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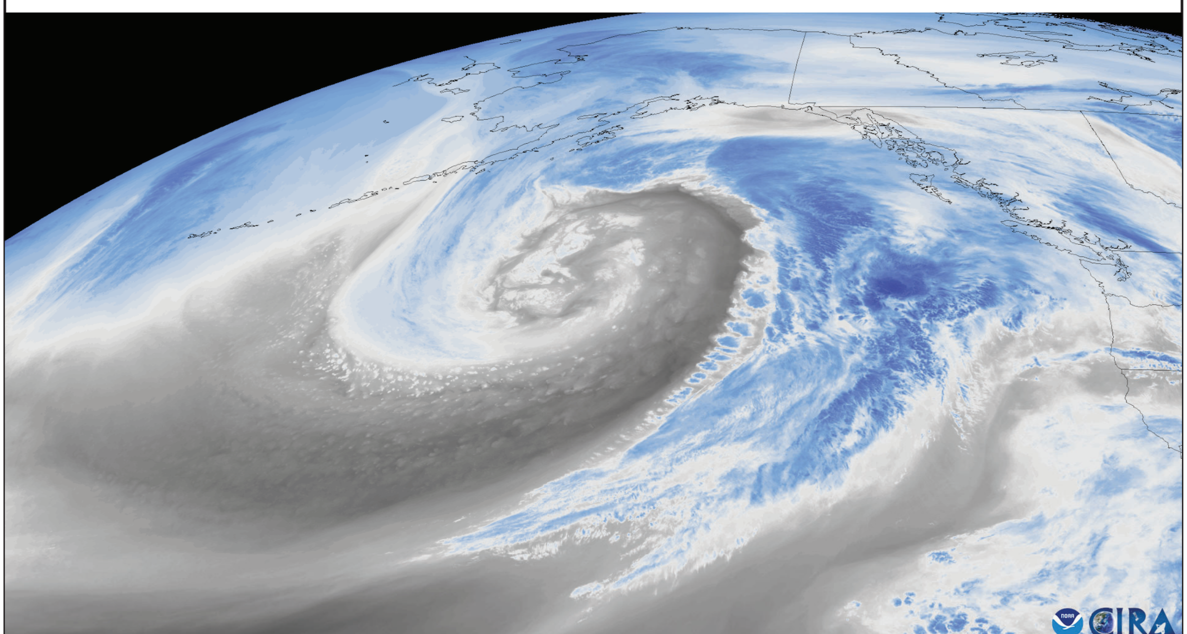
INTERAGENCY COUNCIL FOR ADVANCING METEOROLOGICAL SERVICES

National Winter Season Operations Plan

FCM-P13-2023



Washington, DC
December 2023

Cover Image: GOES-18 Channel 9 water vapor imagery from 0750 UTC 4 December 2023 depicting an evolving atmospheric river prior to its U.S. Pacific Northwest impact and a large extratropical cyclone over the Northeast Pacific Ocean. *(Credit: NOAA and the Cooperative Institute for Research in the Atmosphere)*

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NATIONAL WINTER SEASON OPERATIONS PLAN

FCM-P13-2023
Washington, D.C.
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Change and Review Log

Use this page to record changes and notices of reviews.

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Foreword

The purpose of the National Winter Season Operations Plan (NWSOP) is to coordinate the efforts of the Federal meteorological community to provide enhanced observations of strong winter weather systems impacting the United States. This plan focuses on the coordination of requirements for winter season reconnaissance observations provided by the Air Force Reserve Command's (AFRC) 53rd Weather Reconnaissance Squadron (53 WRS), 403rd Aircraft Maintenance Squadron (403 AMXS), 403rd Maintenance Squadron (403 MXS), and NOAA's Aircraft Operations Center (AOC).

The goal is to improve the accuracy and timeliness of impactful winter weather forecasts and warning services provided by the Nation's weather service organizations. Forecast and warning responsibilities are shared by the National Weather Service (NWS), within the Department of Commerce (DOC) and the National Oceanic and Atmospheric Administration (NOAA); and the weather services of the United States Air Force (USAF) and the United States Navy (USN), within the Department of Defense (DOD).

The Winter Season Working Group (WSWG) is responsible for maintaining the plan. This working group operates under the auspices of the Interagency Council for Advancing Meteorological Services (ICAMS), under the Committee for Observational Systems. The Interagency Meteorological Coordination Office is responsible for publishing the plan. This year marks the 37th edition of the National Winter Season Operations Plan (NWSOP).

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Acting Executive Director
ICAMS

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Chapter 1
Responsibilities of Cooperating Agencies

1.1. General.

Every year, winter storms threaten lives and property, and cause significant disruptions to travel and commerce. However, accurate forecasts can mitigate the disruption, allowing more time for local officials and the general public to plan for these events. Large forecast errors can occur when observations, in certain upstream "sensitive" regions over the Pacific, Gulf of Mexico, and Western Atlantic, are lacking or inaccurate. The main purpose of Winter Season Reconnaissance (WSR) is to collect data in these "sensitive" oceanic regions where conventional upper-air observations are lacking and satellites are unable to effectively resolve the vertical structure of the atmosphere (usually within cloudy regions). The data collected from the WSR program by the NOAA G-IV and US Air Force WC-130 aircraft are transmitted to operational forecast centers, and assimilated into global numerical prediction models.

The Western United States are extremely susceptible to water shortages and surpluses. These conditions pose a significant risk to the public, property, and commerce as well as numerous Department of Defense (DOD) interests both in wartime readiness and Defense Support of Civil Authorities (DSCA) along the West Coast. The intent of Atmospheric River (AR) aerial reconnaissance is to support water management decisions and flood forecasting through the execution of targeted airborne dropsonde, GNSS airborne radio occultation (ARO), and buoy observations over the Central and Eastern Pacific Ocean to improve forecasts of the landfall and impacts of ARs for civil authorities and DOD decision makers along the U.S. West Coast (Reference Appendix H for further technical background). Operations for AR Recon occurs from November through March and utilizes two USAF WC-130s and the NOAA G-IV aircraft from up to three different locations when approved and subject to aircraft availability. Operations include the sampling of ARs and associated atmospheric features with up to three aircraft simultaneously to capture full atmospheric and oceanic profiles for integration into numerical weather prediction models (see Figure 1-1).

AR Recon (described in Ralph et al. 2020) is executed as a Research And Operations Partnership between NOAA/NWS/National Centers for Environmental Prediction, NOAA/OMAO/Aircraft Operations Center (AOC), NWS Western Region, U.S. Air Force Reserve Command (AFRC) 53rd Weather Reconnaissance Squadron (53 WRS), 403rd Aircraft Maintenance Squadron (403 AMXS), 403rd Maintenance Squadron (403 MXS), and the Center for Western Weather and Water Extremes (CW3E) at the University of California San Diego (UCSD)/Scripps Institution of Oceanography (SIO). CW3E and NWS partner to organize the weather reconnaissance requirements, including input from a team of forecasting, science and flight operations experts from a variety of organizations.

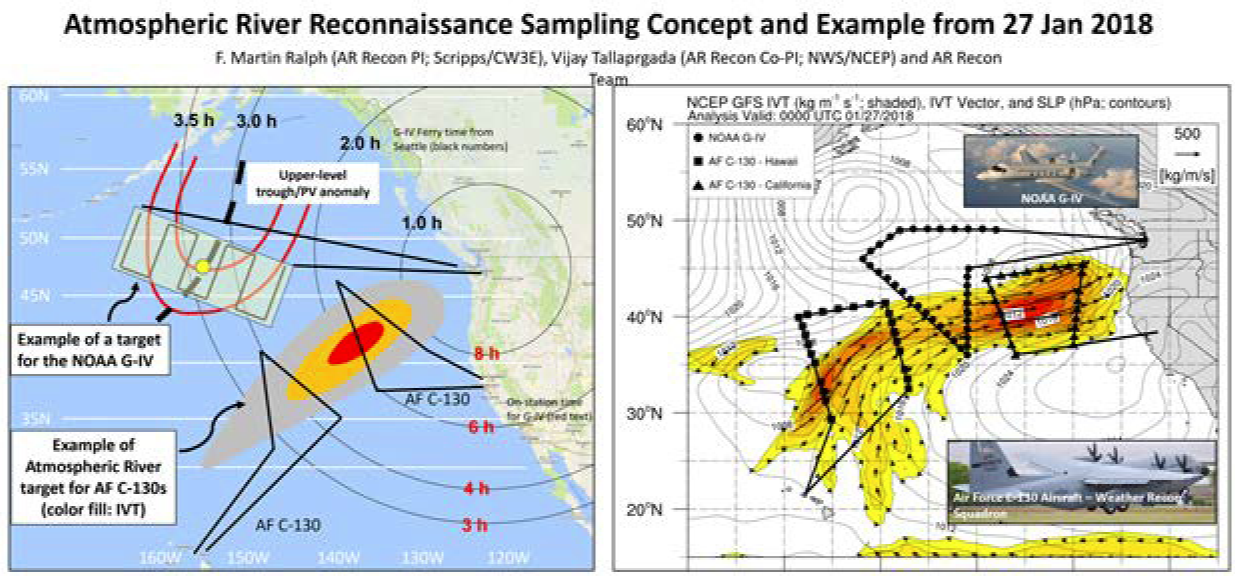


Figure 1-1. Atmospheric river reconnaissance targeting concept and example using 3 aircraft, executed on 27 Jan 2018. In addition, moist adjoint method is used to identify regions of large initial condition error impacts, which largely match the location of the AR.

During an AR Reconnaissance scenario, aircraft operations may begin as early as five days prior to landfall and will end at the point of AR landfall. The frequency of flights during operations is dependent upon the scenario as well as the needs of forecast models, however, may include up to daily flights of each aircraft sampling the feature centered around 0000 UTC. During operations, an AR Recon Flight Planning Mission Director at UCSD/SIO/CW3E identifies important AR events to observe and provides flight tracks and data collection requirements via either the NWS Western Region Meteorological Services Director, EMC representative or WPC representative to the Senior Duty Meteorologist (SDM) at NCEP Central Operations. CARCAH works with the SDM to determine the ability of reconnaissance units to meet requirements, considering the availability of resources with mission requirements and incorporates tasked requirements into the Winter Season Plan of the Day (WSPOD).

The WSR program in the Pacific basin focuses on targeting large-scale extratropical systems that could potentially influence major weather events downstream. These events are predicted to affect the continental U.S. in medium-range time scales on the order of about three to six days by the global models, but with a large degree of uncertainty. The Pacific missions generally require deployments of staff and equipment from the NOAA AOC and the AFRC’s 53WRS, 403 AMXS, and 403 MXS to remote operating bases. For the Gulf and Atlantic area of responsibility, the program concentrates on targeting specific weather systems containing a defined central core that have the potential to rapidly intensify and cause major impacts to heavily populated areas in the Eastern U.S. These WSR missions are executed on short-range time scales within 72 hours of the forecasted impact. The 403rd Wing (403 WG) operates Gulf of Mexico and Western Atlantic missions from its headquarters at Keesler Air Force Base in Biloxi, MS, and deployments are not necessary.

1.1.1. National Oceanic and Atmospheric Administration's National Weather Service.

The NWS is responsible for issuing winter weather forecasts, outlooks, Winter Storm watches and warnings (including Blizzard/Ice Storm and Wind Chill), and winter weather advisories to the public and various special user groups. A suite of deterministic and probabilistic information provides users with a range of possibilities assisting in Decision Support. Its responsibilities are documented in NWS Policy Directive 10-5, Public Weather Services, and in NWS Instructions 10-513, WFO Winter Weather Products Specification and NWSI 10-514, National Winter Weather Products Specification. For further details on NWSI 10-513 and NWSI 10-514, consult the NWS Directives website. Additional documents below the Instructions refer to more specific regional policy.

1.1.2. U.S. Navy (USN).

The Navy will forward the following NWS warnings (Hurricane, Tropical Storm, Small Craft, Gale, Storm, Special marine) via phone and unclassified record message traffic/command Email to affected installations and fleet units according to the NMOC Instruction 3140.1 series.

1.1.3. U.S. Air Force (USAF).

The USAF, through centralized weather units (CWU), is responsible for issuing military weather watches, warnings, and advisories to all United States Air Force (USAF) and Army (including Reserve and National Guard) installations, facilities, and operations related to winter storms for those hazardous phenomena specified in local agreements (such as Memorandum of Agreements (MOA) or local regulations).

1.2. Responsibilities.

1.2.1. The Department of Commerce (DOC).

The DOC, through the National Oceanic and Atmospheric Administration (NOAA), may:

1.2.1.1. With appropriate funding and approvals, furnish aircraft from the NOAA AOC to support the following operational reconnaissance objectives:

- To provide additional real-time meteorological data which is made available to operational forecasters and for assimilation into global numerical prediction models to improve the forecasts of U.S. high-impact winter weather events over the U.S. (including Alaska and Hawaii) one to six days in advance through the application of targeted and adaptive observation techniques over data-sparse regions.
- To provide the data and analyses to better understand the structure and dynamics of these winter season systems.

1.2.1.2. Coordinate with the DOD, through the Air Force Reserve Command's (AFRC) 403 WG, by 15 September on the proposed upcoming winter season reconnaissance plan and requirements to include geographic deployed regions and the number of flying hours.

1.2.1.3. Provide all East Coast/Atlantic and West Coast/Pacific winter-storm aircraft reconnaissance requirements to the Chief, Aerial Reconnaissance, and All Hurricanes (CARCAH) through the Senior Duty Meteorologist (SDM) at the National Centers for Environmental Prediction (NCEP) Central Operations (NCO) Operational Monitoring Branch.

1.2.1.4. Provide basic surface, upper air, and radar observations from its network of stations making such observations.

1.2.1.5. Provide additional observations when required making available all reports to any requesting agency.

1.2.1.6. Provide basic analyses and forecasts through the National Centers for Environmental Prediction (NCEP), College Park, Maryland.

1.2.1.7. Provide products under the multi-tier concept from Weather Forecast Offices (WFO) which will provide outlooks, watches, warnings, and advisories, when appropriate.

1.2.1.8. Operate satellite systems capable of providing coverage of the coastal areas of the contiguous United States during the winter season.

1.2.1.9. Coordinate with the National Aeronautics and Space Administration (NASA) to obtain pertinent meteorological data from NASA research and development experimental satellites.

1.2.1.10. Coordinate with the DOD to obtain pertinent meteorological data from the Defense Meteorological Satellite Program (DMSP).

1.2.1.11. Provide satellite data for selected situations to authorized research facilities.

1.2.1.12. Provide oceanographic and meteorological surface data, when possible, obtained from offshore buoy deployment, within existing facilities.

1.2.2. The Department of Defense (DOD).

The DOD will:

1.2.2.1. Make available to NOAA agencies, through the 557th Weather Wing (557 WW), basic surface, upper air, and radar observations from those DOD stations making such observations, pilot reports (PIREP), and aircraft reports (AIREP) that become available.

1.2.2.2. Furnish to NWS aircraft reconnaissance observations supporting the objectives listed in paragraph 1.2.1.1 that are within its capabilities and in accordance with established reconnaissance priorities and special observations detailed in Chapter 2 of this plan.

1.2.2.3. Designate CARCAH as the point of contact for coordination with the NCEP/NCO SDM for aircraft reconnaissance required in support of this plan.

1.2.2.4. Provide a mission planning element during peak US West Coast operations to be collocated with the DOC/NOAA, or designated agent, flight planning team for the purposes of liaising, planning, and advising on the best utilization of aircraft assets to meet specific lead Federal agency requirements.

1.2.2.5. Provide weather reconnaissance data monitor services through CARCAH to evaluate and disseminate reconnaissance reports.

1.2.2.6. Provide the necessary communications to relay reconnaissance reports from the aircraft to CARCAH.

1.2.2.7. Provide warnings to all DOD facilities and military units of weather that threatens to impact their operations or damage their installations.

1.2.2.8. Maintain situational awareness of weather reconnaissance forces providing support to NOAA. The situational awareness should be maintained through US Air Forces Northern Command (USAFNORTH) and the appropriate combatant commander whose area of responsibility the mission is being conducted.

1.2.3. Department of Transportation (DOT)/Federal Aviation Administration (FAA).

The FAA will:

1.2.3.1. Provide Air Traffic Control (ATC) services as appropriate to support this plan.

1.2.3.2. Disseminate PIREPs and AIREPs.

1.2.3.3. Provide hourly and special weather observations at selected terminal and flight service station locations.

1.2.4. Department of Homeland Security (DHS)/U.S. Coast Guard (USCG).

1.2.4.1. Provide surface observations to NWS from its coastal facilities and vessels.

1.2.4.2. Collect special weather observations from surface ships of opportunity and provide them to the NWS.

1.2.4.3. Provide personnel, vessel, and communications support to the National Data Buoy Center for development, deployment, and operation of environmental data buoy systems.

Chapter 2
Aircraft Reconnaissance

2.1. General.

For the purposes of aircraft reconnaissance, the winter season runs from November 1 through March 31. All Department of Commerce (DOC) winter season reconnaissance needs will be requested and provided in accordance with the procedures of this chapter. Operational control of aircraft flying winter season reconnaissance (WSR) missions will remain with the operating agencies that own the aircraft.

2.2. Responsibilities.

2.2.1. DOD.

The DOD, through the Air Force Reserve Command (AFRC), is responsible for:

- Providing operational aircraft for winter season high-altitude synoptic track and buoy missions in response to DOC needs (see Figure 2-1) over the Atlantic Ocean, Gulf of Mexico, and North Pacific Ocean east of the International Date Line. DOC has identified a requirement for, and the DOD/AFRC maintains aircraft to support, up to four operational sorties per day. Requirements exceeding four sorties will be accomplished on a "resources-permitting" basis.

  NOTE - In times of increased military operations, national emergency or war, some or all DOD reconnaissance resources may not be available to fulfill DOC needs.

- Developing operational procedures and deploying data buoys to satisfy DOC needs. Maintaining the capability of operating from three (3) deployed locations, to include home station, simultaneously.

  - To meet this requirement, the standard support package includes three (3) WC-130Js for each location. To ensure aircraft operability, each deployed location will include one (1) spare parts kit, referred to as a War Readiness Spares Kit (WRSK).
  - Less than three (3) aircraft may be provided for buoy requests or as agreed upon with the requesting agency.

2.2.1.1. Combatant Command (COCOM) Situational Awareness. COCOM situational awareness should be maintained through the Tanker and Airlift Duty Officer (TADO), or equivalent, based on the area of responsibility in which weather reconnaissance missions are being conducted. For Atlantic and Gulf of Mexico areas of operations, United States Air Forces Northern Command (USAFNORTH) is the responsible COCOM. For the Pacific area of operations, United States Air Forces Indo-Pacific Command (USINDOPACOM) is the responsible COCOM.

2.2.1.2. Global Decision Support System (GDSS).

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

2.2.2. DOC.

With appropriate planning and budgeting in advance, the DOC, through the NOAA/OMAO, is responsible for:

- Providing operational aircraft for winter season tracks in the North Pacific Ocean, which can deploy to U.S. West Coast, Alaska, and Hawaii (see Figure 2-2). Aircraft surveillance operations in the Pacific will be flown to support the NWS/National Centers for Environmental Prediction (NCEP).
- Backing up AFRC aircraft reconnaissance for Atlantic/Gulf of Mexico winter season requirements when DOD resources are not available.
- Conducting possible aircraft missions for winter season systems of research interest as requested by the NOAA line offices.

2.2.3. Department of Transportation (DOT).

The DOT is responsible for providing air traffic control (ATC) services to aircraft when within airspace controlled by the FAA. This includes offshore oceanic airspace. Detailed procedures for the expeditious handling of WSR aircraft are outlined in Chapter 3, Aircraft Operations.

2.3. Reconnaissance Requirements.

2.3.1. Meteorological Parameters.

Data needs in priority order are as follows:

- Vertical thermodynamic and kinematic data from dropsonde soundings.
- Wind data (continuous observations along the flight track) for flight level.
- Temperature at flight level.
- Dew point temperature at flight level.
- Pressure at flight level.
- Vertical thermodynamic data from GNSS ARO in terms of bending angle and refractivity.
- Radar reflectivity imagery and high-density three-dimensional Doppler radial velocities (these data should be transmitted in real time as needed).
- Sea-surface temperature.

Figure 2-1. AFRC WC-130J Weather Reconnaissance Aircraft

Figure 2-2. NOAA Gulfstream IV-SP Weather Surveillance Aircraft

2.3.2. Accuracy.

2.3.2.1. Wind Direction.

Flight level for winds greater than 20 knot (kt): within 5 deg.

2.3.2.2. Wind Speed.

Flight level: within 4 kt.

2.3.2.3. Pressure Height.

- Flight level at or below 500 mb: within 10 m.
- Flight level above 500 mb: within 20 m.

2.3.2.4. Temperature.

- Sea surface: within lºC.
- Flight level: within lºC.

2.3.2.5. Dew-Point Temperature.

- From -20ºC to +40°C: within lºC.
- Less than -20ºC: within 3ºC.

2.3.2.6. Absolute Altitude: Within 10 m.

2.3.2.7. Vertical Sounding.

- Pressure: within 2 mb.
- Geopotential Height of Each Mandatory Level:
  - Within 10 meters at or below 500 mb.
  - Within 20 meters above 500 mb.
- Temperature: within 1ºC.
- Dew point temperature:
  - From -20º to +40ºC: within 1ºC.
  - Less than -20ºC: within 3ºC.
- Wind direction: within 10 deg.
- Wind speed: within 5 kt.

2.3.2.8. Doppler Radar.

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

2.3.2.9. GNSS ARO.

- Tracking a minimum of 8 satellites on 2 frequencies (operator viewable - real time verification)
- 60 % of profiles collected will fall within the following accuracy for refractivity and bending angle:
  - Refractivity within 10%
  - Bending angle within 20%

2.3.3. RECCO and Dropsonde Data Requirements.

Manual flight-level horizontal observations will be encoded and transmitted as standard reconnaissance code (RECCO) messages. Dropsonde vertical atmospheric sounding data consisting of upper-level pressure, temperature, humidity, and wind observations will be encoded and transmitted in World Meteorological Organization (WMO) TEMP DROP format. In addition, all dropsonde data will also be transmitted in BUFR format from the NOAA G-IV. CARCAH will only quality-control TEMP DROP code observations. See Appendix F for details on these aircraft messages.

2.3.4. High-Density/High-Accuracy (HD/HA) Data Requirements.

The HD/HA data include UTC time, aircraft latitude, longitude, static pressure, geopotential height, extrapolated sea level pressure or D-Value, air temperature, dew point temperature, flight-level (FL) wind direction, FL wind speed, peak 10-second (10-s) average FL wind speed, peak 10-s average surface wind speed from the stepped frequency microwave radiometer (SFMR), SFMR-derived rain rate, and quality control flags. Except for the peak values noted above, all data provided in HDOB messages are 30-second averages, regardless of the interval at which the HDOB messages are reported. See Appendix F for HDOB message formats. HD/HA observations should be transmitted throughout the duration of a mission to the maximum extent feasible.

2.3.5. Radar Data Requirements.

The NOAA G-IV Tail Doppler Radar (TDR) system will be operated and data transmitted as required.

2.3.6. Observational Frequency.

Observation requirements are summarized in Table 2-1. Deviations to these requirements will be coordinated through CARCAH. For high-altitude synoptic track missions, the National Centers for Environmental Prediction Central Operations Senior Duty Meteorologist (NCEP/NCO SDM) will notify CARCAH where dropsondes will be released for coordination with the reconnaissance flying units. Specific drop locations for Pacific atmospheric rivers missions will be recommended by a team of forecasters, scientists, and flight planners led by the Center for Western Weather and Water Extremes (CW3E) at the University of California San Diego’s Scripps Institution of Oceanography (UCSD/SIO). The spacing between the drop locations will assure detailed coverage in the vicinity of features of interest and regions of model derived maximum uncertainty and sensitivity.

Table 2-1. Requirements for Aircraft Reconnaissance Data

	RECCO Section 1 plus 4ddff and 9VTTT as applicable	Vertical Data WMO Temp Drop Code (FM37-VII)	High Density Observation (HDOB)
En route to Operating Area	Approx. every 30 minutes over water not to exceed 200 nm	Approx. every 300-400 nm over water, or fewer/relocated per request or sonde conservation	30-sec interval
Operating Area	Only if requested by customer	At or near customer-requested geographical positions	30-sec interval
En route from Operating Area	Approx. every 30 minutes over water not to exceed 200 nm, at Aerial Reconnaissance Weather Officer (ARWO) / Flight Director discretion (optional when HDOBs are sent).	Approx. every 300-400 nm over water, or fewer/relocated per request or sonde conservation, at Aerial Reconnaissance Weather Officer (ARWO) / Flight Director discretion.	30-sec interval

2.4. Reconnaissance Planning and Flight Notification.

2.4.1. DOC Requests for Aircraft Reconnaissance Data.

2.4.1.1. NWS/NCEP Requirements Coordination. Any NOAA/NWS facility needing aircraft reconnaissance flights (e.g., the NCEP Environmental Modeling Center (EMC), the NWS Western Region) should contact the NCEP/NCO SDM no later than 1630 UTC at least one day prior to a requirement in accordance with the logistical constraints stated in paragraph 2.4.2.1.1.1. After consultation and coordination with other NCEP units, NWS field offices, and/or DOD forecasters, the SDM determines whether or not a flight would be beneficial. The SDM is then responsible for requesting all DOC/NOAA Atlantic/Gulf and Pacific reconnaissance flights for the next 24-hour period (1100 to 1100 UTC), an outlook for the succeeding 24-hour period, and potentially an additional day outlook as operational requirements dictate. This coordinated request will be relayed to CARCAH as soon as possible, but no later than 1745 UTC each day in the format of Figure 2-3.

2.4.1.1.1. Pacific Requirements. If Pacific aircraft reconnaissance operations are being conducted, the SDM, in consultation with the UCSD/SIO/CW3E planning team, will monitor all operational model guidance using tools developed by the EMC, with particular attention on North America, Hawaii, and Alaska. Regions upstream of the United States, over the North Pacific Ocean where the models have a higher degree of disagreement, are examined for additional targeted observational opportunities in which aircraft supplied data would positively affect the forecast. A targeting strategy will be employed based on objective methods for determining regions of high or enhanced uncertainty that are related to synoptic-scale features, such as atmospheric rivers.

2.4.1.1.2. Buoy Deployment Mission Requirements. All NOAA requests for operational drifting-buoy deployment missions by weather reconnaissance aircraft should be coordinated with CARCAH (see Figure 2-4). CARCAH will then issue, through the WSPOD, an alert or outlook 48 hours before the planned drifting buoy deployment. NOAA will ensure buoys and mission-related NOAA personnel are delivered to AFRC for mission execution. Hard tasking for the buoy deployment will be issued via the WSPOD at least 16 hours before the scheduled take-off time.

Seasonal buoy deployment requirements will be coordinated in accordance with guidance provided in Chapter 4, para 4.2.2.

Decision issued from NCEP at 15Z on 01/02/2018

a

FLIGHT REQUEST FOR 20180104
An Atlantic flight is requested from Biloxi along track 65
with a control time of 04/00Z

Verification information is as follows:

Verification time: 2018010500
Latitude: 41
Longitude: -70
Priority: HIGH
Comments: Strong low-pressure system developing off the Atlantic
coast with heavy snow over the Northeast corridor and New England

OUTLOOK FOR 20180105

No flights are anticipated.

Decision issued from NCEP at 1700Z on 03/09/2021

b

FLIGHT REQUEST FOR 20210311
Pacific flight is requested from Honolulu, HI (PHNL; 1 G-IV)
along TRACK P99 with a control time of 11/00Z
Verification information is as follows:
Verification time: 2021031200
Latitude: 39.0
Longitude: -160.0 Priority: HIGH
Comments: IOP:25 The flight will target an AR in the NE Pacific.
Flight Pattern: Area bounded by 30.0N 167.0W, 30.0N 152.0W, 48.0N 152.0W, 48.0N 167.0W
Dropsonde Releases: 30 along track, 60 nm spacing

FLIGHT REQUEST FOR 20210311
Pacific flight is requested from Reno, NV (KRNO; 1 C-130)
along TRACK P99 with a control time of 11/00Z
Verification information is as follows:
Verification time: 2021031200
Latitude: 38.0
Longitude: -128 Priority: HIGH
Comments: IOP:25 The flight will target a cutoff low forecast to affect California.
Flight Pattern: Area bounded by 30.0N 135.0W, 30.0N 120.0W, 46.0N 120.0W, 46.0N 135.0W
Dropsonde Releases: 25 along track, 60 nm spacing

OUTLOOK FOR 20210312
One G-IV flight out of Honolulu, HI is a possibility with a designated synoptic time of 12/00Z
One C-130 flight out of Reno, NV is a possibility with a designated synoptic time of 12/00Z

OUTLOOK FOR 20210313+
One G-IV flight out of Honolulu, HI is a possibility with a designated synoptic time of 13/00Z
One C-130 flight out of Reno, NV is a possibility with a designated synoptic time of 13/00Z

Figure 2-3. Examples of NWSOP Coordinated Requests for a) Atlantic/Gulf and b) Pacific Aircraft Reconnaissance

Decision issued from NCEP at 1930Z on 01/06/2021

VALID FOR DEPLOYMENTS BETWEEN JAN 10 AND JAN 16

LINE 1: SP 40N 150W EP 50N 140W EVEN SPACING 5 BOXES
LINE 2: SP 19N 150W EP 21N 138W EVEN SPACING 5 BOXES
EACH BOX CONTAINS 2 SVP-B, 1 DWS-B

Priority: HIGH

Figure 2-4. Example NWSOP Buoy Tasking Order Request

2.4.1.2. Changes to Requirements. Changes to mission requirements will be accepted by CARCAH based on the following guidelines:

2.4.1.2.1. 53 WRS.

- Early departures will not be requested.
- When notification is received more than 4 hours prior to scheduled aircraft departure:
  - Changes to tracks normally will be limited to substitution of one track for another only for Atlantic/Gulf missions. For Pacific missions, customized tracks can be changed but only after proper coordination with the crews and consideration of available resources.
  - Departure delays of up to 6 hours will be acceptable in accordance with Air Force Manual (AFMAN) 11-2WC-130J Vol. 3.
  - Departure delay requests will be evaluated in accordance with appropriate flight management directives.
- Revised/final buoy deployment positions must be provided before the flight crew shows for pre-flight briefing.

