT WINDS 100NE  75SE  75SW 100NW.
RADIUS OF 34 KT WINDS 200NE 150SE 150SW 200NW.
RADIUS OF 12 FT SEAS OR HIGHER 200NE 150SE 150SW 200NW.

REPEAT CENTER LOCATED AT 27.1N 73.1W AT 25/1600Z.

FORECAST VALID 26/0000Z 28.5N 74.5W.
MAX SUSTAINED WINDS 130 KT WITH GUSTS TO 150 KT.
RADIUS OF 50 KT WINDS 100NE  75SE  75SW 100NW.
RADIUS OF 34 KT WINDS 200NE 150SE 150SW 200NW.

FORECAST VALID 26/1200Z 31.0N 76.0W.
MAX SUSTAINED WINDS 130 KT WITH GUSTS TO 150 KT.
RADIUS OF 50 KT WINDS 100NE  75SE  75SW 100NW.
RADIUS OF 34 KT WINDS 200NE 150SE 150SW 200NW.

FORECAST VALID 27/0000Z 35.0N 75.5W.
MAX SUSTAINED WINDS 110 KT WITH GUSTS TO 130 KT.
RADIUS OF 50 KT WINDS 100NE  75SE  75SW 100NW.
RADIUS OF 34 KT WINDS 200NE 150SE 150SW 200NW.

STORM TIDE SECTION*

HEAVY PRECIPITATION SECTION*

THE FOLLOWING FORECAST SHOULD BE USED ONLY FOR GUIDANCE
PURPOSES BECAUSE ERRORS MAY EXCEED A FEW HUNDRED MILES.

FORECAST VALID 27/1200Z 39.0N 75.0W.
MAX SUSTAINED WINDS 80 KT WITH GUSTS TO 95 KT.
RADIUS OF 50 KT WINDS 50NE 50SE 25SW 25NW.

FORECAST VALID 28/1200Z 46.0N 73.0W.
MAX SUSTAINED WINDS 40 KT NEAR CENTER.

REQUEST FOR 3 HOURLY SHIP REPORTS WITHIN 300 MILES OF 27.1N 73.1W.

NEXT ADVISORY AT 25/2200Z.

NOTE...PROBABILITIES OF HURRICANE/TROPICAL STORM CONDITION ARE
AVAILABLE IN THE PUBLIC HURRICANE ADVISORY.  SEE AFOS HEADER
CCCTCPAT3 OR WMO HEADER WTNT33 KMIA.**

--------------------------
*To be used when appropriate.

**Atlantic only.
```

Figure 4-1. Marine advisory format.

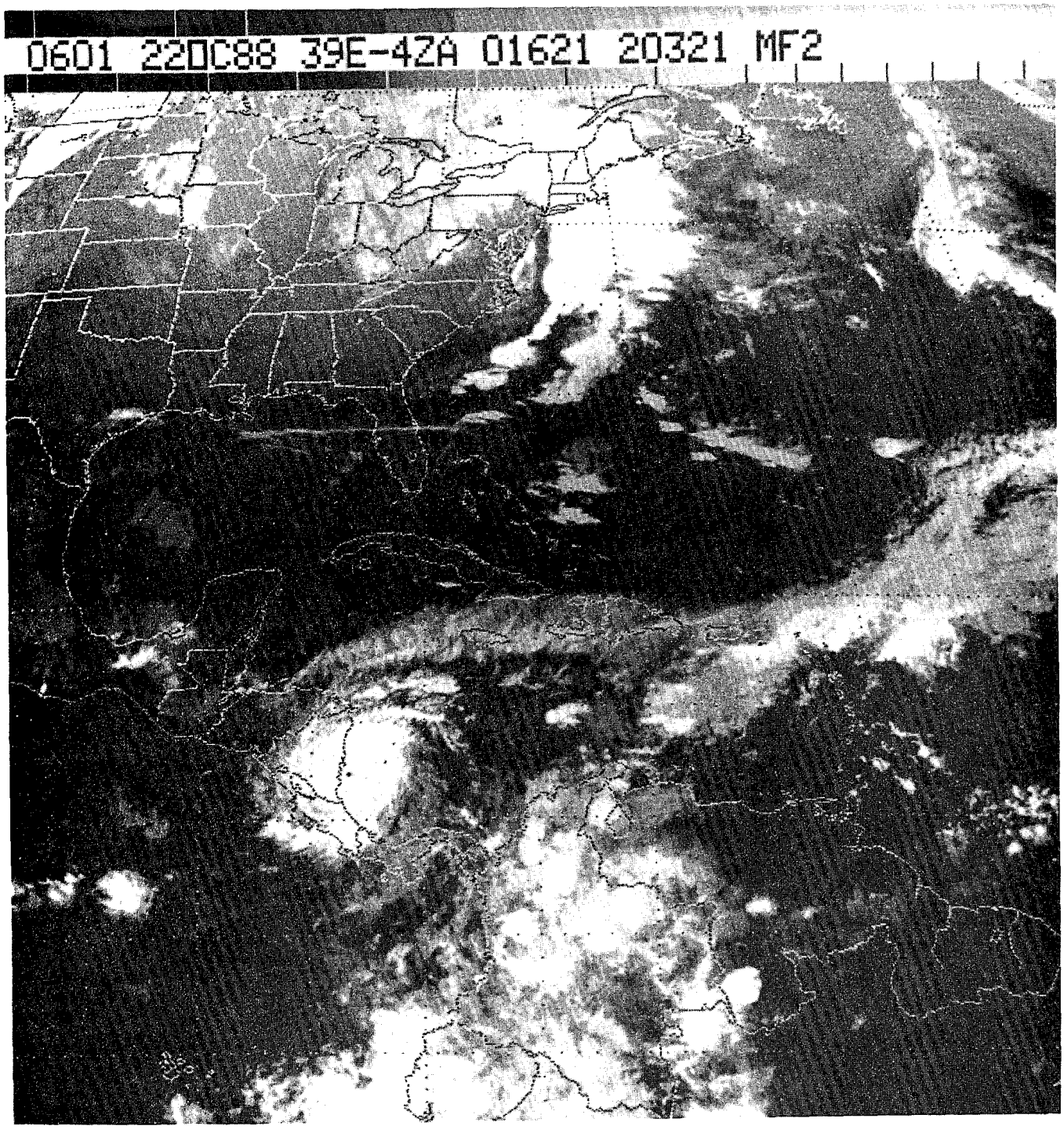


Figure 4-2. Hurricane Joan, October 22, 1988, 0601 UTC.

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 U.S. Air Force (USAF)/National Oceanic and Atmospheric Administration (NOAA) Memorandum of Understanding (see Appendix C), DOC has identified a requirment 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. Congress has directed the DOD to maintain a combined active and reserve Air Force flying hour program of 1600 hours in support of hurricane reconnaissance coverage. In times of national emergency or war, some or all DOD reconnaissance resources may not be available to fulfill DOC needs.

5.2. Responsibilities.

5.2.1. The DOD is responsible for:

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

5.2.1.2. Developing operational procedures to deploy data buoys to satisfy DOC needs.

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

5.2.2.1. Augment USAF operational aircraft reconnaissance with high-density, high-accuracy (HD/HA) data when storms are within 24 hr of landfall of the continental United States.

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

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 that assume an operational responsibility to the hurricane centers.

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

5.4. Reconnaissance Requirements.

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

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

5.4.2. Required Meteorological Reconnaissance Data, Ranges, and Accuracies. Required reconnaissance data accuracies are as follows:

5.4.2.1. Geographic position.

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

5.4.2.2. Wind direction.

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

5.4.2.3. Wind speed.

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

5.4.2.4. Pressure height.

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

5.4.2.5. Temperature.

- Sea surface: within $1^{o}C$
- Flight level: within $1^{o}C$

5.4.2.6. Dew-point temperature.

- Range from $-20^{o}C$ to $+40^{o}C$: within $1^{o}C$
- Less than $-20^{o}C$: within $3^{o}C$

5.4.2.7. Absolute altitude: within 10 m

5.4.2.8. Vertical sounding.

- Pressure: within 2 hPa
- Temperature: within $1^{o}C$
- Dew-point temperature:
  Range of $-20^{o}C$ to $+40^{o}C$: within $1^{o}C$
  Less than $-20^{o}C$: within $3^{o}C$
- Wind direction: within 10 deg
- Wind speed: within 5 kt

5.4.2.9. 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. Required Frequency and Content of Observations.

5.4.3.1. Horizontal observations. Standard RECCO Section 1 or Section 3, plus 4ddff and $9V_iT_WT_WT_W$, if applicable, (9-groups are not required for WC-130s in the storm or invest area). Section 3 RECCO will not be used if HD/HA data are being transmitted. The format is as specified in Military Airlift Command Regulation (MACR) 105-25, Weather Reconnaissance Observations, and Appendix G of the NHOP.

5.4.3.1.1. Enroute. Horizontal observations will be taken and transmitted every 200 nmi over water enroute to and from the storm area. Data from the 500-hPa level are preferred,

if possible, otherwise other levels are acceptable. If an automated system is not in use, encode observations every 15 min when over water within 15 degrees of the tasked coordinates, and transmit hourly.

5.4.3.1.2. Fix missions. One horizontal observation is required midway between the outbound leg and inbound leg of the Alpha and modified Alpha flight patterns. This is not required if HD/HA data are available.

5.4.3.1.3. Invest missions. See para 5.8.2.

5.4.3.2. High-density/high-accuracy data. The HD/HA data include time, latitude, longitude, flight-level wind, pressure altitude, radar altitude, D-value, flight-level wind speed and direction, temperature, and dew-point temperature. These observations are collected every minute (MINOBS) and transmitted every 20 min (WC-130) or 30 min (WP-3). See Appendix G for the format of the MINOBS or para 5.9.4.1. for the ASDL data format.

5.4.3.3. Vortex and supplemental vortex observations. Vortex and supplemental vortex observations are collected, encoded, and transmitted in accordance with NHOP pattern requirements (see para 5.7.). Supplementary vortex observations are not required when HD/HA data are transmitted. See Figures 5-1 and 5-2 for data formats. NOTE: Non-automated systems are marginal in satisfying these requirements. Data will be collected as close to stated requirements as possible, and will be considered satisfactory as long as observations are accomplished every 30 min.

5.4.3.4. Vertical observations. The frequency of vertical observations enroute to and from the storm or invest area will be approximately every 400 nmi over water in accordance with MACR 105-25, unless otherwise specified. the frequency will be as specified (NHOP flight patterns or TCPOD) within the tasked area. The format for all vertical observations is WMO TEMP DROP code (FM 37-VII). See Appendix G for the format.

5.4.4. High Density/High Accuracy Requirements. The DOC requires rapid acquisition and transmission of tropical cyclone data, especially within the last 24-hr period prior to landfall. Since only a limited number of aircraft currently have a high-density, high-accuracy (HD/HA) capability, DOC reconnaissance requests should specify which tropical cyclone reconnaissance sorties should use HD/HA aircraft. The HD/HA aircraft will be provided on a "resources permitting" basis only.

VORTEX DATA MESSAGE

MANOP HEADING (PRECEDENCE IMMEDIATE)

MISSION IDENTIFIER AND OBSERVATION NUMBER

(ABBREVIATED) (DETAILED) VORTEX DATA MESSAGE

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

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

Figure 5-1. Form 3--Vortex data message.

SUPPLEMENTARY VORTEX DATA MESSAGE

MANOP HEADING *(completed by monitors only)*

UR ___ ___ 14 ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

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

AF___ ___ ___

SUPPLEMENTARY VORTEX DATA MESSAGE

($I_o L_o L_o$)	($L_o L_o L_o L_o$)	(IHHH)	($TTT_d T_d$)	(ddff)
01	1	1	1	
02	2	2	2	
03	3	3	3	
04	4	4	4	
05	5	5	5	
06	6	6	6	
07	7	7	7	
($I_o L_o L_o$) MF	($L_o L_o L_o L_o$) M	(fff) MF		

OBS 01 AT: ___ Z OBS ___ AT ___ Z OBS 01 SFC WND:

($I_o L_o L_o$)	($L_o L_o L_o L_o$)	(IHHH)	($TTT_d T_d$)	(ddff)
01	1	1	1	
02	2	2	2	
03	3	3	3	
04	4	4	4	
05	5	5	5	
06	6	6	6	
07	7	7	7	
($I_o L_o L_o$) MF	($L_o L_o L_o L_o$) M	(fff) MF		

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

REMARKS *(end of message)*

PREPARED BY:

TRANSMISSION TIME:

LEGEND

01 INDICATOR FOR DATA COLLECTED APPROXIMATELY 100 NM FROM STORM CENTER (INBOUND) OR APPROXIMATELY 15 NM FROM CENTER (OUTBOUND)

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

MF = INDICATOR FOR MAXIMUM FLIGHT LEVEL WIND OBSERVED

ff = SPEED OF WIND IN KNOTS

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

$TTT_d T_d$ = TEMP/DEWPOINT IN DEGREES CELSIUS: ADD 50 FOR NEGATIVE VALUES

IHHH = PRESSURE HEIGHT DATA IN RECCO FORMAT

$L_o L_o L_o$ = LATITUDE IN DEGREES/TENTHS

$L_o L_o L_o L_o$ = LONGITUDE IN DEGREES/TENTHS

/ = DATA UNKNOWN/UNOBTAINABLE

SAMPLE MESSAGE

URNT 16 KMIA 241703
AF 966 0411 FREDERIC OB 14
SUPPLEMENTARY VORTEX DATA MESSAGE

01178	10899	13107	10908	36027
02177	20898	23108	20908	35042
03178	30891	33092	30807	36052
04177	40887	43088	40907	35070
05178	50883	53076	50908	36088
06178	60880	63066	61010	35108
07178	70877	73062	71211	35120

MF178 M0877 MF120
OBS 01 AT 1530Z OBS 07 AT 1600Z
OBS 01 SFC WND 36025

01177	10872	13089	11010	16120
02178	20868	23070	21009	17098
03178	30862	33086	30909	18090
04177	40858	43093	40908	17050
05177	50854	53102	50908	17048
06178	60850	63108	60905	18031
07177	70844	73114	70902	18025

MF177 M0872 MF120
OBS 01 AT 1630Z OBS 07 AT 1700Z
OBS 07 SFC WIND 16025
REMARKS HEAVY RAIN OUTBOUND

Figure 5-2. Form 4--Supplementary vortex data message.

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

5.5. Reconnaissance Planning and Flight Notification.

5.5.1. DOC Requests for Aircraft Reconnaissance Data.

5.5.1.1. The National Hurricane Center (NHC) will coordinate with the Central Pacific Hurricane Center (CPHC) to determine a list of the total DOC requirements for data on tropical and subtropical cyclones or disturbances for the next 24-hr period (0500 to 0500 UTC) and an outlook for the succeeding 24-hr period. This coordinated request will be provided to CARCAH as soon as possible, but not later than 1630 UTC each day in the format of Figure 5-3). Amendments will be provided as required.

5.5.1.2. From the above coordinated DOC request, CARCAH will publish the Tropical Cyclone Plan of the Day (TCPOD). When DOC reconnaissance needs exceed DOD and DOC resources, CARCAH will coordinate with the NHC to establish priorities of requirements.

5.5.1.3. The following reconnaissance requests can be anticipated for a forecast or actual storm location:

5.5.1.3.1. The Atlantic, Gulf of Mexico, Caribbean, Eastern and Central Pacific:

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

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

5.5.1.3.2. Investigative flights may be requested for disturbances in areas defined in paragraph 5.5.1.3.1., above, i.e., one or two flights per day dependent upon proximity of landfall and upon known or suspected stage of development.

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

NHOP COORDINATED REQUEST FOR AIRCRAFT RECONNAISSANCE

___ Original
___ Amendment
(Check One)

I. ATLANTIC REQUIREMENTS

STORM NAME DEPRESSION # SUSPECT AREA	FIX OR ON STATION TIME	COORDI-NATES	FLIGHT PATTERN	FCST MVMT	HIGH DENS ACCY REQT	NHC PRI-ORITY

SUCCEEDING DAY OUTLOOK _____

_____

REMARKS _____

_____

II. EASTERN AND CENTRAL PACIFIC REQUIREMENTS

STORM NAME DEPRESSION # SUSPECT AREA	FIX OR ON STATION TIME	COORDI-NATES	FLIGHT PATTERN	FCST MVMT	HIGH DENS ACCY REQT	NHC PRI-ORITY

SUCCEEDING DAY OUTLOOK _____

_____

REMARKS _____

_____

III. DISTRIBUTION

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

B. DATE _____ TIME _____ FCSTR INIT _____

Figure 5-3. Form 1--NHOP coordinated request for aircraft reconnaissance.

Table 5-1. Vortex data message entry explanation

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

Table 5-1. Vortex data message entry explanation (continued)

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

Table 5-1. Vortex Data Message Entry Explanation (Continued)

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

5.5.2. DOD Reconnaissance Aircraft Responsiveness.

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

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

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

5.5.3. Reconnaissance Tropical Cyclone Plan of the Day.

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

5.5.3.1.1. The CARCAH will coordinate the TCPOD with the NHC, 53rd Weather Reconnaissance Squadron, 815th Weather Operations Flight, and the Office of Aircraft Operations before publication.

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

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

Figure 5-4. USAF WC-130 weather reconnaissance aircraft equipped with the Improved Weather Reconnaissance System.

5.5.3.1.4. 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 that provide support to or control of reconnaissance aircraft or are a part of the tropical cyclone warning service. Under normal circumstances, the TCPOD will be disseminated by 1800 UTC each day. Amendments will be disseminated as required.

5.5.3.3. NOTE: the TCPOD will not be disseminated by message on weekends or holidays if there are no current-day or succeeding-day reconnaissance requirements. The CARCAH, however, will still coordinate with concerned agencies by telephone as in paragraph 5.5.3.1.1., above.

5.5.4. Air Traffic Control (ATC) Clearances.

5.5.4.1. Air traffic control agencies will provide air traffic control separation between all aircraft operating on storm missions and between storm aircraft and nonparticipating aircraft operating on instrument flight rules within controlled airspace. Mission commanders are reminded that nonparticipating aircraft may be operating near storm areas; thus, adherence to ATC clearances is mandatory for safety. The CARCAH will indicate in the TCPOD if clearance into warning areas is required.

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

FM OL-G, 7WW CORAL GABLES FL/CARCAH

TO (MAC-APPROVED ADDRESSEES)/(NOAA-APPROVED ADDRESSEES)

SUBJECT TROPICAL CYCLONE
RECON POD FROM _____Z (MONTH) (YEAR) TO _____Z (MONTH) (YEAR) FOLLOWS

I. ATLANTIC

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

FLIGHT ONE (NHC PRIORITY, if applicable)

A. _____Z FIX TIMES/ON STATION TIMES
(Resources Permitting if applicable)
_____Z

B. _____ MISSION IDENTIFIER

C. _____Z ETD

D. _____ DEPARTURE STATION

E. _____ FORECAST POSITION/STORM NAME

F. _____ DESTINATION STATION

G. _____ FLIGHT PATTERN

H. _____ FORECAST MOVEMENT

I. _____ REMARKS

FLIGHT TWO (if applicable, same as FLIGHT ONE)