2.4.1.2.2. NOAA AOC.

- G-IV aircraft launch times will be tuned by the AOC project manager/flight planning team to have the highest number of TEMP DROP messages reach NCEP/NCO within the GFS data assimilation window of the designated synoptic time. Outside of this tuning, early departures will not be requested.
- Customized tracks can be adjusted up to 3.5 hours prior to scheduled aircraft departure time but only after consultation with the AOC G-IV project manager and crew, and they are limited to 3,500 nautical miles in length. AOC will coordinate with NCEP and the UCSD/SIO/CW3E planning team to determine the direction of flight around the pattern for maximum efficiency.

2.4.1.3. Cancellation of Requirements. Missions should be canceled as much in advance as possible to allow maximum resource conservation. Cancellation after departure may result in degradation of follow-on mission capability.

2.4.2. Winter Season Plan of the Day (WSPOD).

The WSPOD lists all DOD/AFRC and DOC/NOAA/OMAO operational reconnaissance requirements and tasked missions for the 24-hour valid period between 1100 UTC of the next day to 1100 UTC of the following day. Research missions will be included as remarks when provided to CARCAH before transmission time. The coordinated WSPOD is NOAA’s Request for Assistance (RFA) to DOD. Since DOD’s support to NOAA is congressionally mandated and funded through the DOD Appropriations Act, it is considered a validated and approved RFA. When DOC reconnaissance needs exceed DOD and DOC resources, CARCAH will coordinate with the NCEP/NCO SDM to establish priorities of requirements.

NOTE - *During November, operational requirements and tasked missions for both winter and hurricane seasons are consolidated into the Tropical Cyclone Plan of the Day (TCPOD) message issued by CARCAH. A separate WSPOD message will not be published. See subparagraph 2.4.2.4 for details.*

2.4.2.1. WSPOD Coordination. The SDM will coordinate in accordance with para 2.4.1.1 and provide the following information to CARCAH as needed for the WSPOD (see Figure 2-3 for format):

Atlantic/Gulf of Mexico/East Coast Requests

- Track number(s).
- Designated synoptic time of requirements.
- Additional dropsonde release special requirements.
- Succeeding day outlook and optional additional day outlook (anticipated tracks and designated synoptic times if available).

Pacific/West Coast Requests

- Three to Four days before mission execution:
  - Designated synoptic time of first possible requirement.
- One-two days before mission execution:
  - Description of custom track for requested mission(s).
  - Designated synoptic time of requirements.
  - Turn points, scheduled dropsonde release points, and special requirements.
  - Succeeding day outlook and optional additional day outlook (anticipated tracks and designated synoptic times if available).

Flight patterns are determined based on the situation, targeted key atmospheric features, and tracks approved by NWS/NCEP.

2.4.2.1.1. DOD and DOC Reconnaissance Aircraft Responsiveness.

2.4.2.1.1.1. Requirement Notification. To account for planning time, mandatory crew rest, transit time to the staging locations, and arrival at staging base(s) with sufficient time to allow 16 hours plus en route flying time to the first drop point, notification of reconnaissance requirements should be made according to Table 2-2.

Table 2-2. Requirement Notification Criteria for Select Areas of Operations.

REGION	NOTIFICATION CRITERIA
Alaska/Hawaii	3-4 days prior
CONUS West Coast	2-3 days prior
Atlantic/Gulf of Mexico	1-2 days prior

2.4.2.1.1.2. Prepositioning.

The "Succeeding Day Outlook" portion of the WSPOD 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 WSPOD to authorize units to preposition aircraft.

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

2.4.2.2. Preparation. After a coordinated request is received from the SDM, CARCAH will convey the requirements to the 403rd Operations Support Squadron Current Operations Office (403 OSS Current Ops) and NOAA AOC and task operational reconnaissance missions. CARCAH will then prepare and publish the WSPOD daily during the period from November 1 to March 31 and at other times during the year as required using the format depicted in Figure 2-5. Transmitted WSPODs will be serially numbered each season.

2.4.2.2.1. Reverse Tracks. If a 53 WRS or NOAA AOC mission planner desires a track direction opposite of what is originally specified, it should be indicated in the WSPOD on the Item F remark line tasking specifications (e.g. “Clockwise” or “Counterclockwise”).

2.4.2.2.2. WSPOD Amendments. Amendments to the WSPOD will be prepared and published only when requirements change. When amended, the impact on each listed flight will be identified (i.e., No Change, Change Added, or Cancelled).

2.4.2.3 Dissemination.

The WSPOD will be made available to all appropriate departments and agencies, such as the FAA, DOD, and NOAA, which provide support to or control of reconnaissance aircraft. CARCAH is responsible for disseminating it as soon as possible after DOC requirements, including changes, are fully coordinated. Under normal circumstances, CARCAH is responsible for disseminating it **by 1830 UTC** each day during the period specified in para. 2.4.2.2, including weekends and holidays. If there are no current day or succeeding-day reconnaissance requirements, a negative report, which covers the appropriate time frame, will be disseminated. Amendments will be disseminated as required.

COCOM headquarters and their air component command headquarters will pull weather reconnaissance RFA information daily after 1830 UTC from the NHC Aircraft Reconnaissance webpage.

NOTE - *The POD “For Today” identifies missions flying that day while the POD “For Tomorrow” identifies future flying requirements to incorporate into air tasking orders.*

WINTER SEASON PLAN OF THE DAY (WSPOD) FORMAT
ATLANTIC AND PACIFIC OCEANS

NOUS42 KHNC _______________ (Date/Transmission Time in UTC)
WEATHER RECONNAISSANCE FLIGHTS
CARCAH, NATIONAL HURRICANE CENTER, MIAMI, FL
______ (Local Time) ____ (Time Zone) _____ (Day) _______________ (Issuance Date, Month, &Year)
SUBJECT: WINTER SEASON PLAN OF THE DAY (TCPOD)
VALID ______Z (Date/Time) TO ______Z (Date/Time) ____________ (Month & Year)
WSPOD NUMBER….. ____ - ______ (2-Digit Year - Edition #)

I. ATLANTIC REQUIREMENTS

1. FLIGHT ONE – TEAL or NOAA ____ (Call Sign) or NEGATIVE RECON REQUIREMENTS.

A. _________________ (Designated Synoptic Date/Time in UTC)

B. _________________ (Mission Identifier)

C. _________________ (Estimated Departure Date/Time in UTC)

D. _________________ (Drops Required and Additional Drop Positions)

E. _________________ (Flt Pattern Altitude(s)/Drop Release Window Date/Times in UTC)

F. _________________ (Remarks, if needed)

2. FLIGHT TWO (if applicable, same format as Flight One)

(Repeat for each successively tasked mission for system using same format as Flight One.)

3. OUTLOOK FOR SUCCEEDING DAY

A. _________________ (Anticipated Track/Designated Synoptic Date/Time or NEGATIVE)

B. _________________ (Additional Anticipated Track/Designated Date/Synoptic Time)

4. REMARKS (if needed)

II. PACIFIC REQUIREMENTS

(included when there are operational considerations for the Pacific basin--same format as Atlantic)

Figure 2-5. Winter Season Plan of the Day (WSPOD) Format

[NOTE: The WSPOD is disseminated under the header "MIAREPRPD" for AWIPS users and "NOUS42 KNHC" for AWDS users. The WSPOD can also be accessed via the National Hurricane Center homepage; access the Data & Tools drop down menu, then click on 'Aircraft Reconnaissance,' and then select 'For Today' or 'For Tomorrow' under the 'Plan of the Day' heading.]

2.4.2.4. November Publication. The first month of winter season and the last month of hurricane season both occur in November. During this overlapping period, CARCAH may receive RFAs for NWSOP and National Hurricane Operations Plan (NHOP) aerial reconnaissance requirements. Both types will be published within a single TCPOD message rather than separate TCPOD and WSPOD messages. The NWSOP items will appear as a note below the NHOP items. Should the combined NHOP and NWSOP needs exceed the number of available DOD and DOC resources, CARCAH will notify the duty SDM and lead forecasters at the National Hurricane Center (NHC) and/or the Central Pacific Hurricane Center (CPHC). The NWS Centers will coordinate internally on priority and communicate their decision to CARCAH prior to TCPOD publication. The NHOP requirements will normally have precedence over the NWSOP.

2.5. Reconnaissance Effectiveness Criteria.

2.5.1. General.

Specified criteria are established to allow for a sufficient number of observations to be transmitted by reconnaissance aircraft for incorporation into the numerical weather model data assimilation process. The following will be used to assess reconnaissance mission effectiveness:

2.5.1.1. High-Altitude Synoptic Track Missions. These include any WSR tracks with required dropsonde release locations.

- SATISFIED. Requirements are considered satisfied when 80% or more of the drops requested within the release window are accomplished to fulfill customer requirements within these prescribed temporal criteria:

  In order for dropsonde data to be ingested into an NCEP GFS data assimilation cycle for a designated synoptic time, sondes must be released no earlier than 3 h 30 m before the synoptic time and all messages must be received at NCEP Central Operations (NCO) by 2 h 45 m after that time. As a result, the last sonde should be released with an adequate amount of time for it to splash, the data to be processed, and the generated messages to be transmitted from the aircraft to NCO (via CARCAH for WC-130s) before the data-assimilation cycle window closes. Aircrews should keep in mind that higher release altitudes require more time before the messages can be transmitted. Examples:

  Recommended dropsonde release window for 00 UTC: 2030-0220 UTC
  Recommended dropsonde release window for 12 UTC: 0830-1420 UTC

  If timing constraints become a factor, aircraft takeoff times should be optimized to obtain the most, or the most important, atmospheric soundings within these periods as specified by the customer.

- PARTIALLY SATISFIED. Requirements are considered partially satisfied when 50-79% of the drops requested within the release window are accomplished to fulfill customer requirements within the temporal criteria described above.
- DEGRADED. Customer requirements are considered degraded when at least one but less than 50% of the drops requested within the release window are accomplished to fulfill customer requirements within the temporal criteria described above.
- MISSED. When the requirements listed above are not at least partially satisfied. When none of the customer requirements are accomplished.

- CANCELED. Customer communicates to CARCAH that the mission is no longer needed prior to the scheduled aircraft departure.

2.5.1.2. Buoy Missions.

- SATISFIED. Requirements are considered satisfied when 80% or more of the buoys are successfully deployed.
- PARTIALLY SATISFIED. Requirements are considered partially satisfied when 50-79% of the required buoys are successfully deployed.
- DEGRADED. Customer requirements are considered degraded when at least one but less than 50% of the required buoys are successfully deployed.
- MISSED. When the requirements listed above are not at least partially satisfied. When none of the customer requirements are accomplished.
- CANCELED. Customer communicates to CARCAH that the mission is no longer needed prior to the scheduled aircraft departure.

2.5.2. Mission Assessment.

The requesting agency, NCEP, and/or an NWS WFO, may provide CARCAH a written evaluation (Figure 2-6) of the weather reconnaissance mission any time its timeliness and quality are outstanding or substandard. Mission requirements levied as "resources permitting" will not be assessed for timeliness but may be assessed for quality of data gathered. These assessments should be mailed or emailed to CARCAH at:

CARCAH
National Hurricane Center
11691 SW 17th Street Miami, FL 33165-2149
ncep.nhc.carcah@noaa.gov

2.5.3. Summaries.

CARCAH will maintain monthly and seasonal reconnaissance summaries detailing requirements tasked by NCEP and missions accomplished.

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

2.6.1. Mission Coordination.

Coordination for all airborne missions will be accomplished through CARCAH.

2.6.2. Post-flight Debriefing.

Unless otherwise directed, the flight meteorologist will provide either an airborne or post-flight debriefing to NCEP through CARCAH to ensure all observations were received.

MISSION EVALUATION FORM

DATE: ______________________________________

MEMORANDUM FOR: OL-A, 53 WRS/CARCAH

FROM: ______________________________________

SUBJECT: MISSION ________________ EVALUATION
(Mission Identifier)

PUBLISHED REQUIREMENTS:

Designated Synoptic Time ____

Flight Track/Pattern ____

Miscellaneous (Drop Points, Altitudes, etc.) ____________________________________

____

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

OVERALL MISSION EVALUATION:

Outstanding ______

Unsatisfactory ______ for: ______ Completeness ______ Accuracy ______ Timelines

______ Equipment ______ Procedures ______ Other

REMARKS: (Brief but specific)

____
Forecaster's Signature

Figure 2-6. Mission Evaluation Form

2.6.3. Aerial Reconnaissance Abbreviated Communications Headings.

Each type of aerial weather-reconnaissance message (defined in Appendix F) is assigned designated abbreviated communications headings that are dependent on the geographical region. Table 2-3 provides the WMO and Advanced Weather Interactive Processing System (AWIPS) abbreviated headers for each data product. The WMO header consists of three groups. The first has four letters followed by a two-digit product index number. The initial two letters of that group indicate the data type: UR for aerial reconnaissance horizontal observations and UZ for aerial reconnaissance vertical observations. The next two letters depict the basin of the observation: NT for Atlantic, PN for EPAC and Central Pacific, and PA for Western Pacific (see Figure 2-7). The second element of the header has the ground location ICAO identifier at which the message is received from the aircraft and subsequently disseminated through channels described in paragraph 2.8.1. The remaining element is a date-time group with the time listed in UTC. The AWIPS product ID contains five letters followed by a product index number. The first three letters indicate the message type: REP for standard observations (RECCO or dropsonde) and AHO for high-density observations. The other two letters depict the basin location using the same geographical conventions as the WMO header.

2.6.4. Mission Identifier.

All weather messages will include a mission ID containing the five-character agency/aircraft indicator, CARCAH-assigned mission indicator, and intensive observation period (IOP) number (Pacific) or track number (Atlantic/Gulf). The five-character CARCAH-assigned mission indicator will consist of the sequential number of the mission being flown in the given basin, followed by the letters “WS” to signify a Winter Season reconnaissance mission, followed by a location identifier based on the mission departure point: A = Atlantic; E = Eastern Pacific; or C = Central Pacific. Due to computer requirements for processing the data, there is no space between “IOP” or “TRACK” and the number signifying the IOP or track being flown. Table 2-4 summarizes elements of the mission identifier.

2.6.5. Observation Numbering.

All aerial weather reconnaissance text messages will contain the mission identifier followed by an observation number as the first mandatory remark. Standard observation messages (RECCO and dropsonde) will be sequentially numbered in the order they are transmitted from the aircraft. The final message will contain a "LAST REPORT" remark. High-density observation (HDOB) messages will also be numbered sequentially but separately from the other messages.

Table 2-3. Summary of Aerial Reconnaissance Data Products and their Associated Headers

PRODUCT	WMO HEADER	AWIPS ID
RECCO		
Atlantic	URNT10 *ICAO* ddhhmm	REPNT0
East and Central Pacific	URPN10 *ICAO* ddhhmm	REPPN0
Western Pacific	URPA10 *ICAO* ddhhmm	REPPA0
TEMP DROP Code (dropsonde observation)		
Atlantic	UZNT13 *ICAO* ddhhmm	REPNT3
East and Central Pacific	UZPN13 *ICAO* ddhhmm	REPPN3
Western Pacific	UZPA13 *ICAO* ddmmmm	REPPA3
High-Density Observations		
Atlantic	URNT15 *ICAO* ddhhmm	AHONT1
East and Central Pacific	URPN15 *ICAO* ddhhmm	AHOPN1
Western Pacific	URPA15 *ICAO* ddhhmm	AHOPA1

NOTE - ICAO identifier is KNHC (National Hurricane Center--primary) or KBIX (Keesler Air Force Base--backup) for data messages originating from AFRC/53 WRS aircraft and KWBC (National Weather Service HQ) for data messages originating from NOAA or other agency aircraft.

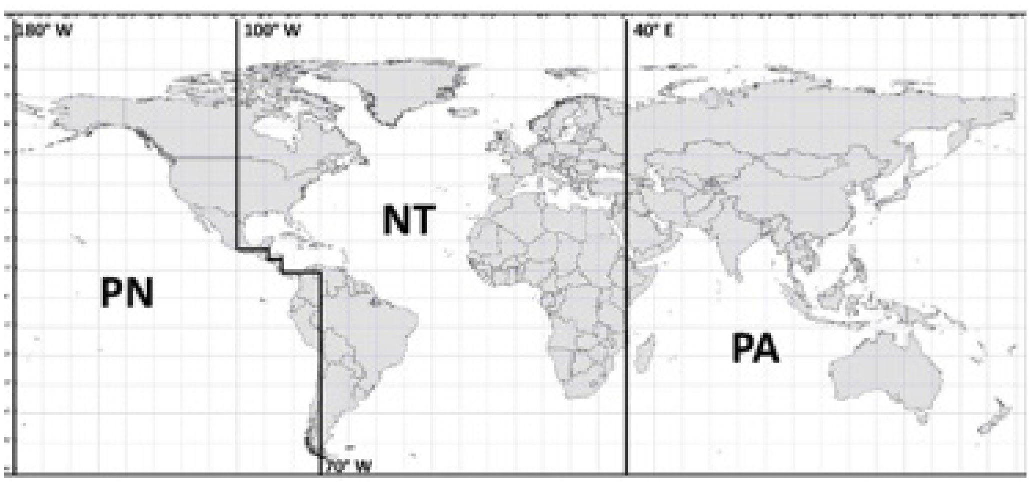


Figure 2-7. Geographical Basins in Aerial Reconnaissance Abbreviated Headings

Table 2-4. Elements of the Mission Identifier

<table>
<tr><th>AGENCY/ AIRCRAFT</th><th colspan="3">MISSION WINTER SEASON SYSTEM INDICATOR</th></tr>
<tr><td>Agency + Aircraft Number[1,2]</td><td>Sequential number of mission in basin indicator</td><td>“WS” and Location Identifier[3]</td><td>IOP or Track Number</td></tr>
<tr><th colspan="4">EXAMPLES</th></tr>
<tr><td colspan="2">AF302 03WSA TRACK64</td><td colspan="2">USAF aircraft 5302 on the third winter season reconnaissance mission in the Atlantic basin flying Track 64.</td></tr>
<tr><td colspan="2">NOAA9 11WSC IOP12</td><td colspan="2">NOAA aircraft N49RF on the eleventh winter season reconnaissance mission in the Central Pacific basin flying a customized track for IOP12.</td></tr>
</table>

2.6.6. Corrections to Observations.

A correction indicator should be appended to the WMO abbreviated header after the date/time group and to any lines containing the mission identifier and observation number within corrected aircraft messages. This includes the first remark line in a RECCO, each of the 61616 lines in a sonde TEMP DROP code, and the second line in an HDOB data message. The first corrected message will have an indicator of CCA; subsequent corrections will have indicators of CCB, CCC, etc. Examples of corrected observations are in Table 2-5.

---

[1] AF plus last 3 digits of tail number

[2] NOAA, plus last digit of aircraft registration number

[3] Location identifier based on the mission departure point: For Northern Hemisphere (North of Equator): A=Atlantic, Caribbean, or Gulf of Mexico (West of 40°E to North/Central/South America [approximately 100°W]); E=Eastern Pacific (From North/Central/South America [approximately 100°W] to 140°W); C=Central Pacific (140°W to 180°); W=Western Pacific (West of 180° to 100°E); I= Indian (West of 100°E to 40°E). For Southern Hemisphere (South of Equator): L= Southern Atlantic (West of 30°E to 70°W); S= Southern Indian and Pacific Ocean (West of 70°W to 30°E)

Table 2-5. Examples of Corrected Observations

EXAMPLES	
URNT10 KNHC 051233 CCA 97779 12235 60363 71600 00600 28116 94//3 /7058 RMK AF307 04WSA TRACK64 OB 12 CCA SWS = 16 KTS DEW POINT NEG 55 DEGREES C	Correction for RECCO message OB 12 from the AF307 04WSA TRACK64 mission.
UZPN13 KWBC 262303 CCA XXAA 76222 99468 71449 15964 99994 07256 22540 00551 ///// ///// 92584 01440 22547 85257 04524 23052 70758 14563 23548 50521 34369 23057 40674 40977 22590 30867 48386 22105 25988 46387 20578 20136 50178 21556 88302 48186 22104 88267 47386 21082 77359 22122 44311 31313 09608 82157 51515 10190 15326 61616 NOAA9 03WSC IOP02 OB 07 CCA 62626 SPL 4703N14465W 2212 MBL WND 22544 AEV 20801 DLM WND 22561 993169 WL150 22042 084 REL 4684N14493W 215704 SPG 4702N14466W 221 134 = XXBB 76228 99468 71449 15964 00994 07256 11850 04524 22837 05150 33805 07356 44755 10365 55715 13163 66601 23164 77548 29162 88500 34369 99431 39774 11376 41184 22307 47986 33260 47586 44238 43188 55202 50183 66184 46566 77169 47560 21212 00994 22540 11953 22546 22897 22546 33850 23052 44779 24051 55618 23041 66447 23057 77359 22122 88291 22105 99245 20076 11233 22073 22208 22555 33182 19554 44169 21557 31313 09608 82157 51515 10190 15326 61616 NOAA9 03WSC IOP02 OB 07 CCA 62626 SPL 4703N14465W 2212 MBL WND 22544 AEV 20801 DLM WND 22561 993169 WL150 22042 084 REL 4684N14493W 215704 SPG 4702N14466W 221 134 =	Correction for sonde TEMP DROP code message OB 07 from the NOAA9 03WSC IOP02 mission.

2.7. Operational Flight Patterns.

This section details the operational flight patterns utilized for WSR missions.

2.7.1. Customized Tracks.

Missions with customized tracks are flown over the Pacific to obtain large-scale moisture and wind fields of atmospheric rivers systems. These tracks are essential in isolating regions where dropsonde deployments can have a maximum impact in improving the quality of forecasted meteorological variables and play a key role in identifying and reducing outlier forecasts. While the SDM is the final approval authority for customized tracks, the track design is determined in consultation with the UCSD/SIO/CW3E planning team, flying unit mission planners, and other NWS personnel as needed using objective guidance tools and techniques based on the situation and location of deployed aircraft assets. See Figures E-7 through E-9 in Appendix E for examples.

In WSPOD tasking specifications (Figure 2-5), customized Pacific tracks are indicated as IOP## for the mission identifier in Item B, which designates the IOP of a single mission or simultaneous group of Pacific WSR missions for a specific synoptic date/time.

Customized tracks for the Western Atlantic and Gulf of Mexico are under development and will be tested to target a variety of atmospheric features.

2.7.2. Predetermined Tracks.

Legacy predetermined flight tracks are utilized for missions over the Western Atlantic and Gulf of Mexico (A61-66, see Figures E-1 through E-6 in Appendix E) to obtain observations of developing maritime and coastal winter storms and events that are forecast to impact the eastern U.S. They are retained in this plan and may be replaced by the sampling strategies used for Pacific operations following evaluation. The nomenclature for the storm tracks is "WSRP-A##" where WSRP is an abbreviation for Winter Season Reconnaissance Program. In WSPOD tasking specifications (Figure 2-5), this is indicated as "TRACK##" for the mission identifier in Item B.

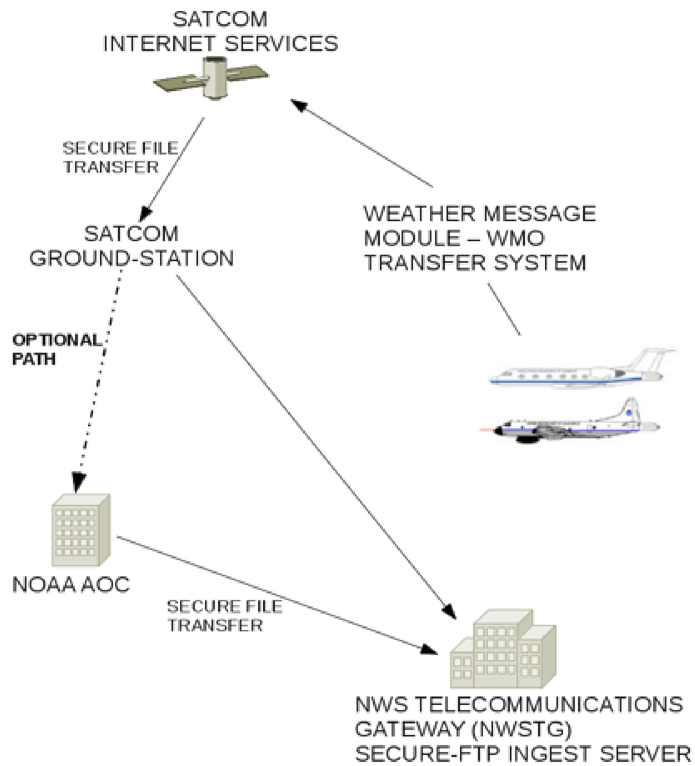
2.8. Aircraft Reconnaissance Communications.

2.8.1. General.

The 53 WRS WC-130 aircraft will normally transmit reconnaissance observations via the Air Force Satellite Communications System (SATCOM) to a ground station at NHC (primary) or Keesler AFB (backup). The CARCAH or 53 WRS mission monitor is responsible for quality-controlling the airborne weather-data messages before sending them securely to the Air Force 557 WW, Moving Weather (MW) at Offutt AFB for global dissemination. The NOAA G-IV and WP-3D aircraft will normally transmit aircraft messages via commercial SATCOM to a secure ingest server that is part of the National Weather Service Telecommunications Gateway (NWSTG) located at the NOAA Center for Weather and Climate Prediction in College Park, MD with backup located in Boulder, CO. Figures 2-8 and 2-9 depict the NOAA and USAF communications links. Flight meteorologists should maintain contact with CARCAH continuously throughout the mission to ensure the transmitted data are received and properly formatted.

2.8.2. Backup Air-to-Ground Communications.

The weather reconnaissance crew may relay weather data via SATPHONE to the mission monitor at CARCAH. The monitor will evaluate these reports and disseminate them through the 557 WW MW or to the NWSTG. The NOAA aircraft may optionally send messages to a ground-relay system located at AOC, which, in turn, will transfer them to the NWSTG if direct transmission from the aircraft is not possible.



Schematic of WMO Message Path for NOAA G-IV and P-3 Aircraft

Figure 2-8. Schematic of WMO Message Path for NOAA G-IV and P-3 Aircraft

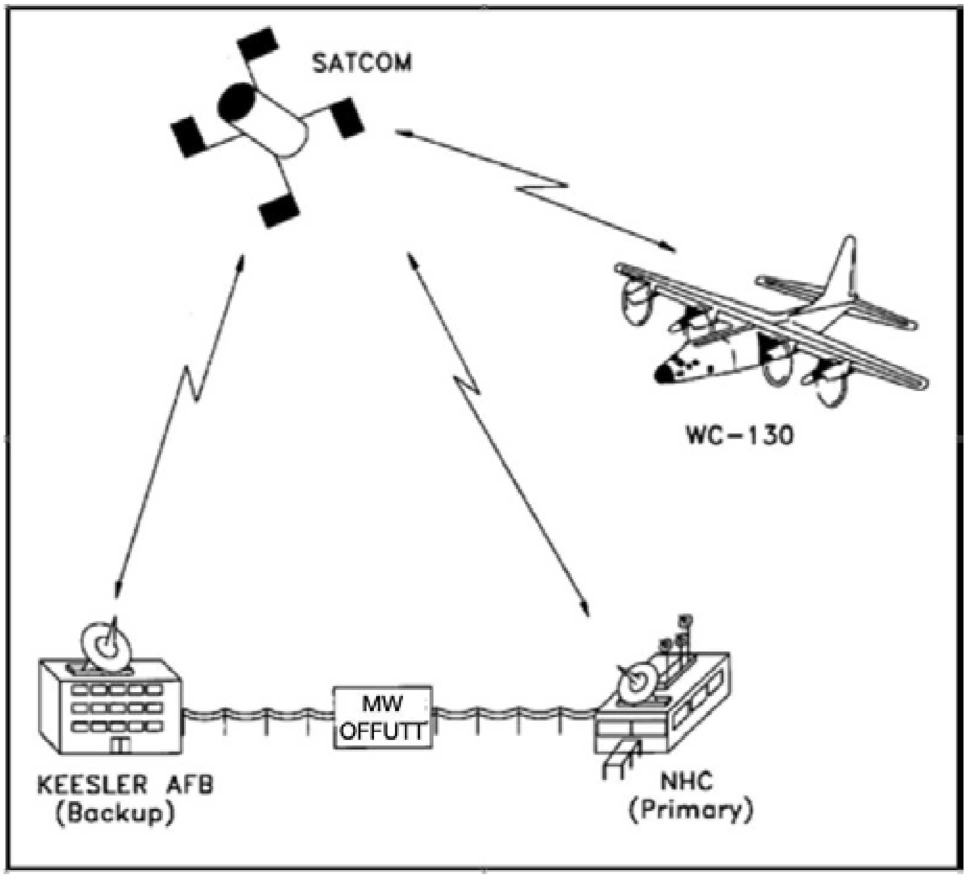


Figure 2-9. Schematic of Aircraft-To-Satellite Communications (SATCOM) for AFRC WC-130J Aircraft

NOTE - *An Internet link from Keesler AFB to NHC provides the capability for all observation types to be passed directly to NHC without going through Offutt Air Force Base.*

2.8.3. Backup CARCAH Procedures.

Satellite ground stations, which are used to receive and process data from AFRC reconnaissance aircraft, are installed at CARCAH (located within NHC) and the 53 WRS (located at Keesler Air Force Base). The backup 53 WRS ground station has a similar configuration and communications capability as the primary satellite ground station installed at CARCAH. Each ground station can fully transmit data using SATCOM to the other ground station. Both can securely send reconnaissance aircraft messages to the MW, which then relays them to the GTS and NWSTG for world-wide distribution, and to an NHC local server (see Figure 2-9). In the event that backup procedures are required due to severe communications failures, severe weather conditions, or other extreme events affecting NHC, some or all CARCAH responsibilities may need to be transferred to the 53 WRS, ensuring reconnaissance aircraft data flow remains uninterrupted.