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

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

A. POSSIBLE __(Unit)__ ON STATION REQUIREMENT NEAR __(Location)__
AT __(Time)__Z.

II. EASTERN AND CENTRAL PACIFIC (Same as in ATLANTIC)

Figure 5-5. Form 2--Tropical Cyclone Plan of the Day format.

5.5.4.2. When storm aircraft cannot maintain assigned altitudes due to turbulence, ATC should be advised. Normal vertical separation of 1,000 ft at flight level (FL) 290 and below and 2,000 ft above FL 290 will be provided by ATC to aircraft operating in the storm area. Unless otherwise coordinated with ATC, the altitudes between storm-mission aircraft may be used by ATC for nonparticipating aircraft. Any procedure desired by storm-mission aircraft commanders that is outside these parameters must be coordinated with the appropriate ATC facility.

5.5.4.3. Dropsonde releases will be coordinated with the appropriate Air Route Traffic Control Center and participating aircraft if within controlled airspace, and with participating aircraft only, if outside controlled airspace. Contact between participating aircraft will be made using the frequencies listed in paragraph 5.9.3.

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.

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

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

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

5.6.1.1.4. 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.

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

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

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

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

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

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

5.7.1. Vortex Data. The detailed vortex data message (Form 3, Figure 5-1) will be prepared with all observed vortex fix information for all scheduled fixes. For intermediate fixes, either an abbreviated or detailed vortex data message may be transmitted, depending upon availablility of information and forecaster requirements.

5.7.2. Center Fix Data. When proximity to unfriendly territory, air traffic control restriction, or other factors prevent actual penetration of the vortex by the reconnaissance aircraft, it is permissible to fix the cyclone by radar. All aircraft radar fix reports will be made in plain text and appended to a RECCO observation taken at fix time or to a supplementary vortex data message completed up to the time of the radar fix, e.g., RADAR CENTER FIX 21.5N 83.0W, POOR RADAR PRESENTATION, NAV ACCURACY 5NMI. The remark stating the type of radar fix and quality of the radar presentation is in accordance with Chapter 7, paragraph 7.2.2.

5.7.3. Supplementary Vortex Data. Penetration and collection of supplementary vortex data will normally begin at a radius of approximately 105 nmi from the center as determined by the flight meteorologist. The required supplementary vortex data are as

MISSION EVALUATION FORM

DATE: _____

TO: OL-G, 7WW/CARCAH

FROM: (Director, NHC, CPHC)

SUBJECT: Mission _____ Evaluation
(Mission Identifier)

PUBLISHED REQUIREMENTS:

Permission Coordinates (As Updated Prior to TKO) _____ N _____ W

Flight Pattern _____

Mission Requirements Times _____

RECONNAISSANCE MISSION PERFORMANCE:

Flight Flown: ____Completely ____Partially ____Other

Horizontal Data Coverage: ____Complete ____Timely ____Accurate
____Incomplete ____Untimely ____Inaccurate

Vertical Data Coverage: ____Complete ____Timely ____Accurate
____Incomplete ____Untimely ____Inaccurate

Requirements Accomplished: ____On Time ____Early ____Late
____Missed

Remarks: _____

OVERALL MISSION EVALUATION:

	Outstanding	Satisfactory	Unsatisfactory
Equipment:	_____	_____	_____
Accuracy:	_____	_____	_____
Timeliness:	_____	_____	_____
Procedures:	_____	_____	_____
Completeness:	_____	_____	_____

Remarks: _____

Figure 5-6. Form 5--Mission evaluation form.

shown in Figure 5-2 (Form 4). Supplementary vortex data are not required when HD/HA data are received or available at CARCAH or NHC. [NOTE: Present weather reconnaissance equipment is inadequate to provide full data for 15 nmi supplementary vortex data; data will be collected as close to stated requirements as possible and within the capabilities of the flight crew.] If a fix is not possible and supplementary vortex data have been collected, transmit the inbound leg as a complete observation and add clarifying remarks, e.g., "FIX NOT MADE, CLOSED CIRCULATION NOT FOUND, INVESTIGATIVE PROFILE BEGUN AT 23/1522Z."

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 to ensure all observations were received and understood.

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

Agency/Aircraft Indicator	Mission Storm System Indicator		
Agency + Aircraft Number*	Number of mission this storm system	Depression number or XX if not a depression or greater	Storm name or words CYCLONE or INVEST

*AF plus last 3 digits of tail number
*NOAA plus last digit of aircraft registration number

-EXAMPLES-

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

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

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

5.7.7. Observation Numbering and Content.

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

-EXAMPLE-

AF966 0308A EMMY OB 01
97779 TEXT TEXT... DPTD KBIX AT 10/2100Z ETA 31.5N 75.0W AT 11/0015Z

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

-EXAMPLE-

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

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

-EXAMPLE-

AF963 0317A JOAN OB 16
97779 TEXT TEXT ... ETA KBIX 15/2030Z, LAST REPORT, OBS 01 THRU 16 TO KMIA.

5.8. Operational Flight Patterns. This section includes operational flight patterns that provide vortex and peripheral

data on tropical and subtropical cyclones including two 6-hourly and intermediate fixes.

5.8.1. Flight Pattern ALPHA Operational Details

5.8.1.1. Flight levels will normally be at 1,500 ft, 850 hPa, or 700 hPa, depending on data requirements and flight safety. The flight sequence is shown in the figure. The pattern sequence can be entered at any point and then repeated for the mission duration. See Figure 5-7.

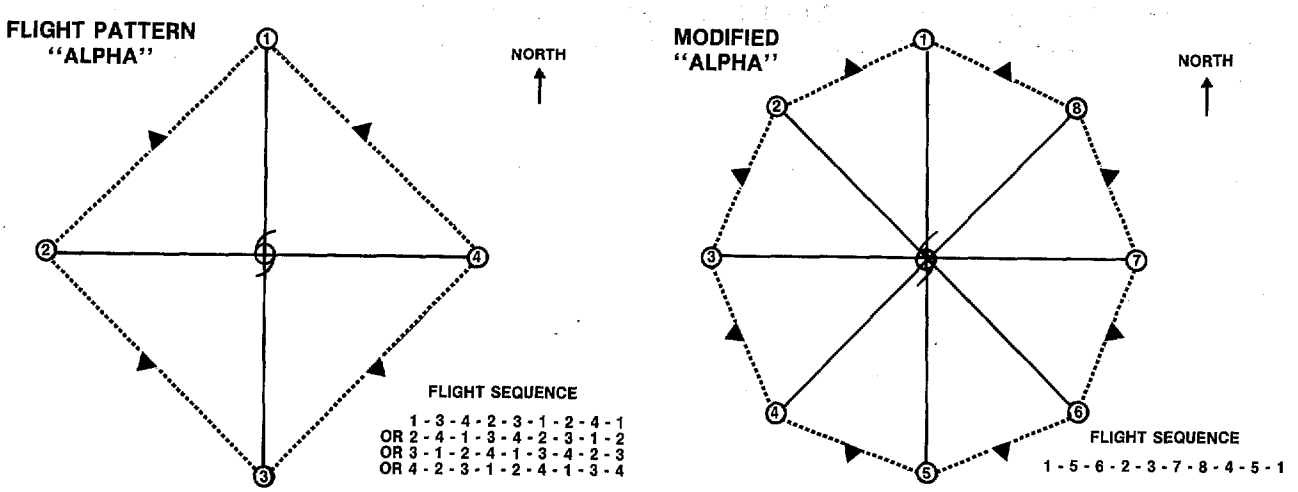


Figure 5-7. Flight patterns ALPHA and modified ALPHA.

5.8.1.2. Reconnaissance code (section 1 plus 4ddff) is required for each transit of a triangle (Δ) position in Figure 5-8. These data are transmitted immediately. Groups with the indicator 4 are included in observations only when surface winds are discernible. Open circle (O) positions indicate the beginning or ending of supplementary vortex data on inbound or outbound radials.

5.8.1.3. Supplementary vortex data are required for each radial flown inbound or outbound. Transmit data to the appropriate monitor at the end of each pair of inbound or outbound legs flown. When HD/HA data are available at CARCAH or NHC, the supplementary vortex data message is not required from the aircraft. The CARCAH or NHC will prepare and disseminate the sea-level pressure using Table 5-2 or an approved computer program.

5.8.1.5. Dropsonde data, when required in the periphery of the storm will be determined on a case-by-case basis and coordinated through the TCPOD.

5.8.1.6. The entry and exit track should be on one of the cardinal directions (see recommended pattern "A" execution, Figure 5-8). Prior to starting an inbound or an outbound track the aircrew should evaluate all available data, e.g., radar presentation, satellite photo, and select a course within plus or minus 20 deg of the cardinal direction. Once started on the course, every effort should be made to maintain a straight track and the tasked altitude unless flight safety becomes a factor.

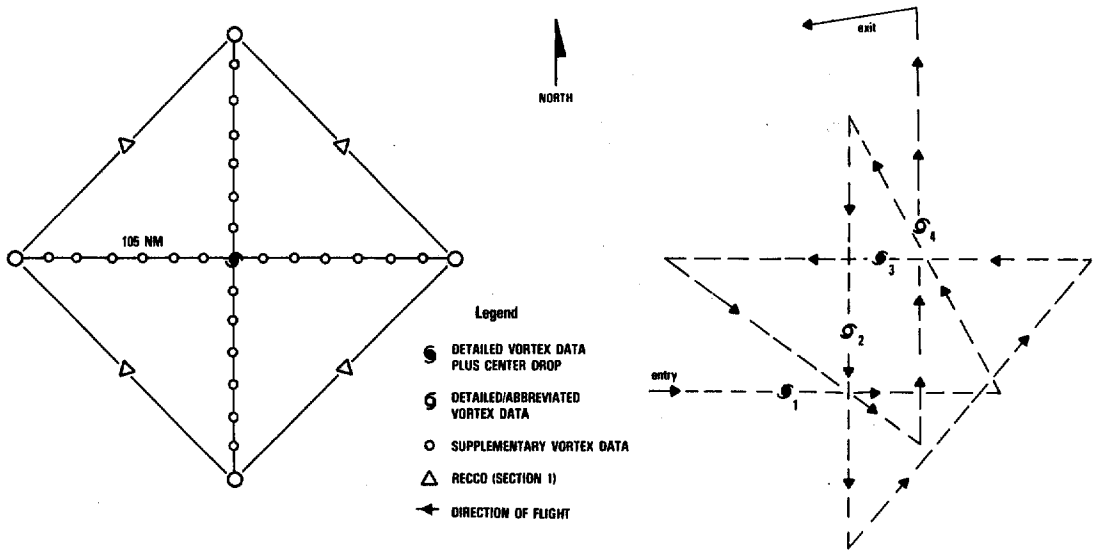


Figure 5-8. Recommended pattern ALPHA execution.

Table 5-2. Surface Pressure as a Function of 850-hPa Height for Normal Tropical Temperature in Summer.

850-hPa Ht (meters)	Sfc Press (hPa)	850-hPa Ht (meters)	Sfc Press (hPa)	850-hPa Ht (meters)	Sfc Press (hPa)
1626	1025	1403	999	1183	974
1618	1024	1394	998	1174	973
1609	1023	1386	997	1165	972
1601	1022	1377	996	1156	971
1592	1021	1368	995	1147	970
1584	1020	1359	994	1138	969
1575	1019	1351	993	1129	968
1567	1018	1342	992	1120	967
1558	1017	1333	991	1111	966
1550	1016	1324	990	1102	965
1541	1015	1316	989	1093	964
1532	1014	1307	988	1084	963
1524	1013	1298	987	1075	962
1515	1012	1289	986	1066	961
1507	1011	1280	985	1057	960
1498	1010	1272	984	1048	959
1489	1009	1263	983	1039	958
1481	1008	1254	982	1030	957
1472	1007	1245	981	1021	956
1464	1006	1236	980	1012	955
1455	1005	1227	979	1003	954
1446	1004	1218	978	993	953
1438	1003	1209	977	984	952
1429	1002	1201	976	975	951
1421	1001	1192	975	966	950
1412	1000				

Log P(Sfc) = 0.00005Z = Log 850, where Z = 850hPa height in meters

5.8.1.7. Lack of an automated data collection system on DOD aircraft may preclude complete and timely satisfaction of all requirements.

5.8.2. Operational Flight Pattern DELTA. Operational flight pattern Delta provides a suggested (but not the only) approach to the investigation of a disturbance to ascertain the existence or nonexistence of a closed circulation, supply RECCO observations in required areas, and locate the vortex center. This pattern is normally not tasked when a closed circulation has been identified and scheduled fixes are required. See Figure 5-9 for the pattern.

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

5.8.2.2. Reconnissance observations (Section 1 or 3, plus 4ddff and $9V_iT_WT_WT_W$ if applicable--see para 5.4.3.1.) are required approximately every 15 min and at major turn points. Section 3 observations will be appended to the next RECCO Section 1 observation and data will be transmitted at least every 30 min. If HD/HA data are available, transmit a Section 1 observation approximately every 15 min. The 4- or 9- group will not be reported if data are unavailable.

5.8.2.3. A detailed vortex data message is required if a vortex fix is made.

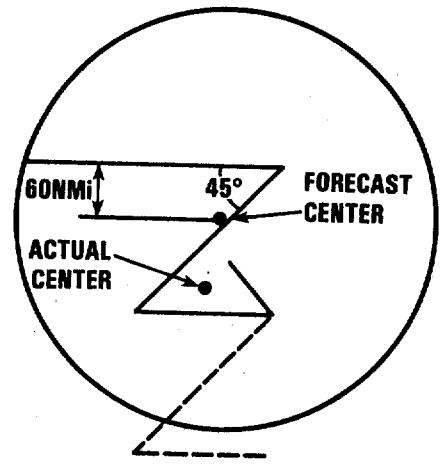


Figure 5-9. Flight pattern DELTA.

5.8.2.4. The DELTA pattern is designed to provide the flexibility required in the investigation of a distrubance as follows:

5.8.2.4.1. The pattern is converted west-east to a mirror image if entry is to be made from the east.

5.8.2.4.2. The length of the legs is to be adjusted during the pattern to coincide with cyclonic circulation wind shifts, i.e., turn points are selected by the flight meteorologist after observing appropriate sustained wind shifts.

5.8.2.4.3. If observed data indicate that the aircraft is on the southern side of the circulation, the pattern is converted south-north to a mirror image pattern to enable investigation in the proper areas.

5.8.2.4.4. If data indicate to the flight meteorologist that the aircraft is far north of any existing cirulation, the pattern is extended (as shown by the dashed lines) to allow further investigation.

5.8.2.4.5. If the location of the center becomes obvious, the pattern may be broken off to accomplish a vortex fix. Forecast agencies may request changes in the pattern as dictated by their data requirements.

5.9. Aircraft Reconnaissance Communications.

5.9.1. General. The USAF and NOAA aircraft will normally transmit reconnaissance observations via the Air Force Satellite Communications System (AFSATCOM), Aircraft-to-Satellite Data Link, or high frequency (HF) radio phone patch. Flight meteorologists should attempt to make voice contact with the CARCAH following the first fix and periodically throughout the mission, especially during invests.

5.9.2. Air-to-Ground Communications (HF Radio). The weather reconnaissance crew will relay weather data via direct telephone patch to the weather data monitor. Monitors will evaluate these reports and disseminate them to either the Automated Digital Weather Switch or the weather communications facility at Suitland, Maryland. When requested, aeronautical stations will provide a discrete frequency for mission use, if possible. Specific radio procedures and terminology will comply with Allied Communications Publication 125, Standard Telephone and Radio Procedures. Because of the perishable nature and potential operational impact of weather data, USAF has authorized the use of IMMEDIATE precedence for transmission of hurricane reconnaissance data. Data will be routed as follows:

- Primary. Direct phone patch between the aircraft and Miami Weather Monitor (Atlantic and Eastern Pacific) or Hickam Weather Monitor (Central Pacific).

- Secondary. Direct phone patch between the aircraft and any weather monitor.

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

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

5.9.4. Aircraft-to-Satellite Data Link (ASDL) Equipped Aircraft. Aircraft equipped with ASDL have the option to utilize the ASDL system using the following procedures (See Figure 5-10):

5.9.4.1. Data format. The following format will be used for data transmission by the ASDL system.

- One minute observation--all locations

```
(Message Header)        (Date/Time)
URNT40 KMIA             291630
(Platform Identifier)   (Date/Time-NESDIS)
15C9419C                23012 3220
(Mission Identifier)
NOAA2 0401A ANA
(Time) (Latitude) (Longitude) (Press Alt) (D Value)
1233   2803       08037      06173       +0436
(Wind) (Temperature) (Dew Point)
213010 ±138          ±096
(End of Message)
NNNN
```

- RECCO Observation--Atlantic Area

```
(Message Header)        (Date/Time)
URNT40 KMIA             291630
(Platform Identifier)   (Date/Time-NESDIS)
15C9419C                23012 3220
(Observation MANOP Heading)
URNT11 KMIA
(Mission Identifier)
NOAA2 0401A ANA OB 03
(RECCO Text)
97779 12428...  93275
(End of Message)
NNNN
```

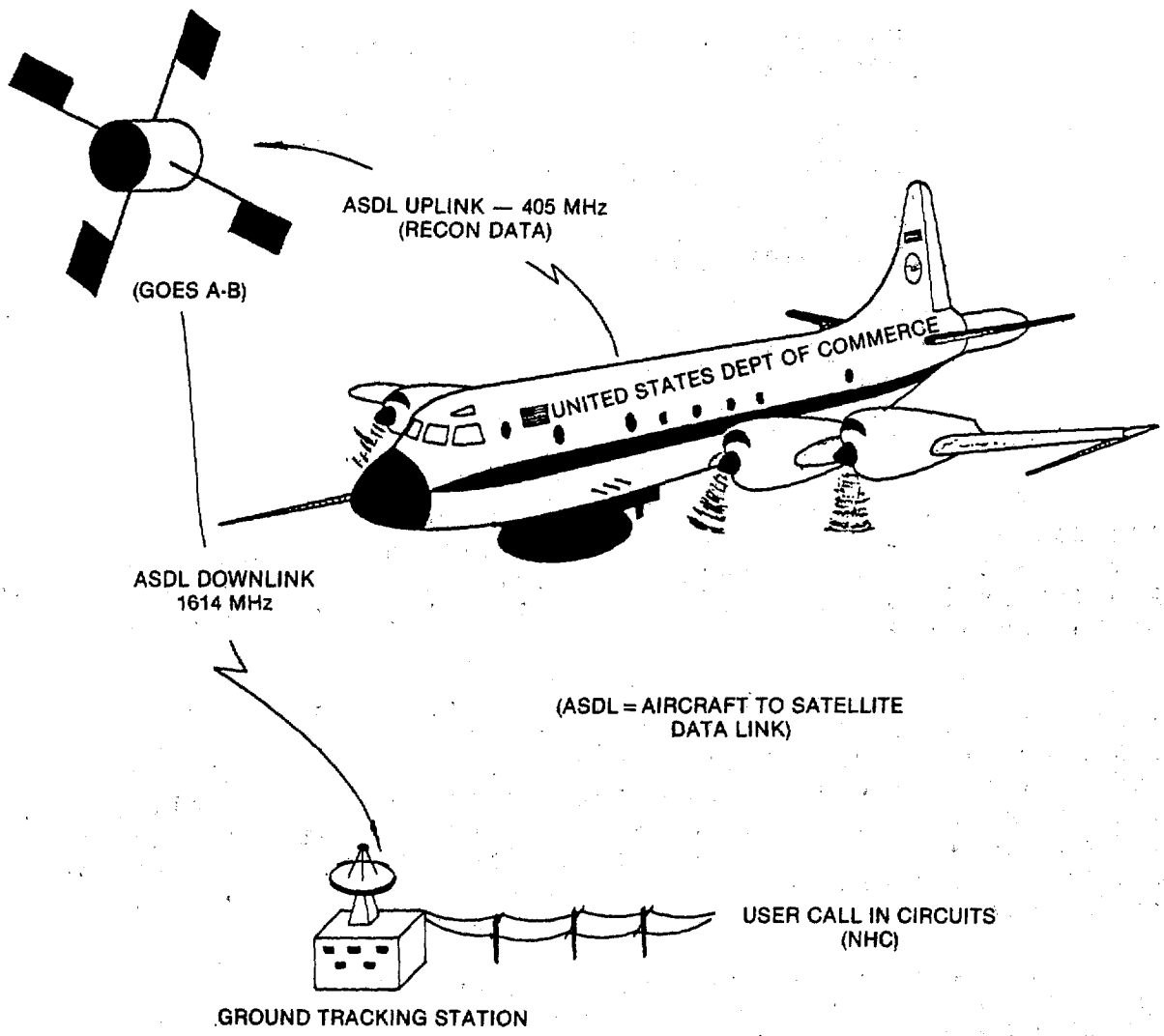


Figure 5-10. Schematic of aircraft-to-satellite data link for NOAA P-3 aircraft.

- RECCO Observation--Eastern and Central Pacific. This is the same as the one above except that the observation MANOP heading is URPN11 KMIA. [NOTE: 11 is used for routine tropical cyclone observations; 12 is used for vortex reports, etc.]

```
(Message Header)        (Date/Time)
URPN11 KMIA             291630
(Platform Identifier)   (Date/Time-NESDIS)
15C9419C                23012 3220
(Observation MANOP Heading)
UPRN11 KMIA
(Mission Identifier)
NOAA2 0401A ANA OB 03
(RECCO Text)
97779 12428...  93275
(End of Message)
NNNN
```

5.9.4.2. Data tranmission schedule. To aid the transmission of data from several aircraft through one circuit, each aircraft will be assigned a specific block of time within the 30-min interval for transmission of its data. The schedule is shown in Table 5-2.

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

5.9.5. Improved Weather Reconnaissance System (IWRS) Equipped Aircraft. The USAF aircraft equipped with IWRS will use the AFSATCOM data link with Keesler AFB, MS to relay data to the NHC via the AWN. Figure 5-11 depicts these communication links.

Table 5-3. ASDL data transmission schedule.

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

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

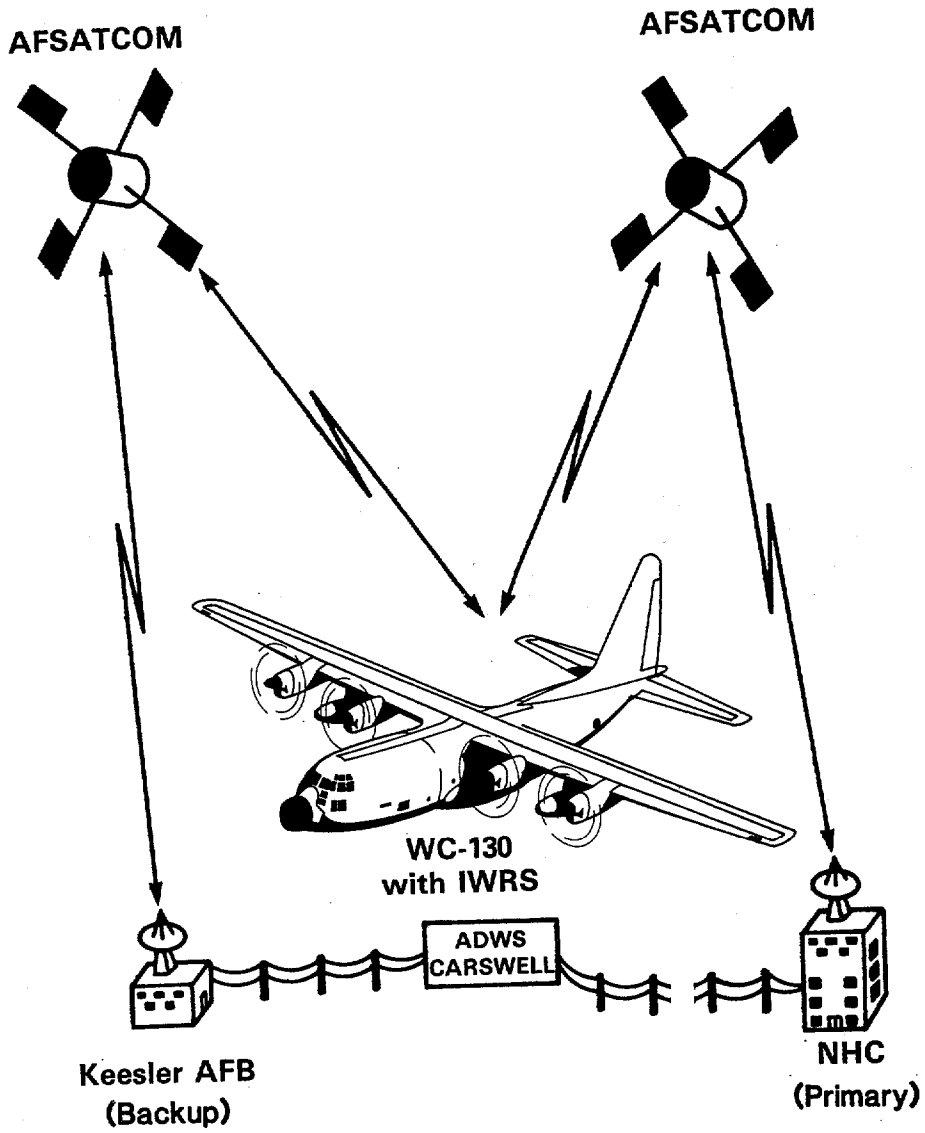


Figure 5-11. Schematic of AFSATCOM data link for USAF WC-130 aircraft.

CHAPTER 6

SATELLITE SURVEILLANCE OF TROPICAL AND SUBTROPICAL CYCLONES

6.1. Satellites.

6.1.1. Geostationary Operational Environmental Satellite (GOES). The GOES system currently consists of one operational spacecraft, GOES-7 at 108°W. The GOES-7 will move to 98°W in late spring of 1989 and return to 108°W in November, 1989. The principal GOES products are one-half hourly pictures with implanted grids automatically applied to all sectors. During daylight hours, approximately 1-, 2-, and 4-km resolution fixed standard sectors are produced. During the night (and during daylight) the same geographical coverage standard sectors are produced with 7-km resolution in infrared (IR). The IR data may be enhanced to emphasize various features. Also, 14-km resolution sectors of water vapor are available half-hourly. Floating sectors, which are scheduled by the Satellite Field Distribution Facilities (SFDF), are produced to augment the standard sector coverage. All products are delivered in near real time to the National Environmental Satellite, Data, and Information Service's (NESDIS) Synoptic Analysis Branch (SAB), the SFDF's, and Weather Service Forecast Offices (see Table 6-1).

6.1.2. National Oceanic and Atmospheric Administation (NOAA) Polar-orbiting Satellites. These Television Infrared Observation Satellites cross the United States twice daily near the equatorial crossing times indicated in Table 6-1. Data are available via direct readout--high resolution picture transmission (HRPT) or automatic picture transmission (APT)--or central processing. Data from the Advanced Very High Resolution Radiometer (AVHRR) are available on a limited basis through the GOES distribution system (Figure 6-1). The Air Force Global Weather Central (AFGWC), Offutt AFB, NE, receives global NOAA imagery data direct from central readout sites on a pass-by-pass basis. Data are processed in mapped and unmapped form for use internally.

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; phone numbers are in Appendix H.

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

SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
GOES-7	VAS	Every 30 min (24 hr/day) Limited scan for short-interval viewing available.)	1. 1-, 2-, and 4-km resolution visible standard sectors covering Western, Midwest, and Eastern United States. 2. 7-km resolution equivalent IR standard sectors for U.S. (night) 3. Equivalent IR-enhanced imagery. 4. Floating sectors at 1-2-, and 4-km resolution (visible) (equivalent to 7-km resolution IR) 5. Full disc IR (day and night) 6. 14-km resolution water vapor sectors (day and night) 7. Wind analysis 8. Cloud top heights 9. VDUC-derived products: Deep layer mean wind, wind analysis, and moisture imagery. 10. Moisture analysis
NOAA-10	AVHRR GAC and LAC (recorded) HRPT and APT (direct) TOVS	0740/1940	1. Mapped imagery 2. Unmapped imagery (all data types) at DMSP sites. 3. Sea-surface temperature analysis 4. Soundings
NOAA-11	GAC and LAC (recorded) HRPT and APT (direct) TOVS	1340/0140	

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

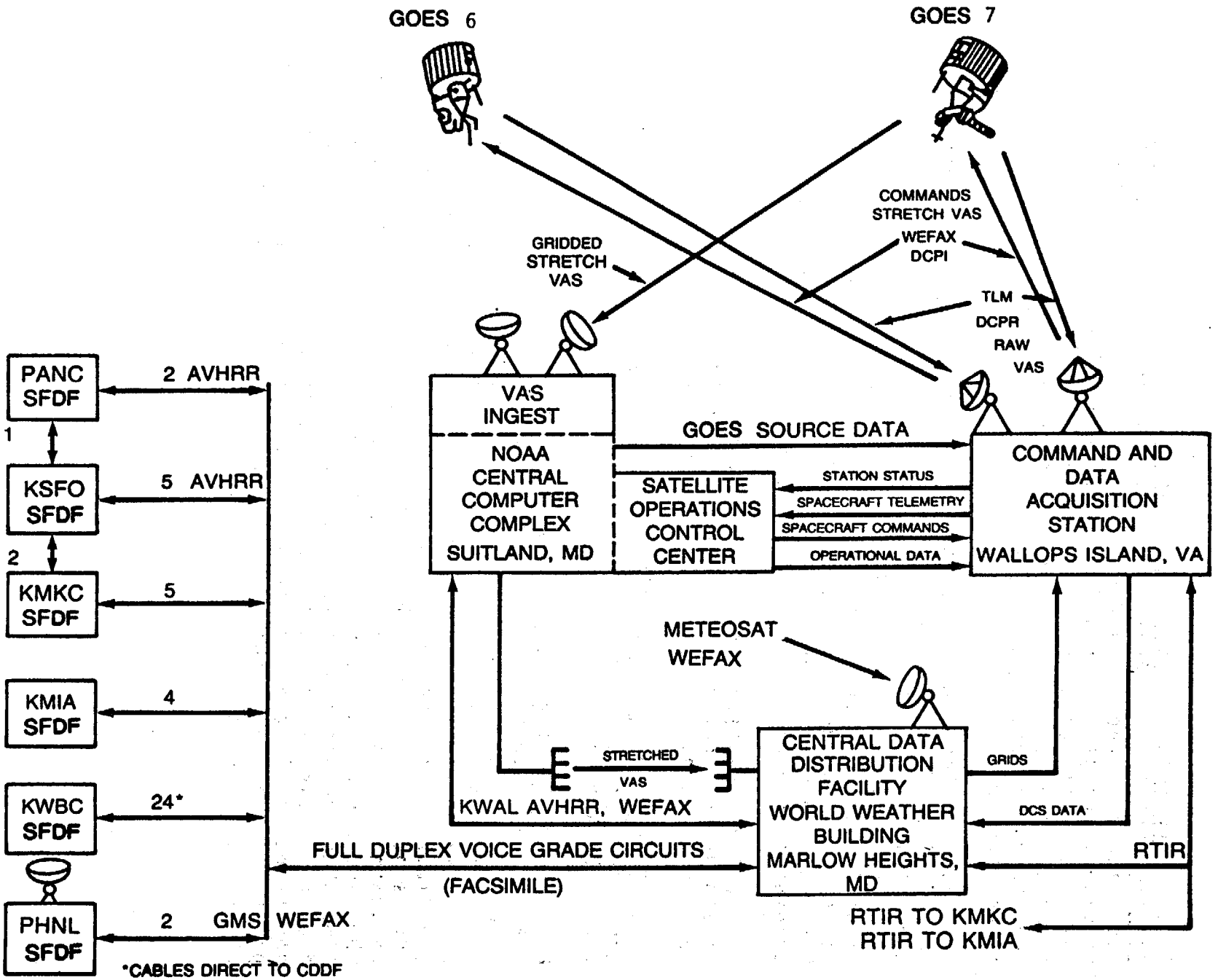
SATELLITE	TYPE OF DATA	LOCAL TIME	PRODUCTS
DMSP F-8	Operational Linescan System (OLS) (recorded and direct) Microwave temperature sounder (SSM/T) (recorded) Microwave imager (SSM/I) (recorded)	0611/1811	1. AFGWC 1.5 nmi resolution visual and infrared imagery. 2. Hickam Direct Readout 0.3 and 1.5 nmi resolution visual and infrared imagery. 3. SSM/T data transmitted to NESDIS via shared processing. 4. SSM/I data validation ongoing.
DMSP F-9	OLS imagery (recorded and direct) SSM/T (recorded)	0930/2130	

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

- Satellite tropical disturbance summaries
- Satellite interpretation messages
- Tropical weather discussions
- Tropical disturbance rainfall estimates

6.2.3. Satellite Tropical Disturbance Summary. The Miami, San Francisco, and Honolulu SFSSs distribute satellite summaries (see Figure 6-2 for an example) twice daily at the times indicated in Table 6-2. These describe significant weather in tropical regions of the Atlantic, Eastern Pacific, and Central Pacific (north and south between 140°W and 100°W), respectively.

6.3. NESDIS Synoptic Analysis Branch. The SAB operates 24 hr a day to provide satellite support to the National Meteorological Center. The SAB also distributes twice daily a satellite tropical disturbance summary for the Indian Ocean. Telephone numbers for the SAB are in Appendix H.


GOES 6
GOES 7
COMMANDS
STRETCH VAS
WEFAX
DCPI
GRIDDED
STRETCH
VAS
TLM
DCPR
RAW
VAS
PANC
SFDF
2 AVHRR
1
KSFO
SFDF
5 AVHRR
2
KMKC
SFDF
5
KMIA
SFDF
4
KWBC
SFDF
24*
PHNL
SFDF
2 GMS WEFAX
*CABLES DIRECT TO CDDF
VAS
INGEST
NOAA
CENTRAL
COMPUTER
COMPLEX
SUITLAND, MD
GOES SOURCE DATA
SATELLITE
OPERATIONS
CONTROL
CENTER
STATION STATUS
SPACECRAFT TELEMETRY
SPACECRAFT COMMANDS
OPERATIONAL DATA
COMMAND AND
DATA
ACQUISITION
STATION
WALLOPS ISLAND, VA
METEOSAT
WEFAX
STRETCHED
VAS
KWAL AVHRR, WEFAX
CENTRAL DATA
DISTRIBUTION
FACILITY
WORLD WEATHER
BUILDING
MARLOW HEIGHTS,
MD
GRIDS
DCS DATA
RTIR
FULL DUPLEX VOICE GRADE CIRCUITS
(FACSIMILE)
RTIR TO KMKC
RTIR TO KMIA

6.4. AFGWC Support and the Defense Meteorological Satellite Program (DMSP). The AFGWC uses all available meteorological satellite data when providing fix information. The DMSP will provide coverage of tropical and subtropical cyclones whenever possible. Data covering the National Hurricane Operations Plan areas of interest are received centrally at AFGWC and locally at the direct readout site at Detachment 4, 20th Weather Squadron, Hickam AFB, HI.

6.4.1. North Atlantic and Central Pacific Surveillance. The AFGWC readouts will augment NESDIS surveillance for the North Atlantic and Central Pacific. The AFGWC will transmit teletype bulletins describing the location and intensity classification of the system, in the format shown in Figure 6-3, to the National Hurricane Center (NHC) or Central Pacific Hurricane Center, as appropriate, on organized disturbances evident at the tropical classification one (T-1) or higher.

6.4.2. Eastern Pacific Surveillance. If the NHC determines the coverage from available NESDIS satellites should be supplemented, they will request the data from AFGWC.

6.5. Satellites and Satellite Data Availability for the Current Hurricane Season. Table 6-1 lists satellite capabilities for the 1989 hurricane season.

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