2.8.3.1. Satellite Antenna Communications Failure at NHC. If an outage is expected to be temporary, CARCAH will coordinate with the 53 WRS to have operators man the ground station located at Keesler AFB. They will be responsible for maintaining contact with airborne reconnaissance aircraft. There is currently no established method of relaying the data to the CARCAH ground station when this situation occurs. However, one using the Internet may be developed and implemented in the future. In the event communications lines between Keesler AFB and NHC are also severed, the 53 WRS ground station will be configured to transmit data directly to the MW system.

For long-term outages, CARCAH will send personnel to Keesler AFB if necessary. They will monitor the aircraft data and ensure they are transmitted to MW and downstream to the GTS, NWSTG, and external users from that location.

2.8.3.2. Network Communications Failure. In the event there is a long-term network communications outage between NHC and 557 WW, the CARCAH ground station will still be able to receive aircraft data. If Internet access problems originate at NHC, the CARCAH ground station will be configured to relay the data to Keesler AFB ground station via SATCOM. The 53 WRS ground station will in turn be configured to automatically transmit them to the 557 WW MW system. However, if network connectivity issues between the CARCAH ground station and MW are beyond NHC's purview, the data may alternately be sent to the 557 WW through the Air Force Weather Web Services (AFW-WEBS) portal. Finally, if there is a circuit breach between the 557 WW and the NWSTG, which would affect data being routed to the GTS and received by non-military users, CARCAH can send aircraft messages directly to the NWSTG via the NWS eMail Data Input System (EDIS).

2.8.3.3. NHC Emergency Backup Plan. In the event NHC activates its COOP backup plan, designated CARCAH personnel will deploy to Keesler AFB to operate the 53 WRS ground station.

Chapter 3
Aircraft Operations

3.1. Mission Coordination.

3.1.1. Administration

3.1.1.1. Annual Liaison Meetings. An annual liaison meeting will be conducted between the following participants:

- National Oceanic and Atmospheric Administration (NOAA) Office of Marine and Aviation Operations (OMAO)
- National Oceanic and Atmospheric Administration (NOAA) Aircraft Operations Center (AOC)
- Headquarters U.S. Air Force Reserve Command (HQ AFRC)
- 53rd Weather Reconnaissance Squadron (53 WRS)
- Federal Aviation Administration (FAA) Air Traffic Control System Command Center (ATCSCC), System Operations Security, and participating Air Traffic Control (ATC) facilities
- Department of Defense (DOD) Policy Board on Federal Aviation (PBFA) designated representative (optional)

This meeting will review the previous season's operations, any proposed changes to the current NWSOP; changes, additions, and deletions to Atlantic or Gulf of Mexico fixed tracks; Letters of Agreement (LOA); arranging FAA familiarization flights; and procedures to conduct international oceanic operations in accordance with International Civil Aviation Organization (ICAO) standards and recommended practices. This meeting will normally be conducted in conjunction with the Tropical Cyclone Operations and Research Forum, in which related proposed changes to the NWSOP and National Hurricane Operations Plan (NHOP) will be discussed.

3.1.1.2. Visits and Briefings. Annual visits by participating FAA ATC facilities, System Operations Security, and ATCSCC; and briefings by 403 WG personnel, NOAA AOC personnel, and FAA Military Liaisons are encouraged. These joint visits emphasize the unique challenges and non-standard operational procedures, communication and coordination required to successfully and safely accomplish aerial weather reconnaissance missions for winter season systems.

3.1.1.3. FAA Familiarization Flights. FAA familiarization flights on USAF (IAW AFI 11-401 and DOD 4515.13) and NOAA weather reconnaissance aircraft are authorized and encouraged. These flights are important in providing FAA controllers with a better understanding of weather reconnaissance/research operations, and how to better provide Air Traffic Control (ATC) services to these critical flights. These familiarization flights may be requested by FAA controllers, in accordance with FAA Order 3120.29, Flight Deck Training Program.

3.1.2. Weather Reconnaissance/Research Aircraft

3.1.2.1. Participating Aircraft. A "Participating Aircraft" for the purposes of the NWSOP and related documents is defined as a NOAA AOC or 53 WRS manned aircraft listed in the Winter Season Plan of the Day (WSPOD – see format in Figure 2-5) or tasked with an operational mission annotated on the Tropical Cyclone Plan of the Day (TCPOD).

- **53 WRS:** "TEAL 70 through 79" (WC-130J aircraft)
- **NOAA AOC:** "NOAA 49" (G-IV aircraft)

3.1.2.2. Other Weather Reconnaissance/Research Aircraft.

- **NASA:** "NASA 809" (ER-2 aircraft); "NASA 426" (P-3B aircraft)
- **NOAA AOC:** "NOAA 42 and 43" (WP-3D aircraft)

3.1.3. Pre-Mission Coordination.

3.1.3.1. Mission Coordination with FAA Facilities. The 53 WRS or the AOC operations officials upon receipt of tasking will coordinate directly with the ATCSCC and affected ATC facilities. The following information will be provided:

- Mission call-sign.
- WSPOD number.
- Departure airfield/ETD.
- Route of flight.
- Aircraft SATCOM #.
- HF Selcal (if applicable).
- Requested NORAD transponder code.
- ARTCCs, FIRs affected.
- Any special requests or deviations from published routes.
- Point of contact information.

NOTE - *Every effort will be made to accommodate release of Special Use Airspace (SUA). However, in some cases, SUA will not be available for release. SUA Using Agencies determine if Department of Defense (DOD) operational requirements are compatible with the flight path of the NWSOP tasked mission and should define deconfliction procedures for SUA that may not be released.*

3.1.3.2. Chief, Aerial Reconnaissance Coordination All Hurricanes (CARCAH).

CARCAH's pre-mission coordination procedures include:

- Preparing, publishing, and disseminating the Winter Season Plan of the Day (WSPOD) daily during winter season as stipulated in Section 2.4.2.

- Coordinating with the affected ATC facilities and the ATCSCC as required.
- Briefing 53 WRS and NOAA AOC aircrews flying operational NWSOP missions tasked in the WSPOD about requirements, conditions, and other relevant information.
- Notifying 53 WRS and NOAA AOC flight crews flying operationally-tasked or research missions about any other weather reconnaissance aircraft will be airborne in or near the operations area at the same time, including the call signs, planned altitudes or block altitudes, and other essential information.

3.1.3.3. 53 WRS and NOAA AOC.

- Transmit the information in Appendix D to the U.S. Notice to Airmen (NOTAM) office no later than two hours prior to departure or as soon as possible.
- Use of NORAD Mode 3/A Transponder Codes. 53 WRS and NOAA AOC NWSOP missions may request NORAD assigned mode 3/A transponder codes. These codes are only applicable in FAA controlled airspace in the Gulf of Mexico and Atlantic. These codes are issued by the 601st Air-Operations Center, Airspace Management Team (DSN 523-5837 or COM 850-283-5837) and must be requested as needed.
- If a transponder code is not assigned by NORAD, a code will be assigned by ATC.
- For NWSOP missions, 53 WRS crews may request one of five "discreet" Mode 3 Beacon Codes, as issued by the Department of Defense (DOD) Code Manager.
- Crews should make a best effort to confirm that CARCAH has received information about adjustments to the planned flight track pattern.

3.1.3.4. Flying Agencies (other than the 53 WRS or NOAA AOC).

- NASA or any other agency planning research missions for a winter season system must first coordinate with affected FAA ATC facilities and CARCAH as soon as possible prior to all flights.
- The flying unit must provide the items according to subparagraph 3.1.3.1 and transmit the information in Appendix D to the U.S. NOTAM office no later than two hours prior to departure or as soon as possible.
- Flights in support of the NWSOP (conducted by the 53 WRS and NOAA AOC operations) are outlined and published in the WSPOD by 1830 UTC daily during winter season. (Note: They will be included in the TCPOD during the month of November.) Research missions will be listed as remarks, provided CARCAH is notified about them prior to publication. Reference the WSPOD to assist in deconfliction efforts. (See Section 2.4.2 for a description of WSPOD elements and format.)
- The flying unit will provide CARCAH with advance details of all planned research missions in areas where NWSOP operations are being conducted, including proposed flight tracks, aircraft altitudes, and locations where weather instruments may be released and/or sensors may be activated; this information, including relevant updates, should be e-mailed to ncep.nhc.carcah@noaa.gov prior to aircraft departure.
- Transponder codes will be assigned by ATC.

NOTE - *CARCAH coordination is normally restricted to what is required between the 53 WRS, NOAA AOC, NCEP, and ARTCCs in support of operational tasking. Due to staffing constraints, the CARCAH unit's operating hours vary and often depend on the requirements levied. Its ability* *to coordinate non-operational missions is extremely limited. When there is a tasked mission, research missions will only be supported by CARCAH on a non-interference basis or when data collected will be directly beneficial to NCEP in real time.*

3.1.3.5. Flight Plan Filing Procedures.

- Flight plans must be filed with the FAA as soon as practicable before departure time.
- Only the following remarks should be included in the "Other Information" block:
    - "EET" to FIR boundaries,
    - Navigation Performance (ex. RNP-10)
    - "RMK/MDCN" diplomatic clearance information.

3.1.3.6. Mission Cancellation. When a mission is cancelled or delayed, the unit flying the mission must notify the affected ATC facilities and the ATCSCC as soon as possible.

3.1.4. FAA Coordination.

3.1.4.1. Responsibilities. The ATCSCC and the affected ATC facilities are responsible for operational coordination in support of the NWSOP.

3.1.4.2. ATCSCC Procedures.

- Review the WSPOD (TCPOD during the month of November), available daily on the NHC Aircraft Reconnaissance webpage by 1830 UTC during winter season, for notification of scheduled NWSOP missions and any updates. (See Figure 2-5 for explanation of format.)
- Review the mission coordination information specified in 3.1.3.1. Prepare a public Flow Evaluation Area (FEA) based on the latitude/longitude points specified when a mission is scheduled to be flown. The FEA naming convention is the aircraft call sign. Modify the FEA when requested by the affected facilities. (The flying unit will submit the mission coordination information to the ATCSCC and the affected ATC facilities upon receipt of tasking).
- Coordinate with the affected ATC facilities as required and designate a primary ATC facility when the Operations Area includes airspace managed by multiple ATC facilities.
- When NOAA or TEAL aircraft receive priority handling as specified in FAA Order 7110.65 paragraph 2-1-4.k, assist affected ATC facilities with traffic flow priorities.
- Conduct winter season system and customer teleconferences, as necessary.

3.1.4.3. Affected ATC Procedures

- Review the WSPOD (TCPOD during the month of November), available daily on the NHC Aircraft Reconnaissance webpage by 1830 UTC during winter season, for notification of scheduled NWSOP missions and any updates. (See Figure 2-5 for explanation of format.)
- Review the mission coordination information specified in 3.1.3.1. - the flying unit will submit it to the ATCSCC and affected ATC facilities upon receipt of tasking

- Coordinate with all other affected ATC and Terminal facilities within their area of responsibility.
- Coordinate with all impacted DOD facilities and SUA Using Agencies in accordance with Letters of Agreement (LOA), including deconfliction procedures for SUA that may not be approved for release.
- When applicable, assign 53 WRS and NOAA aircraft the designated NORAD transponder code associated with their call sign provided in the mission coordination information.
- When designated by the ATCSCC, the primary ATC facility will:
    - Coordinate with CARCAH and aircrew(s) on flight plan specifics, when necessary.
    - If the mission profile changes, coordinate with the ATCSCC for FEA modifications, and ensure other affected ATC facilities are aware of the change.
    - Advise the ATCSCC and other affected ATC facilities of any mission cancellation or delay information received from the flying unit.

3.1.5 Military Coordination. For east coast storms, the U.S. Navy, through Fleet Forces Atlantic Exercise Coordination Center (FFAECC), will review the WSPOD for each proposed flight to determine if clearance into a particular area will be required. Each mission will need to be coordinated with the regional controlling agencies for each warning area. The reconnaissance unit flying the mission will contact the appropriate clearance agencies prior to entry into any restricted airspace.

3.2. Mission Execution.

3.2.1. Aircrew Responsibilities.

3.2.1.1. Aircraft Commander Authority. Aircraft Commanders must exercise their authority in the interest of safety or during an aircraft emergency, regardless of NWSOP procedures. It is the responsibility of the aircraft commander to remain clear of obstacles and nonparticipating aircraft when operating in Class G airspace.

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

3.2.1.3. Obstacle Clearance. Aircrews are responsible for maintaining their own clearance from the surface of the sea, obstacles, and oil platforms while operating below the Minimum IFR Altitude (MIA).

Table 3-1. Aircraft Radio Communications Frequencies for NWSOP Missions

METHOD	FREQUENCY
Primary	VHF 123.05 MHz
Secondary	UHF 304.8 MHz
Backup	HF 4701 KHz

3.2.1.4. Military Assumes Responsibility for Separation of Aircraft (MARSA). Aircrews of the 53 WRS may apply MARSA, in accordance with FAA Order 7110.65 and FAA Order 7610.4, between 53 WRS aircraft. MARSA may not be applied between 53 WRS aircraft and NOAA AOC participating aircraft.

3.2.1.5. ATC Communications. The aircrew normally maintains ATC communications with only the primary ATC facility. Normally, VHF, UHF or HF radios will be used for communications with ATC, when within range. If VHF, UHF, and HF is unusable, satellite communications (SATCOM), either phone or data messaging, may be used as a back-up (see Appendix G). IFR aircraft flying in domestic or international airspace are required to maintain continuous two-way communications with ATC, even while flying in uncontrolled airspace (Class G). Crews should monitor the active ATC radio frequency for any other air traffic transiting the area.

The 53 WRS and AOC are responsible for ensuring that air traffic clearances and messages are relayed to/from the FAA in an accurate manner when those relays are initiated by the 53 WRS or AOC and are routed by some other means other than ARINC.

NOTE - *While in international airspace, aircrews will make periodic "Operations Normal" calls to the primary ATC facility if not in radar contact and no transmissions have been made within the previous 20-40 minutes (reference: ICAO 4444/RAC 501/12 VI, 2.1).*

3.2.1.6. Backup ATC Communications. 53 WRS or AOC aircrews of participating aircraft are required to maintain contact with CARCAH at all times. When they should request CARCAH to assist in relaying communications as described in Section 3.2.5 if the aircraft has the capability to communicate through the digital satellite communications (SATCOM) relay.

3.2.1.7. Coordination of Non-Standard Procedures. Any procedure, desired by WSR mission commanders, that is outside the parameters specified in this document must be coordinated with the appropriate ATC center.

3.2.1.8. Communications Between Participating Aircraft. Contact between crews of participating aircraft must be made using the frequencies listed in Table 3-1.

3.2.2 Airspace.

3.2.2.1. ATC Separation. The FAA will provide ATC services and separation from nonparticipating aircraft flying on instrument flight rules (IFR) to the 53 WRS and AOC aircraft operating in other than Class G airspace in accordance with 7110.65, Air Traffic Control. Nonparticipating aircraft not flying on instrument flight rules may be flying in the operations area of the winter season system; therefore, adherence to ATC clearances is mandatory for safety purposes.

3.2.2.2. International Airspace. International airspace is defined as the airspace beyond a sovereign State's 12 NM territorial sea limit. Beyond this limit ICAO rules apply. In international airspace, VFR flight is not allowed at night. In Class A controlled airspace, aircraft must operate using IFR procedures: ATC separation is provided between IFR aircraft. In Class E controlled airspace, both VFR and IFR operations are allowed; separation is provided between IFR aircraft but only traffic and terrain advisories are provided to VFR traffic.

3.2.2.3. IFR Procedures and Clearance. Aircrews will conduct flight operations utilizing Instrument Flight Rule (IFR) procedures to the maximum extent possible and will not normally conduct these flight operations under the provisions of "Due Regard." These procedures do not preclude aircraft commanders from exercising their authority in the interest of safety or during an aircraft emergency.

3.2.2.4. Operations in Controlled Airspace. While IFR, ATC will assign an altitude or a block of altitudes and provide standard vertical separation between all IFR aircraft and will provide VFR traffic advisories as far as practical.

3.2.2.5. Operations in Uncontrolled Airspace (Class G). Per FAA Order 7110.65, ATC is not authorized to assign altitudes nor provide separation between aircraft in uncontrolled airspace. While in uncontrolled airspace, the aircraft commander is the IFR clearance authority. In addition, aircrews are responsible for maintaining their own separation from the surface of the sea, obstacles, and oil platforms while operating below the Minimum IFR Altitude (MIA). In Class G uncontrolled airspace, both Visual Flight Rule (VFR) and IFR operations are allowed. When operating in uncontrolled airspace, flight information service, which includes known traffic information, is provided and the pilot is responsible for situating the aircraft to avoid other traffic (ICAO, Annex 11).

3.2.3. High-Altitude Synoptic Track Missions.

3.2.3.1. Flight Plan. Tracks are planned and flown at the highest altitude feasible. A normal Instrument Flight Rules (IFR) flight plan will be filed for this mission. When operating under an IFR flight plan, reconnaissance aircraft will fly only at Air Traffic Control (ATC) assigned altitudes and will accept altitude changes as directed by ATC.

3.2.3.2. NOTAM. A NOTAM request must be submitted by the 53 WRS, NOAA AOC, or NASA for NWSOP high-altitude missions in which weather instruments (e.g., dropsondes, etc) will be released. The NOTAM must contain individual coordinates or an area defined by coordinates for all releases. Submit NOTAM request per Appendix D procedures.

3.2.3.3. Release of Dropsondes. During NWSOP missions and when in other than Class G airspace, dropsonde instrument releases from FL 190 or higher and sensor activation must be coordinated with the appropriately affected ATC facilities by advising of a pending drop or sensor activation about 10 minutes prior to the event when in direct radio contact with ATC. When ATC has radar contact with the aircraft, they will notify the aircrew of any known traffic below them that might be affected. The aircraft commander is solely responsible for release of the instrument after clearing the area by all means available.

- When contact with ATC is via Aeronautical Radio, Incorporated (ARINC), event coordination must be included with the position report prior to the point where the action will take place, unless all instrument release points have been previously relayed to the affected ATC facilities. EXAMPLE: "TEAL 73, SLATN at 1215, FL310, estimating FLANN at 1250. CHAMP next, Weather instrument release at FLANN." Contact between participating aircraft must be made using the frequencies listed in Table 3-1.
- During NWSOP missions, approximately five (5) minutes prior to release the aircrew will broadcast in the blind on radio frequencies 121.5 MHz and 243.0 MHz to advise any traffic in the area of the impending drop. Pilots must not make these broadcasts if they will interfere with routine ATC communications within the vicinity of an ATC facility. The aircraft commander is responsible for determining the content and duration of a broadcast concerning the release or sensor activation.

3.2.4. Buoy Deployment Mission. Regardless of the designated class of airspace (A through G) the following rules apply:

3.2.4.1. Flight Plan. A normal IFR flight plan will be filed for this mission. The coordinates for some of the planned deployments may need to be changed while en route based on developing meteorological conditions. Local USAF or NOAA AOC command and control authority will be responsible for relaying any revisions to the flight crew via CARCAH. The aircraft routing may be altered by ATC if the routing does not impact mission execution (some missions may require the buoys to exit the aircraft in a specified order and they cannot be rearranged in flight).

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

3.2.5. CARCAH Responsibilities.

When missions are in progress, CARCAH is responsible for:

- Maintaining regular situational awareness of airborne operational and research flights from all agency flying units.
- Providing logistical and general support to 53 WRS aircrews.
- Briefing 53 WRS and NOAA AOC aircrews flying operational NWSOP missions tasked in the WSPOD about changes to requirements, conditions, and other essential information.
- Handling backup communications to ensure that ATC clearances, clearance requests, and messages are relayed in an accurate manner through any means available, but only when contact cannot be established directly between an aircraft and ATC.
- Relaying any revisions to the coordinates of planned releases for a buoy deployment mission to the aircrew as described in paragraph 3.2.4.1.

Chapter 4
Other Observations

4.1 General.

In addition to aerial reconnaissance data, the observational systems used in support of the National Winter Season Operations Plan include land surface, ship, radar, buoy, upper air, and satellite data. The routine operations of these various data sources are detailed in Federal Meteorological Handbooks and agency directives, which include:

- Federal Meteorological Handbook (FMH) No. 1, Surface Weather Observations and Reports
- FMH No. 2, Surface Synoptic Codes
- FMH No. 3, Rawinsonde and Pibal Observations
- FMH No. 11, Doppler radar (Parts A, B, C, and D) to include section 3.15, Snow Accumulation Algorithm.
- Various National Weather Service (NWS) Operations & Services directives (e.g., NWS Instructions 10-13XX series; NWS Instructions 10-14XX series)

4.2. National Data Buoy Capabilities and Requirements.

4.2.1. Winter Season Analysis and Forecasting Support.

4.2.1.1. Automated Reporting Stations.

The National Data Buoy Center (NDBC) maintains automated reporting stations in the coastal and deep ocean areas of the Gulf of Mexico, the Atlantic and Pacific Oceans, and in the Great Lakes. These data acquisition systems collect real-time meteorological and oceanographic measurements for operational and research purposes. NDBC also quality controls and releases meteorological data from the National Ocean Service Water Level Observing Network and from moorings and coastal stations operated by cooperating Regional Ocean Observing Systems. The NDBC website provides locations, latest operating status, and site-specific information for NDBC stations and provides links to details on partner organization stations. Specific questions may be addressed to:

NDBC Data Management and Communications Branch
Stennis Space Center, Mississippi 39529-6000
Phone: 228-688-2835

4.2.1.2. Data Acquisition.

Moored buoy and Coastal-Marine Automated Network (C-MAN) stations routinely acquire, store, and transmit data every hour; a few selected stations report more frequently. Data obtained operationally include sea level pressure, wind speed and direction, peak wind, and air temperature. Sea surface temperature and wave spectra data are measured by all moored buoys and a limited number of C-MAN stations. Relative humidity is measured at several stations. Ocean currents and salinity are measured at a few coastal stations.

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

4.2.2. Drifting Buoys and Floats.

4.2.2.1. Aerial Reconnaissance Deployment Requests.

Seasonal drifting buoy deployment requirements should be coordinated through the DOC/NOAA. Deployment requests should be received by the USAF Reserve 53 WRS at least eight weeks prior to desired release time.

Specific buoy deployment missions will be coordinated with CARCAH in accordance with guidance provided in Chapter 2, para. 2.4.1.1.2.

4.2.2.2. Global Ocean Drifter Array and Profiling Float Observations.

To augment NWSOP/AR Recon dropsonde observations in the Central and Eastern North Pacific (CPAC/ EPAC), observations from arrays of drifting buoys maintained by the UCSD/SIO's Lagrangian Drifter Lab (LDL), a component of NOAA's Global Drifter Program, and the oceanographic drifting float array for both Pacific and Atlantic regions maintained by Service Argo, SIO, and the WMO Joint Commission Oceanography and Marine Meteorology (JCOMM) are utilized. These are displayed respectively on the LDL and JCOMM websites: and Displays can also be found of Argo float, drifting buoy, and glider locations for both Atlantic and Pacific superimposed on various fields such as SST on the NOAA/AOML website. (See the NOAA Coast Watch website for more information.)

Additionally, in following years both drifter and float observations maintained by the NOAA/AOML/PHOD Global Drifter Program will be utilized for the Western North Atlantic and Gulf of Mexico, as displayed on the PHOD website.

Examples of these products are shown below in Figures 4-1, 4-2, and 4-3.

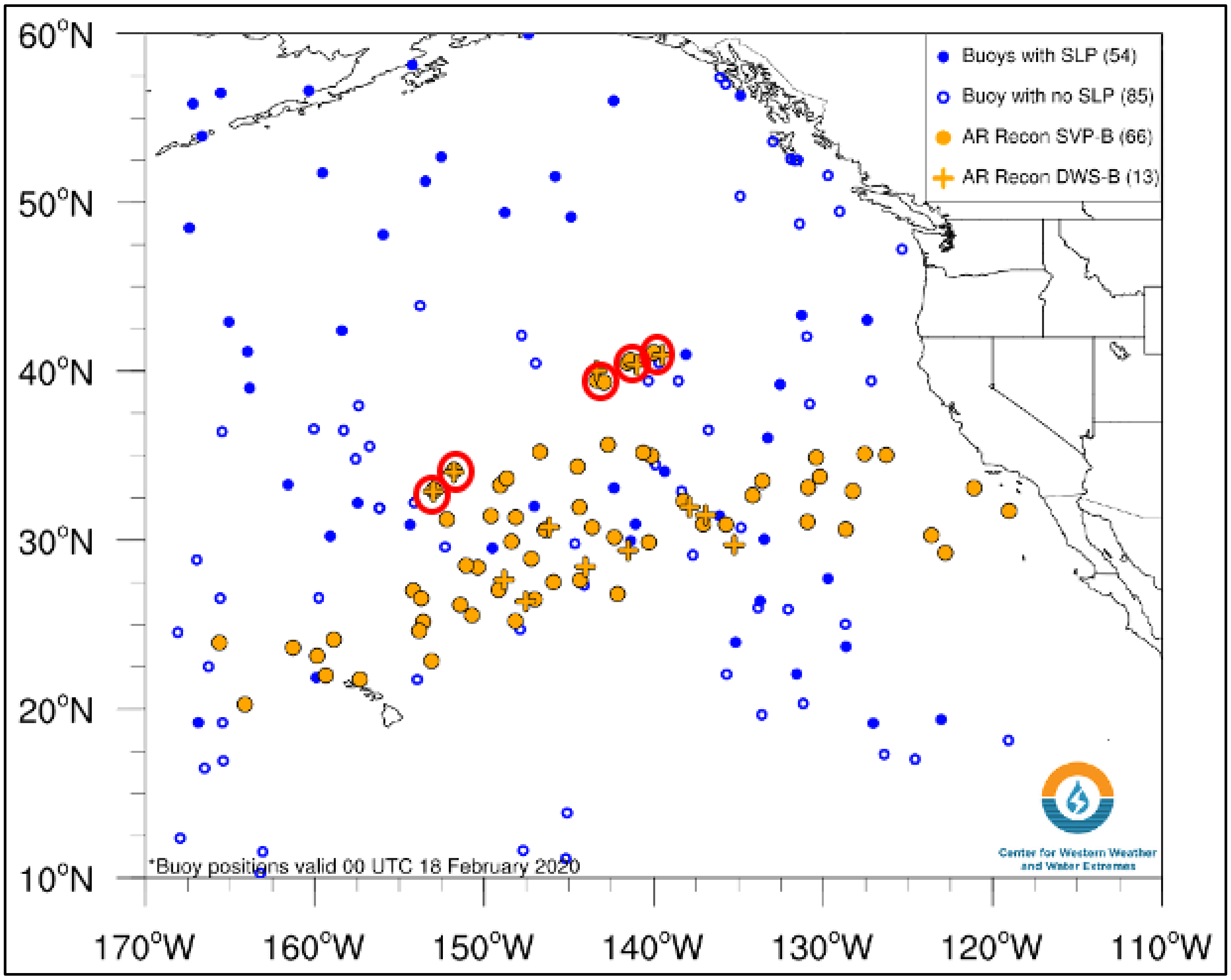


Figure 4-1. Distribution of Scripps Institution of Oceanography's Lagrangian Drifter Lab drifting buoys after AR Recon 2020, IOP4 as of 18 February 2020. Blue symbols are Scripps drifting buoys deployed by ships of opportunity during 2019 and 2020, with SST sensors and with/without atmospheric pressure sensors. Tan symbols are a mix of Scripps ship of opportunity drifters and air-deployed drifters by 53 WRS at the start of AR Recon 2020, which were a mix of Surface Velocity Program Barometer (SVP-B) and Directional Wave Spectra Barometer (DWS-B) drifter types. The drifters circled in red were air-deployed during a second re-seeding deployment during AR Recon IOP4 to the north of the earlier drifter deployments, consisting of packages of three drifters together: two SVPB and one DWSB. All drifters are drogued.

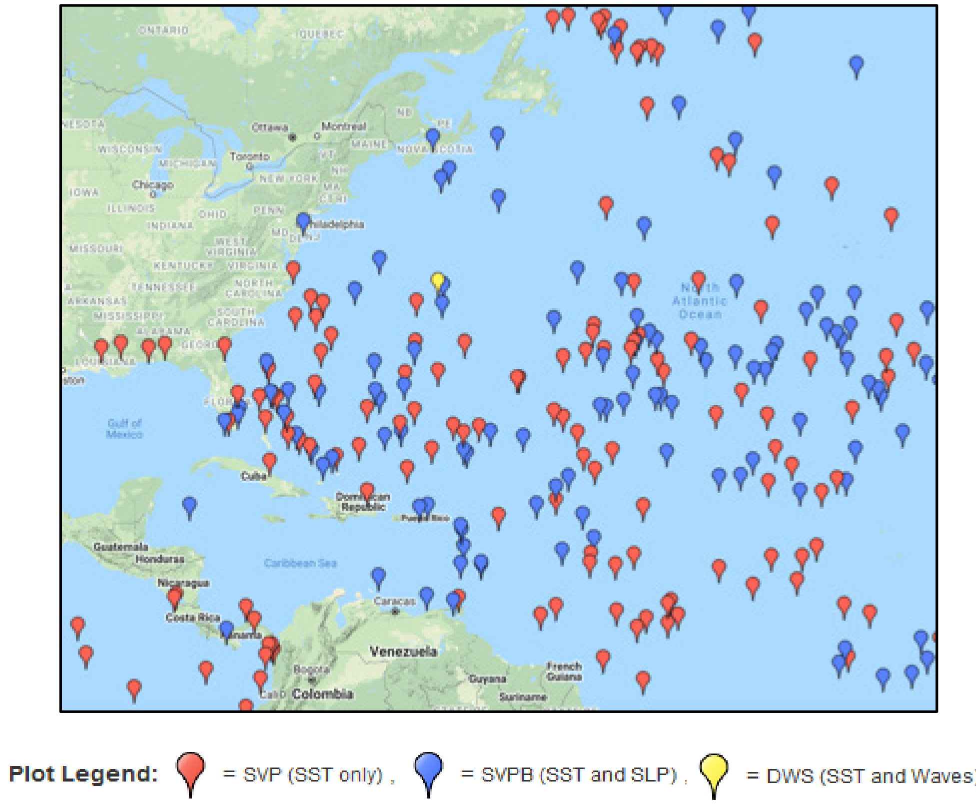


Figure 4-2. Distribution of drogued and undrogued drifting buoys and C-MAN coastal sensors during March 2020 for Western North Atlantic regions from Scripps Institution of Oceanography's Lagrangian Drifter Lab. Note: There are no drifters in Gulf of Mexico and Caribbean.