```
==================================================================
ABXX15 KMIA 210800Z

SATELLITE TROPICAL DISTURBANCE SUMMARY

ALL MOVEMENTS AND TRENDS 24 HOURS UNLESS OTHERWISE STATED

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

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

ATLANTIC GOES EAST IR NITE 210630Z

NO TROPICAL STORMS OBSERVED

ITC 3 TO 5 DEG WIDE FM 10N 20W TO 14N 50W IS MSTLY BRKN AND
MDTLY ACTV WITH LTL GHG.  BRKN ACTV ITC FM 14N 50W TO 17N 57W 4
DEG WIDE HAS INCREASED IN WIDTH.
==================================================================
*Whenever a tropical system is located in the Atlantic,
Caribbean, Eastern, or Central Pacific, Part 1 will carry the
following statement:  "See latest (NHC or CPHC) advisory(ies)."
```

Figure 6-2. Sample satellite tropical disturbance summary.

MESSAGE HEADING:
TPNT CCCC

A CYCLONE DESIGNATOR	A.	Designator of tropical cyclone category including name/number. When a cloud system has not yet been designated by name/number enter TROPICAL DISTURBANCE. Sample entry: TROPICAL STORM AMY (15)
B DATE/TIME (Z) OF FIX	B.	Date and nodal crossing time in Zulu; round time to nearest minute. Sample entry: 252303Z
C LATITUDE OF POSITION	C.	Latitude to nearest tenth of degree (N or S), followed by checksum. Sample entry: 29.9N/0
D LONGITUDE OF POSITION	D.	Longitude to nearest tenth of degree followed by checksum. Sample entry: 56.7 W/8
E POSITION CODE NUMBER	E.	Enter Position Code number (PCN) and source of data (DMSP, NOAA 2, etc.). Spell out PCN number. Select PCN number from code below: GEOGRAPHICAL GRIDDING ONE: eye fix THREE: well defined circulation center FIVE: poorly defined circulation center EPHEMERIS GRIDDING TWO: eye fix FOUR: well defined circulation center SIX: poorly defined circulation center Sample entry: ONE/DMSP
F DVORAK CLASSIFICATION	F.	Dvorak classification for storm intensity as described in NOAA technical Memorandum NESS 45 and 1WW/TN-81/001. Dvorak classification will be made once each day and must be based on visual data. If a new Dvorak classification number cannot be derived, use the last reported number. Include in parenthesis the date and nodal time of the data on which the Dvorak analysis is based. Sample entry: T 4.5/4.5/D1.0/25HRS (252305Z)
G REMARKS	G.	Include information, as appropriate, on data type, eye characteristics, spiral rainbands, unexpected changes in storm movement, departures from Dvorak (modelled) intensities, etc.

Figure 6-3. Center fix data form and message format (satellite).

Table 6-2. Communications headings for satellite tropical disturbance summaries.

HEADING	TIME ISSUED	OCEANIC AREA	TYPE OF DATA
TCI010 KWBC	1100 UTC	Indian Ocean	VIS
TCI011 KWBC	2300 UTC	Indian Ocean	IR Day
TCPW11 PHNL	1000 UTC	Western Pacific (north and south of 100°E to 175°W)	IR Night
TCPW10 PHNL	2200 UTC	Western Pacific (north and south of 100°E to 175°W)	VIS/IR Day
TCPA11 PHNL	1000 UTC	Central Pacific (north and south of 175°W to 140°W)	IR Night
TCPA10 PHNL	2200 UTC	Central Pacific (north and south of 175°W to 140°W)	VIS/IR Day
TCPW11 PHNL	0500 UTC	Western Pacific (north and south of 170°E)	VIS

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

C.I. NUMBER	MAXIMUM WIND SPEED	T-NUMBER	MINIMUM SEA-LEVEL PRESSURE (Atlantic)	(NW Pacific)
1	25 kt	1		
1.5	25	1.5		
2	30	2	1009 hPa	1003 hPa
2.5	35	2.5	1005	999
3	45	3	1000	994
3.5	55	3.5	994	988
4	65	4	987	981
4.5	77	4.5	979	973
5	90	5	970	964
5.5	102	5.5	960	954
6	115	6	948	942

CHAPTER 7

SURFACE RADAR REPORTING

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

7.2. Procedures.

7.2.1. Radar observations of tropical cyclones will be made in accordance with the Federal Meteorological Handbook (FMH)-7, Part A, Weather Radar Observations. Stations that normally transmit hourly radar weather observations (network stations) will include tropical cyclone features in routine reports at 35 min past the hour (H+35) and will make and transmit special observations at H+10 whenever an eye or center is observed. It is highly desirable for stations that do not normally transmit hourly reports (local warning radars) to make and transmit a radar observation whenever an eye, center, or spiral band is observed. The local warning radar sites may transmit only abbreviated special observations, defined in FMH-7, at H+10 and H+35. The Air Weather Service (AWS) units at MacDill AFB and Tyndall AFB, Florida will take and transmit radar reports, to include tropical cyclone features, at H+10 and H+35 whenever an eye or center is observed. All other AWS radar units will take and transmit such reports at H+35.

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

7.2.3. Timely transmission of tropical cyclone radar reports is essential. Normally, radar reports are transmitted over the Automation of Field Operations and Service System or the CONUS Meteorological Data System circuit equipment. Radar facilities not having weather transmission capability may call the nearest National Weather Service Office collect.

7.3. Special Provisions.

7.3.1. If NWS network radars (WSR-57s and selected WSR-74s) and DOD weather radar facilities are collocated (within 25 nmi), the NWS radar will have the primary responsibility for making and transmitting tropical cyclone radar reports; DOD will provide backup service. If a radar facility is less powerful than the WSR-57 and is collocated with a North American Aerospace Defense Command (NORAD) long-range radar facility, the NORAD long-range radar facility will have the primary responsibility for making and transmitting tropical cyclone radar reports provided it is manned by a qualified weather radar operator. The less powerful radar facility will provide backup service. Any backup radar facility, however, may transmit radar reports as desired.

7.3.2. If radar reports are needed from NORAD long-range radar facilities, NWS will dispatch weather radar specialists to those facilities to make and transmit tropical cyclone radar observations. The DOD has authorized the Director, NWS, to dispatch NWS radar specialists to NORAD sites during critical hurricane threats to make and transmit hurricane radar observations. Specific procedures regarding notification, access to sites, clearances, etc., as agreed to by DOD and NWS will be the responsibility of the Warning and Forecast Branch, Office of Meteorology, NWS Headquarters, and will be strictly adhered to.

7.3.3. Air Weather Service staff weather officers providing support to NORAD long-range radar units act as coordinators for visits. These coordinators are the listed below. Telephone numbers are in Appendix H. Participating radar sites are listed in Table 7-1.

- Commander, Detachment (Det) 9, 3rd Weather Squadron (WS) for the Southeast Air Defense Sector, Tyndall AFB, FL.

- Commander, Det 8, 26 WS, for the Northeast Air Defense Sector, Griffiss AFB, NY.

- Commander, Det 4, 20 WS, Hawaii Regional Operations Control Center (ROCC), Hickam AFB, HI,

7.3.4. The radar used depends upon the location of the hurricane; the one in use will be properly identified.

Table 7-1. Participating radar stations.

LOCATION	TYPE RADAR	LATITUDE	LONGITUDE
NATIONAL WEATHER SERVICE RADARS			
Apalachicola, FL	WSR-57	29°44'N	84°59'W
Atlantic City, NJ	WSR-57	39°27'N	74°35'W
Baton Rouge, LA#	WSR-74C	30°32'N	91°90'W
Brownsville, TX	WSR-57	25°54'N	97°26'W
Cape Hatteras, NC	WSR-57	35°16'N	75°33'W
Charleson, SC	WSR-57	32°54'N	80°02'W
Chatham, MA	WSR-74S	41°39'N	69°57'W
Corpus Christi, TX	WSR-74C	27°46'N	97°30'W
Daytona Beach, FL	WSR-57	29°11'N	81°03'W
Galveston, TX	WSR-57	29°18'N	94°48'W
Jackson, MS	WSR-57	32°19'N	90°05'W
Key West, FL	WSR-57	24°33'N	81°45'W
Lake Charles, LA	WSR-57	30°07'N	93°13'W
Los Angeles, CA#	WSR-74C	34°03'N	118°27'W
Miami, FL	WSR-57	25°43'N	80°17'W
Mobile, AL#	WSR-74C	30°41'N	88°15'W
Mt Laguna, CA	FPS-7	32°53'N	116°25'W
New York City, NY	WSR-57	40°46'N	73°59'W
Patuxant, MD	WSR-74S	38°17'N	76°25'W
Pensacola, FL	WSR-57	30°21'N	87°19'W
Portland, ME	WSR-57	43°39'N	70°18'W
San Jaun, PR	FPS-67*	18°16'N	65°46'W
San Padro, CA	ARSR	33°45'N	118°20'W
Savannah, GA	WSR-74C	32°08'N	81°12'W
Slidell, LA	WSR-57	30°17'N	89°49'W
Tampa, FL	WSR-57	27°42'N	82°24'W
Victoria, TX#	WR-100-5	28°51'N	96°55'W
Volens, VA	WSR-74S	36°57'N	79°00'W
Waycross, GA	WSR-57	31°15'N	82°24'W
West Palm Beach, FL#	WSR-74S	26°41'N	80°06'W
Wilmington, NC	WSR-57	34°16'N	77°55'W
DEPARTMENT OF DEFENSE			
Andrews AFB, MD	FPS-77	38°48'N	76°53'W
Barksdale AFB, LA	FPS-77	32°30'N	93°40'W
Bermuda NAS	FPS-106	32°22'N	64°41'W
Cape Canaveral AFS, FL	FPQ-21	28°28'N	80°33'W
Chase Field NAS, TX	FPS-106	28°22'N	97°40'W
Cherry Point MCAS, NC	FPS-106	34°54'N	76°53'W
Corpus Christi NSA, TX	FPS-106	27°42'N	97°16'W
Eglin AFB, FL	FPS-77	30°29'N	86°31'W
Homestead AFB, FL	FPS-77	25°29'N	80°23'W

Howard AFB, CZ	FPQ-21	08°77'N	79°36'W
Hurlbert Field, FL	FPQ-21	30°26'N	86°41'W
Jacksonville NAS, FL	FPS-106	30°14'N	81°41'W
Keesler AFB, MS	FPS-77	30°24'N	88°55'W
MacDill AFB, FL	FPS-77	27°51'N	82°30'W
McGuire AFB, NJ	FPS-77	40°00'N	74°36'W
New Orleans NAS, LA	FPS-106	29°50'N	90°01'W
Norfork NAS, VA	FPS-106	36°56'N	76°18'W
Pope AFB, NC	FPQ-21	35°12'N	79°01'W
Randolph AFB, TX	FPS-77	29°32'N	98°17'W
Robins AFB, GA	FPS-77	32°38'N	83°36'W
Seymour Johnson AFB, NC	FPS-77	35°20'N	77°58'W
Guantanamo Bay, Cuba	FPS-106	19°54'N	75°10'W
Roosevelt Roads, PR	FPS-106	18°15'N	65°38'W
Hickam AFB, HI	FPQ-21	20°19'N	157°55'W
NORAD SITES			
Northeast Air Defense Sector			
OLAF, 23ADS, Patrick AFB, FL**		28°13'N	80°36'W
OLAD, 23ADS, Ft Lonesome, FL**		27°36'N	82°06'W
OLAJ, 23ADS, Key West NAS, FL		24°35'N	81°41'W
678 RS, Tyndall, AFB, FL**		30°05'N	85°37'W
701 RS, Ft Fisher AFS, NC		33°59'N	77°55'W
OLAC, 23ADS, Jedburg, SC		33°06'N	80°12'W
Southeast Air Defense Sector			
762 RS, North Truro AFS, MA		42°02'N	70°03'W
772 RS, Gibbsboro AFS, NJ		39°79'N	74°57'W
OLAA, 24ADS, Sulfolk, NY		40°54'N	72°42'W
OLAE, 24ADS, Bucks Harbor, ME		44°38'N	67°24'W
HAWAII ROCC			
150 AC&WS, Kokee, AFS, HI		22°09'N	159°39'W
169 AC&WS, Mt Kaala AFS, HI		21°30'N	158°08'W
COOPERATING SITES			
NASA			
Bay St Louis, MS	CPS-9	30°42'N	89°07'W
Wallops Station, VA	MPS-19	37°50'N	75°29'W
	SPS-12	37°56'N	75°28'W
	FPS-16	37°50'N	75°29'W
	FPQ-6	37°52'N	75°31'W
Universities			
MIT	CPS-9	42°42'N	71°06'W
	M-33	42°42'N	71°06'W
Texas A&M	CPS-9	30°37'N	96°21'W
Univ of Miami	SP-1M	25°43'N	80°17'W
	CPS-68	25°43'N	80°17'W

*FAA-USN joint-use radar,**Remoted to FAA ARTCC,#Local Warning Radar

CHAPTER 8

NATIONAL DATA BUOY CENTER REPORTING STATIONS

8.1. General.

8.1.1. The National Data Buoy Center (NDBC) maintains automated reporting stations in the Gulf of Mexico, off the east and west coasts of the United States, and at coastal land areas. Also, a stockpile of four rapid response drifting data buoys are available for aerial deployment in the event of emergencies. These data acquisition systems obtain measurements of meterological and oceanographic parameters for operations and research purposes. Moored buoy station locations and configurations are given in Table 8-1. The location of Coastal Marine Automated Network (C-MAN) stations are listed in Table 8-2 and shown in Figure 8-4. The status and capability of stations can be obtained from the Data Systems Division, NDBC.

8.1.2. Moored buoy and C-MAN stations routinely acquire, store, and transmit data every hour. Data obtained operationally include sea-level pressure, wind speed and direction, air temperature, sea-surface temperature, and wave spectral data.

8.1.3. Drifting buoys are available in two types called Wind Speed Direction (WSD) and Air Sea Interaction Drifter (ASID). A WSD buoy measures sea-level pressure, wind speed and direction, air temperature, and sea-surface temperature. An ASID buoy measures the same parameters and can be configured with a subsurface thermistor array to measure hydrostatic pressure and subsurface ocean temperature. See Figure 8-1.

8.2. Requests for Drifting Buoy Deployment. The Department of Commerce (DOC) through the National Atmospheric and Oceanic Administration (NOAA) will initiate a request through the Office of the Federal Coordinator for Meteorological Services and Supporting Research to the U.S. Air Force (USAF) for each desired aerial deployment of drifting data buoys for a pre-storm array in the Atlantic or Pacific Oceans. Normally, USAF C-130 or C-141 aircraft are tasked for this mission; the 53rd Weather Reconnaissance Squadron or the 815th Weather Operations Flight are not capable of deploying drifting data buoys. Requests for deployment should allow at least a 30-day lead time. For deployments in advance of a U.S. land-threatening hurricane,

a 36- to 48-hr notification is required. All requests will include specifics regarding onloading base, accompanying technicians, desired pickup times, offload points, reimbursement funding, and any other pertinent data.

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

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

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

8.2.3. The final deployment position will be provided prior to the flight crew briefing. Two examples of possible buoy deployment patterns are shown in Figure 8-2.

8.3. Communications. Moored buoy and C-MAN data are transmitted by ultra-high frequency communications via the Geostationary Operational Environmental Satellite to the National Enviromental Satellite, Data, and Information Service and then are relayed on to the National Meteorlogical Center (NMC) for processing and dissemination. Moored buoy data are formatted into the World Meteorological Organization (WMO) FM 13-IX ship code, and C-MAN data are formatted into C-MAN code, which is very similar to the WMO FM 12-IX synoptic code. These codes are defined in Federal Meteorlogical Handbook 2, Surface Synoptic Codes. Drifting buoy data are telemetered through the NOAA polar orbiting satellites to the U.S. ARGOS Global Processing Center, Landover Maryland, for processing. These data are formatted by Service ARGOS into the WMO FM 14-VIII (DRIBU) code defined in the WMO Manual on Codes, Volume I, and then are routed to NMC over the Global Telecommunications Service for distribution and dissemination to users in the United States.