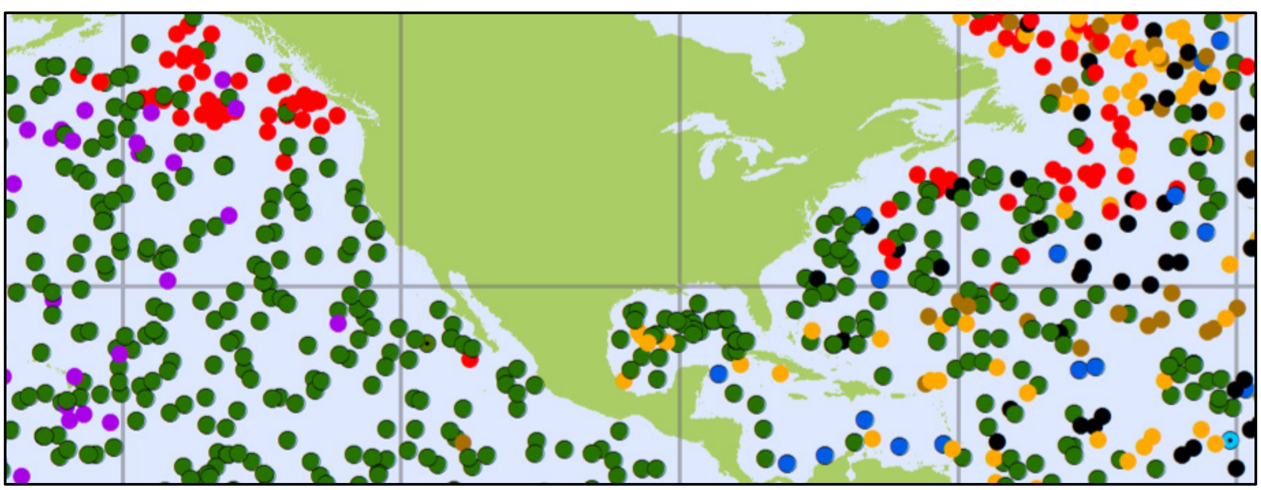


Figure 4-3. Service ARGO Float locations March, 2020 for Central and Eastern North Pacific, Central and Western North Atlantic, Gulf of Mexico, and Caribbean. Map from Service ARGO and GCOS/GOOS: WMO Joint Commission on Oceanography and Marine Meteorology (JCOMM). Colors indicate country of ownership: Green- USA, Red- Canada, Purple- Japan, Black- Germany, Orange- France, Brown- UK, Blue- EU.

4.2.3. Communications.

Moored buoy and C-MAN data are transmitted via NOAA Geostationary Operational Environmental Satellite (GOES) to the National Environmental Satellite, Data, and Information Service (NESDIS) or via the Iridium satellite communication system and then are relayed to the NWS Telecommunications Gateway (NWSTG) for processing and dissemination. Data from partner organizations acquired by NDBC are relayed to the NWSTG for processing and dissemination. Moored buoy observations are formatted into the World Meteorological Organization (WMO) FM13 SHIP code. C-MAN and other partner organization coastal station data are formatted into C-MAN code, which is very similar to the WMO FM12 SYNOP code. Drifting buoys transmit data via NOAA's Polar Orbiting Environmental Satellites (POES) to the U.S. Argos Global Processing Center, Largo, Maryland. Service Argos processes and formats the data into WMO FM18 BUOY code. The messages are then routed to the NWSTG for distribution. The formats for WMO encoded messages may be found in the WMO Manual on Codes Volume One, WMO-No. 306.

4.3 Satellite Surveillance of Winter Season Systems.

4.3.1. Satellites.

4.3.1.1. Geostationary.

4.3.1.1.1 Geostationary Operational Environmental Satellite (GOES).

GOES East.

GOES-East (GOES-16) is stationed at 75.2°W. GOES-16 became operational on December 18, 2017 and serves NOAA operations, including the NWS, other Federal agencies, and the private sector. Various imager channels are being utilized to monitor winter season systems over the Atlantic Ocean, Gulf of Mexico, and a portion of the East Pacific.

GOES West.

GOES-West (GOES-17) is currently stationed at 137.2°W. The GOES-17 satellite became operational in the GOES-West position February 12, 2019 with improved GOES-R series sensor capabilities. The routine scanning mode of GOES-West provides coverage of the Northern and Southern Hemisphere eastern Pacific Ocean as well as the western United States. The GOES-West satellite also supports the missions of the NWS and provides coverage of winter season systems over the East and Central Pacific.

GOES-R Series.

GOES-R Series satellites (16, 17, T, U) provide routine imaging over the CONUS occurs at 5-minute frequency with Full Disk coverage every 10 minutes. There is also the capability for mesoscale sector coverage as frequently as every 30 seconds. There are 16 spectral bands on the imager - 2 in the visible spectrum and 14 in the Infrared/Near-Infrared. Band 2 (0.64 µm in the red visible wavelength) has a nominal resolution of .5 km while band 1 (0.47 µm in the blue visible wavelength) has a resolution of 1 km. Two of the Near-IR bands (band 3 at .86 μm and band 5 at 1.6 μm) have 1 km resolution. All other Near-IR and IR bands are at 2 km resolution. In addition to the individual channel imagery a number of multispectral derived products for a wide variety of applications are also available. This series of satellites does not have a sounder instrument. The Geostationary Lightning Mapper (GLM) instrument aboard GOES-16 and GOES-17 detects total lightning activity across the Western Hemisphere: in cloud, cloud-to-cloud, and cloud-to-ground.

4.3.1.1.2. EUMETSAT Meteosat Geostationary Satellites.

EUMETSAT's current series of geostationary satellites, Meteosat Second Generation (MSG), includes Meteosat-8, and -11, each supporting a specific mission. Located at different positions, they cover Europe and the Indian Ocean. The designed life for an MSG satellite is seven (7) years, but some satellites have exceeded that time frame.

Meteosat-11 launched in July 2015 is EUMETSAT's prime operational geostationary satellite stationed at 0° longitude. The satellite provides a full earth scan (FES) every 15 minutes in 12 spectral channels. Meteosat-11 also provides geostationary earth radiation budget data, search and rescue monitoring, and relay of Data Collection Platform data.

Meteosat-8, stationed at 41.5°E and launched in August 2002, supports the FES mission over the Indian Ocean. It also provides Search and Rescue monitoring and Data Collection Platform relay service.

The MSG satellites carry a pair of instruments: the Spinning Enhanced Visible and InfraRed Imager (SEVIRI) and the Geostationary Earth Radiation Budget (GERB) instrument, a visible-infrared radiometer for Earth radiation budget studies. SEVIRI has twelve spectral channels, compared to three spectral channels on Meteosat First Generation satellites. These provide more precise data throughout the atmosphere, giving improved quality to the starting conditions for numerical weather prediction models. Eight of the channels are in the thermal infrared, providing, among other information, permanent data about the temperatures of clouds, land and sea surfaces. One of the SEVIRI channels is called the High Resolution Visible (HRV) channel, and has a sampling resolution at nadir of 1 km, compared to the 3 km resolution of the other visible channels. The improved horizontal image resolution for the visible light spectral channel helps weather forecasters in detecting and predicting the onset or end of severe weather. Using infrared channels that absorb ozone, water vapor and carbon dioxide, MSG satellites allows meteorologists to analyze the characteristics of atmospheric air masses and reconstruct a three-dimensional view of the atmosphere.

4.3.1.1.3. Himawari.

The current 8th and 9th geostationary weather satellites operated by the Japan Meteorological Agency (JMA) are named Himawari -8 and -9.Himawari-8 was launched in October 2014 and effective July 2015, is currently operating at 140° East, the prime geostationary satellite position to support JMA's meteorological and environmental monitoring services over eastern Asia and the West Pacific Ocean.Himawari-9 was launched in November 2016 and is positioned at 140.7 degrees East in standby as a backup to Himawari-8 in the event of a failure.Himawari-8 replaced

MTSAT-2 as JMA's prime geostationary satellite in July 2015.Himawari-8 introduced a new series of imager instrument, Advanced Himawari Imager (AHI), which consists of 16 spectral channels at higher spatial resolution for improved sensing of the earth's atmosphere and surface. Full earth scans are transmitted every 10 minutes. The higher spatial resolution and higher number of channels from the AHI also provide significant improvements in monitoring, intensity estimation, and forecasting of tropical cyclones over the West Pacific Ocean, many of which transition to major typhoons. The Himawari AHI is analogous to NOAA's GOES-R series Advanced Baseline Imager (ABI). Through an agreement, NOAA acquires Himawari data from JMA's HimawariCloud service and then makes the data available to NOAA sites including NESDIS SAB and NWS NCO and DOD. JMA plans to replace Himawari-8 with Himawari-9 in 2022.

4.3.1.1.4. COMS-1.

The Communication, Ocean and Meteorology Satellite (COMS) is the first operational weather and ocean satellite from The Republic of Korea. COMS-1 was developed by the Korean Astronomical Research Institute (KARI) through contract with EADS Astrium, and carries a 5-channel imager similar to the imager on board GOES L-N. Full disk images are directly broadcast from the satellite every 27 minutes. Stationed at 128°E, the Korean Meteorological Administration (KMA) began prime operations of COMS-1 in 2011, providing supplemental coverage of the West Pacific and East Indian oceans. The primary U.S government user of COMS-1 data is DOD.

4.3.1.2. Low Earth Orbiting (LEO) Satellites.

4.3.1.2.1. Initial Joint Polar System (IJPS).

Two operational polar orbiting satellites, NOAA's NOAA-19 (PM Prime Services Mission) and EUMETSAT's Metop-B (AM Primary), provide image coverage four times a day over a respective area in 6 spectral channels (however only 5 channels can be supported at one time; channel switching is used to support the 6th channel). These satellites cross the U.S. twice per day at 12-hour intervals for each geographical area near the Equatorial crossing times listed in Table 3-1.

NOAA-19 and Metop-B provide the same capabilities as previous NOAA satellites, except that the Advanced Microwave Sounding Unit–B (AMSU-B) sensor flown aboard NOAA-17 and previous polar orbiters has been replaced by the Microwave Humidity Sounder (MHS) on NOAA-19. Data are available via direct readout—high-resolution picture transmission (HRPT) or automatic picture transmission (APT)—or via central processing. The 557 WW receives global data from the Advanced Scatterometer (ASCAT) on board Metop-B direct from central readout sites on a pass-by-pass basis. The AMSU data are used as input to tropical cyclone intensity estimation algorithms used by NHC, CPHC and JTWC. The Command and Data Acquisition (CDA) stations at Fairbanks, AK, and Wallops, VA, acquire recorded global area coverage data sub-sampled to a 4 km spatial resolution, and then route the data to NESDIS computer facilities in Suitland, MD, where the data are processed and distributed to the NOAA, the DOD, and private communities. Ground equipment installed at various NWS regions including Kansas City, Miami (NOAA/AOML), and Monterey enable direct readout and data processing of 1.1 km resolution AVHRR and VIIRS data from NOAA-19 and Metop-B. The high-resolution polar data and products generated at AOML complement other satellite data sources to support tropical mission objectives.

The Command and Data Acquisition (CDA) stations at Fairbanks, AK, and Wallops, VA, acquire recorded global area coverage data sub-sampled to a 4 km spatial resolution, and then route the data to NESDIS computer facilities in Suitland, MD, where the data are processed and distributed to the NOAA, the DOD, and private communities. Ground equipment installed at various NWS regions including Kansas City, Miami (NOAA/AOML), and Monterey enable direct readout and data processing of 1.1 km resolution AVHRR and VIIRS data from NOAA-19 and Metop-B. The high-resolution polar data and products generated at AOML complement other satellite data sources to support tropical mission objectives.

4.3.1.2.2. S-NPP.

Suomi National Polar-Orbiting Partnership satellite (S-NPP) launched in October, 2011, is part of the Joint Polar Satellite System (JPSS), the next generation polar-orbiting operational environmental satellite system. S-NPP carries five instruments, including Visible Infrared Imaging Radiometer Suite (VIIRS), Advanced Technology Microwave Sounder (ATMS) and Cross-track Infrared Sounder (CrIS). CrIS provides global hyperspectral infrared observations twice daily for profiling atmospheric temperature and water vapor, critically needed information for improving weather forecast accuracy out to seven days. CrIS also supplies information used to retrieve greenhouse gases, land surface and cloud properties. CrIS measures infrared spectra in three spectral bands: the longwave IR (LWIR) band from 650 to 1095 cm^{-1}, mid-wave IR (MWIR) band from 1210 to 1750 cm^{-1} and shortwave IR (SWIR) band from 2155 to 2550 cm^{-1}. Normal spectral resolution (NSR) and full spectral resolution (FSR) operational modes provide a total of 1305 and 2211 radiance channels, respectively. The time scale of tropical cyclone track and intensity changes is on the order of 12 hours, which makes JPSS instruments well suited for the forecasting of these parameters. Two basic methods exist for improving tropical cyclone forecasts with S-NPP. First is to assimilate data in numerical forecast models, and second is to improve analysis and statistical post-processing forecast products. NOAA/NESDIS has integrated the S-NPP data into operational applications whose products are used by NCEP, including MiRS, bTPW, eTRaP, and statistical intensity and wind structure estimation algorithms. NESDIS also reformats the S-NPP ATMS data into the BUFR for use by the NOAA NWP community, and some international agencies.

4.3.1.2.3. JPSS Satellites.

The Joint Polar Satellite System (JPSS) is the Nation's next generation of polar-orbiting operational environmental satellite system. JPSS is a collaborative program between NOAA and its acquisition agent, NASA. This interagency effort is the latest generation of U.S. polar-orbiting, non-geosynchronous environmental satellites. JPSS-1, now designated NOAA-20, was launched on November 18, 2017 into a 1330 Local Time Ascending Node (LTAN) sun-synchronous polar orbit and is now the PM primary operational spacecraft. Capitalizing on the success of Suomi NPP, NOAA-20 features five similar instruments: (1) VIIRS, (2) CrIS, (3) ATMS, (4) OMPS-N, and (5) CERES-FM6. NOAA-20 has a design life of seven years and it will circle the Earth in the same orbit as Suomi NPP, although the two satellites will be separated in time and space by 50 minutes.

Forty-eight days after launch, on January 5, 2018, the NOAA-20 Cross-track Infrared Sounder (CrIS) started collecting science data. With the same design as Suomi NPP CrIS, NOAA-20 CrIS provides global hyperspectral infrared observations twice daily for profiling atmospheric temperature and water vapor, critically needed information for improving weather forecast accuracy out to seven days. CrIS also supplies information used to retrieve greenhouse gases, land surface and cloud properties.

The JPSS-2 spacecraft will feature several instruments similar to those found on NOAA-20—VIIRS, CrIS, ATMS and OMPS-N—and provide operational continuity of satellite-based observations of atmospheric, terrestrial and oceanic conditions for both weather forecasting and long-term climate and environmental data records. It is scheduled to launch in 2021. JPSS-3, the third spacecraft in the JPSS series, is scheduled to launch in 2026. Benefiting from on the success of previous JPSS spacecraft, JPSS-3 will carry instruments similar to those found on earlier JPSS satellites: VIIRS, CrIS, ATMS and OMPS-N. Scheduled to launch in 2031, JPSS-4 is the fourth and final spacecraft of the JPSS constellation. Similar to previous JPSS spacecraft, JPSS-4 will host the latest versions of the VIIRS, CrIS, ATMS and OMPS-N instruments.

The ground system for the JPSS mission is a global network of receiving stations linked to NOAA, which distributes the satellite data and derived products to users worldwide. The versatile ground system controls the spacecraft, ingests and processes data and provides information to users like NOAA's National Weather Service. The JPSS ground system delivers fresh data from the next generation of polar-orbiting satellites to users more quickly than ever before.

In addition to supporting the Suomi NPP, NOAA-20, JPSS-2, JPSS-3 and JPSS-4 satellite missions, the ground system provides support to the wide variety of polar missions, which include but are not limited to: NESDIS Free Flyer Satellites, EUMESTAT Metop Satellites, The Japanese Global Change Observation Mission (GCOM), and the U.S. Navy Windsat Mission.

4.3.1.2.4. COSMIC-2A Satellites.

The satellites, six of the 24 payloads flying on the U.S. Air Force’s Space Test Program-2, make up the Constellation Observing System for Meteorology, Ionosphere, and Climate, called COSMIC-2. COSMIC-2 data feed into NOAA’s sophisticated numerical weather prediction models to forecast weather and climate and monitor dynamic changes in Earth's ionosphere, leading to improved weather and space weather forecasts.

4.3.1.3. Non-NOAA LEO Satellites.

NOAA uses dedicated ground support systems to ingest and process data from select Non-NOAA satellite systems for use in operational forecasting and winter season system analysis. These include data from the NASA Earth Observing System (EOS) satellites: Terra, Aqua, and Aura; CORIOLIS from the Department of Defense; Jason-3 from the joint NOAA, NASA, Centre National d’Etudes Spatiales (CNES), and EUMETSAT mission; and SARAL from the cooperative altimetry technology mission of the Indian Space Research Organization and CNES.

These satellites employ multiple infrared and microwave radiometers as well as active scatterometers to assess environmental features on the ocean surface.

4.3.1.3.1. Defense Meteorological Satellite Program (DMSP).

Defense Meteorological Satellite Program (DMSP). DMSP has been collecting weather data for U.S. military operations for over five decades. Two operational DMSP satellites are in polar orbits at about 458 nautical miles (nominal) at all times. The primary weather sensor on DMSP is the Operational Linescan System, which provides continuous visual and infrared imagery of cloud cover over an area 1,600 nautical miles wide. Additional satellite sensors measure atmospheric vertical profiles of moisture and temperature. Military weather forecasters use these data to monitor and predict regional and global weather patterns, including the presence of severe thunderstorms.

The Special Sensor Microwave Imager Sounder (SSM/IS) is a 24-channel, linearly polarized passive microwave radiometer system. The instrument is flown on board the DMSP F-16 and F-18 satellites, which were launched in October 2003 and October 2009, respectively. It is the successor to the Special Sensor Microwave/Imager (SSM/I). These microwave imagers have been particularly useful for winter season system reconnaissance and analysis in the vast reaches over the Pacific Ocean.

4.3.1.3.2. GCOM-W1.

The "Global Change Observation Mission" (GCOM) is a series of Japan Aerospace Exploration Agency (JAXA) Earth missions lasting 10-15 years designed to obtain observations related to water and climate. The GCOM-W1 was launched May 18, 2012 and is the first satellite of the GCOM-W series. GCOM-W1 is in a sun-synchronous orbit (~700 km altitude) and part of the "A-Train" with an ascending node equator crossing time of 13:30 UTC. The AMSR2 (Advanced Microwave Scanning Radiometer 2) instrument onboard the GCOM-W1 satellite will continue Aqua/AMSR-E observations of water vapor, cloud liquid water, precipitation, SST, sea surface wind speed, sea ice concentration, snow depth, and soil moisture. NOAA/NESDIS has integrated the GCOM-W1 data into a few operational applications whose products are used by National Hurricane Center, including bTPW, eTRaP, GCOM-W1 AMSR2 Algorithm Software Package (GAASP). NESDIS also reformats the GCOM-W1 AMSR2 data into the BUFR for use by the NOAA NWP community, and some international agencies.

4.3.1.3.3. GPM.

The Global Precipitation Measurement (GPM) mission is an international network of satellites that provide the next-generation global observations of rain and snow. The GPM core Observatory, initiated by NASA and JAXA as a global successor to TRMM, serves as a reference standard to unify precipitation measurements from the GPM constellation of research and operational satellites. The GPM Core Observatory was launched on February 27th, 2014 at 1:37pm EST from Tanegashima Space Center. The onboard instrument, GPM microwave imager (GMI) measures microwave radiance at seven frequencies (10.65GHz, 18.70GHz, 23.80GHz, 36.50GHz, 89.0GHz), which are subsequently processed and converted into different GPM data and products. NOAA/NESDIS has integrated the GPM GMI data into a few operational applications whose products are used by the National Hurricane Center, including Microwave Integrate Retrieval System (MiRS), Blended Total Precipitable Water (bTPW), Ensemble Tropical Rainfall Potential (eTRaP). NESDIS also reformats the GPM data, specifically the L1C-R data, into the Binary Universal Format (BUFR) for use by the NOAA NWP community, and some international agencies.4.3.2. National Weather Service (NWS) Support.

4.3.2 National Weather Service (NWS) Support.

The GOES imagery is available in support of the surveillance of winter weather systems at specific NWS offices. Satellite meteorologists can be contacted at these offices; telephone numbers are in Appendix G.

4.3.3. NESDIS Satellite Analysis Branch (SAB).

The SAB operates 24 hours a day to provide satellite support to the WPC/OPC, NHC, CPHC, JTWC, and other worldwide users. The telephone number for the SAB is located in Appendix G.

4.3.4. Department of Defense Support

Data covering the NWSOP areas of interest are received centrally at the Air Force 557 WW and distributed to the Air Force's Operational Weather Squadrons (OWS) and the Navy's Fleet Numerical Meteorology and Oceanography Center (FNMOC) at Monterey, CA.

4.3.5. Satellites and Satellite Data Availability.

Table 4-1 lists satellite capabilities for the current winter season.

Table 4-1 Satellite and Satellite Data Availability for the Current Winter Season

Satellite	Type of data	Scan time	Products
GOES-16 (75.2°W) GOES-17 137°W	Multi-band imager (16 spectral channels)	Full disk every 15 minutes CONUS 5 minute frequency Mesoscale Sector coverage every 30 seconds	1. ABI band 2 is .5 km resolution 2. Bands 1, 3, 5 are 1 km resolution and all other banks are 2 km resolution. 3. GLM provides total lightning activity across the Western Hemisphere. 4. For list of baseline products see: GOES Baseline Products (Note: GOES-16 L2+ products are not yet available.) 5. Global Hydro-Estimator (GHE)
METEOSAT-11 at 3.4° W (Prime Meridian) METEOSAT-8 at 41.5°E (Indian Ocean)	Multi-spectral Spin-Scan Radiometer (SEVIRI) and High Resolution Visible (HRV)	SEVIRI: Full disk image every 15 minutes. HRV: Sector scan to move with local noon/available daylight.	1. 1 km resolution VIS imagery (HRV); 3 km resolution IR imagery (SEVIRI). 2. 3 km resolution VIS and IR WEFAX imagery. 3. 3 km water vapor imagery. 4. Tropical storm monitoring and intensity analysis. 5. Volcanic ash detection and analysis. 6. Advanced Dvorak Technique (ADT) 7. Tropical Cyclone Formation Probability Guidance Product (TCFP) 8. Ensemble Tropical Rainfall Potential (eTRaP) 9. Multiplatform Tropical Cyclone Surface Winds Analysis (MTCSWA) 10. Global Hydro-Estimator (GHE)
Himawari-8 and 9 at 140.7°E (Asian Pacific)	Multi-band imager (16 spectral channels)	Full disk every 10 minutes	1. AHI .5 km band 3 resolution 2. 1 km resolution for bands 1, 2, and 4. All other bands 2 km resolution. 3. Tropical storm monitoring and intensity analysis. 4. Volcanic ash detection and analysis 5. Aerosol monitoring. 6. Advanced Dvorak Technique (ADT) 7. Tropical Cyclone Formation Probability Guidance Product (TCFP) 8. Ensemble Tropical Rainfall Potential (eTRaP) 9. Multiplatform Tropical Cyclone Surface Winds Analysis (MTCSWA) 10. Global Hydro-Estimator (GHE)

Table 4-1 Satellite and Satellite Data Availability for the Current Winter Season (Continued)

Satellite	Type of data	Scan time	Products
COMS-1 at 128°E (Asian Pacific)	Meteorological Imager (MI) (5 spectral channels)	Full disk every 30 minutes	1. MI 1 km resolution VIS imagery. 2. MI 4 km resolution in 4 IR channels. 3. Tropical storm monitoring. 4. Aerosol monitoring.
GPM (Global Precipitation Mission)	GMI	Fluctuates from 60°N to 60°S	1. Microwave Integrated Retrieval System (MiRS) 2. Blended Total Precipitable Water (bTPW) 3. Ensemble Tropical Rainfall Potential (eTRaP) 4. Advanced Dvorak Technique (ADT) 5. Blended Rain Rate
S-NPP/ NOAA-20	VIIRS and ATMS	Every 12 hours	1. Microwave Integrated Retrieval System (MiRS) 2. Blended Total Precipitable Water (bTPW) 3. Ensemble Tropical Rainfall Potential (eTRaP) 4. Cross-track Infrared Sounder (CrIS) to monitor moisture and pressure 5. Microwave based tropical cyclone intensity estimates. 6. Blended Rain Rate
S-NPP/ NOAA-20	OMPS	granular	1. OMPS Nadir Mapper Total Ozone Environmental Data Record (EDR) 2. OMPS Nadir Profiler Ozone Profile Environmental Data Record (EDR) 3. OMPS Nadir Mapper SO2 EDR
GCOM-W1	AMSR2	Sun-synchronous orbit (~700 km altitude) ascending node equator crossing time of 13:30 UTC	1. Blended Total Precipitable Water (bTPW) 2. Ensemble Tropical Rainfall Potential (eTRaP) 3. GCOM-W1 AMSR2 Algorithm Software Package (GAASP) 4. Advanced Dvorak Technique (ADT) 5. Blended Rain Rate

Table 4-1 Satellite and Satellite Data Availability for the Current Winter Season (Continued)

Satellite	Type of data	Scan time	Products
MetOp-A and B NOAA-19 NOAA-18 (secondary) NOAA-15 (secondary)	AVHRR (GAC and LAC [recorded]); HRPT (direct); (AMSU-A; MHS [N-19]; HIRS)	Local Crossing Times: MetOp-B: 0931D / 2131A MetOp-A: 0929D / 2129A NOAA-19: 0246D / 1436A NOAA-18: 0553D / 1753A NOAA-15: 0546D / 1746A	1. 1 km resolution HRPT and Local Area Coverage (LAC) data. 2. 4 km resolution APT and Global Area Coverage (GAC) data. 3. Mapped imagery. 4. Unmapped imagery (all data types) at DMSP sites. 5. Sea-surface temperature analysis. 6. Soundings. 7. Moisture profiles. 8. Remapped GAC sectors. 9. Sounding-derived products--total precipitable water, rain rate, and surface winds under sounding 10. Daily northern hemisphere snow cover analysis. 11. Twice daily fire and smoke analysis over specific areas within CONUS. 12. AMSU based tropical cyclone intensity estimates. 13. Ensemble Tropical Rainfall Potential (eTRaP) 14. Multiplatform Tropical Cyclone Surface Winds Analysis (MTCSWA) 15. Blended Total Precipitable Water (bTPW) 16. Microwave Integrated Retrieval System (MiRS) 17. Blended Rain Rate
DMSP F-16 Secondary DMSP F-18 Ops	OLS Imagery (recorded and direct), SSM/IS	Local Crossing Times: F16: 0350D / 1550D F-18: 0610D/ 1810A	1. 0.3 nm (regional) and 1.5 nm (global) resolution (visual and infrared) imagery available via stored data recovery through 557 WW. 2. Regional coverage at 0.3 nm and 1.5 nm resolution (visual and infrared) imagery available from numerous DOD tactical terminals. 3. SSM/IS data transmitted to NESDIS and FNMOC from 557 WW. 4. Ensemble Tropical Rainfall Potential (eTRaP) 5. Advanced Dvorak Technique (ADT)

Chapter 5
Communications

5.1 Department of Commerce (DOC).

5.1.1 National Weather Service (NWS).

All communication systems of the NWS are used in support of the data collection and warning program given in the plan. These communication systems are described in the publication, Operations of the National Weather Service.

5.1.2 Aircraft Operations Center (AOC).

The NOAA G-IV and WP-3D aircraft will normally transmit aircraft messages via commercial SATCOM to a secure ingest server that is part of the NWSTG, as described in section 2.8.

5.2 Department of Defense (DOD).

5.2.1 U.S. Air Force.

5.2.1.1. 557th Weather Wing (557 WW).

Headquarters (HQ), 557 WW posts Winter Storm bulletins received from the NWS on the Air Force Weather-Web Services (AFW-WEBS) where they are accessible to DOD users worldwide.

5.2.1.2. 53rd Weather Reconnaissance Squadron (53 WRS).

Weather reconnaissance observations from the 53 WRS will be transmitted to CARCAH via Air Force satellite communications (SATCOM), checked for accuracy, and then transmitted to NOAA via the 557 WW for dissemination. See section 2.8 for more information regarding aircraft and ground station communications systems used to transmit observations.

5.2.2 U.S. Navy.

For the maritime environment, the primary means of dissemination for gale, storm, high-seas warnings, other winter storm advisories, and special observations is via the Naval Meteorology and Oceanography Command's web page, where both graphical and alphanumeric warnings are posted. In addition, the Defense Message Service (DMS) is also used to distribute alphanumeric data and gale, storm, and high-seas graphics. Unclassified DISN ATM Services (DATMS-U) will be used for exchange of data between NWS and FNMOC.

5.3 Department of Homeland Security (DHS).

5.3.1. U.S. Coast Guard.

The Coast Guard operates activities that routinely collect and/or report meteorological data. Those units that collect and transmit (or report) data for this program are Coast Guard Communications facilities at Boston, MA; Chesapeake, VA; Miami, FL; New Orleans, LA; Kodiak, AK; Honolulu, HI; and San Francisco, CA. These facilities collect Automated Mutual Assistance Vessel Rescue (AMVER) messages from merchant vessels and METEO messages from merchant and Coast Guard vessels on a routine basis. The METEO data are then passed directly to NCEP on the Coast Guard Data Network (CGDN).

Chapter 6
Publicity

6.1 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, whenever possible.

6.2 Public Affairs Points of Contact.

Copies of these releases, along with any pertinent information, are highly encouraged and are requested to be forwarded to the following winter season aerial reconnaissance agencies:

NOAA Office of Marine and Aviation Operations (OMAO): david.l.hall@noaa.gov

NOAA Aircraft Operations Center (AOC): jonathan.shannon@noaa.gov

NOAA/National Weather Service (NWS): susan.buchanan@noaa.gov

NOAA/Interagency Meteorological Coordination (IMCO): icams.portal@noaa.gov

Office of the Director of Air Force Weather (HQ USAF/A3O-W): usaf.pentagon.af-a3.mbx.a3w-weather-workflow@mail.mil

403rd Wing Public Affairs (AFRC 403 WG/PA), includes the 53rd Weather Reconnaissance Squadron (53 WRS): 403WG.PA2@us.af.mil

6.3 Public Affairs Web Pages.

Media releases can also be found at:

National Oceanographic and Atmospheric Administration (NOAA)

National Weather Service (NWS)

Air Force Reserve Command (AFRC)

Federal Aviation Administration (FAA)

Commander, Naval Meteorology and Oceanography Command (CNMOC)

Appendix A
Abbreviations

-A-

ADT	Advanced Dvorak Technique
AFB	Air Force Base
AFW-WEBS	Air Force Weather-Web Services
ABI	GOES Advanced Baseline Imager
AFI	Air Force Instruction
AFMAN	Air Force Manual
AFRC	Air Force Reserve Command
AHI	Advanced Himawari Imager
AIM	Aeronautical Information Manual
AIREP	Aircraft Report
AMSR2	Advanced Microwave Scanning Radiometer 2
AMVER	Automated Mutual Assistance Vessel Rescue (USCG)
AMSU	Advanced Microwave Sounding Unit
AOC	Aircraft Operations Center
AOML	Atlantic Oceanographic and Meteorological Laboratory (NOAA)
APT	Automatic Picture Transmission
AR	Atmospheric River
ARINC	Aeronautical Radio, Incorporated
ARTCC	Air Route Traffic Control Center
ARWO	Aerial Reconnaissance Weather Officer (USAF)
ATC	Air Traffic Control
ATCSCC	Air Traffic Control System Command Center
ATM	AFLOAT Toolbox for Maintenance (USN)
ATMS	Advanced Technology Microwave Sounder
AVHRR	Advanced Very High-Resolution Radiometer
AWIPS	Advanced Weather Interactive Processing System

-B-

BTPW	Blended Total Precipitable Water
BUFR	Binary Universal Format

-C-

C	Celsius
CARCAH	Chief, Aerial Reconnaissance Coordination, All Hurricanes
CARF	Central Altitude Reservations Function
CERES	Clouds and the Earth's Radiant Energy System
CGDN	Coast Guard Data Network
Class G Airspace	Uncontrolled Airspace
C-MAN	Coastal-Marine Automated Network

CNES	Centre National d'Etudes Spatiales
CNMOC	Commander, Naval Meteorology and Oceanography Command
COCOM	Combatant Command
COM	Commercial Phone Line
COMS	Communication, Ocean and Meteorology Satellite
CONUS	Continental United States
CPAC	Central Pacific
CPHC	Central Pacific Hurricane Center
CrIS	Cross-track Infrared Sounder
CW3E	Center for Western Weather and Water Extremes
CWU	Centralized Weather Unit (USAF)

-D-

DATMS-U	Unclassified DISN ATM Services
deg	degree
DHS	Department of Homeland Security
DISN	Defense Information System Network
DHS	Department of Homeland Security
DMS	Defense Message Service
DMSP	Defense Meteorological Satellite Program
DOC	Department of Commerce
DOD	Department of Defense
DOT	Department of Transportation
DSCA	Defense Support of Civil Authorities
DSN	Defense Switched Network (formerly AUTOVON)
DWS-B	Directional Wave Spectra Barometer

-E-

EDR	Environmental Data Record
EMC	NCEP Environmental Modeling Center
EOS	NASA Earth Observing System
EPAC	Eastern Pacific
ETD	Estimated Time of Departure
eTRaP	Ensemble Tropical Rainfall Potential
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites

-F-

FAA	Federal Aviation Administration
FAD	Force Activity Designator
FEA	Flow Evaluation Area (FAA)
FES	Full Earth Scan
FIR	Flight Information Region
FFAECC	Fleet Forces Atlantic Exercise Coordination Center (USN)
FL	Flight Level
FMH	Federal Meteorological Handbook
FNMOC	Fleet Numerical Meteorology and Oceanography Center (USN)
FSR	Full Spectral Resolution
ft	foot/feet

-G-

G-IV	Gulfstream IV-SP aircraft
GAC	Global Area Coverage
GAASP	GCOM-W1 AMSR2 Algorithm Software Package
GCOM	Global Change Observation Mission
GCOS	Global Climate Observing System
GDSS	Global Decision Support System
GHE	Global Hydro-Estimator
GLM	Geostationary Lightning Mapper
GMI	GPM Microwave Imager
GOES	Geostationary Operational Environmental Satellite
GOOS	Global Ocean Observing System
GPM	Global Precipitation Mission
GTS	WMO Global Telecommunications System

-H-

h	hour(s)
HA	High Accuracy
HD	High Density
HDOB	High Density Observation
HF	High Frequency
HIRS	High Resolution Infrared Radiation Sounder
HRPT	High Resolution Picture Transmission
HRV	High Resolution Visible Satellite Imagery

-I-

ICAO	International Civil Aviation Organization
IMCO	Interagency Meteorological Coordination Office
IOP	Intensive Observing Period
IVT	Integrated Water Vapor Transport

-J-

JAXA	Japan Aerospace Exploration Agency
JCS	Joint Chiefs of Staff
JMA	Japan Meteorological Agency
JCOMM	WMO Joint Commission Oceanography and Marine Meteorology
JPSS	Joint Polar Satellite System
JTWC	Joint Typhoon Warning Center

-K-

KARI	Korean Astronomical Research Institute
KBIX	ICAO identifier for Keesler AFB, MS
KHz	Kilohertz
km	kilometer(s)
KMA	Korean Meteorological Administration
KNHC	ICAO identifier for the National Hurricane Center, Miami, FL
kt	knot(s)
KWBC	ICAO identifier for NCEP

-L-

LAC	Local Area Coverage
LDL	Lagrangian Drifter Lab (UCSD/SIO)
LOA	Letter of Agreement
LTAN	Local Time Ascending Node
LWIR	Longwave Infrared

-M-

m	meter(s) or minute(s)
MARSA	Military Assumes Responsibility for Separation of Aircraft
mb	millibar(s)
METEO	Cable Address for Ships
METEOSAT	European Space Agency Geostationary Meteorological Satellite
MHS	Microwave Humidity Sounding
MHz	Megahertz
MI	Meteorological Imager
mi	(statute) mile(s)
MIA	Minimum IFR Altitude
MiRS	Microwave Integrate Retrieval System
MOA	Memorandum of Agreement or Military Operations Area
mph	mile(s) per hour
m/s	meter(s) per second
MSG	Meteosat Second Generation
MTCSWA	Multiplatform Tropical Cyclone Surface Winds Analysis
MW	Moving Weather

MWIR	Mid-wave Infrared

-N-

NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NCEP	National Centers for Environmental Prediction
NCO	NCEP Central Operations
NDBC	National Data Buoy Center
NESDIS	National Environmental Satellite, Data, and Information Service
NHC	National Hurricane Center
nm	nautical mile(s)
NMOC	Naval Meteorology and Oceanography Command
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NOTAM	Notice to Airmen
NSR	Normal Spectral Resolution
NWS	National Weather Service
NWSI	National Weather Service Instruction
NWSTG	National Weather Service Telecommunications Gateway
NWSOP	National Winter Season Operations Plan
NWP	Numerical Weather Prediction

-O-

OB	Observation
OLS	DMSP Operational Linescan System
OMAO	Office of Marine and Aviation Operations
OMPS	Ozone Mapping and Profiler Suite
OPC	NCEP Ocean Prediction Center
OWS	Operational Weather Squadron (USAF)

-P-

Pa	Pascal
PBFA	Policy Board on Federal Aviation (DOD)
PHOD	Physical Oceanography Division (NOAA/AOML)
PIREP	Pilot Report
POES	Polar-Orbiting Environmental Satellite

-R-

RECCO	Reconnaissance Coded Observation
RFA	Request for Assistance

-S-

s	second(s)
SAB	NESDIS Satellite Analysis Branch
SARAL	Satellite with ARgos and ALtiKa
SATCOM	Satellite Communications
SATPHONE	Satellite Phone
SDM	Senior Duty Meteorologist (NCEP/NCO)
SFMR	Stepped Frequency Microwave Radiometer
SEVIRI	Multi-spectral Spin-Scan Radiometer
SIO	Scripps Institution of Oceanography
S-NPP	Suomi National Polar-orbiting Partnership
SSM/I	Special Sensor Microwave/Imager
SSM/IS	Special Sensor Microwave/Imager Sounder
SUA	Special Use Airspace
SVP-B	Surface Velocity Program Barometer
SWIR	Shortwave Infrared

-T-

TADO	Tanker and Airlift Duty Officer
TCFP	Tropical Cyclone Formation Probability Guidance Product
TCORF	Tropical Cyclone Operations and Research Forum
TCPOD	Tropical Cyclone Plan of the Day
TEMP DROP	Dropwindsonde Code
TDR	Tail Doppler Radar
TEAL	USAF Weather Reconnaissance Aircraft Callsign
TRMM	Tropical Rainfall Measurement Mission

-U-

UAS	Unmanned Aircraft System
UCSD	University of California San Diego
UHF	Ultra High Frequency
UND	Urgency of Need Designator
USAF	United States Air Force
USAFNORTH	United States Air Forces Northern Command
USCG	United States Coast Guard
USINDOPACOM	United States Air Forces Indopacific Command
USN	United States Navy
UTC	Universal Coordinated Time (Z)

-V-

VHF	Very High Frequency
VIIRS	Visible Infrared Imaging Radiometer

-W-

WEFAX	Weather Facsimile
WFO	Weather Forecast Office (NOAA/NWS)
WG	Working Group or an AF Organization (wing)
WG/WSO	Working Group for Winter Season Operations
WMO	World Meteorological Organization
WPC	NCEP Weather Prediction Center
WRS	Weather Reconnaissance Squadron (USAF)
WS	Winter Season
WSPOD	Winter Season Plan of the Day
WSR	Winter Season Reconnaissance
WSRP	Winter Season Reconnaissance Program
WW	Weather Wing

-Z-

Z	Zulu Time (UTC)

Appendix B
Glossary

Agency: Any Federal agency or organization participating in the winter season/storm forecasting and warning service.

Air Traffic Control System Command Center (ATCSCC): The FAA facility that monitors and manages the flow of air traffic throughout the National Airspace System (NAS), producing a safe, orderly, and expeditious flow of traffic while minimizing delays. The ATCSCC is a 24 hour a day, 7 day a week operation.

Area of Responsibility: The geographic area the National Winter Season Operations Plan covers including the Gulf of Mexico, Atlantic Ocean, and Pacific Ocean. The Gulf of Mexico area of responsibility includes the entire Gulf of Mexico and extends about 150 miles inland along the U.S. Gulf Coast. In the Atlantic, the area of responsibility ranges from latitudes 25°N to 48°N, west of longitude 55°W, and extends about 150 miles inland along the eastern coast of the United States. In the Pacific, the area of responsibility includes the North Pacific Ocean east of the International Date Line and extends about 150 miles inland along the Pacific coast of the United States along with the state of Hawaii.

Atmospheric River: A long, narrow, and transient corridor of strong horizontal water vapor transport that is typically associated with a low-level jet stream ahead of the cold front of an extratropical cyclone. The water vapor in atmospheric rivers is supplied by tropical and/or extratropical moisture sources.

Blizzard Warning: The NWS issues a Blizzard Warning to notify the public when blizzard conditions (sustained wind or frequent gusts of 35 mph or more accompanied by falling and/or blowing snow, frequently reducing visibility less than one-fourth mile for three hours or more) are occurring, imminent, or have a high probability of occurrence within the next 36 hours.

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

- Controlled airspace is a generic term that covers Class A, Class B, Class C, Class D, and Class E airspace.
- Controlled airspace is also that airspace within which all aircraft operators are subject to certain pilot qualifications, operating rules, and equipment requirements in 14 CFR Part 91 (for specific operating requirements, please refer to 14 CFR Part 91). For IFR operations in any class of controlled airspace, a pilot must file an IFR flight plan and receive an appropriate ATC clearance. Each Class B, Class C, and Class D airspace area designated for an airport contains at least one primary airport around which the airspace is designated (for specific designations and descriptions of the airspace classes, please refer to 14 CFR Part 71).
- Controlled airspace in the United States is designated as follows:

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

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

CLASS C: Generally, that airspace from the surface to 4,000 feet above the airport elevation (charted in MSL) surrounding those airports that have an operational control tower, are serviced by a radar approach control, and that have a certain number of IFR operations or passenger enplanements. Although the configuration of each Class C area is individually tailored, the airspace usually consists of a surface area with a 5 nautical mile (NM) radius, a circle with a 10 NM radius that extends no lower than 1,200 feet up to 4,000 feet above the airport elevation and an outer area. Each person must establish two-way radio communications with the ATC facility providing air traffic services prior to entering the airspace and thereafter maintain those communications while within the airspace. VFR aircraft are only separated from IFR aircraft within the airspace.

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

CLASS E: Generally, if the airspace is not Class A, Class B, Class C, or Class D, and it is controlled airspace, it is Class E airspace. Class E airspace extends upward from either the surface or a designated altitude to the overlying or adjacent controlled airspace. When designated as a surface area, the airspace will be configured to contain all instrument procedures. Also, in this class are Federal airways, airspace beginning at either 700 or 1,200 AGL used to transition to/from the terminal or en route environment, en route domestic, and offshore airspace areas designated below 18,000 feet MSL. Unless designated at a lower altitude, Class E airspace begins at 14,500 MSL over the United States, including that airspace overlying the waters within 12 nautical miles of the 48 contiguous States and Alaska, up to, but not including 18,000 MSL, and the airspace above FL 600.

Dropsonde: An expendable cylindrically-shaped weather instrument launched from reconnaissance aircraft that obtains a vertical atmospheric sounding over a body of water. An attached parachute opens after its release to help stabilize the fall so that high-resolution measurements of pressure, temperature, humidity, and wind can be collected as the probe descends from flight level to the water surface below.

Due Regard: Due regard is an operation wherein state operated aircraft assume responsibility for separation from all other aircraft without ATC assistance.

Extratropical cyclone: A cyclone (of any intensity) for which the primary energy source is baroclinic (i.e., results from the temperature contrast between warm and cold air masses).

Freezing Rain (or Drizzle): Rain or drizzle that falls in liquid form but freezes upon impact with the ground or exposed objects. Small accumulations of ice can cause driving and walking difficulties while heavy accumulations produce extremely dangerous and damaging situations primarily by pulling down trees and utility lines.

High-Density/High-Accuracy (HD/HA) Data: The flight-level and SFMR data provided by automated observation systems on 53 WRS and NOAA AOC aircraft at regular intervals, usually set at 30 s.

Heavy Snow Warning: The NWS issues a Heavy Snow Warning to notify the public when heavy snow (four inches or more accumulation in 12 hours or six or more inches accumulation in 24 hours in most areas of the country, but some variation in the snowfall criterion is allowable on a regional basis) is occurring, imminent, or has a high probability of occurrence within the next 36 hours.

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

Ice Storm Warning: NWS issues an Ice Storm Warning to notify the public when significant ice accumulations (generally one-quarter inch or greater, but some variation in the ice accumulation criterion is allowable on a regional basis) are occurring, imminent, or have a high probability of occurrence within the next 36 hours and no other predominant winter weather element is expected to occur.

Intensive Observing Period: A single winter season reconnaissance mission or group of simultaneous missions flown for a Pacific system or event, such as an atmospheric river, for a specific synoptic date/time.

Mission: A flight by an aircraft, as described in the NWSOP, to conduct weather reconnaissance/research operations.

Mission Identifier: The nomenclature assigned to winter season aircraft reconnaissance missions for weather data identification. It comprises an agency-aircraft indicator followed by a

CARCAH-assigned mission-system indicator and an intensive observation period number (Pacific) or a track number (Atlantic/Gulf).

NOTAM: A Notice to Airmen is an unclassified bulletin filed with air traffic control authorities that contains information concerning the establishment, condition, or change in any aeronautical facility, service, procedure, or hazard, the timely knowledge of which is essential to personnel concerned with flight operations in the National Airspace System (NAS).

Reconnaissance Aircraft Sortie: A flight that meets the requirements of the Winter Season Plan of the Day.

Resources Permitting: An aerial reconnaissance requirement which either does not meet coordination timing requirements or occurs outside the standard season as defined in the applicable operations plan. These missions are conducted only if dedicated aircraft, crew, support, and maintenance assets are available.

Sleet: Sleet is a type of precipitation consisting of transparent or translucent pellets of ice, 5 mm or less in diameter. These pellets of ice usually bounce when hitting hard ground and make a sound upon impact. Heavy sleet is a relatively rare event defined as an accumulation of ice pellets covering the ground to a depth of 2 inch or more.

Special Use Airspace: Airspace of defined dimensions identified by an area on the surface of the earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon aircraft operations that are not a part of those activities. Types of special use airspace are:

14. Alert Area - Airspace which may contain a high volume of pilot training activities or an unusual type of aerial activity, neither of which is hazardous to aircraft. Alert Areas are depicted on aeronautical charts for the information of nonparticipating pilots. All activities within an Alert Area are conducted in accordance with Federal Aviation Regulations, and pilots of participating aircraft as well as pilots transiting the area are equally responsible for collision avoidance.
15. Controlled Firing Area - Airspace wherein activities are conducted under conditions so controlled as to eliminate hazards to nonparticipating aircraft and to ensure the safety of persons and property on the ground.
16. Military Operations Area (MOA) - A MOA is airspace established outside of Class A airspace area to separate or segregate certain nonhazardous military activities from IFR traffic and to identify for VFR traffic where these activities are conducted.
17. (Refer to AIM.)
18. Prohibited Area - Airspace designated under 14 CFR Part 73 within which no person may operate an aircraft without the permission of the using agency.

    (Refer to AIM.)
    (Refer to En Route Charts.)

19. Restricted Area - Airspace designated under 14 CFR Part 73, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated joint use and IFR/VFR operations in the area may be authorized by the

controlling ATC facility when it is not being utilized by the using agency. Restricted areas are depicted on en route charts. Where joint use is authorized, the name of the ATC controlling facility is also shown.

(Refer to 14 CFR Part 73.)
(Refer to AIM.)

20. Warning Area - A warning area is airspace of defined dimensions extending from 3 nautical miles outward from the coast of the United States, that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning area is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both.

Synoptic Time: One of the standardized times designated by WMO convention at six-hour intervals starting with 0000 UTC for which meteorological observations are made simultaneously throughout the world. It is also the centralized time corresponding to a numerical weather prediction model cycle in which the data are assimilated and the model is run.

Synoptic Track: Winter season reconnaissance mission flown to provide vital meteorological information in data sparse ocean areas as a supplement to existing surface, radar, and satellite data. Synoptic flights better define the upper atmosphere and aid in the analysis and prediction of winter weather systems and events.

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

Winter Season: The portion of the year generally having the highest incidence of winter weather systems and storms. In this plan the period is defined from November 1 to March 31.

Winter Season Plan of the Day (WSPOD): The WSPOD is a coordinated mission plan that tasks operational weather reconnaissance requirements during the next 24-hour period (1100 to 1100 UTC). The WSPOD describes reconnaissance flights committed to satisfy operational requirements, identifies possible reconnaissance requirements for the succeeding 24-hour period and potentially the following 24-hour period.

Winter Storm: A baroclinic synoptic weather system anchored by an extratropical cyclone that is often characterized by impacts of heavy sleet, heavy snow, ice/freezing rain, blowing snow, coastal flooding, and high winds or a combination of events.

Winter Storm Outlook: This product may be issued when there is a good chance of a major Winter Storm beyond the point normally covered by a watch. The intent of an outlook is to provide information to those who need considerable lead time to prepare for the event.

Winter Storm Warning: The NWS issues a Winter Storm Warning to notify the public when more than one predominant winter weather hazard (i.e., heavy snow and blowing snow, snow and ice, snow and sleet, sleet and ice, or snow, sleet and ice) is occurring, imminent, or has a very high probability of occurrence within the next 36 hours and is expected to meet or exceed locally defined 12 and/or 24 hour warning criteria for at least one of the precipitation elements.

Winter Storm Watch: The NWS issues a Winter Storm Watch when conditions are favorable for a hazardous winter weather event to develop in the next 12 to 48 hours, but its occurrence, location, and/or timing are uncertain. It is intended to provide enough lead time so those who need to set their plans in motion can do so. The watch will cover the possible occurrence of the following elements, either separately or in combination: heavy snow, significant accumulations of freezing rain, and/or heavy sleet. Some event specific watches are issued when only one predominant winter weather hazard is expected. The event specific watches are: Blizzard Watch, Lake Effect Snow Watch, and Wind Chill Watch.

Winter Weather Advisories: Event-specific advisories are used to describe conditions that do not constitute a serious enough hazard to warrant a warning for the general public but; nevertheless, pose a significant threat to specific users. They are highlighted in forecasts and statements. These types of advisories include snow, blowing snow, lake effect snow, wind chill, and freezing rain.

Winter Weather Event: A winter weather phenomenon (such as snow, sleet, ice, wind chill) that impacts public safety, transportation, and/or commerce.

Appendix D
Format for NHOP/NWSOP Flight Information for International and Domestic NOTAM Issuance

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

HEADER

<u>Request a Domestic NOTAM be Issued</u>

A. Affected Center(s). This field will include all affected ARTCCs in 3-letter identifier format; e.g., ZNY, ZOA, ZAN. Synoptic track flights will probably utilize more than one ARTCC, and any adjacent ARTCC should be included when the flight track is within 100 miles of the adjacent center's airspace. Flights that are flying in the storm environment will utilize the ARTCC whose airspace is mostly affected.

B. Start Time (YYMMDDZZZZ). For example, 0006011600. This time would correspond to the entry time on a reconnaissance track or time at the storm fix latitude/longitude.

C. Ending Time (YYMMDDZZZZ). This would be the completion time of reconnaissance track or the time exiting the storm environment.

E.* Text. This field is free form and should include the following information: route of flight for the mission portion (latitude/longitude, fixes, airways), type of activity (laser, dropsonde, etc.), frequency/location of deployment, broadcast frequencies, and any other pertinent information that may concern other flights. Include a unit/agency phone number and point of contact for possible questions.

F. Lower Altitude (during mission). Use "Surface" since the dropsonde is the "reason" for the NOTAM as much as or more so than the aircraft altitude.

G. Upper Altitude (during mission). For example, FL450.

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

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

NOTES:

1. Only ICAO approved contractions may be used.

2. Using this format will help ensure timely and accurate information dissemination.

Appendix E
Aerial Reconnaissance Flight Tracks

This first part of this appendix contains the legacy Western Atlantic and Gulf of Mexico WSR Program (WSRP) predetermined flight tracks A61-A66. They are depicted in Figures E-1 through E-6.

The second section in this appendix has three examples of representative Pacific WSR customized tracks for AR Recon involving a three-aircraft IOP. They are shown in Figures E-7 through E-9. Customized-track flight patterns are designed to best sample the major atmospheric feature(s) thought to be characterized by the peak uncertainty values computed by global forecast model ensembles. These features may include incipient surface low-pressure systems, mid-level cyclonic systems, polar and subtropical jet streaks, moisture-driven atmospheric rivers systems, mid-level blocking ridges, and other key meteorological entities that are associated with peak uncertainty regions.

WSRP A61					
Point	Identifier	Lat	Long	Drop #	Enroute
Keesler	KBIX	N 30 24.63	W088 55.47		# mins
SEMMES	SJI	N 30 43.56	W088 21.56		11
CATLN	CATLN	N 31 18.43	W087 34.80		11
MONTGOMERY	MGM	N 32 13.34	W086 19.18		16
MACON	MCN	N 32 41.47	W083 38.83		26
TWINS	TWINS	N 32 46.71	W082 18.73		13
TYDOE	TYDOE	N 32 49.28	W081 33.70		7
CHARLESTON	CHS	N 32 53.66	W080 02.27		14
WILMINGTON	ILM	N 34 21.10	W077 52.46		26
TOMMZ	TOMMZ	N 35 24.15	W075 03.83		29
LEXAD	LEXAD	N 36 45.33	W072 23.64	1	29
SAVIK	SAVIK	N 37 42.69	W070 59.03	2	17
		N 38 15.00	W069 00.00	3	19
		N 37 00.00	W067 45.00	4	18
DRYED	DRYED	N 38 37.94	W066 40.05	5	21
JOBOC	JOBOC	N 40 07.00	W067 00.00	6	17
		N 39 50.00	W070 00.00	7	26
BERGH	BERGH	N 39 07.95	W072 03.10	8	20
		N 37 30.00	W074 00.00	9	25
TOMMZ	TOMMZ	N 35 24.15	W075 03.83	10	25
WILMINGTON	ILM	N 34 21.10	W077 52.46		29
CHARLESTON	CHS	N 32 53.66	W080 02.27		26
TYDOE	TYDOE	N 32 49.28	W081 33.70		14
TWINS	TWINS	N 32 46.71	W082 18.73		7
MACON	MCN	N 32 41.47	W083 38.83		13
MONTGOMERY	MGM	N 32 13.34	W086 19.18		26
CATLN	CATLN	N 31 18.43	W087 34.80		16
SEMMES	SJI	N 30 43.56	W088 21.56		10
Keesler	KBIX	N 30 24.63	W088 55.47		10
Elapsed Time 8+41					

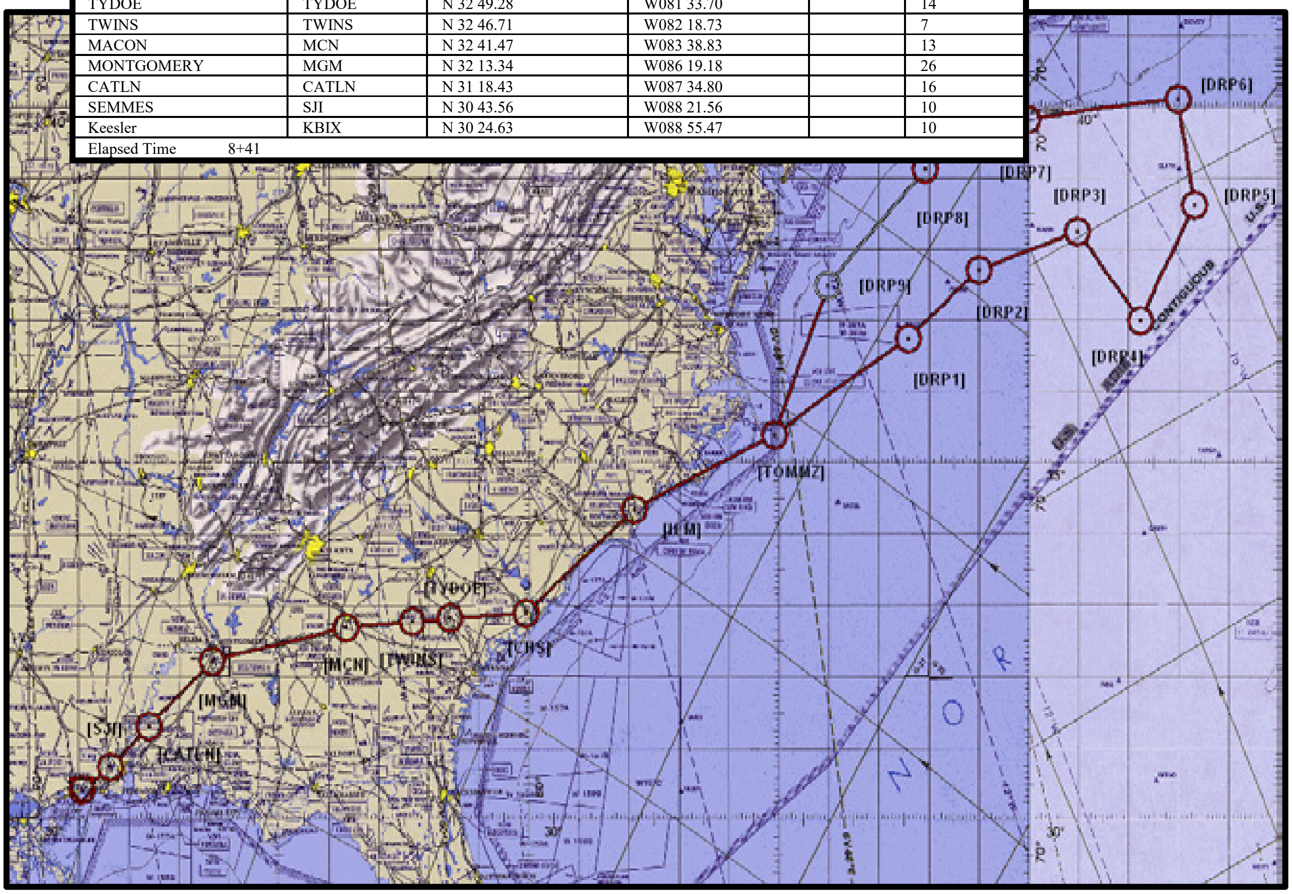


Figure E-1. Western Atlantic Flight Track WSRP-A61

WSRP A62					
Point	Identifier	Lat	Long	Drop #	Enroute
Keesler	KBIX	N 30 24.63	W088 55.47		# mins
SEMMES	SJI	N 30 43.56	W088 21.56		6
CATLN	CATLN	N 31 18.43	W087 34.80		10
MONTGOMERY	MGM	N 32 13.34	W086 19.18		16
AJFEB	AJFEB	N 33 38.42	W084 10.23		26
COLLIERS	IRQ	N 33 42.44	W082 09.72		19
COLUMBIA	CAE	N 33 51.44	W081 03.23		10
FLORENCE	FLO	N 34 13.98	W079 39.43		13
DWYTE	DWYTE	N 34 15.67	W079 16.02		4
MULLS	MULLS	N 34 16.73	W079 00.89		2
BARTL	BARTL	N 34 18.19	W078 39.09		3
WILMINGTON	ILM	N 34 21.10	W077 52.46		7
N3430W07445		N 34 30.00	W074 45.00	1	27
N3710W07254		N 37 10.00	W072 54.00	2	34
AZEZU	AZEZU	N 37 52.47	W072 22.72		9
KENDA	KENDA	N 39 21.18	W070 29.97	3	21
LACKS	LACKS	N 40 00.00	W068 11.96		18
SLATN	SLATN	N 39 07.00	W067 00.00	4	13
N39W065		N 39 00.00	W065 00.00		15
N37W067		N 37 00.00	W067 00.00	5	30
TILED	TILED	N 37 15.97	W068 58.40		21
N3550W07026		N 35 50.00	W070 26.00	6	22
ONGOT	ONGOT	N 33 58.91	W072 18.10	7	28
WILYY	WILYY	N 32 18.71	W073 06.21	8	20
N3122W07558		N 31 22.00	W075 58.00	9	31
CARPX	CARPX	N 30 24.48	W077 45.00		21
OHLAA	OHLAA	N 30 24.88	W078 05.90		3
OZENA	OZENA	N 30 25.17	W078 20.90		2
SNABS	SNABS	N 30 25.22	W078 31.22		2
TORRY	TORRY	N 30 25.33	W078 51.82	10	3
BAHAA	BAHAA	N 30 25.38	W078 59.68		1
JAWSS	JAWSS	N 30 26.83	W080 47.30		17
DINNS	DINNS	N 30 27.90	W081 48.10		10
TAYLOR	TAY	N 30 30.28	W082 33.17		7
ZOOSS	ZOOSS	N 30 32.11	W083 31.02		9
CAPPS	CAPPS	N 30 32.72	W083 54.30		4
SEMINOLE	SZW	N 30 33.37	W084 22.44		5
OJHAP	OJHAP	N 30 47.63	W085 08.24		8
DEFUN	DEFUN	N 30 48.85	W086 07.88		9
CRESTVIEW	CEW	N 30 49.57	W086 40.75		5
INBRD	INBRD	N 30 48.50	W087 00.45		3
SEMMES	SJI	N 30 43.56	W088 21.56		13
Keesler	KBIX	N 30 24.63	W088 55.47		10
Elapsed Time 8+58					