Table 8-1. Data buoy locations and configuration.

STATION ID	LOCATION	BUOY SIZE	SENSOR HEIGHT
MOORED BUOYS IN THE GULF OF MEXICO			
42001	25.9°N 89.7°W	10 m	10 m
42002	26.0°N 93.5°W	10 m	10 m
42003	26.0°N 85.9°W	10 m	10 m
42007	30.1°N 88.9°W	12 m	10 m
42015 *	30.1°N 88.2°W	3 m	5 m
42016 *	30.2°N 88.1°W	3 m	5 m
MOORED BUOYS IN THE ATLANTIC OCEAN			
41001	34.9°N 72.9°W	6 m	5 m
41002	32.3°N 75.3°W	6 m	5 m
41006	29.3°N 77.4°W	6 m	5 m
41008 *	30.7°N 81.1°W	3 m	5 m
41009 *	28.5°N 80.2°W	3 m	5 m
41010 *	28.9°N 78.6°W	10 m	10 m
44004	38.5°N 70.6°W	6 m	5 m
44005	42.7°N 68.3°W	6 m	5 m
44007	43.5°N 70.1°W	12 m	13 m
44008	40.5°N 69.5°W	12 m	13 m
44009	38.5°N 74.6°W	12 m	13 m
44011	41.1°N 66.6°W	6 m	5 m
44012	38.8°N 74.6°W	12 m	13 m
44013	42.4°N 70.8°W	12 m	13 m
MOORED BUOYS IN THE PACIFIC OCEAN			
46011 *	34.9°N 120.9°W	10 m	10 m
46023 *	34.3°N 120.7°W	10 m	10 m
46025 *	33.7°N 119.1°W	10 m	10 m
51001	23.4°N 162.3°W	6 m	5 m
51002	17.2°N 157.8°W	6 m	5 m
51003	19.2°N 160.8°W	6 m	5 m
51004	17.5°N 152.5°W	6 m	5 m
DRIFTING BUOYS			
STATION ID	LOCATION	BUOY SIZE	ANEMOMETER HEIGHT
WMO 5-digit identifier assigned immediately before deployment	Variable	ASID or WSD	1 m

* Temporary sites established in support of other programs.

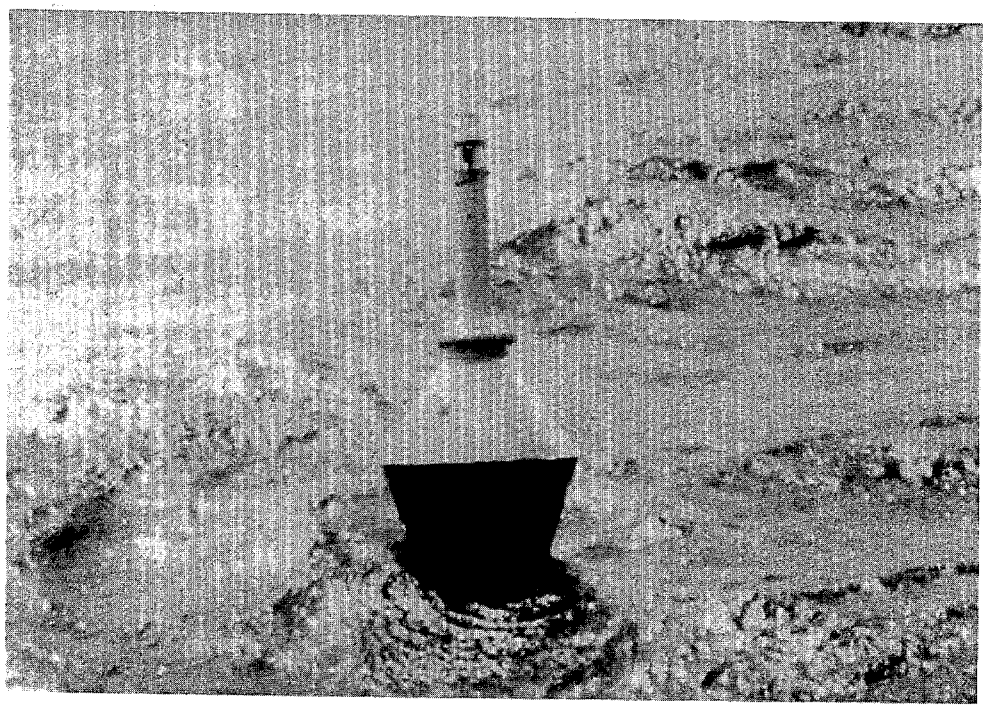


Figure 8-1. A drifting data buoy.

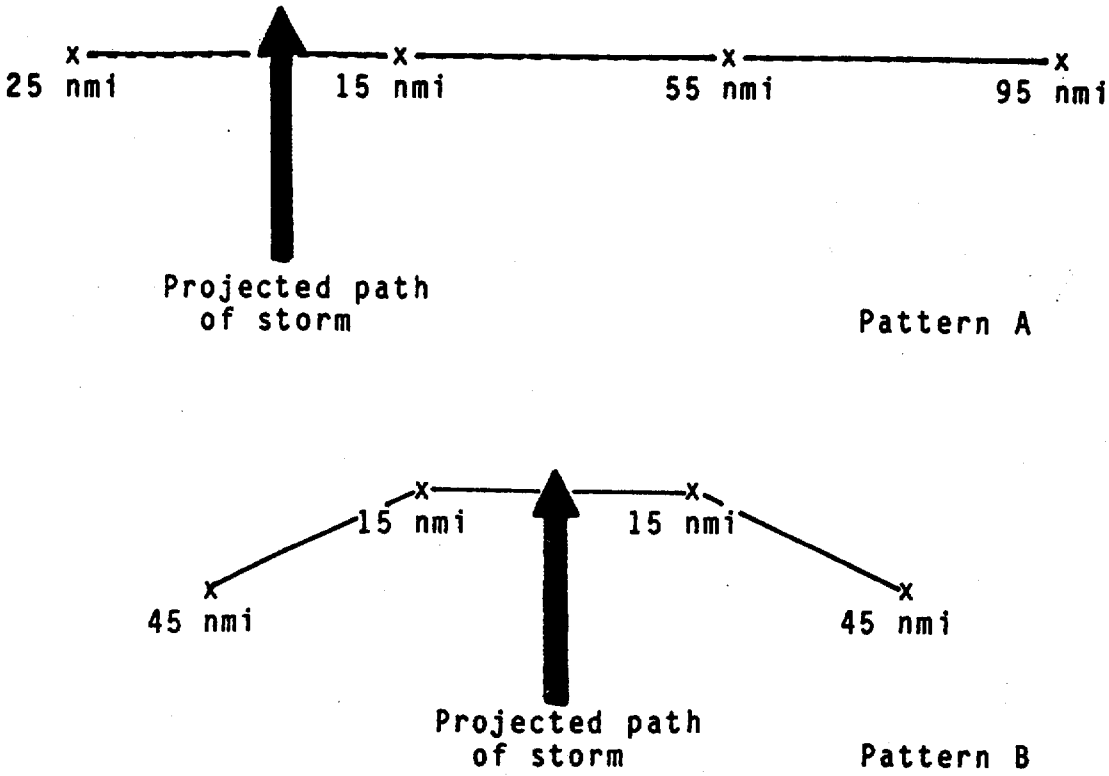


Figure 8-2. Drifting buoy deployment patterns.

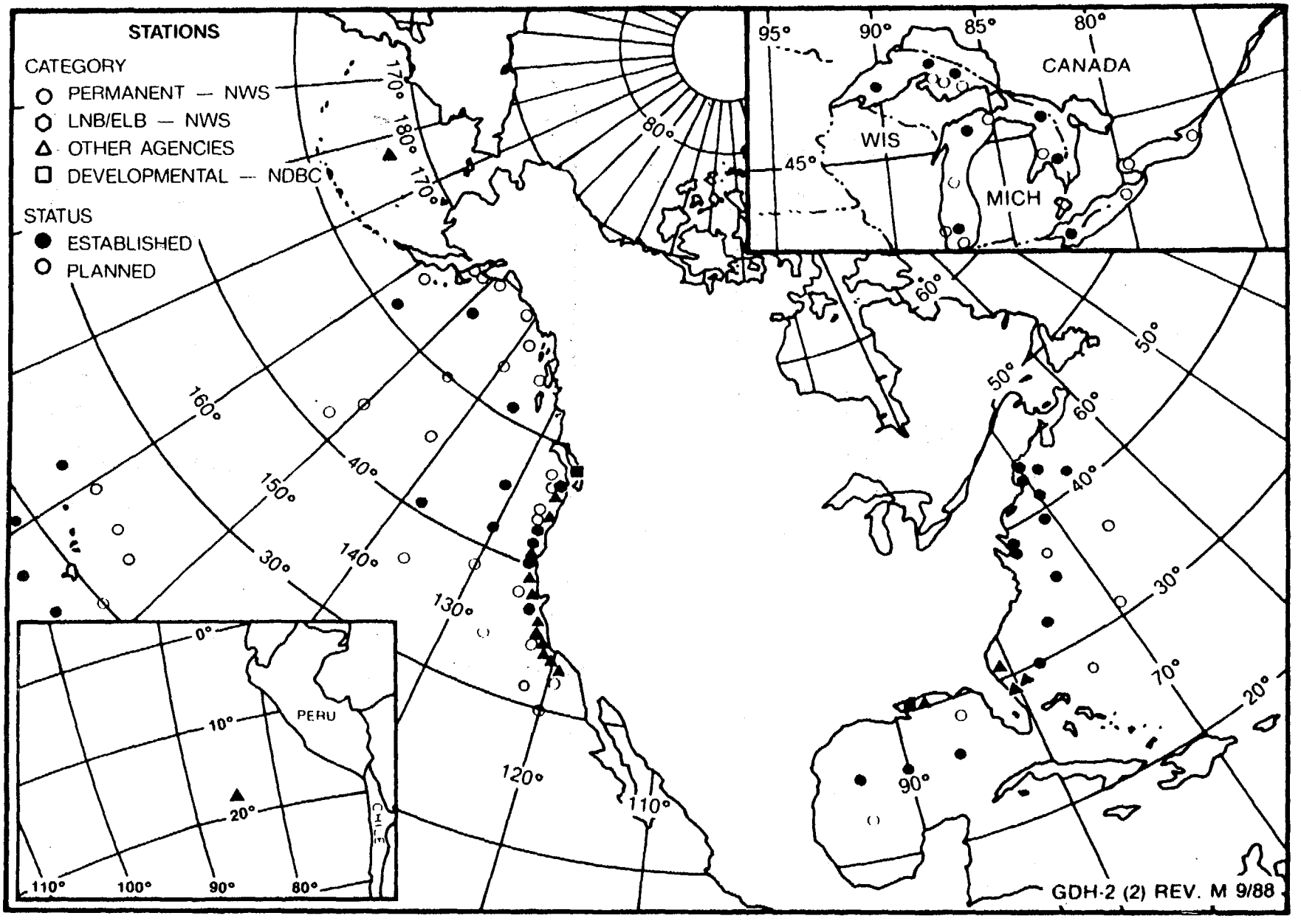


Figure 8-3. NDBC buoy locations.

Table 8-2. C-MAN sites.

STATION ID	LOCATION	STATION NAME
	C-MAN SITES IN THE GULF OF MEXICO	
BURL1	28.9°N 89.4°W	Southwest Pass, LA
CSBF1	29.7°N 85.4°W	Cape San Blas, FL
DPIA1	30.3°N 88.1°W	Dauphin Island, AL
GDIL1	29.3°N 90.0°W	Grand Isle, LA
MPCL1 *	29.4°N 88.6°W	Main Pass Block 133C
PTAT2	27.8°N 97.1°W	Port Aransas, TX
SRST2	29.7°N 94.1°W	Sabine, TX
	C-MAN SITES IN THE ATLANTIC OCEAN	
ALSN6	40.5°N 73.8°W	Ambrose Light, NY
BUZM3	41.4°N 71.0°W	Buzzards Bay, MA
CHLV2	36.9°N 75.7°W	Chesapeake, Light, VA
CLKN7	34.6°N 76.5°W	Cape Lookout, NC
DSLN7	35.2°N 75.3°W	Diamond Shoals, NC
FBIS1	32.7°N 79.9°W	Folly Island, SC
FPSN7	33.5°N 77.6°W	Frying Pan Shoals, NC
IOSN3	43.0°N 70.6°W	Isle of Shoals, NH
LKWF1	26.6°N 80.0°W	Lake Worth, FL
MDRM1	44.0°N 68.1°W	Mt Desert Rock, ME
MISM1	43.8°N 68.9°W	Mantinicus Rock, ME
MLRF1	25.0°N 80.4°W	Molasses Reef, FL
SAUF1	29.9°N 81.3°W	St. Augustine, FL
SPGF1	26.7°N 79.0°W	Settlement Point, GBI
SVLS1	32.0°N 80.7°W	Savannah Light, FL
SMKF1	24.6°N 81.1°W	Sombrero Key, FL
TPLM2	38.9°N 76.4°W	Thomas Point, MD
VENF1	27.1°N 82.5°W	Venice, FL
	C-MAN SITES IN THE PACIFIC OCEAN	
CARO3	43.3°N 124.4°W	Cape Arago, OR
DESW1	47.7°N 124.5°W	Destruction Island, WA
FFIA2	57.3°N 133.6°W	Five Finger Light, AK
NWPO3	44.6°N 124.1°W	Newport, OR
PTAC1	39.0°N 123.7°W	Point Arena, CA
PTCG1	34.6°N 120.7°W	Point Arguello, CA
SISW1	48.3°N 122.8°W	Smith Island, WA
TTIW1	48.4°N 124.7°W	Tatoosh Island, WA
WPOW1	47.7°N 122.4°W	West Point, WA

* Temporary site established in support of other programs.

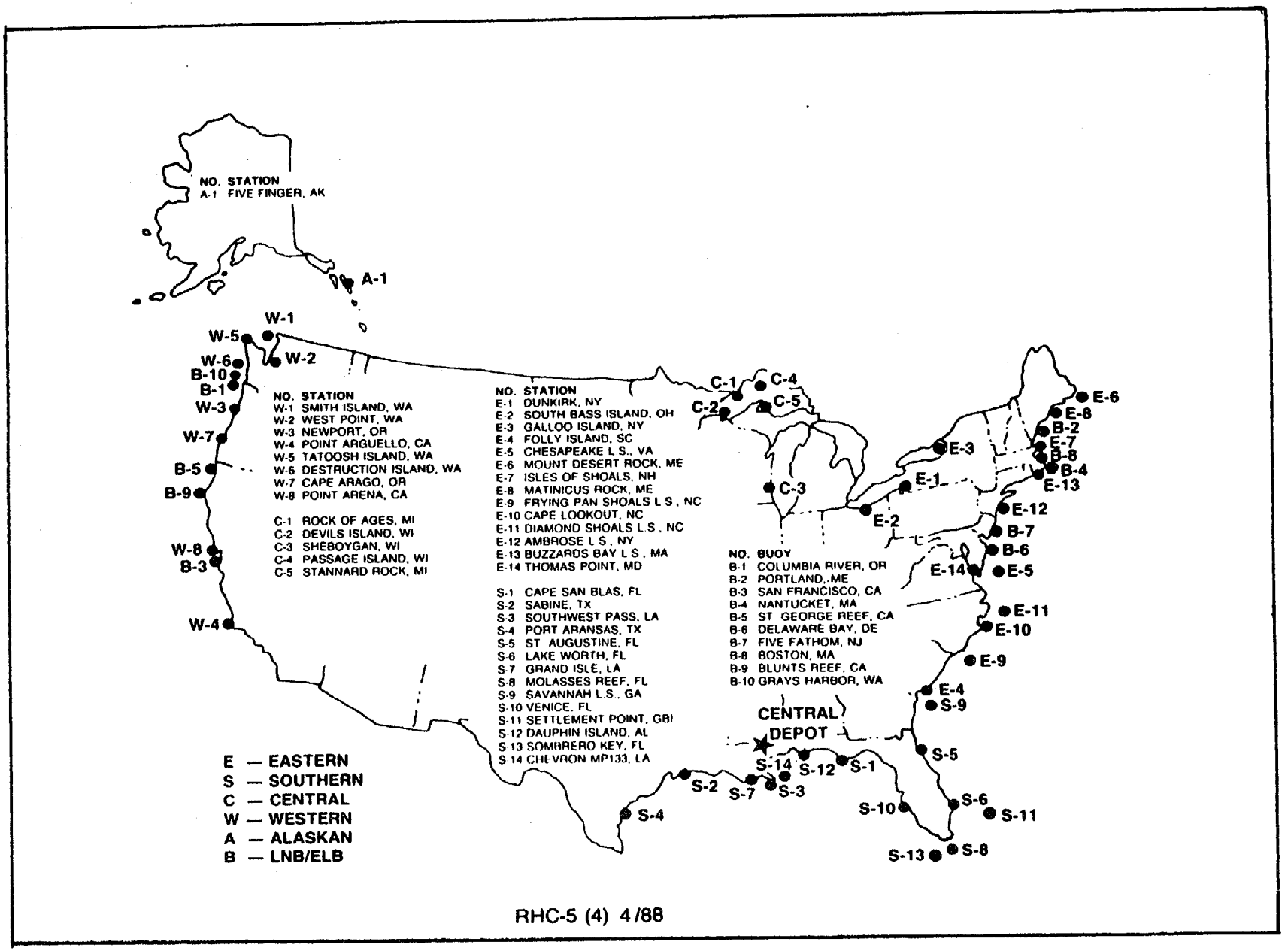


Figure 8-4. C-MAN sites.

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

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

$M_i M_i M_j M_j$ $A_i b_w n_b n_b n_b$ YYGGi $99L_a L_a L_a$ $Q_c L_o L_o L_o L_o$

$i_r i_x$/// /ddff $1s_n$TTT 4PPPP 5appp

22200 $0s_n T_w T_w T_w$ $1P_{wa} P_{wa} H_{wa} H_{wa}$

333 921ff 925ff 926dd

U.S. NATIONAL CODE FORM (C-MAN LAND STATION CODE)
(MODIFIED CODE FORM FM12-VIII)

CMAN YYGGi

$XXXXn_t$ $i_R 9_x$hVV Nddff (00fff) $1s_n$TTT 4PPPP 5appp 6RRRt

222// $0s_n T_w T_w T_w$ $1P_{wa} P_{wa} H_{wa} H_{wa}$ $70H_{wa} H_{wa} H_{wa}$

333 921ff

555 11fff 22fff 3GGgg $4ddf_m f_m f_m$ 9GGgg

CODE FORM FM 14-VIII (DIRBU)
REPORT OF A DRIFTING BUOY OBSERVATION

$M_i M_i M_j M_j$

YYMMJJ GGggi $Q_c L_a L_a L_a L_a$ $L_o L_o L_o L_o L_o$

(1PPPP) $(2s_n T_w T_w T_w)$ (3ddff) $(4s_n$TTT) (5appp)

888 $z_0 z_0 T_0 T_0 T_0$ $z_1 z_1 T_1 T_1 T_1$ ... $z_n z_n T_n T_n T_n$

999zz $z_1 z_1 T_1 T_1 T_1$ ... $z_n z_n T_n T_n T_n$

(00000)

61616 $(1Q_P Q_2 Q_{TW} Q_4)$ $(2Q_n Q_L$ //) $(Q_c L_a L_a L_a L_a$ $L_o L_o L_o L_o L_o)$ $(8V_i V_i V_i V_i)$
or
$(H_L V_B V_B d_B d_B)$

$(9i_d Z_d Z_d Z_d)$ 69696

333 $A_i b_w n_b n_b n_b$

CHAPTER 9

MARINE WEATHER BROADCASTS

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

9.2. Broadcast Procedures. The DOT and DOD will arrange for broadcast of all marine tropical cyclone advisories immediately upon receipt. The latest tropical cyclone forecast will be transmitted according to the schedule and on the frequencies given in Worldwide Marine Weather Broadcasts. The latest position estimate will be used by DOT and DOD along with the latest forecast for storms on which postions estimates are being issued. The broadcasts will be made in both voice and continuous wave (CW) mode.

Table 9-1. Marine tropical cyclone forecast broadcast stations.

STATION CALL LETTERS	AGENCY	LOCATION
NMW	DOT	Astoria, OR
NMF	DOT	Boston, MA
NMO	DOT	Honolulu, HI
NMQ	DOT	Channel Island, CA
NMA	DOT	Miami, FL
NMG	DOT	New Orleans, LA
NAM	DOD	Norfolk, VA
NMN	DOT	Portsmouth, VA
NMC	DOT	San Francisco, CA
NMR	DOT	San Juan, PR

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
  6010 Executive Boulvard
  Rockville, MD 20852

- Commander, Naval Oceanography Command
  Stennis Space Center, MS 39529

- Hq Military Airlift Command (MAC/PA)
  Scott AFB, IL 62225-5000

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

- Chief, Environmental Services Division (J-3)
  The Joint Chiefs of Staff
  Washington, DC 20301-5000

- Federal Aviation Administration (AAT-150)
  800 Independence Avenue, SW
  Washington, DC 20591

- Federal Coordinator for Meteorological
  Services and Supporting Research
  Suite 300, 11426 Rockville Pike
  Rockville, MD 20852

APPENDIX A

ABBREVIATIONS

-A-

AB	Data type header for Tropical Weather Outlook
ADWS	Automated Digital Weather System
AES	Atmospheric Environmental Service (Canada)
AFB	Air Force Base
AFGWC	Air Force Global Weather Central
AFOS	Automation of Field Operations and Services
AFRES	Air Force Reserve
AFS	Air Force Station
AFSATCOM	Air Force Satellite Communications System
AFTN	Aeronautical Fixed Telecommuncations Network
APT	Automatic Picture Transmission
ARGOS	ARGOS, Inc., a French data collection system
ARTCC	Air Route Traffic Control Center
ARWO	Aerial Reconnaissance Weather Officer
ASDL	Aircraft-to-Satellite Data Link
ASID	Air-Sea Interaction Drifter
ATC	Air Traffic Control
AUTOVON	Automated Voice Network (DOD)
AV	AUTOVON
AVHRR	Advanced Very High Resolution Radiometer
AWS	Air Weather Service

-C-

CARCAH	Chief, Aerial Reconnaissance Coordinator, All Hurricanes (OL-G, 7WW)
CDDF	Central Data Distribution Facility (NESDIS)
C.I.	Current Intensity
C-MAN	Coastal-Marine Automated Network
COM	Commercial (telephone)
CONUS	Continental United States
COMEDS	CONUS Meteorological Data System (USAF)
CPHC	Central Pacific Hurricane Center
CW	Continuous Wave
^{o}C	degree/degrees Celcius

-D-

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

-E-

EDT	Eastern Daylight Time
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure

-F-

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

-G-

GAC	Global Area Coverage
GOES	Geostationary Operational Environmental Satellite
GMS	Geostationary Meteorological Satellite
GTS	Global Telecommunications System

-H-

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

-I-

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

-J-

JTWC	Joint Typhoon Warning Center

-K-

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

-L-

LAC	Local Area Coverage
LF	Light Fine
LI	Long Island
LS	Light Smooth

-M-

m	meter/meters
MAC	Military Airlift Command (USAF)
MACR	MAC Regulation
MANOP	communications header
MAX	maximum
MB	millibars
METEOSAT	European Space Agency meteorological satellite
min/MIN	minute
MINOB	Minute Observation (IWRS)
MOU	Memorandum of Understanding
mph	mile/miles per hour
MVMT	movement

-N-

NASA	National Space and Aeronautics Administration
NAVEASTOCEANCEN	Naval Eastern Oceanography Center
NAVOCEANCOM	Naval Oceanography Command
NAVOCEANCOMDET	Naval Oceanography Command Detachment
NAVOCEANCOMFAC	Naval Oceanography Command Facility
NAVWESTOCEANCEN	Naval Western Oceanography Center
NDBC	National Data Buoy Center
NESDIS	National Environmental Satellite, Data, and Information Service
NHC	National Hurricane Center
NHOP	National Hurricane Operations Plan
NLT	Not Later Than
NMC	National Meterological Center
nmi	nautical mile/miles
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NSSFC	National Severe Storms Forecast Center
NSTL	National Space Technology Laboratories (NASA)
NWS	National Weather Service

-O-

OAC	Oceanic Aircraft Coordinator (USN)
OAO	Office of Aircraft Operations (NOAA)
OBS	observation
OFCM	Office of the Federal Coordinator for Meterological Services and Supporting Research
OL-G	Operating Location G, 7th Weather Wing (CARCAH)

-P-

PA	Public Affairs
PANC	ICAO identifier for Anchorage, AK
PCN	Position Code Number
PHNL	ICAO identifier for Honolulu, HI
POD	Plan of the Day

-R-

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

-S-

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

-T-

TCD	Tropical Cylone Discussion
TCPOD	Tropical Cyclone Plan of the Day
TD	Tropical Depression
TEMP	temperature
TEMP	temporary
TEMP DROP	Dropwindsonde Code
TF	Thermal Fine
TKO	takeoff
T-number	Tropical classification number
TOVS	TIROS-N Operational Vertical Sounder
TS	Thermal Smooth
TWO	Tropical Weather Outlook

-U-

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

-V-

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

-W-

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

-X-

XMTD	transmitted

-Z-

Z	Zulu (UTC)

APPENDIX B

GLOSSARY

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

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.

Cyclone. An atmospheric closed circulation rotating counterclockwise in the Northern Hemisphere.

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.

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

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

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

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

Hurricane Warning Offices. The designated hurricane warning offices follow:

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

Hurricane Warning. A warning that sustained winds of 64 kt (74 mph) or higher associated with a hurricane are expected in a specified coastal area in 24 hr or less. A hurricane

warning can remain in effect when dangerously high water or a combination of dangerously high water and exceptionally high waves continue, even though winds may be less than hurricane force.

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

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

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

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.

Reconnaissance Aircraft Sorties. 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 resonable representation of the cyclone's movement.

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

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

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

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

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

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

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

Tropical Cyclone Plan of the Day. A coordinated mission plan that tasks operational weather reconnaissance requirements during the next 0500 to 0500 UTC day or as required, describes reconnaissance flights committed to satisfy both operational and research requirements, and identifies possible reconnaissance requirements for the succeeding 24-hr period.

Tropical Depression. A tropical cyclone in which the maximum sustained surface wind speed (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 hr or more. It may or may not be associated with a detectable perturbation of the wind field.

Tropical Storm. A tropical cyclone in which the maximum sustained surface wind speed (1-min mean) ranges from 34 kt (39 mph) to 63 kt (73 mph).

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

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

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

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

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

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.

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

APPENDIX C

BIBLIOGRAPHY OF OFFICIAL INTERAGENCY AGREEMENTS

The following references are pertinent to the agreed interagency responsibilities designated in this plan:

- Memorandum of Understanding (MOU) between the Department of the Air Force (DAF) and the National Oceanic and Atmospheric Administration (NOAA), dated March 16, 1976. The purpose of this MOU is to establish policies, principles, and procedures under which the DAF will provide aircraft weather reconnaissance to NOAA.

- Memorandum of Understanding between the Military Airlift Command (MAC) and the Director of Operations, Logistics and Emergency Planning (NOAA), dated October 12, 1976. The purpose of this MOU is to establish procedures by which NOAA will reimburse MAC and the Air Force Reserve for airborne weather reconnaissance.

APPENDIX D

DISTRIBUTION

DEPARTMENT OF COMMERCE

Regional Office of Audits	1
DOC Budget Office	1

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Director, Office of Public Affairs, NOAA	2
NOAA Library	4
Director, Office of NOAA Corps (NC)	1
Admin Office, Office of Aircraft Operations	20
Director, National Climate Program (CP)	1
NOAA Budget Officer, Office of Management and Budget	1
Asst Administrator for Ocean Svcs and Coastal Zone Management (N)	1
Asst Administrator for Satellite and Information Services (E)	1
Chief, Satellite Services Division (E/SP2)	1
Chief, Information Services Division, National Climatic Data Center	2
Director, Office of Climate and Atmospheric Research (R/CAR)	1
Director, Program Development and Coordination Staff (R/PDC)	1
Director, Environmental Research Laboratories	4