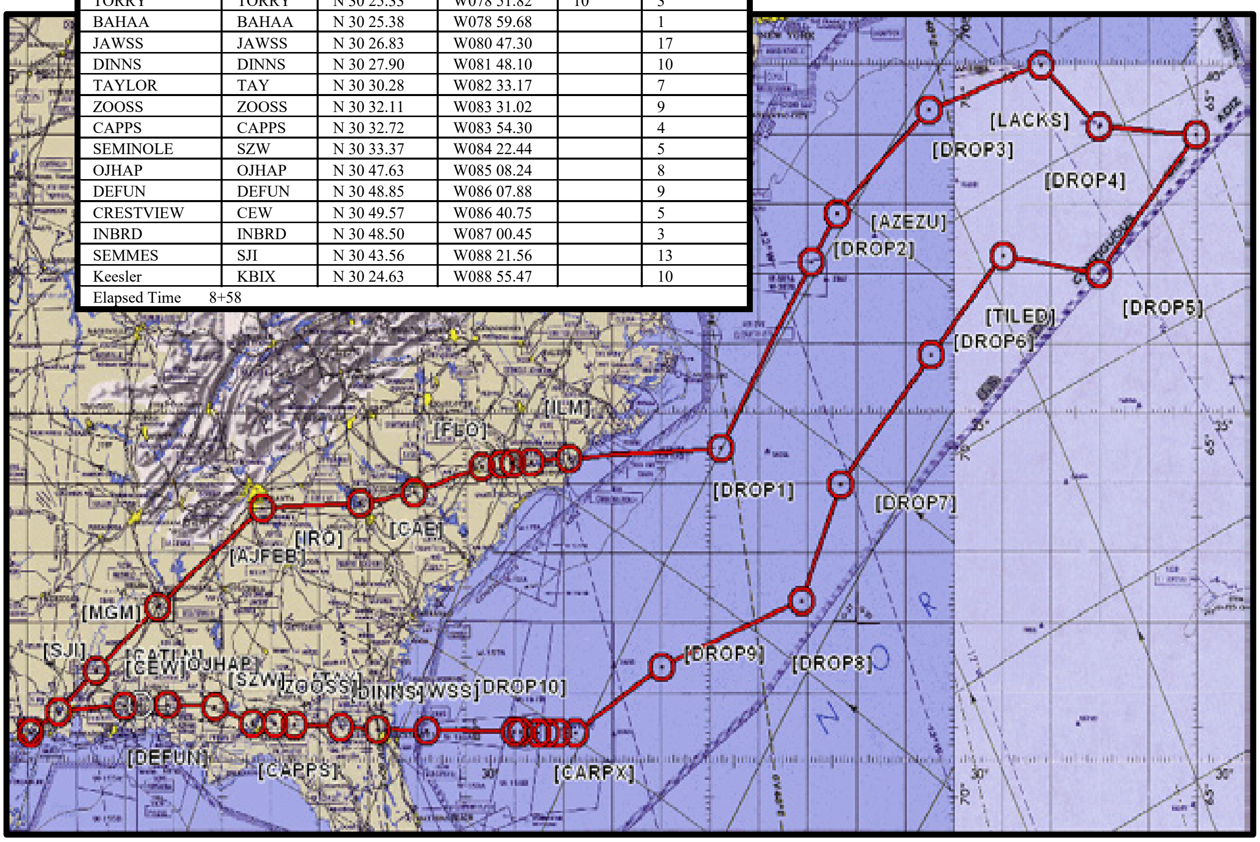


Figure E-2. Western Atlantic Flight Track WSRP-A62

P A63					
Point	Identifier	Lat	Long	Drop #	Enroute
Keesler	KBIX	N 30 24.63	W088 55.47		# mins
SEMMES	SJI	N 30 43.56	W088 21.56		7
CATLN	CATLN	N 31 18.43	W087 34.80		10
MONTGOMERY	MGM	N 32 13.34	W086 19.18		16
AJFEB	AJFEB	N 33 38.42	W084 10.23		26
GREENWOOD	GRD	N 34 15.09	W082 09.25		20
DARRL	DARRL	N 34 47.82	W081 03.36		12
BEAUU	BEAUU	N 35 46.94	W078 58.79		22
RALEIGH-DURHAM	RDU	N 35 52.35	W078 47.00		2
FRANZ	FRANZ	N 35 57.47	W077 54.47		8
TAR RIVER	TYI	N 35 58.60	W077 42.23		2
ELIZABETH CITY	ECG	N 36 15.45	W076 10.54		14
N36W07430		N 36 00.00	W074 30.00	1	16
BOJAN	BOJAN	N 38 10.90	W072 58.57	2	28
N40W071		N 39 40.00	W071 00.00	3	24
LACKS	LACKS	N 40 00.00	W068 11.96	4	25
DRYED	DRYED	N 38 37.94	W066 40.05	5	20
N3830W06930		N 38 30.00	W069 30.00	6	25
N37W06930		N 37 00.00	W069 30.00	7	17
N36W072		N 36 00.00	W072 00.00	8	25
RUNDY	RUNDY	N 34 05.87	W073 46.23	9	27
OTTNG	OTTNG	N 32 04.28	W077 00.00	10	38
CHARLESTON	CHS	N 32 53.66	W080 02.27		30
TYDOE	TYDOE	N 32 49.28	W081 33.70		14
TWINS	TWINS	N 32 46.71	W082 18.73		7
MACON	MCN	N 32 41.47	W083 38.83		13
MONTGOMERY	MGM	N 32 13.34	W086 19.18		26
CATLN	CATLN	N 31 18.43	W087 34.80		16
SEMMES	SJI	N 30 43.56	W088 21.56		10
Keesler	KBIX	N 30 24.63	W088 55.47		10
				Elapsed Time	8+30

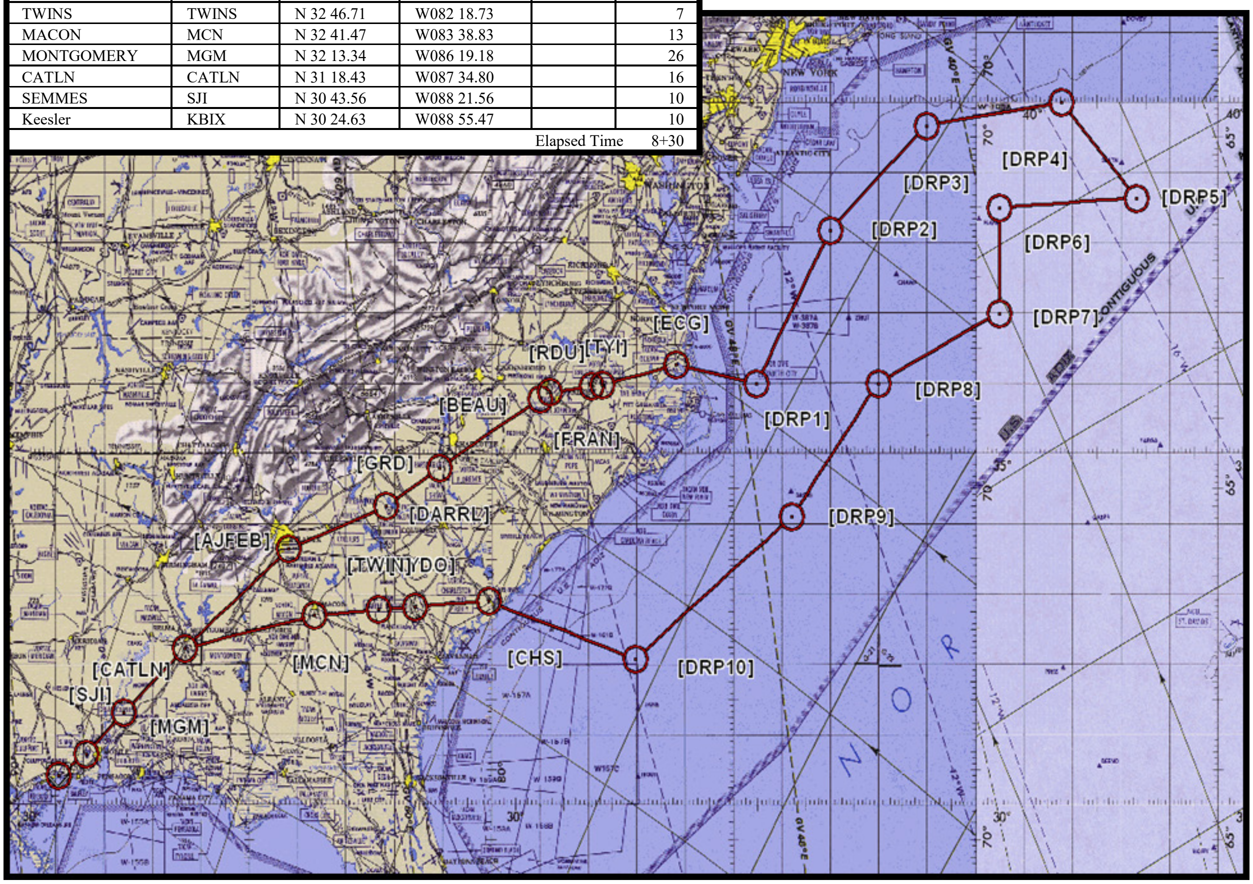


Figure E-3. Western Atlantic Flight Track WSRP-A63

WSRP A64					
Point	Identifier	Lat	Long	Drop #	Enroute
Keesler	KBIX	N 30 24.63	W088 55.47		# mins
SEMMES	SJI	N 30 43.56	W088 21.56		7
INBRD	INBRD	N 30 48.50	W087 00.45		13
CRESTVIEW	CEW	N 30 49.57	W086 40.75		3
DEFUN	DEFUN	N 30 48.85	W086 07.88		5
OJHAP	OJHAP	N 30 47.63	W085 08.24		10
SEMINOLE	SZW	N 30 33.37	W084 22.44		8
CAPPS	CAPPS	N 30 32.72	W083 54.30		5
ZOOSS	ZOOSS	N 30 32.11	W083 31.02		4
TAYLOR	TAY	N 30 30.28	W082 33.17		9
BAHAA	BAHAA	N 30 25.38	W078 59.68		35
JENKS	JENKS	N 30 38.12	W078 41.73		4
EMCEE	EMCEE	N 30 47.56	W078 27.55		3
LANIE	LANIE	N 30 56.50	W078 14.14		3
PERIE	PERIE	N 31 13.72	W077 47.81		5
HANRI	HANRI	N 31 45.88	W077 00.00	1	10
PAEPR	PAEPR	N 35 02.52	W072 24.99	2	57
RESQU	RESQU	N 37 28.76	W071 26.83	3	29
WEBBB	WEBBB	N 37 40.29	W071 58.92		5
AZEZU	AZEZU	N 37 52.47	W072 22.72		4
LYNUS	LYNUS	N 38 00.88	W072 39.24		3
AGUNE	AGUNE	N 38 06.48	W072 50.03		2
BOJAN	BOJAN	N 38 10.90	W072 58.57	4	2
BERGH	BERGH	N 39 07.95	W072 03.10	5	13
KENDA	KENDA	N 39 21.18	W070 29.97	6	14
N3730W070		N 37 30.00	W070 00.00	7	21
N3630W070		N 36 30.00	W070 00.00	8	11
N34W070		N 34 00.00	W070 00.00	9	28
N3020W075		N 30 20.00	W075 00.00	10	63
TROUT	TROUT	N 30 23.00	W077 00.00		19
CARPX	CARPX	N 30 24.48	W077 45.00		7
OHLAA	OHLAA	N 30 24.88	W078 05.90		3
OZENA	OZENA	N 30 25.17	W078 20.90		2
SNABS	SNABS	N 30 25.22	W078 31.22		2
TORRY	TORRY	N 30 25.33	W078 51.82		3
BAHAA	BAHAA	N 30 25.38	W078 59.68		1
JAWSS	JAWSS	N 30 26.83	W080 47.30		17
DINNS	DINNS	N 30 27.90	W081 48.10		10
TAYLOR	TAY	N 30 30.28	W082 33.17		7
ZOOSS	ZOOSS	N 30 32.11	W083 31.02		9
CAPPS	CAPPS	N 30 32.72	W083 54.30		4
SEMINOLE	SZW	N 30 33.37	W084 22.44		5
OJHAP	OJHAP	N 30 47.63	W085 08.24		8
DEFUN	DEFUN	N 30 48.85	W086 07.88		10
CRESTVIEW	CEW	N 30 49.57	W086 40.75		5
INBRD	INBRD	N 30 48.50	W087 00.45		3
SEMMES	SJI	N 30 43.56	W088 21.56		13
Keesler	KBIX	N 30 24.63	W088 55.47		10
			Elapsed Time		8+34

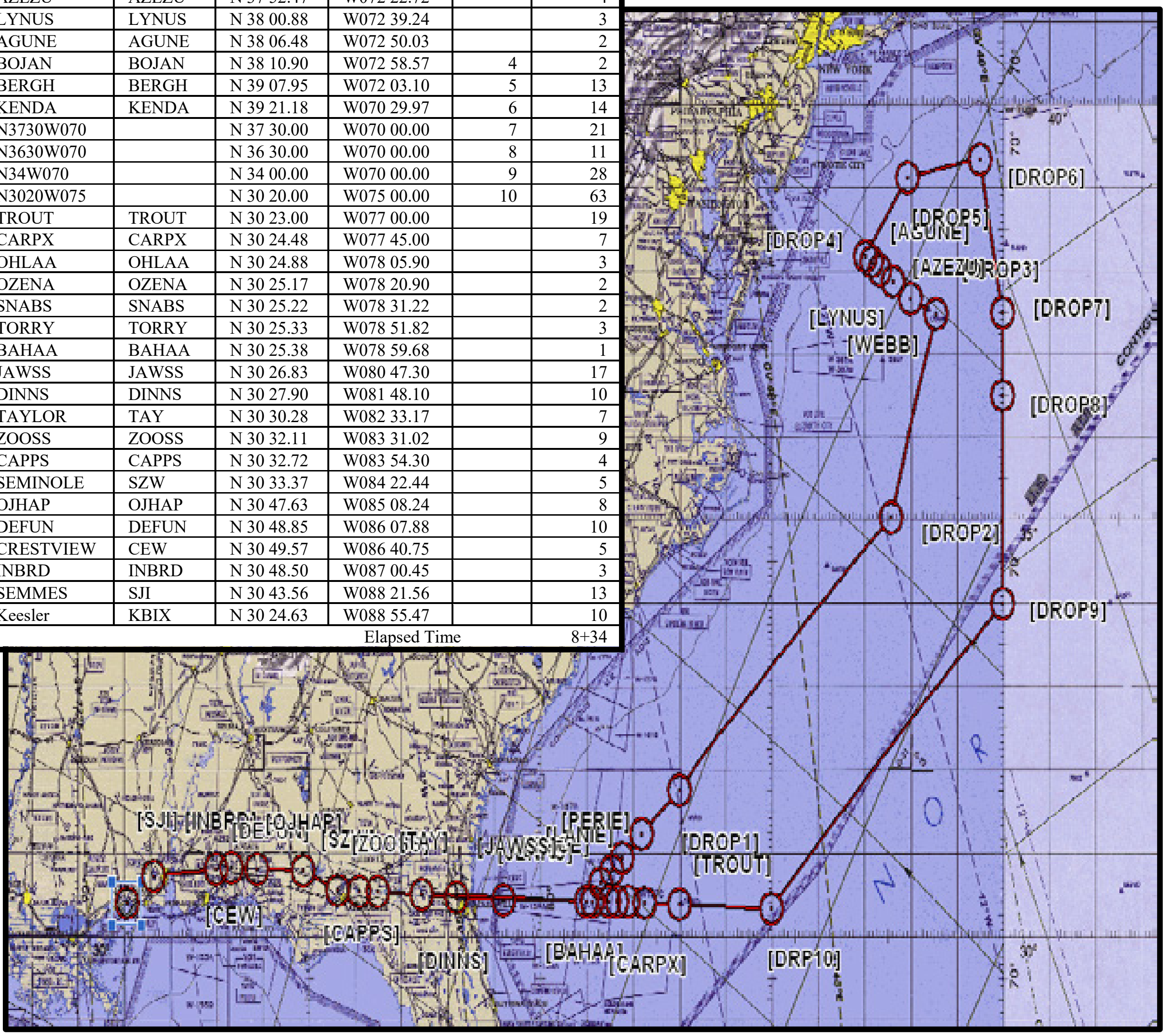


Figure E-4. Western Atlantic Flight Track WSRP-A64

WSRP A65					
Point	Identifier	Lat	Long	Drop #	Enroute
Keesler	KBIX	N 30 24.63	W088 55.47		# mins
SEMMES	SJI	N 30 43.56	W088 21.56		7
INBRD	INBRD	N 30 48.50	W087 00.45		13
CRESTVIEW	CEW	N 30 49.57	W086 40.75		3
DEFUN	DEFUN	N 30 48.85	W086 07.88		5
OJHAP	OJHAP	N 30 47.63	W085 08.24		10
SEMINOLE	SZW	N 30 33.37	W084 22.44		8
CAPPS	CAPPS	N 30 32.72	W083 54.30		5
ZOOSS	ZOOSS	N 30 32.11	W083 31.02		4
TAYLOR	TAY	N 30 30.28	W082 33.17		9
JAWSS	JAWSS	N 30 26.83	W080 47.30		17
LANIE	LANIE	N 30 56.50	W078 14.14	1	25
N33W07720		N 33 00.00	W077 20.00	2	25
N34W07530		N 34 00.00	W075 30.00	3	21
TOMMZ	TOMMZ	N 35 24.15	W075 03.83	4	16
N3525W073		N 35 25.00	W073 00.00	5	19
N3415W072		N 34 15.00	W072 00.00	6	16
N3240W07215		N 32 40.00	W072 15.00	7	18
N30W075		N 30 00.00	W075 00.00	8	40
SUMRS	SUMRS	N 28 42.70	W076 33.51	9	21
STIFF	STIFF	N 27 36.31	W078 38.77	10	24
PALM BEACH	PBI	N 26 40.80	W080 05.19		18
PAHOKEE	PHK	N 26 46.96	W080 41.49		6
LA BELLE	LBV	N 26 49.69	W081 23.49		7
CHRRI	CHRRI	N 27 03.01	W081 39.25		4
MMDUQ	MMDUQ	N 27 15.77	W081 54.43		3
SARASOTA	SRQ	N 27 24.42	W082 33.82		7
REMIS	REMIS	N 27 53.04	W085 15.47		27
ROZZI	ROZZI	N 28 18.87	W086 42.31		15
REDFN	REDFN	N 28 52.98	W088 42.11		21
EYEKO	EYEKO	N 29 33.74	W089 30.57		11
GULFPORT	GPT	N 30 24.41	W089 04.61		10
Keesler	KBIX	N 30 24.63	W088 55.47		10
				Elapsed Time	7+25

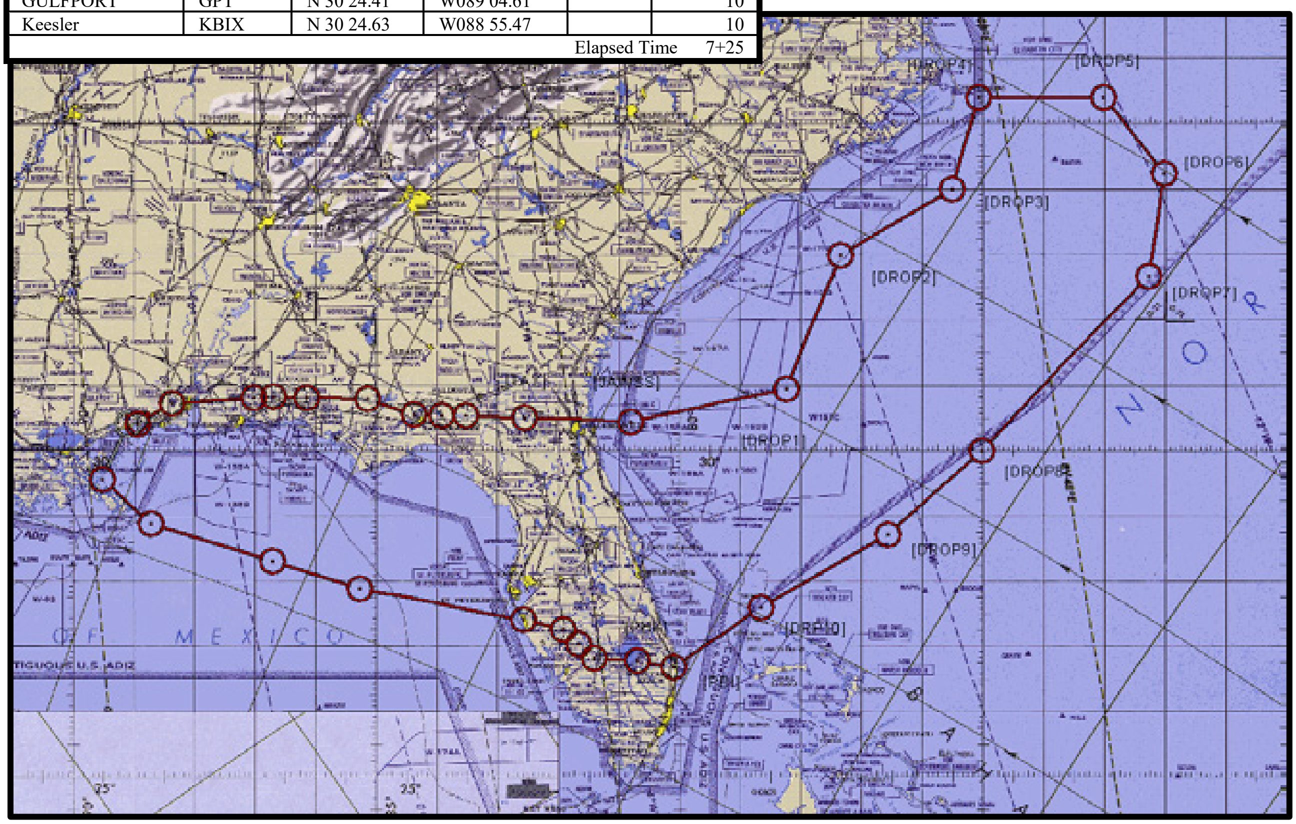


Figure E-5. Western Atlantic Flight Track WSRP-A65

WSRP A66					
Point	Identifier	Lat	Long	Drop #	Enroute
Keesler	KBIX	N 30 24.63	W088 55.47		# mins
EYEKO	EYEKO	N 29 33.74	W089 30.57		17
REDFN	REDFN	N 28 52.98	W088 42.11	1	12
ROZZI	ROZZI	N 28 18.87	W086 42.31		21
N2814W08628		N 28 14.00	W086 28.00	2	3
REMIS	REMIS	N 27 53.04	W085 15.47		13
CIGAR	CIGAR	N 27 29.61	W084 46.99		6
N2657W08514		N 26 57.00	W085 14.00	3	8
MINOW	MINOW	N 26 02.79	W085 58.98		13
N2530W08655		N 25 30.00	W086 55.00	4	11
ELIOM	ELIOM	N 25 03.46	W087 41.03		9
SWORD	SWORD	N 24 30.00	W088 37.00		11
N2430W08912		N 24 30.00	W089 12.00	5	6
KEHLI	KEHLI	N 24 29.06	W089 50.50		7
MARTE	MARTE	N 24 30.00	W091 47.09	6	20
COKER	COKER	N 24 57.80	W093 52.89	7	22
N2630W09500		N 26 30.00	W095 00.00	8	21
MUSYL	MUSYL	N 28 10.23	W094 07.75		21
N2812W09350		N 28 12.00	W093 50.00	9	3
KLAMS	KLAMS	N 28 15.00	W092 49.66		10
BOGGY	BOGGY	N 28 15.03	W091 27.76	10	14
LEEVILLE	LEV	N 29 10.51	W090 06.24		17
EYEKO	EYEKO	N 29 33.74	W089 30.57		7
GULFPORT	GPT	N 30 24.41	W089 04.61		10
KEESLER AFB	BIX	N 30 24.63	W088 55.47		10
				Elapsed Time	4+52

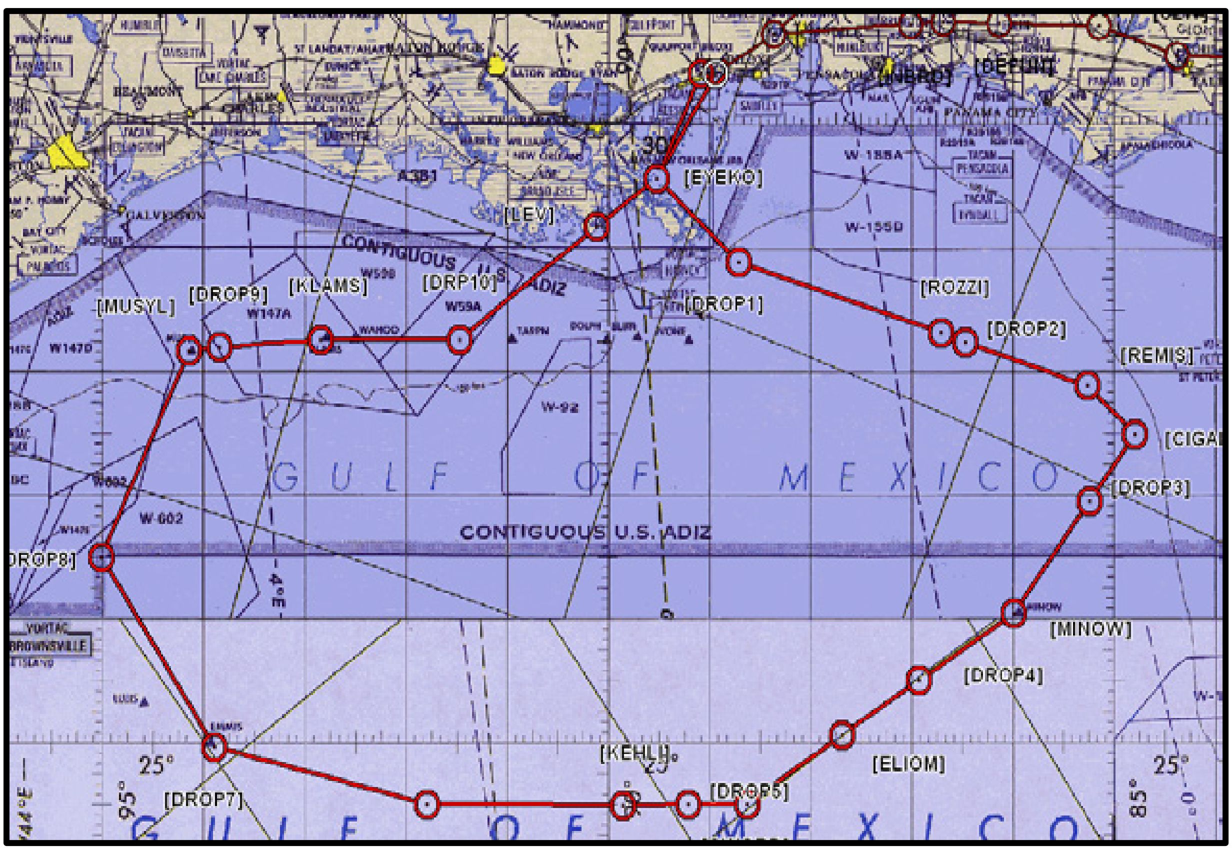


Figure E-6. Western Atlantic Flight Track WSRP-A66

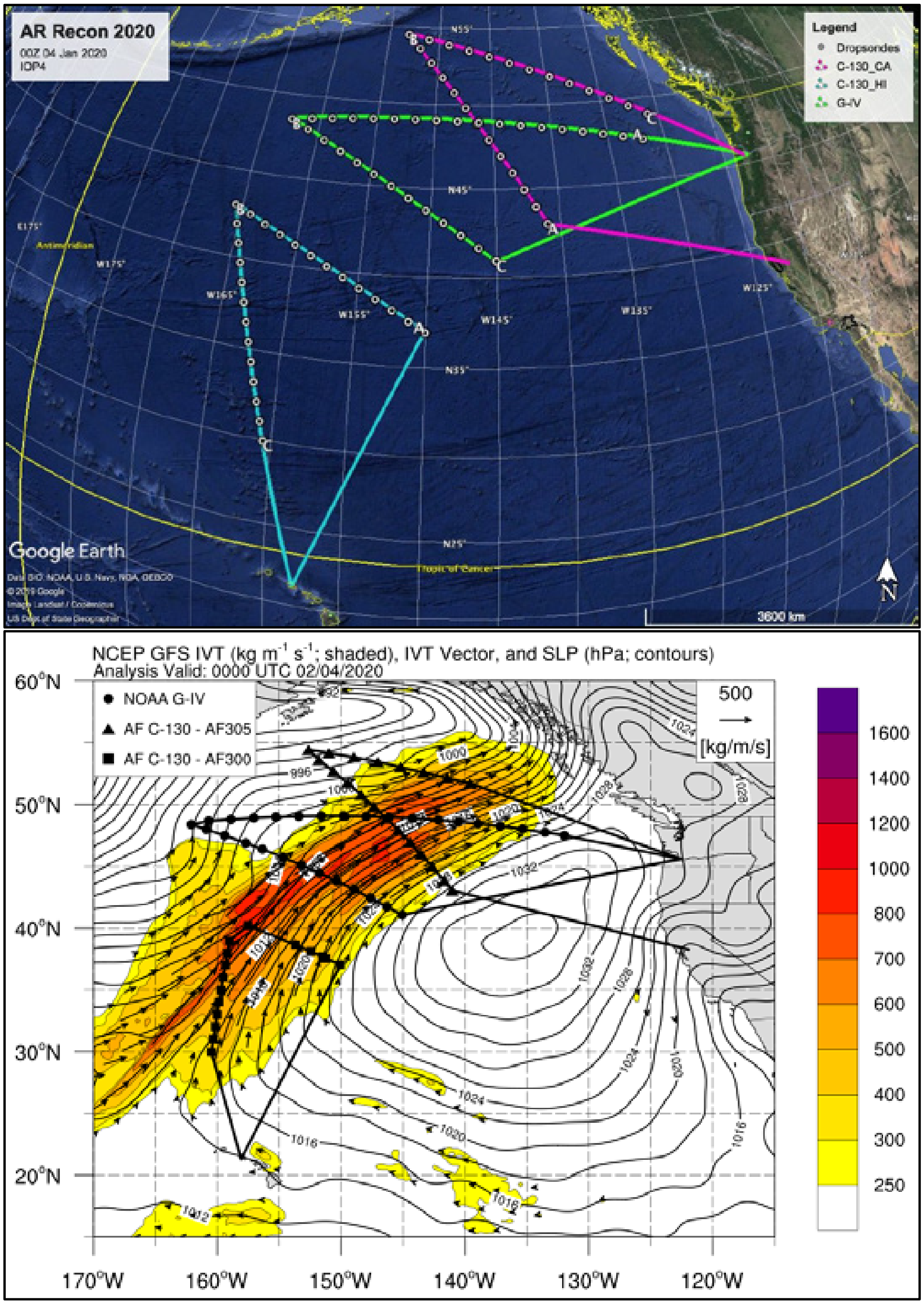


Figure E-7. Example Triangular Customized Pacific Flight Tracks for a Three-Aircraft IOP. The top diagram displays the planned AR Recon flight patterns. The bottom panel shows the actual flight patterns flown across the AR superimposed on GFS analyses of IVT (kg m^{-1} s^{-1}), IVT vector, and mean sea-level pressure (mb) at the designated synoptic date/time of the IOP.