Director, AOML Hurricane Research Division (R/E/AO)	5
Asst Administrator for Weather (W)	1
Director, Office of Meteorology (W/OM)	1
Chief, International Activities Division (W/OM3)	1
Chief, Warning and Forecast Branch (W/OM11)	20
Chief, Aviation Services Branch (W/OM13)	1
Chief, Services Development Branch (W/OM23)	1
Director, Office of Hydrology (W/OH)	1
Director, National Meteorological Center (W/NMC)	5
Chief, Meteorological Operations Division (W/NMC3)	2
Chief, Development Division, NMC (W/NMC2)	1
WFSO, Washington	5
Director, National Data Buoy Center	23
Director, National Hurricane Center	20
Director, NWS Eastern Region	50
Director, NWS Central Region	16

Director, NWS Southern Region	50
Director, NWS Western Region	15
Director, NWS Pacific Region	15
Chief, Library Div MASC	1
WFSO, Boston, MA	5
WFSO, San Jaun, PR	5
WFSO, Redwood City, CA	5
WFSO, New Orleans, LA	5
WFSO, Miami, FL	1

DEPARTMENT OF DEFENSE

DEPARTMENT OF THE AIR FORCE

HQ USAF/XOORF	2
HQ USAF/XOORZ	1
HQ USAF/REO	3
HQ USAF/PRPFM	1
HQ MAC/XPPT/XPQS/DOOS	3
HQ AFRES/DOOM	3
HQ 4AF/DOO	2
HQ 23 AF/DO/DOC/DOO	4
HQ 41 RWRW/DOO	2
53 WRS/DO	2
HQ 403 TAW/DO	2
815 TAS/DO	2
815 WOF/DOW	20
HQ AWS/CSE	70
OL-G, 7WW/CARCAH	20
Det 1, 7WW/CC	30
3350 TCHTG/TTMU	1
AFGL/LY	1

DEPARTMENT OF THE ARMY

Hq Department of the Army/DAMI-IS	2

DEPARTMENT OF THE NAVY

Commandant of the Marine Corps (DCS/Aviation)	7
Oceanographer of the Navy	2
Commander, Naval Oceanography Command	100
Commander in Chief (02M) U.S. Pacific Fleet	1
USCINCPAC (J37)	1
Commanding Officer, NAVOCENACOMCEN/JTWC Guam	3
Commanding Officer, NAVOCENCOMFAC, San Diego	1
COMTHIRDFLT	1
CINCLANTFLT/OAC	1
Commander, Naval Air Systems Command	2
COMFITMATAEWWINGLANT, Oceana NAS, VA	1
Commanding Officer, NAVEASTOCEANCEN, Norfolk, VA	5

Commanding Officer, NAVOCEANCOMFAC, Jacksonville	2
Commanding Officer, NAVWESTOCEANCEN, Pearl Harbor, HI	5
Officer in Charge, NAVOCEANCOMDET, Barbers Pt, HI	1
Officer in Charge, NAVOCEANCOMDET, FPO Miami, FL	1
Commanding Officer, NAVOCEANCOMFAC, FPO New York, NY	1

OFFICE OF THE JOINT CHIEFS OF STAFF

OJCS/J3/ESD	6

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

Air Traffic Operations Service ATO-1 (ATO 100)	40
Air Traffic Requirements Service ATR-1	40
FAA-AIA 101	3
FAA AMC 100	3
Miami AIFSS (QAS)	2
FAA ATO 120, NWS	5
Each FAA Air Route Traffic Control Centers (TMO/NWS/MLS)	3

U.S. COAST GUARD

Commandant, USCG Headquarters (G-OIO)	3
Commandant, USCG (FLAGPLOT)	1
Commander, Atlantic Area, USCG	2
Commander, First Coast Guard District	1
Commander, (OPC) Third Coast Guard District	2
Commander, Fifth Coast Guard District	2
Commander, (RE) Seventh Coast Guard District	3
Commander, Eighth Coast Guard District	3
Commanding Officer, Otis AFB, MA	1
Commanding Officer, USCG Air Station, Clearwater, FL	1
Commanding Officer, USCG Air Station, Opa Locka , FL	1
Commanding Officer, USCG Air Station, Corpus Christi, TX	1
Commanding Officer, USCG Air Station, Floyd Bennett Field, Brooklyn, NY	1
Commanding Officer, USCG Air Station, New Orleans, LA	1
Commanding Officer, USCG Air Station, Elizabeth City, NJ	1
Commander, Pacific Area, USCG	2
Commander, Eleventh Coast Guard District	1
Commander, Twelfth Coast Guard District	1
Commander, Fourteeth Coast Guard District	1
Commanding Officer, USCG Air Station, McClellan AFB, CA	1
Commanding Officer, USCG Air Station, Barbers Point, HI	1
Commanding Officer, USCG Air Station, Kodiak, AK	1
Commanding Officer, USCG Reserve Training Center	1

DEPARTMENT OF AGRICULTURE

World Agriculture Outlook Board	1

DEPARTMENT OF INTERIOR

Chief, Science and Technology Staff	1
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, Division of Atmospheric Science	1

NATIONAL SPACE AND AERONAUTICS ADMINISTRATION

Director, Atmospheric Sciences Division, MSFC	1

OTHER U.S.

Roddenbery Memorial Library, Cairo, GA	1
Congressional Research Service, Library of Congress	1
CWP Project Office, JPL	1
University of Chicago Library, The Joseph Regenstein Library	1
South Florida Water Management District	1
Natural Hazards Research and Applications Information Center, Institute of Behavioral Science	1
Dr. William Gray, Department of Atmospheric Sciences, Colorado State University	1
Mr. Jerry Hill, CCM	1

GOVERNMENT OF CANADA

Director, Canadian Meteorological Centre, (AES) Downsview, ON	1
Meteorolical 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
Base Meteorological Officer, CFB Summerside, PEI	1
Maritime Weather Centre (AES), Bedford NS	1

UNITED KINGDOM

Assistant Director, Head of Defence Services, Meteorological Office	1

APPENDIX E

SAFFIR-SIMPSON HURRICANE SCALE[1]

CATEGORY ONE HURRICANE--WEAK

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

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

CATEOGORY TWO HURRICANE--MODERATE

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

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

CATEGORY THREE HURRICANE--STRONG

Winds: 111-130 mph (96-113 kt) at standard anemometer elevations. F-scale is 2.0-2.4. Damage occurs to shrubbery and trees: foliage is blown off trees, large trees are blown down. Practically all poorly constructed signs are blown down, some roofing material damage occurs, some window and door damage occurs, and some structural damage occurs to

small residences and utility buildings. Mobile homes are destroyed. There is a minor amount of curtainwall failure.

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

CATEGORY FOUR HURRICANE--VERY STRONG

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

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

CATEGORY FIVE HURRICANE--DEVASTATING

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

Storm Surge: Height is nominally greater than 18 ft (5.5 m) above normal. Major damage occurs to lower floors of all structures located less than 15 ft (4.6 m) above sea level and within 500 yd (457 m) of the shoreline. Low-lying

escape routes inland are cut by rising water 3-5 hr before the storm center arrives.

Massive evacuations of residential areas situated on low ground within 5-10 mi (8-16 km) of the shoreline may be required.

---

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

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

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

APPENDIX F

PHONETIC PRONUNCIATION LISTING

CARIBBEAN BASIN

Abaco	AB-a-ko
Anguilla	ang-GWIL-a
Antigua	an-TEE-gua
Aruba	ah-ROO-ba
Antilles	an-TIL-leez
Azores	uh-ZOHRZ
Bahamas	ba-HAHM-ahs
Barbuda	bar-BOO-dah
Barranquilla	bahr-rahn-KEE-yah
Barahona	ba-ra-HO-na
Basse-Terre	bahs-TER
Bermuda	ber-MYOO-da
Biloxi	bi-LUX-ee
Bimini	BIM-i-ni
Bonaire	ba-NAIR
Cap Haitien	kahp ah-ee-SYAN
Caracas	kah-RAH-kahs
Caribbean	kar-a-BE-an
Castries	KAS-trees
Cayman	kay-MAHN
Charlotte Amalie	SHAR-lot a-MAHL-ye
Cozumel	koh-soo-MEL
Curacao	koor-a-SOH
Dominica	dom-i-NEE-ka
Eleuthera	el-OO-thera
Exuma	ek-SOO-ma
Flores	FLO-rish
Fort de France	for-de-FRAHNS
Grenada	gre-NAY-dah
Guadaloupe	GWAH-deh-loop
Guatemala	gwaht-eh-MAH-la
Leeward	LEE-ward
Maiacaibo	mar-a-KYE-boh
Maracay	Mah-rah-KYE
Marigot	ma-ree-GOH
Merida	MAY-re-thah
Miami	mye-AM-ee

Montego	mon-TEE-go
Montserrat	mont-se-RAT
Nicaragua	nik-a-RAH-gwah
Ocho Rios	OH-cho REE-os
Oranjestad	o-RAHN-yuh-stat
Paramaribo	par-a-MAR-i-boh
Parguera	par-GWER-a
Pointe-a-Pitre	pwan-ta-PEE-tr
Ponce	PON-sa
Port-au-Prince	port-oh-PRINS
Saba	SAH-ba
Sao Miguel (Azores)	soun ME-gel
St. Croix	SAINT croy
St. Lucia	SAINT LOO-she-a
Soufriere	soo-free-AR
Surinam	SOOR-i-nam
Tampico	tam-PEE-ko
Tela	TAY-lah
Tobago	to-BAY-go
Yucatan	yoo-ka-TAN

APPENDIX G

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

DATE					ORGANIZATION					MISSION IDENTIFIER									TYPE AIRCRAFT					CALL SIGN
OBSERVATION NUMBER	9	RECCO INDICATOR GROUP SPECIFYING TYPE OF OBSERVATION *Table 1*	G	TIME OF OBSERVATION *(Hours and Minutes)* *(GMT)*	Y	DAY OF WEEK *SUN=1*	L_a	LONGITUDE DEGREES AND TENTHS *(Note 4)*	h_a	PRESSURE ALTITUDE OF AIRCRAFT REPORTED TO THE NEAREST DECAMETER	d	WIND DIRECTION AT FLIGHT LEVEL *(Tens of deg. true.)*	T	TEMPERATURE WHOLE °C *(Note 6)*	/	INDICATOR	1	INDICATOR	C	CLOUD TYPE *Table 11*	C	CLOUD TYPE *Table 11*	C	CLOUD TYPE *Table 11*
	X		G		Q	OCTANT *Table 3*	L_a		h_a		d		T		J	INDEX TO H H H *Table 9*	k_n	NR OF CLOUD LAYERS *(Note 9)*	h_s	ALTITUDE OF BASE *Table 12*	h_s	ALTITUDE OF BASE *Table 12*	h_s	ALTITUDE OF BASE *Table 12*
	X		S		L_a	LATITUDE DEGREES AND TENTHS	L_o		h_a		f	WIND SPEED AT FLIGHT LEVEL *(Knots)*	T_d	DEW POINT WHOLE °C *(Note 6)*	H	GEO-POTENTIAL HEIGHT/ D-VALUE OR SLP PER INDEX j *(Note 8)*	N_s	AMOUNT OF CLOUDS *(Note 9)* *Table 10*	h_s		h_s		h_s	
	X		S		L_a		B	TURBULENCE *Table 4*	d_t	TYPE OF WIND *Table 6*	f		T_d		H		N_s		H_t	ALTITUDE OF TOP *Table 12*	H_t	ALTITUDE OF TOP *Table 12*	H_t	ALTITUDE OF TOP *Table 12*
	9		I_d	DEW POINT INDICATOR *Table 2*	L_a		f_c	FLT COND *Table 5* *(Note 5)*	d_a	METHOD OF OBTAINING WIND *Table 7*	f		w	PRESENT WEATHER *(Note 7 Table 8)*	H		N_s		H_t		H_t		H_t	
	1		2		3		4		5		6		7		8		9		10		11		12	

REMARKS

							METEOROLOGIST				RECCO RECORDING FORM																				
1	INDICATOR	C	CLOUD TYPE *Table 11*	C	CLOUD TYPE *Table 11*	C	CLOUD TYPE *Table 11*	4	INDICATOR	6	INDICATOR *(Note 11)*	6	INDICATOR *(Note 11)*	7	INDICATOR	7	INDICATOR	8	INDICATOR	8	INDICATOR	9	INDICATOR	REMARKS
K_n	NR OF CLOUD LAYERS *(Note 9)*	h_s	ALTITUDE OF BASE *Table 12*	h_s	ALTITUDE OF BASE *Table 12*	h_s	ALTITUDE OF BASE *Table 12*	d	DIRECTION OF SFC WIND *(Tens of deg. true)*	W_s	SIGNIFICANT WEA CHANGES *Table 14*	W_s	SIGNIFICANT WEA CHANGES *Table 14*	I_r	RATE OF ICING *Table 17*	h_i	ALT OF BASE OF ICING STRATUM *(Note 12)* *Table 12*	d_r	BEARING OF ECHO CENTER *(Tens of Deg. True)*	E_w	ECHO WIDTH OR DIAM *Table 19*	V_i	INFLIGHT VISIBILITY *Table 23*	
N_s	AMOUNT OF CLOUDS *(Note 9)* *Table 10*	h_s		h_s		h_s		d		S_s	DISTANCE OF OCCURRENCE OF Ws *Table 15*	S_s	DISTANCE OF OCCURRENCE OF Ws *Table 15*	I_t	TYPE OF ICING *Table 18*	h_i		d_r		E_l	LENGTH OF MAJ AXIS *Table 19*	T_w	SEA SURFACE TEMPERATURE DEGREES AND TENTHS	
N_s		H_t	ALTITUDE OF TOP *Table 12*	H_t	ALTITUDE OF TOP *Table 12*	H_t	ALTITUDE OF TOP *Table 12*	f	SURFACE WIND SPEED *(knots)* *(Note10)*	W_d	DISTANT WEATHER *Table 16*	W_d	DISTANT WEATHER *Table 16*	S_b	DISTANCE TO BEGINNING OF ICING *Table 15*	H_i	ALTITUDE OF TOP OF ICING STRATUM *(Note 12)* *Table 12*	S_r	DISTANCE TO ECHO CEN *Table 19*	c_e	CHARACTER OF ECHO *Table 21*	T_w		
N_s		H_t		H_t		H_t		f		d_w	BEARING OF W_d *Table 13*	d_w	BEARING OF W_d *Table 13*	S_e	DISTANCE TO ENDING OF ICING *Table 15*	H_i		O_e	ORIENTATION OF ELLIPSE *Table 20*	I_e	INTENSITY OF ECHO *Table 22*	T_w		
13		14		15		16		17		18		19		20		21		22		23		24		

Figure G-1. Reconnaissance code recording form (AWS Form 32).

Table G-1. Reconnaissance code tables.

TABLE 1 XXX

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

TABLE 2 i_d

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

TABLE 3 Q

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

TABLE 4 B

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

TABLE 5 f_c

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

TABLE 6 d_1

0 Spot Wind
1 Average Wind
/ No wind reported

TABLE 7 d_a

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

TABLE 8 w

0 Clear
1 Scattered (trace to 4/8 cloud coverage)
2 Broken (5/8 to 7/8 cloud coverage)
3 Overcast/undercast
4 Fog, thick dust or haze
5 Drizzle
6 Rain (continous or intermittent precip − from stratiform clouds)
7 Snow or rain and snow mixed
8 Shower(s) (continous 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 decametets
6 Altitude 300 mb surface in geopotential decameters
7 Altitude 250 mb surface in geopotential decameters *(thousands fig if any omitted)*
8 D − Value in geopotential decameters; if negative 500 is added to HHH
9 No absolute altitude available or geopotential data not within ± 30 meters/4 mb accuracy requirements.

TABLE 10 N_s

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

TABLE 11 C

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

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

00 Less than 100
01 100 ft
02 200 ft
03 300 ft
etc, etc
49 4,900 ft
50 5,000 ft
51_ 55 Not used
56 6,000 ft
57 7,000 ft
etc, etc
79 29,000ft
80 30,000 ft
81 35,000 ft
82 40,000 ft
etc, etc
89 Greater than 70,000 ft
// Unknown

TABLE 13 d_w

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

TABLE 14 W_s

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

TABLE 15 $S_b S_e S_s$

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

Table G-1. Reconnaissance code tables (continued).

TABLE 16 w_d

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

TABLE 17 I_r

7 Light
8 Moderate
9 Severe
/ Unknown or contrails

TABLE 18 I_t

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

TABLE 19 S_r, E_w, E_1

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

TABLE 20 O_e

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

TABLE 21 c_e

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

TABLE 22 i_e

2 Weak
5 Moderate
8 Strong
/ Unknown

TABLE 23 V_i

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

RECCO SYMBOLIC FORM

SECTION ONE (MANDATORY)

$9XXX9\ GGggi_d\ YQL_aL_aL_a\ L_oL_oL_oBf_c\ h_ah_ah_ad_td_a$
$ddfff\ TTT_dT_dw\ /jHHH$

SECTION TWO (ADDITIONAL)

$Ik_nN_sN_sN_s\ Ch_sh_sH_tH_t$ .... $4ddff$
$6W_sS_sW_dd_w\ 7I_rI_tS_bS_e\ 7h_ih_i\ H_iH_i\ 8d_rd_rS_rO_e$
$8E_wE_1c_ei_e\ 9V_iT_wT_wT_w$

SECTION THREE (INTERMEDIATE)

$9XXX9\ GGggi_d\ YQL_aL_aL_a\ L_oL_oL_oBf_c\ h_ah_ah_ad_td_a$
$ddfff\ TTT_dT_dw\ /jHHH$

Table G-2. Reconnaissance code regulations.

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

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

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

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

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

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

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

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

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

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

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

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

```
URNT50 KBIX 132240
AF966        WX            MINOB 17 KBIX
2220 05278 09031 05512 5072 305 088 171 323 040 05436 00000 00000
2221 05270 09031 05511 5085 310 033 169 323 038 05422 00000 00000
2222 05263 09027 05511 5080 306 035 169 333 037 05426 00000 00000
2223 05263 09027 05511 0149 309 035 147 349 038 05379 00000 00000
2224 05249 09020 04670 0620 294 019 109 389 026 05379 00000 00000
2225 05241 09017 04056 5107 228 005 091 417 009 05379 00000 00000
2226 05228 08997 03526 5107 136 005 063 425 006 05379 00000 00000
2227 05221 08995 02980 5107 119 006 021 405 007 05379 00000 00000
2228 05215 08993 02438 5021 095 012 014 327 017 02684 00000 00000
2229 05209 08991 02004 5024 084 017 032 007 018 01998 00000 00000
2230 05203 08990 01524 5076 081 011 002 000 017 01467 00000 00000
2231 05198 08988 01183 5058 029 008 029 031 009 01144 00000 00000
2232 05193 08986 01060 5056 034 010 058 021 011 01024 00000 00000
2233 05188 08985 01042 5038 027 011 850 188 013 01023 00000 00000
2234 05183 08982 00806 5020 035 013 850 182 014 00800 00000 00000
2235 05179 08980 00721 5024 038 010 850 176 012 00710 00000 00000
2236 05174 08978 00518 0014 059 010 104 006 011 00532 00000 00000
2237 05171 08974 00449 0017 058 010 005 019 011 00466 00000 00000
2238 05167 08971 00449 0015 028 008 007 019 010 00462 00000 00000
2239 05163 08971 00460 0018 028 006 009 019 007 00476 00000 00000
```

Figure G-2. Sample MINOB Message.

Table G-3. MINOB Message Format

HHMM $L_aL_aL_a$th $L_oL_oL_o$th PPPPP DDDD WWW SSS TTT ddd MMM RRRRR FFFFF FFFFF

HHMM:	The time of observation in hours and minutes (UTC).
$L_aL_aL_a$th:	The latitude of the observation in degrees, tenths, and hundredths. The latitude ranges from 0° to 180°, with 00000 signifying the North Pole, 18000 the South Pole. For example, 20.25^oN would be encoded as 06975.
$L_oL_oL_o$th:	The longitude of the observation in degrees, tenths, and hundredths. The longitude value ranges from 0 to 359.99, with 00000 signifying the Greenwich Meridian, 0900 signifying 90.00^oW, and 27000 signifying 90.00^oE.
PPPPP:	The pressure altitude in meters.
DDDD:	The absolute value of the D-value in meters (a 5 occupies the thousands place if the D-value is negative. For example, -34 m is encoded as 5034.
WWW:	The wind direction in degrees, with 0 being north, increasing clockwise.
SSS:	The wind speed in knots.
TTT:	The air temperature in degrees and tenths Celsius. The tenths digit is even for temperatures at or above 0^oC, odd for temperatures below 0^oC.
ddd:	The dew point temperature, encoded the same way as air temperature.
MMM:	The maximum wind speed in knots measured during the minute. This is the peak wind speed averaged over a 10-sec period.
RRRRR:	Radar altitude in meters
FFFFF:	Default status for the MINOB data. A "0" indicates the parameter is defaulted (suspect value) or based on a parameter that is defaulted. A "1" indicates the value is not defaulted. The fields (five digits each) indicate default for (in order): latitude, longitude, pressure altitude, D-value, wind direction, wind speed, air temperature, dew point, maximum wind speed, radar altimeter.

Table G-4. TEMP DROP code breakdown.

CODE FORM:

PART A

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

PART A

SECTION 1- IDENTIFICATION AND POSITION

M_iM_i- Identification letters of the report = XX

M_jM_j- Identification letters of the part of the report = AA

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

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

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

99- Indicator for aircraft position

$L_aL_aL_a$- Latitude, in tenths of a degree.

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

$L_oL_oL_oL_o$- Longitude, in tenths of a degree.

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

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

U_{La}- Units digit in the reported latitude

U_{Lo}- Units digit in the reported longitude

SECTION 2- SURFACE AND STANDARD ISOBARIC SURFACES

99- Indicator for surface

$P_0P_0P_0$- Pressure in whole millibars, thousands digits omitted. ($P_0P_0P_0$ is always surface level)

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

$h_1h_1h_1$- Height of the mandatory pressure level in geopotential meters or
... decameters above the surface. Encoded in meters up to 501mbs; Encoded
$h_nh_nh_n$ in decameters above 501mbs. Add 500 to hhh for negative 1000mb heights. Report 1000mb groups as 00/// ///// when surface pressure is less than 950mbs.

T_0T_0- Tens and units digit of air temperature (not rounded off) in degrees
T_1T_1 Celsius, at specified levels beginning with surface.
...
T_nT_n

Tao- Approximate tenths value and sign (plus or minus) of the air

T_{a1} temperature. Even = plus Odd = minus
...
T_{an}

D_0D_0- Dewpoint depression (with respect to water) at standard isobaric
D_1D_1 surfaces beginning with surface level. When the depression is 4.9C or
... less encode the units and tenths digits of the depression. Encode
D_nD_n depressions of 5.0 through 5.4 as 50; Encode depressions of 5.5 through 5.9 as 56. Dewpoint depressions of 6.0 and above are encoded in tens and units with 50 added. Dewpoint depressions for relative humidities less than 20% are encoded as 80. When air temperature is below -40°C report D_nD_n as two solidii.

d_0d_0- True direction (rounded off to nearest 5 degress) in tens of degrees,
d_1d_1 from which the wind is blowing. (Dropwindsonde)
...
d_nd_n

$f_0f_0f_0$- Wind speed in knots (Dropwindsonde)
$f_1f_1f_1$
...
$f_nf_nf_n$

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

SECTION 3- DATA FOR TROPOPAUSE LEVELS

88- Indicator for tropopause data.

$P_tP_tP_t$- Pressure at the tropopause level reported in whole millibars

T_tT_t- Air temperature in whole degrees Celsius, at the tropopause level.

T_{at}- Approximate tenths value and sign (plus or minus) of the air temperature at the tropopause level.

D_tD_t- Dewpoint depression at the tropopause level

d_td_t- True direction (rounded off to the nearest 5 degrees), in tens of degrees, from which the wind is blowing at the tropopause level.

$f_tf_tf_t$- Wind speed, in knots, at the tropopause level

88999- Tropopause data not available.

SECTION 4- MAXIMUM WIND DATA

66- Indicator that data for maximum wind level and for vertical wind shear follow (the of the wind sounding corresponds to the highest wind speed observed throughout the decent)

77- Indicator that data for maximum wind level and for vertical wind shear follow (maximum wind level does not coincide with the of the wind sounding.

$P_mP_mP_m$- Pressure at maximum wind level in whole millibars

d_md_m-True wind direction (rounded off to nearest 5 degrees), in tens of degrees, from which the maximum wind is blowing.

$f_mf_mf_m$- Maximum wind speed in knots

4- Indicator for vertical wind sheer data

v_av_a- Absolute value of vector difference between max wind and wind blowing 3000 feet ABOVE the level of maximum wind. Reported to the nearest knot. Use "//" if missing and 4 group is reported. A vector difference of 99 knots or more is reported with the code figure 99.

v_bv_b- Absolute value of vector difference between max wind and wind blowing 3000 feet BELOW the level of maximum wind. Reported to the nearest knot. Use "//" if missing and 4 group is reported. A vector difference of 99 knots or more is reported with the code figure 99.

CODE FORM:

PART B

SECTION 1 $M_iM_iM_jM_j$ YYGG/ $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ $MMMUL_aU_{Lo}$

SECTION 5 $n_0n_0P_0P_0P_0$ $T_0T_0T_{a0}D_0D_0$

$n_1n_1P_1P_1P_1$ $T_1T_1T_{a1}D_1D1$

.....

$n_nn_nP_nP_nP_n$ $T_nT_nT_{an}D_nD_n$

SECTION 6 21212 $n_0n_0P_0P_0P_0$ $d_0d_0f_0f_0f_0$

$n_1n_1P_1P_1P_1$ $d_1d_1f_1f_1f_1$

.....

$n_nn_nP_nP_nP_n$ $d_nd_nf_nf_nf_n$

SECTION 9 51515 10166 10167 10190 10191

PART B

SECTION 1- IDENTIFICATION AND POSITION

M_jM_j- Identification letters of the part of the report = BB

/- Filler figure for YYGG group

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

SECTION 5- DATA FOR SIGNIFICANT TEMPERATURE AND RELATIVE HUMIDITY LEVELS

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

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

$P_0P_0P_0$- Pressure at specified levels in whole millibars, beginning with P_1P_1P1 surface.

...

$P_nP_nP_n$

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

SECTION 6- DATA FOR SIGNIFICANT WIND LEVELS

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

SECTION 9- ADDITIONAL DATA GROUPS

51515- Additional data in regional code follow.

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

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

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

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

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

10190- Extrapolated altitude data follows:

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

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

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

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

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

APPENDIX H

TELEPHONE AND TELETYPE LISTING

AGENCY	LOCATION	TTY	TELEPHONE
	DEPARTMENT OF COMMERCE		
Alternate NHC (NMC, Met Ops Div)	Washington, DC	A C	COM 301-763-8201 FTS 763-8201
CPHC	Honolulu, HI	C	COM 808-836-1831 FTS 546-2853
CPHC Satellite Coordinator	Honolulu, HI	C	COM 808-836-2776
NDBC (Data Systems Div) (See USCG entry)	NSTL, MS		COM 601-688-2836 FTS 494-2836 AV 485-4411
NESDIS SAB	Camp Springs, MD	A C	COM 301-763-8444 301-763-8445 FTS 763-8444 763-8445
NHC	Coral Gables, FL	ABC	COM 305-350-4460 FTS 350-4460
NHC Satellite Coordinator	Coral Gables, FL	ABC	COM 305-350-4460 FTS 350-4460
NMC Meteorological Operations Division	Washington, DC	A C	COM 301-763-8201 FTS 763-8201
NWS Warning and Forecast Branch (Headquarters)	Washington, DC		COM 301-427-8090 FTS 427-8090
OAO	Miami, FL		COM 305-526-2936 FTS 350-2936 AV 894-1600

AGENCY	LOCATION	TTY	TELEPHONE
	DEPARTMENT OF DEFENSE		
AFGWC	Offutt AFB, NE	AB	COM 402-291-2586 FTS 866-2586 AV 271-2586
CARCAH (OL-G, 7 WW)	Coral Gables, FL	ABC	COM 305-666-4612 FTS 350-5547 AV 434-3420
CINCLANTFLT OAC	Oceana, VA		COM 804-433-2851 ext 233 AV 433-2851 ext 233
Det 1, 7 WW (Alternate CARCAH)	Keesler AFB, MS	B	COM 601-377-2544 AV 868-2544
Det 4, 20 WS (Weather Monitor)	Hickam AFB, HI	B	COM 808-449-1634 AV 315-449-1634
Det 4, 20 WS (Hawaii ROCC/WE)	Hickam AFB, HI	B	COM 808-449-7638 808-449-7637 AV 315-449-6262
Det 7, 24 WS (Weather Monitor)	Mather AFB, CA	B	COM 916-364-4377 AV 674-4377
Det 8, 26 WS (Northeast Air Defense Sector/WE)	Griffiss AFB, NY	B	COM 315-330-2410 AV 587-2410
Det 9, 3 WS (Southeast Air Defense Sector/WE)	Tyndall AFB, MS	B	COM 904-283-3215 AV 523-3215
Keesler AFB Command Post	Keesler AFB, MS		COM 601-377-4330 AV 868-4330
NAVEASTOCEANCEN	Norfolk, VA	B	COM 804-444-7750 804-444-3770 FTS 954-7750 954-3770 AV 564-7750 564-3770
NAVWESTOCEANCEN	Pearl Harbor, HI	B	COM 808-741-0363 AV 315-430-0111 ask for 471-0004

AGENCY	LOCATION	TTY	TELEPHONE
53 WRS/DO	Keesler AFB, MS		COM 601-377-4540 AV 868-4540
815 WOF/DO	Keesler AFB, MS	B	COM 601-377-4318 868-4318
34 WF	Keesler AFB, MS	B	COM 601-377-4318 868-4318
DEPARTMENT OF TRANSPORTATION			
Headquarters, Traffic Flow Management Branch	Washington, DC	E	COM 202-426-3636 FTS 267-3636 AV 851-1971
Houston ARTCC	Houston, TX	D	COM 713-230-5560 FTS 527-5560 AV 729-1491
Miami ARTCC	Miami, FL	D	COM 350-592-9753 FTS 820-1210 AV 894-1910
Kansas City ARTCC	Olathe, KS		FTS 753-1225
New York ARTCC	Ronkonkoma, L.I., NY		FTS 663-3490
Washington ARTCC	Leesburg, VA		FTS 925-4440
Chicago ARTCC	Aurora, IL		FTS 388-9203
Cleveland ARTCC	Oberlin, OH		FTS 292-8119
Indianapolis ARTCC	Indianapolis, IN		FTS 332-0222
Minneapolis ARTCC	Farminton, MN		FTS 784-3237
Boston ARTCC	Nashua, NH		FTS 834-6675
Denver ARTCC	Longmont, CO		FTS 323-4261
Salt Lake City ARTCC	Salt Lake City, UT		FTS 586-3128
Seattle ARTCC	Auburn, WA		FTS 390-5283
Atlanta ARTCC	Hampton, GA		FTS 249-3656

AGENCY	LOCATION	TTY	TELEPHONE
Jacksonville ARTCC	Hilliard, FL	FTS	965-1578
Memphis ARTCC	Memphis, TN	FTS	222-3181
Albuquerque ARTCC	Albuquerque, NM	FTS	476-0590
Ft. Worth ARTCC	Euless, TX	FTS	334-1520
Los Angeles ARTCC	Palmdale, CA	FTS	968-8250
Oakland ARTCC	Freemont, CA	FTS	449-6475
U.S. Coast Guard (for after hours contact with NDBC)	New Orleans, LA	COM FTS	504-589-6225 682-6225
INTERDEPARTMENTAL			
OFCM	Rockville, MD	COM FTS AV	301-770-3464 443-8704 851-1460

A TG7073
B COMEDS
C AFOS
D AFTN
E TTY address is KCFCZDZX

☆ U.S. GOVERNMENT PRINTING OFFICE: 1989— 242-202/05013

WORKING GROUP FOR HURRICANE AND WINTER STORM OPERATIONS

MR STEPHEN W. HARNED, Chairman
Department of Commerce
National Weather Service

LTCOL THOMAS J. WITHERELL, USAF
Department of Defense
United States Air Force

MR. JOHN P. GIBBS, JR.
Department of Transportation
Federal Aviation Administration

DR. LISLE A. ROSE
Department of State

MR. EUGENE D. LEGG, JR.
Department of Commerce
National Environmental Satellite,
Data, and Information Service

CDR FREDERICK K. MARTIN, USN
Department of Defense
United States Navy

MR. GLENN HAMILTON
Department of Commerce
National Data Buoy Center

COL ROBERT E. BLACK, USAF, Secretary
Office of the Federal Coordinator
for Meteorological Services and
Supporting Research

139
HCHB..RM.4021
N
1
X

NOAA COASTAL SERVICES CENTER LIBRARY
3 6668 00002 9019