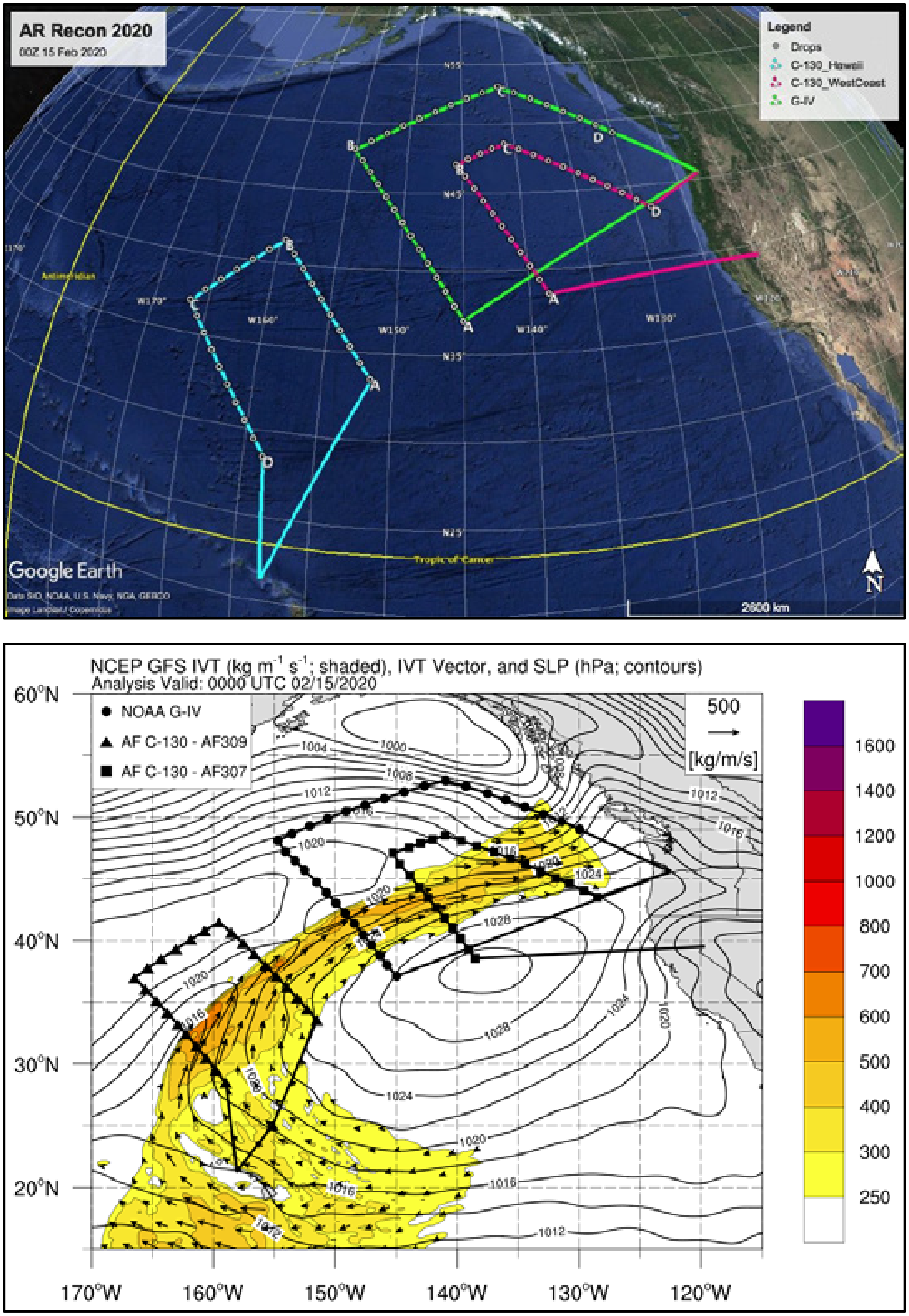


Figure E-8. Example Trapezoidal Customized Pacific Flight Tracks for a Three-Aircraft IOP. The top diagram displays the planned AR Recon flight patterns. The bottom panel shows the actual flight patterns flown across the AR superimposed on GFS analyses of IVT (kg m^{-1} s^{-1}), IVT vector, and mean sea-level pressure (mb) at the designated synoptic date/time of the IOP.

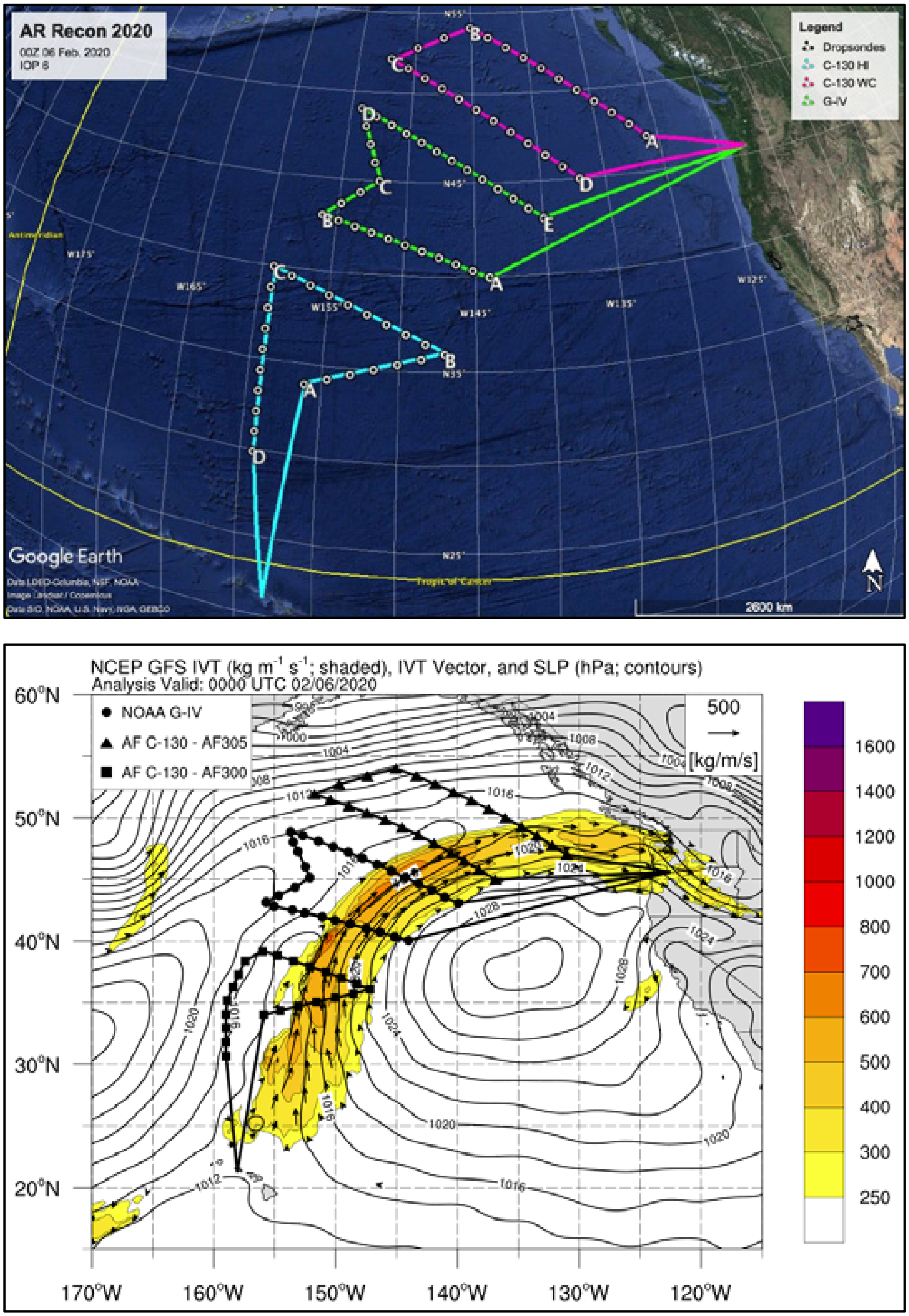


Figure E-9. Example Polygonal Customized Pacific Flight Tracks for a Three-Aircraft IOP. The top diagram displays the planned AR Recon flight patterns. The bottom panel shows the actual flight patterns flown across the AR superimposed on GFS analyses of IVT (kg m^{-1} s^{-1}), IVT vector, and mean sea-level pressure (mb) at the designated synoptic date/time of the IOP.

Appendix F
RECCO, HDOB, and TEMP DROP Codes, Tables, and Regulations

F.1. General.

This appendix contains the formats and detailed explanations of encoded data messages transmitted by weather reconnaissance aircraft. The products include reconnaissance coded observations (RECCOs), high-density/high-accuracy observations (HDOBs), and dropsonde observations (TEMP DROP).

F.2. Aerial Reconnaissance Messages.

F.2.1. RECCO.

The RECCO message is routinely used to convey horizontal weather observations taken manually by meteorologists aboard USAF and NOAA weather reconnaissance aircraft. At the time of the observation, the aircraft observing platform is considered to be located on the axis of a right vertical cylinder with a radius of 30 nautical miles bounded by the earth's surface and the top atmosphere. Flight level winds, temperature, dew point, and geopotential height values are sensed or computed and reported as occurring at the center of the observation circle. Radar echoes, significant weather changes, distant weather, icing, and cloud coverage, types, and amounts are phenomena that may also be observed and reported. Code groups identifying these phenomena may be reported as necessary to adequately describe the meteorological conditions observed. All geopotential computations are made relative to the 1976 US Standard Atmosphere (adjustable altimeters set to 29.92 inches Hg). Since all height reports are in units of geopotential by convention of the World Meteorological Organization, pressure surface height reports from reconnaissance aircraft are in geopotential units.

A sample 53 WRS message and a breakdown of this code is provided in Table F-1. Figure F-1 shows the standard RECCO recording form worksheet with each element described in Table F-2 and regulations explained in Table F-3.

Table F-1. Decoded Example Winter Season USAF Aircraft RECCO Message

```
URNT10 KNHC 122210
97779 22014 20360 70100 94500 23104 93//3 /6924
RMK AF306 04WSA TRACK62      OB 07
DEW POINT NEG 57 DEGREES C
```

URNT10:	WMO abbreviated communications header for a RECCO taken during a mission that is not a tasked invest, tropical cyclone, or subtropical cyclone. *(see Chapter 2, paragraph 2.6.3 for details)*.
KNHC:	ICAO identifier of National Hurricane Center where RECCO message is received and disseminated *(see Chapter 2, paragraph 2.6.3 for details).*
122210:	RECCO transmission date and time is 12th day of the month at 2210 UTC.
97779:	The 9's in the first and last digits are standard delimiters of the first RECCO observation section. The middle three digits, 777, indicate that the observation is taken aboard an aircraft with radar capabilities *(see "Table 1" section of Table F-2)*.
22014:	The first four digits are the time observation is taken of 2210 UTC. The last digit, 4, indicates the aircraft has dew point measuring capability and is below 10 km *(see "Table 2" section of Table F-2)*.
20360:	The first digit, 2, indicates the observation is taken Monday. The second digit, 0, indicates the observation is taken in the northern hemisphere between 0° and 90° W longitude *(see "Table 3" section of Table F-2 and Figure F-2 for graphical depiction)*. The last three digits show the observation is taken at 36.0° N latitude.
70100:	The first three digits show the observation is taken at 70.1° W longitude *(see Note 4 in Table F-3)*. The fourth digit, 0, indicates no aircraft turbulence *(see "Table 4" section in Table F-2).* The last digit, 0, indicates aircraft flight conditions of in the clear (*see "Table 5" section of Table F-2 and Note 5 of Table F-3).*
94500:	The first three digits show the aircraft pressure altitude is 9450 m. The fourth digit, 0, indicates that the wind observation is a spot measurement *(see "Table 6" section of Table F-2)*. The last digit, 0, shows that the wind is obtained by Doppler radar or inertial systems *(see "Table 7" section of Table F-2)*.
23104:	Observed flight-level wind is approximately from 230° (between 225° and 234°) at 104 kt. Note: light and variable winds < 10 kt are encoded as 99005.
93//3:	The first two digits indicate the observed flight-level temperature is -43°C. The next two digits indicate the flight-level dew point temperature is not reported or below -49.4°C (*see Note 6 of Table F-3 for encoding negative temperature values)*. The last digit, 3, indicates that overcast/undercast conditions are observed within 30 nm through

URNT10:	WMO abbreviated communications header for a RECCO taken during a mission that is not a tasked invest, tropical cyclone, or subtropical cyclone. *(see Chapter 2, paragraph 2.6.3 for details)*. a given altitude above or below the aircraft *(see "Table 8" section of Table F-2 and Note 7 of Table F-3)*.
/6924:	The "/6" indicates an observed geopotential height measurement at 300 mb. The last three digits show the height of 9240 m *(see "Table 9" section of Table F-2 and Note 8 of Table F-3)*.
RMK:	Beginning of RECCO plain-language remarks section *(see Note 3 of Table F-3)*.
AF306:	Aircraft in mission ID is U.S. Air Force C-130J with tail number 5306 *(see Chapter 2, Table 2-4 for details).*
04WSA:	Index group in mission ID indicates the fourth mission of the winter season in the Atlantic basin *(see Chapter 2, Table 2-4 for details)*.
TRACK62:	Flight pattern is predetermined track WSRP-A62 *(see Chapter 2, Table 2-4 for details)*.
OB 07:	Observation number 07 is assigned to this RECCO *(see Chapter 2, paragraph 2.6.5 for details)*.
DEW POINT NEG 57 DEGREES C:	Observed flight-level dew point is -57°C, which is reported in the remarks section when the dew point is less than -49.4°C *(see Note 6 of Table F-3)*.

DATE	ORGANIZATION	MISSION IDENTIFIER

OBSERVATION NUMBER																
	9	RECCO INDICATOR SPECIFYING TYPE OF OBSERVATION Table 1	Q	TIME OF OBSERVATION (Hours and Minutes) (GMT)	Y	DAY OF WEEK SUN-1	L_o	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
	X		Q		Q	OCTANT Table 3	L_o		h_a		d		T		j	INDEX TO HHH Table 9
	X		9		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	GEOPOTENTIAL HEIGHT/ D-VALUE OR SLP PER INDEX j (Note 8)
	X		9		L_a		B	TURBULENCE Table 4	d_t	TYPE OF WIND Table 6	f		T_d		H	
	9		i_d	DEW POINT INDICATOR Table 2	L_a		f_c	FLIGHT COND Table 3 (Note 5)	d_a	METHOD OF OBTAINING WIND Table 7	f		w	PRESENT WEATHER (Note 7 Table 8)	H	
	1		2		3		4		5		6		7		8	

REMARKS

TYPE AIRCRAFT	CALL SIGN	METEOROLOGIST

1	INDICATOR	C	CLOUD TYPE Table 11	C	CLOUD TYPE Table 11	C	CLOUD TYPE Table 11	1	INDICATOR	C	CLOUD TYPE Table 11	C	CLOUD TYPE Table 11	C	CLOUD TYPE Table 11
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	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
N_s	AMOUNT OF CLOUDS (Note 9) Table 10	h_s		h_s		h_s		N_s	AMOUNT OF CLOUDS (Note 9) Table 10	h_s		h_s		h_s	
N_s		H_t	ALTITUDE OF TOP Table 12	H_t	ALTITUDE OF TOP Table 12	H_t	ALTITUDE OF TOP Table 12	N_s		H_t	ALTITUDE OF TOP Table 12	H_t	ALTITUDE OF TOP Table 12	H_t	ALTITUDE OF TOP Table 12
N_s		H_t		H_t		H_t		N_s		H_t		H_t		H_t	
9		10		11		12		13		14		15		16	

REMARKS

RECCO RECORDING WORKSHEET

4	INDICATOR	6	INDICATOR (Note 11)	6	INDICATOR (Note 11)	7	INDICATOR	7	INDICATOR	8	INDICATOR	8	INDICATOR	9	INDICATOR	REMARKS
d	DIRECTION OF SFC WIND (Tens of deg. true)	W_s	SIGNIFICANT WEATHER CHANGES Table 14	W_s	SIGNIFICANT WEATHER 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 DIAMETER Table 19	V_i	INFLIGHT VISIBILITY Table 23	
d		S_s	DISTANCE OF OCCURENCE OF Ws Table 15	S_s	DISTANCE OF OCCURENCE 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	
f	SURFACE WIND SPEED (Knots) (Note 10)	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 CENTER Table 19	c_e	CHARACTER OF ECHO Table 21	T_w		
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		
17		18		19		20		21		22		23		24		

REMARKS

Figure F-1. Reconnaissance Code Recording Form

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

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

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

TABLE 5 fc
0 In the clear
8 In and out of clouds
9 In clouds all the time (continuous IMC)
/ Impossible to determine due to darkness or other cause

TABLE 6 dt
0 Spot of Wind
1 Average wind
/ No wind reported

TABLE 7 da
0 Winds obtained using doppler radar or inertial systems
1 Winds obtained using other navigation equipment and/or techniques
/ Navigator unable to determine or wind not compatible

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

TABLE 9 j
0 Sea level pressure in whole millibars (thousands fig if any omitted)
1 Altitude 200 mb surface in geopotential decameters (thousands fig if any omitted)
2 Altitude 850 mb surface in geopotential meters (thousands fig omitted)
3 Altitude 700 mb surface in geopotential meters (thousands fig omitted)
4 Altitude 500 mb surface in geopotential decameters
5 Altitude 400 mb surface in geopotential decameters
6 Altitude 300 mb surface in geopotential decameters
7 Altitude 250 mb surface in geopotential decameters (thousands fig if any omitted)
8 D - Value in geopotential decameters; if negative 500 is added to HHH
9 Altitude 925 mb surface in geopotential meters
/ No absolute altitude available or geopotential data not within ± 30 meters/4 mb accuracy requirements

TABLE 10 Ns
0 No additional cloud layers (place holder)
1 1 okta or less, but not zero (1/8 or less sky covered)
2 2 oktas (or 2/8 of sky covered)
3 3 oktas (or 3/8 of sky covered)
4 4 oktas (or 4/8 of sky covered)
5 5 oktas (or 5/8 of sky covered)
6 6 oktas (or 6/8 of sky covered)
7 7 oktas or more but not 8 oktas
8 8 oktas or sky completely covered
9 Sky obscured (place holder)

TABLE 11 C
0 Cirrus (Ci)
1 Cirrocumulus (Cc)
2 Cirrostratus (Cs)
3 Altocumulus (Ac)
4 Altostratus (As)
5 Nimbostratus (Ns)
6 Stratocumulus (Sc)
7 Stratus (St)
8 Cumulus (Cu)
9 Cumulonimbus (Cb)
/ Cloud type unknown due to darkness or other analogous phenomena

TABLE 12 hshsHtHthihiHiHi
00 Less than 100
01 100 ft
02 200 ft
03 300 ft
etc, etc
49 4,900 ft
50 5,000 ft
51-55 Not used
56 6,000 ft
57 7,000 ft
etc, etc
79 29,000 ft
80 30,000 ft
81 35,000 ft
82 40,000 ft
etc, etc
89 Greater than 70,000 ft
// Unknown

TABLE 13 dw
0 No report 5 SW
1 NE 6 W
2 E 7 NW
3 SE 8 N
4 S 9 all directions

TABLE 14 Ws
0 No change
1 Marked wind shift
2 Beginning or ending or marked turbulence
3 Marked temperature change (not with altitude)
4 Precipitation begins or ends
5 Change in cloud forms
6 Fog or ice fog bank begins or ends
7 Warm front
8 Cold Front
9 Front, type not specified

TABLE 15 SbSeSs
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 Ss)

Table F-2 (Continued) Reconnaissance Code Tables

TABLE 16 wd

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 Ir

7	Light
8	Moderate
9	Severe
/	Unknown or contrails

TABLE 18 It

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 Sr,Ew,El

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 Oe

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 ce

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

TABLE 22 ie

2	Weak
5	Moderate
8	Strong
/	Unknown

TABLE 23 Vi

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

ECCO SYMBOLIC FORM

SECTION ONE (MANDATORY)
9XXX9 GGggid YQLaLaLa LoLoLoBfc hahahadtda
ddfff TTTdTdw /jHHH

SECTION TWO (ADDITIONAL)
1knNsNsNs ChshsHtHt 4ddff
6WsSsWddw 7IrItSbSe 7hihiHiHi 8drdrSrOe
8EwElceie 9ViTwTwTw

SECTION THREE (INTERMEDIATE)
9XXX9 GGggid YQLaLaLa LoLoLoBfc hahahadtda
ddfff TTTdTdw /jHHH

Table F-3. Reconnaissance Code Regulations

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

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

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

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

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

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

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

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

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

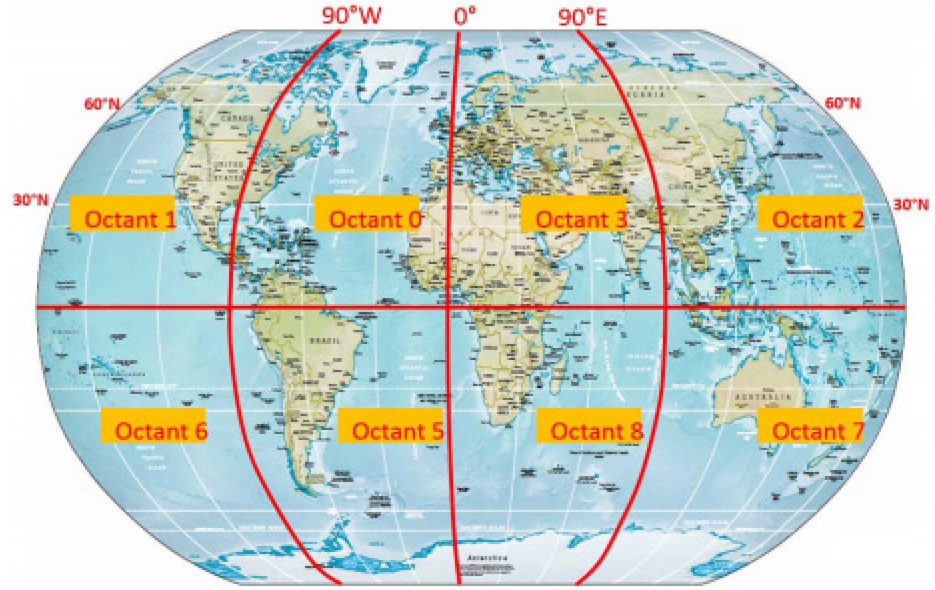


Figure F-2. Geographical Depiction of Octants Encoded in Recco Messages

F.2.2. HDOB.

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

Within an HDOB message, the time interval (resolution) between individual HD/HA observations can be set by the operator to be 30, 60, or 120 seconds. However, regardless of the time resolution of the HD/HA data, the meteorological parameters in the HDOB message always represent 30-second averages along the flight track (except for certain peak values as noted in Table F-6).

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

A sample HDOB message is shown in Figure F-3 (message begins with URPN15...):

```
0         1         2         3         4         5         6         7
01234567890123456789012345678901234567890123456789012345678901234567890
-----------------------------------------------------------------------
URPN15 KNHC 302128
AF309 03WSE TRACK 99           HDOB 27 20200130
212030 3710N 14332W 2995 09407 0233 -425 -468 234073 073 030 000 00
212100 3711N 14334W 2994 09407 0231 -425 -466 234074 074 029 002 00
212130 3712N 14337W 2994 09405 0230 -425 -464 235074 074 030 001 00
212200 3713N 14340W 2995 09405 0230 -425 -465 235074 074 031 000 00
.
.
.
212730 3725N 14408W 2987 09398 0205 -425 -459 232076 077 031 000 00
212800 3726N 14410W 2987 09397 0204 -425 -450 232076 076 030 002 00
212830 3727N 14413W 2987 09395 0203 -425 -450 232077 077 030 001 03
212900 3729N 14415W 2987 09393 0202 -425 -459 232076 077 030 001 00
212930 3730N 14418W 2986 09394 0201 -430 -470 233076 077 030 000 00
213000 3731N 14420W 2986 09392 0199 -430 -477 234078 078 030 001 00
$$
```

Figure F-3. Example Winter Season HDOB Message

Table F-4. Mission/Ob Identifier Line Format for HDOB Messages

A sample mission/ob identifier line is given below (beginning with AF309...), followed by a description of the parameters.

```
0         1         2         3         4         5         6         7
01234567890123456789012345678901234567890123456789012345678901234567890
-----------------------------------------------------------------------
IIIII IIIII IIIIIIIIIIIIIIIIII HDOB NN YYYYMMDD
AF309 03WSE TRACK 99           HDOB 27 20200130   <- example
```

III...III: Mission identifier, as determined in Chapter 2, Table 2-4.

NN: Observation number (01-99), assigned sequentially for each HDOB message during the flight. This sequencing is independent of the numbering of other types of messages (RECCO, DROP, etc.), which have their own numbering sequence.

YYYYMMDD: Year, month, and day of the first HD/HA data line of the message.

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

```
0         1         2         3         4         5         6         7
01234567890123456789012345678901234567890123456789012345678901234567890
-----------------------------------------------------------------------
hhmmss LLLLH NNNNNH PPPP GGGGG XXXX sTTT sddd wwwSSS MMM KKK ppp FF
212030 3710N 14332W 2995 09407 0233 -425 -468 234073 073 030 000 00
```

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

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

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

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

GGGGG: Aircraft geopotential height, in meters, at the observation time. '////'indicates missing value.

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

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

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

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

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

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

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

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

ppp: SFMR-derived rain rate, in mm hr-1, evaluated over the 10-s interval chosen for KKK. /// indicates missing value.

FF: Quality control flags.

First column indicates status of positional variables as follows:

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

Second column indicates status of meteorological variables as follows:

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

F.2.3. TEMP DROP.

The TEMP DROP code message provides a representation of quality-controlled vertical measurements of pressure, temperature, moisture, and winds acquired from dropsondes released from reconnaissance aircraft. The message consists primarily of two main sections: Part A and B. In Part A, temperature, dew point depression, and wind measurements are reported at the surface and at every mandatory pressure level the dropsonde traverses as it descends from flight level. A hydrostatically-computed sea-level pressure obtained from sonde data is reported with the surface data. Calculated geopotential heights based on upward or downward hydrostatic integration of the sonde data are also reported with the mandatory pressure levels. In Part B, thermodynamic (temperature and dew point depressions) and wind measurements are reported at significant pressure levels traversed by the dropsonde from flight level to the surface. The significant levels are selected from a quality-control algorithm where local extrema occur in the vertical profiles of the thermodynamic and wind data and at other set criteria. Additional information is provided in remarks lines at the end of each section, including but not limited to aircraft mission ID, observation number, and dropsonde release and splash times and locations. If the dropsonde is released by an aircraft at a pressure altitude above 100 mb, the TEMP DROP message will contain additional Parts C and D, which are analogous to Parts A and B, for mandatory and significant level measurements < 100 mb.

A sample 53 WRS TEMP DROP message is shown in Figure F-4. A detailed explanation of each element within a TEMP DROP message is presented in Table F-6.

Figure F-4. Example Winter Season TEMP DROP Message

```
UZNT13 KNHC 132300
XXAA  63233 99390 70670 11597 99031 02050 01011 00246 00749 35507
92862 04166 02008 85531 00097 28522 70074 06369 27540 50563 21180
28565 40724 32162 27577 30920 473// 27089 88999 66296 27092 408//
31313 09608 82232
61616 AF309 03WSA TRACK62      OB 10
62626 MBL WND 35008 AEV 33304 DLM WND 28041 030296 WL150 34509 08
0 REL 3904N06700W 223209 SPG 3902N06681W 224430 =
XXBB  63238 99390 70670 11597 00031 02050 11937 05513 22930 05328
33923 03974 44911 04174 55850 00097 66834 01077 77786 01164 88750
02365 99701 06369 11677 08360 22642 11158 33627 11174 44597 12782
55552 17763 66544 18179 77528 18974 88516 20363 99505 20780 11483
22569 22458 25762 33448 26965 44428 28758 55400 32162 66375 35957
77361 37764 88347 39965 99343 40764 11296 48117
21212 00031 01011 11001 35507 22985 35510 33963 00506 44931 03009
55911 34004 66862 29514 77850 28522 88752 29531 99702 27540 11662
29537 22643 29038 33509 29063 44437 27073 55296 27092
31313 09608 82232
61616 AF309 03WSA TRACK62      OB 10
62626 MBL WND 35008 AEV 33304 DLM WND 28041 030296 WL150 34509 08
0 REL 3904N06700W 223209 SPG 3902N06681W 224430 =
```

Table F-6. TEMP DROP Code

Adapted from: WMO-No. 306 MANUAL ON CODES

FM 37-X Ext. TEMP DROP: Upper-level pressure, temperature, humidity and wind report from a sonde released by aircraft. See Figure F-4 for an example TEMP DROP message for winter season operations.

CODE FORM:

PART A

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

SECTION 2 $99P_oP_oP_o$ $T_oT_oT_{ao}D_oD_o$ $d_od_of_of_of_o$
$P_1P_1h_1h_1h_1$ $T_1T_1T_{a1}D_1D_1$ $d_1d_1f_1f_1f_1$
$P_nP_nh_nh_nh_n$ $T_nT_nT_{an}D_nD_n$ $d_nd_nf_nf_nf_n$

SECTION 3 $88P_tP_tP_t$ $T_tT_tT_{at}D_tD_t$ $d_td_tf_tf_tf_t$
or
88999

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

SECTION 10 31313
51515 $101A_{df}A_{df}$ $0P_nP_nP'_nP'_n$.
or
$101A_{df}A_{df}$ $P_nP_nh_nh_nh_n$
61616
62626

PART B

SECTION 1 $M_iM_iM_jM_j$ $YYGG8$ $99L_aL_aL_a$ $Q_cL_oL_oL_o$ $MMMU_{La}U_{Lo}$

SECTION 5 $n_on_oP_oP_oP_o$ $T_oT_oT_{ao}D_oD_o$
$n_1n_1P_1P_1P_1$ $T_1T_1T_{a1}D_1D_1$
$n_nn_nP_nP_nP_n$ $T_nT_nT_{an}D_nD_n$

SECTION 6 21212 $n_on_oP_oP_oP_o$ $d_od_of_of_of_o$
$n_1n_1P_1P_1P_1$ $d_1d_1f_1f_1f_1$
$n_nn_nP_nP_nP_n$ $d_nd_nf_nf_nf_n$

SECTION 7 31313 $s_r r_a r_a s_a s_a$ 8GGgg
SECTION 9 51515 101A_{df} A_{df} or
101A_{df} A_{df} 0$P_nP_nP'_nP'_n$ or
101A_{df} A_{df} $P_nP_nh_nh_nh_n$
SECTION 10 61616
62626

PART ALPHA (A)

IDENTIFICATION LETTERS: M_JM_J

Identifier: **M_JM_J** - Identifier for Part A of the report.

DATE/TIME GROUP: YYGGI_d

Identifier: **YY** - Date group
Identifier: **GG** - Time group
Identifier: **I_d** - The highest mandatory level for which wind is available.

LATITUDE: 99$L_aL_aL_a$

Identifier: **99** – Indicator for data on position follows.
Identifier: **$L_aL_aL_a$** – Latitude in tenths of degrees.

LONGITUDE: $Q_cL_oL_oL_oL_o$

Identifier: **Q_c** – The octant of the globe.
Identifier: **$L_oL_oL_oL_o$** – Longitude in tenths of degrees.

MARSDEN SQUARE: MMM$U_{la}U_{lo}$

Identifier: **MMM** - Marsden square *(see Figure F-5 for geographical depiction)*.
Identifier: **$U_{la}U_{lo}$** – Units digits in the reported latitude and longitude.

SEA LEVEL PRESSURE: 99$P_0P_0P_0$ $T_0T_0T_0D_0D_0$ $d_0d_0f_0f_0f_0$

Identifier: **99** – Indicator for data at the surface level follows.
Identifier: **$P_0P_0P_0$** – Indicator for pressure of specified levels in whole millibars (thousands omitted).
Identifier: **$T_0T_0T_0$** – Tens and digits of air temperature (not rounded off) in degrees Celsius, at specified levels beginning with surface.
Identifier: **D_0D_0** – Dew point depression at standard isobaric surfaces beginning with surface level. NOTE - When the depression is 4.9°C or less encode the units and tenths digits of the depression. Encode depressions of 5.0 through 5.4°C as 50. Encode depressions of 5.5°C through 5.9°C as 56. Dew point depressions of 6.0 and above are encoded in tens and units with 50 added. When air temperature is below –40°C report D_nD_n as //.
Identifier: **d_od_o** – True direction from which wind is blowing rounded to nearest 5 degrees. Report hundreds and tens digits. The unit digit (0 or 5) is added to the hundreds digit of

wind speed.
Identifier: $\mathbf{f_of_of_o}$ – Wind speed in knots. Hundreds digit is sum of speed and unit digit of direction, i.e. 29<u>5</u>° at 125 knots encoded as 29<u>6</u>25.

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

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

STANDARD ISOBARIC SURFACES: $\mathbf{P_1P_1h_1h_1h_1}$ $\mathbf{T_1T_1T_1D_1D_1}$ $\mathbf{d_1d_1f_1f_1f_1}$

Identifier: $\mathbf{P_1P_1}$ – Pressure of standard isobaric surfaces in units of tens of millibars. (1000 mb = 00, 925 mb = 92, 850 mb = 85, 70 mb = 70, 500 mb = 50, 400 mb = 40, 300 mb = 30, 250 mb = 25, 200 mb = 20, 150 mb =15, 100 mb =10).
Identifier: $\mathbf{h_1h_1h_1}$ – Heights of the standard pressure level in geopotential meters or decameters above the surface. Encoded in decameters at and above 500mb omitting, if necessary, the thousands or tens of thousands digits. Add 500 to the absolute value of hhh for negative 1000 mb or 925 mb heights. Report 1000 mb group as 00/// ///// ///// when pressure is less than 950 mb.
Identifier: $\mathbf{T_1T_1T_1D_1D_1}$ – Same temperature/dew point encoding procedures apply to all levels.
Identifier: $\mathbf{d_1d_1f_1f_1f_1}$ – Same wind encoding procedures apply to all levels.

DATA FOR TROPOPAUSE LEVELS: 88 $\mathbf{P_tP_tP_t}$ $\mathbf{T_tT_tT_tD_tD_t}$ $\mathbf{d_td_tf_tf_tf_t}$

Identifier: **88** – Indicator for Tropopause level follows.
Identifier: $\mathbf{P_tP_tP_t}$ – Pressure at the tropopause level reported in whole millibars. Report $88P_tP_tP_t$ as 88999 when tropopause is not observed.
Identifier: $\mathbf{T_tT_tT_tD_tD_t}$ – Same temperature/dew point encoding procedures apply.
Identifier: **dtdtftftf**t - Same wind encoding procedures apply.

MAXIMUM WIND DATA: 77$\mathbf{P_nP_nP_n}$ $\mathbf{d_nd_nf_nf_nf_n}$ 4$\mathbf{v_bv_bv_av_a}$

Identifier: **77** – Indicator that data for maximum wind level and for vertical wind shear follow when max wind does not coincide at flight. If the maximum wind level coincides with flight level encode as 66. Report $77P_nP_nP_n$ as 77999 when maximum wind data has not been observed.
Identifier: $\mathbf{P_nP_nP_n}$.– Pressure at maximum wind level in whole millibars.
Identifier: **dndnfnfnfn** - Same wind encoding procedures apply.

VERTICAL WIND SHEAR DATA: 4$\mathbf{v_bv_bv_av_a}$

Identifier: **4** – Data for vertical wind shear follow.
Identifier: $\mathbf{v_bv_b}$ – Absolute value of vector difference between max wind and wind 3000 feet BELOW the level of max wind, reported to the nearest knot. Use "//" if missing and a 4 is

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

SOUNDING SYSTEM INDICATION, RADIOSONDE/SYSTEM STATUS, LAUNCH TIME: 31313 $\mathbf{s_r r_a r_a s_a s_a}$ 8GGgg

Identifier: $\mathbf{s_r r_a r_a s_a s_a}$ - Sounding system indicator, radiosonde/system status: $s_a r_a r_a s_a s_a$.
Identifier: $\mathbf{s_a}$ - Solar and infrared radiation correction (0 – no correction).
Identifier: $\mathbf{r_a r_a}$ – Radiosonde/sounding system used (96 – Descending radiosonde).
Identifier: $\mathbf{s_a s_a}$ – Tracking technique/status of system used (08 – Automatic satellite navigation).
Identifier: **8GGgg** – Launch time.
Identifier: **8** – Indicator group.
Identifier: **GG** – Time in hours.
Identifier: **gg** – Time in minutes.

ADDITIONAL DATA GROUPS: 51515 101XX $\mathbf{0P_nP_nP_nP_n}$

Identifier: **51515** – Additional data in regional code follow.
Identifier: **10166** – Geopotential data are doubtful between the following levels $0P_nP_nP_nP_n$. This code figure is used only when geopotential data are doubtful from one level to another.
Identifier: **10167** – Temperature data are doubtful between the following levels $0P_nP_nP_nP_n$. This code figure shall be reported when only the temperature data are doubtful for a portion of the descent. If a 10167 group is reported a 10166 will also be reported. EXAMPLE: Temperature is doubtful from 540 mb to 510 mb. SLP is 1020 mb. The additional data groups would be: 51515 10166 00251 10167 05451.
Identifier: **10190** – Extrapolated altitude data follows:

When the sounding begins within 25 mb below a standard surface, the height of the surface is reported in the format **10190 $\mathbf{P_nP_nh_nh_nh_n}$**. The temperature group is not reported. EXAMPLE: Assume the release was made from 310 mb 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 A and B as 10190 30966.

When the sounding does not reach surface, but terminates within 25 mb of a standard surface, the height of the standard surface is reported in Part A of the code in standard format and also at the end of Part A and Part B of the code in the format as **10190 $\mathbf{P_nP_nh_nh_nh_n}$**. EXAMPLE: Assume termination occurred at 980 mb 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.

Identifier: **10191** – Extrapolated surface pressure precedes. Extrapolated surface pressure is only reported when the termination occurs between 850 mb and the surface. Surface pressure is reported in Part A as $99P_0P_0P_0$ ///// and in 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.

AIRCRAFT AND MISSION IDENTIFICATION:

61616 IIIII IIIII IIIIIIIIIIIIIIIII OB NN

Identifier: **61616** – Aircraft and mission identification data follows.
Identifier: **III...III** – The mission identifier, including the aircraft tail number, as determined in Chapter 2, Table 2-4.
Identifier: **OB NN** – The observation number (01-99), assigned sequentially for each aircraft message (both vertical and horizontal) transmitted during the mission.

NATIONALLY DEVELOPED CODES: 62626

Identifier: **62626 –** This is the remarks section.
Identifier: **LST WND XXX** - Height of the last reported wind. If a surface wind is reported the Last Wind remark is omitted. XXX will never be less than 13 meters
Identifier: **MBL WND dddff** - The mean boundary level wind. The mean wind in the lowest 500 meters of the sounding.
Identifier: **AEV XXXXX** – This is the software version of ASPEN used to QC the sounding.
Identifier: **DLM WND ddfff bbbttt** - The Deep Layer Mean wind. It is the average wind over the depth of the sounding, where ddfff is the wind averaged from the first to the last available wind (these would correspond to the first and last significant levels for wind), ttt is the pressure at the top of the layer, and bbb is the pressure at the bottom of the layer (in whole mb, with thousands digit omitted).
Identifier: **WL150 ddfff zzz** - Average wind over the lowest available 150 m of the wind sounding, where ddfff is the mean wind over the 150 m layer centered at zzz m.
Identifier: **REL XXXXNXXXXXW hhmmss** - the time and location of the highest (in altitude) wind reported in the temp drop message
Identifier: **SPG XXXXNXXXXXW hhmmss** - the time and location of the lowest (in altitude) wind reported in the temp drop message.

PART BRAVO (B)

DATA FOR SIGNIFICANT TEMPERATURE AND RELATIVE HUMIDITY LEVELS SIGNIFICANT ISOBARIC LEVELS: $n_0n_0P_0P_0P_0$ $T_0T_0T_0D_0D_0$

IDENTIFICATION LETTERS: M_JM_J

Identifier: **M_JM_J** - Identifier for Part B of the report.

DATE/TIME GROUP: YYGG8

Identifier: **YY** - Date group
Identifier: **GG** - Time group
Identifier: **8** - Indicator for the use of satellite navigation for wind finding.

LATITUDE: 99$L_aL_aL_a$ (Same as Part A)

LONGITUDE: $Q_cL_oL_oL_oL_o$ (Same as Part A)

MARSDEN SQUARE: $MMMU_{la}U_{lo}$ (Same as Part A)

SEA LEVEL PRESSURE: $n_on_oP_0P_0P_0$ $T_0T_0T_0D_0D_0$

Identifier: **n_on_o** – Indicator for level number starting with surface level. Only surface will be numbered as "**00**".
Identifier: **$P_0P_0P_0$** – Indicator for pressure at specified levels in whole millibars (thousands digit omitted).
Identifier: **$T_0T_0T_0$** – Tens and digits of air temperature (not rounded off) in degrees Celsius, at specified levels beginning with surface.
Identifier: **D_0D_0** – Dew point depression at standard isobaric surfaces beginning with surface level. Encoded the same as Part A.

DATA FOR SIGNIFICANT WIND LEVELS: $n_0n_0P_0P_0P_0$ $d_od_of_of_of_o$

Identifier: **n_0n_0** – Indicator for level number starting with surface level. Only surface will be numbered as "**00**".
Identifier: **$P_0P_0P_0$** – Indicator for pressure at specified levels in whole millibars (thousands digit omitted).
Identifier: **d_od_o** – True direction from which wind is blowing rounded to nearest 5 degrees. Report hundreds and tens digits. The unit digit (0 or 5) is added to the hundreds digit of wind speed.
Identifier: **$f_of_of_o$** – Wind speed in knots. Hundreds digit is sum of speed and unit digit of direction, i.e. 29<u>5</u>° at 125 knots encoded as 29<u>6</u>25.

Same notes in Part A apply.

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

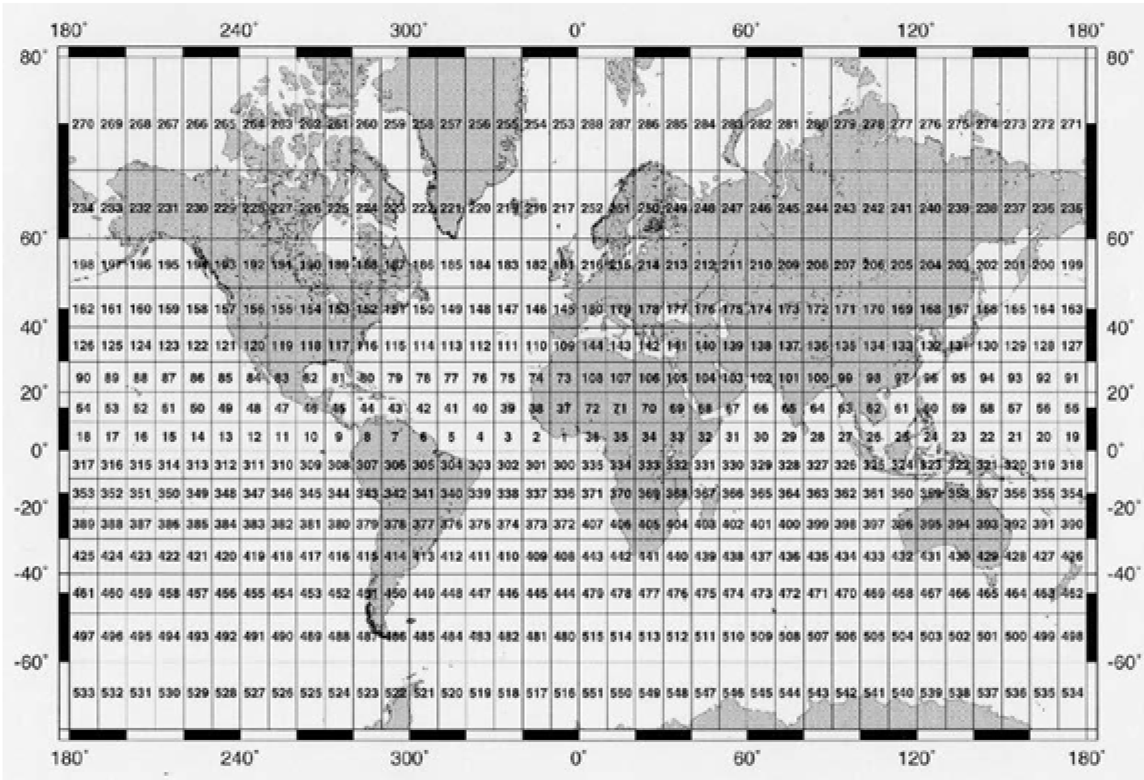


Figure F-5. Marsden Square Reference Diagram

Appendix G
Organizational Contact Information

Table G-1. Agency Contact Information for Winter Season Operations

AGENCY/OFFICE	TELEPHONE	ADDRESS
Interdepartmental		
Interagency Meteorological Coordination Office (IMCO)	COM 301-628-0112	1325 East-West Highway (SSMC2), Suite 7130 Silver Spring, MD 20910
Department of Commerce – National Oceanic and Atmospheric Administration (NOAA)		
National Centers for Environmental Prediction (NCEP) NCEP Central Operations (NCO) Senior Duty Meteorologist (SDM) Environmental Modeling Center (EMC) MDAB Chief Weather Prediction Center (WPC) Lead Forecaster Ocean Prediction Center (OPC) Lead Forecaster	COM 301-683-1315 COM 301-683-1500 FAX 301-683-1501 COM 301-683-3672 COM 301-683-1530 COM 301-683-1520	NOAA Center for Weather and Climate Prediction (NCWCP) 5830 University Research Court College Park, MD 20740
National Weather Service (NWS) Western Region Headquarters	COM 801-524-5120	125 South State Street Salt Lake City, UT 84138-1102
NOAA Office of Marine and Aviation Operations (OMAO)	COM 301-713-1045	National Oceanic and Atmospheric Administration 8403 Colesville Road, Suite 500 Silver Spring, MD 20910-3282
NOAA/OMAO Aircraft Operations Center (AOC)	COM 863-500-3990 FAX 863-500-3859	3450 Flightline Drive Lakeland, FL 33811
National Data Buoy Center (NDBC) Operations Branch Data Management and Communications Branch	COM 228-688-3134 COM 228-688-7720 COM 228-688-2835	National Data Buoy Center Bldg. 3205 Stennis Space Center, MS 39529
National Environmental Satellite, Data, and Information Service (NESDIS) Satellite Analysis Branch (SAB)	COM 301-683-1400 FAX 301-683-1405	NOAA Center for Weather and Climate Prediction (NCWCP) 5830 University Research Court College Park, MD 20740
Department of Defense – U.S. Air Force (USAF)		
US Air Force Reserve Command Weather (AFRC/A3OW)	COM 478-222-6106 COM 478-327-0306	155 Richard Ray Blvd Robins AFB, GA 31098 HQAFRC.A3.OW@us.af.mil
601st Air and Space Operations Center Airspace Management Team (601 AOC/AMT) Combat Operations Division Weather Specialty Team (601 AOC/CODW)	 COM 850-283-5837 DSN 523-5837 COM 850-283-5119 DSN 523-5119	Tyndall AFB, FL

Table G -1 (continued). Agency Contact Information for Winter Season Operations

AGENCY/OFFICE	TELEPHONE	ADDRESS
Department of Defense – U.S. Air Force (USAF)		
557th Weather Wing (557 WW)	COM 402-294-2586 DSN 271-2586	101 Nelson Drive Offutt AFB, NE 68113-1023
403 Operations Support Squadron (403 OSS) Current Operations	COM 228-377-1043 DSN 597-1043	817 H Street, Suite 201 Keesler AFB, MS 39534-2453
53rd Weather Reconnaissance Squadron (53 WRS) Supervisor of Flights (SOF)/Alternate CARCAH Chief Aerial Reconnaissance Weather Officer (ARWO)	COM 228-377-2409 DSN 597-2409 COM 228-377-3207 DSN 597-3207	817 H Street, Suite 201 Keesler AFB, MS 39534-2453
Chief, Aerial Reconnaissance Coordination, All Hurricanes (CARCAH) -- 53 WRS, OL-A	COM 305-229-4474 FAX 305-553-1901	National Hurricane Center 11691 SW 17th Street Miami, FL 33165-2149
Keesler Air Force Base Command Post	COM 228-377-4181/4330 DSN 597-4181/4330	Keesler AFB, MS
Department of Defense – U.S. Navy (USN)		
Fleet Weather Center (FLEWEACEN), Norfolk	COM 757-444-7583 DSN 564-7583	9141 Third Avenue Norfolk, VA 23511-2394
Fleet Weather Center (FLEWEACEN), San Diego	COM 619-767-1271/7750 DSN 735-1271/7750	Naval Base Coronado PO Box 357076 San Diego, CA 92135-7076
Naval Meteorology and Oceanography Command (NMOC)	COM 228-688 4301 FAX 228-688-4880	1100 Balch Blvd. Stennis Space Center, MS 39529
Fleet Numerical Meteorology and Oceanography Center (FNMOC)	COM 831-657-1406 DSN 756-1406	7 Grace Hopper Ave., Stop 1 Monterey CA 93943-5501
Fleet Area Control and Surveillance Facility, Virginia Capes, VA (FACSFAC VACAPES) Fleet Forces Atlantic Exercise Coordination Center (FFAECC) Oceanic Airspace Coordination (OAC) Air Traffic Control Facility – Giant Killer	COM 804-433-1211 DSN 433-1211 COM 804-433-1218/1220 DSN 433-1218/1220 COM 804-433-1233/1225 DSN 433-1233/1225 COM 804-433-1230/1231 DSN 433-1230/1231 FAX 804-433-1209	Naval Air Station Oceana 601 Oceana Blvd. Virginia Beach, VA 23460
Fleet Area Control and Surveillance Facility, Jacksonville, FL (FACSFAC JAX) Air Traffic Control Facility – Sealord	COM 904-542-2004 DSN 942-2004 COM 904-542-2250 DSN 942-2250 FAX 904-542-2525	PO Box 40 Bldg 118 Albemarle Ave. NAS Jacksonville, FL 32212-0010

Table G -1 (continued). Agency Contact Information for Winter Season Operations

AGENCY/OFFICE	TELEPHONE	ADDRESS
Department of Homeland Security – U.S. Coast Guard (USCG)		
USCG Communications Command (COMMCOM)	COM 757-421-6240 Toll Free 800-742-8519	4720 Douglas A. Munro Rd. Chesapeake, VA 23322
Department of Transportation – Federal Aviation Administration (FAA)		
Air Traffic Control System Command Center (ATCSCC) Manager's Office	COM 540-422-4000 COM 540-422-4004	David J. Hurley Air Traffic Control System Command Center 3701 Macintosh Drive Warrenton, Virginia 20187
International Operations Position - Primary Operations Contact Point	COM 540-422-4158 FAX 540-422-4196	
National Operations Center (NOC) - Secondary Operations Contact Point	COM 540-422-4100/4101/4102 Toll Free 800-333-4286 - (Military Use Only) FAX 540-422-4196	
U.S. Notice to Airmen (NOTAM) Office	COM 540-422-4260/4261 FAX 540-422-4983	
Central Altitude Reservation Function (CARF)	COM 540-422-4211/4212/4213 DSN 510-422-4211/4212/4213 FAX 540-422-4291	
DOD Air Traffic Services Cell	COM 540-422-4250 DSN 510-422-4250	

Table G -2. DOT/FAA Air Route Traffic Control Center (ARTCC) Telephone Numbers

FACILITY	ID	PRIMARY OPERATIONS CONTACT POINT	SECONDARY OPERATIONS CONTACT POINT (24 Hour Number)	OPERATIONS FAX NUMBER	CENTRAL WEATHER SERVICE UNIT (CWSU)
Pacific					
Anchorage	ZAN	COM 907-269-1103 (OMIC)	COM 907-269-1108 (TMC)	COM 907-269-1343	COM 907-269-1145
Honolulu HCF	ZHN	COM 808-840-6203 (Missions) COM 808-840-6204 (TMC)	COM 808-840-6201 (Front Line Manager)	COM 808-840-6210	N/A
Los Angeles	ZLA	COM 661-265-8287 (Missions)	COM 661-265-8205 (OMIC)	COM 661-265-8277	COM 661-265-8258
Oakland	ZOA ZLK	COM 510-745-3332 (Missions) COM 510-745-3342 (Oceanic Supervisor)	COM 510-745-3331 COM 510-745-3334 DSN 730-1595 (OMIC)	COM 510-745-3339 COM 510-745-3411	COM 510-745-3425
Seattle	ZSE	COM 253-351-3523 (Missions)	COM 253-351-3520 (OMIC)	COM 253-351-3594 COM 253-351-3538	COM 253-351-3741
Atlantic/Gulf					
Boston	ZBW	COM 603-879-6663/6666 DSN 881-1635 (TMC)	COM 603-879-6655 (OMIC)	COM 603-879-6461	COM 603-879-6698
Houston	ZHU	COM 281-230-5563 DSN 885-1491 (Missions) COM 281-230-5552 (Oceanic Supervisor)	COM 281-230-5560 (OMIC)	COM 281-230-5561	COM 281-230-5676
Jacksonville	ZJX	COM 904-845-1542 DSN 434-3744 (Missions) COM 904-845-1545 - *Atlantic, N. of JAX, Above FL240* COM 904-845-1546 - *Atlantic, N. of JAX, FL240/Below* COM 904-845-1547 - *Atlantic, S. OF JAX, All Altitudes* COM 904-845-1549 - *Gulf of Mexico* (Oceanic Supervisor)	COM 904-845-1537 (OMIC)	COM 904-845-1843	COM 904-845-1840 COM 904-845-1839

TMC – Traffic Management Coordinator OMIC - Operations Manager in Charge STMC – Supervisor Traffic Management Coordinator

Table G –2 (continued). DOT/FAA Air Route Traffic Control Center (ARTCC) Telephone Numbers

FACILITY	ID	PRIMARY OPERATIONS CONTACT POINT	SECONDARY OPERATIONS CONTACT POINT (24 Hour Number)	OPERATIONS FAX NUMBER	CENTRAL WEATHER SERVICE UNIT (CWSU)
Atlantic/Gulf					
Miami	ZMA	COM 305-716-1589 DSN 434-1910 (Missions) COM 305-716-1781 - *Gulf of Mexico* COM 305-716-1784 - *Bahamas & North* COM 305-716-1785 - *Bahamas & South* COM 305-716-1786 - *Atlantic* (Oceanic Supervisor)	COM 305-716-1588 (OMIC)	COM 305-716-1511 COM 305-716-1577	COM 305-716-1635
New York	ZNY	COM 631-468-1427/1429 DSN 881-3730 (Missions) COM 631-468-1496	COM 631-468-1080 (STMC)	COM 631-468-4224 COM 631-468-1428	COM 631-468-1082
Washington	ZDC	COM 703-771-3473 (Missions)	COM 703-771-3470 DSN 937-1420 (OMIC)	COM 703-771-3444	COM 703-771-3480
TMC – Traffic Management Coordinator OMIC - Operations Manager in Charge STMC – Supervisor Traffic Management Coordinator					

Appendix H
Supporting Research

H.1. General.

For the Western Atlantic and Gulf of Mexico area of responsibility, the program concentrates on targeting specific weather systems that have the potential to rapidly intensify and cause major impacts to heavily populated areas over the Eastern U.S. These WSR missions are executed on short-range time scales within 72 hours of the forecasted impact, as opposed to the 5-7-day range for Pacific operations. NOAA AOC and AFRC 53rd WRS flies the Gulf of Mexico and Western Atlantic missions from their home stations at Linder International Airport, Lakeland, FL and Keesler Air Force Base, Biloxi, MS, respectively.

H.2. Background Studies.

The results from seven research and operational field programs, between 1999 and 2005, indicated in 70-90% of the cases, adaptive observations improved the forecasts for the targeted weather events. On average, a 10-20% error reduction was observed in the targeted forecasts. As a result, numerical forecast guidance issued 48 hours prior to the events became as accurate as 36-hour lead time forecasts without the use of adaptive observations (Majumdar 2016). An analysis of the impacts from the 2012 WSR season by Dr. Ron Gelaro, NASA Global Modeling and Assimilation Office, initially indicated that, in some cases, these adaptive observations provided substantial improvement to a global measure of 24-hour forecast errors. However, a more recent report from 2013 by Dr. Thomas Hamill, NOAA Earth System Research Laboratory (ESRL), countered this hypothesis based on studies of 2011 WSR data (Hamill et al. 2013). After the reinstatement of AR Recon in 2016, several studies have shown positive impacts, including Stone et al. (2020) that showed an impact from AR Recon dropsondes in the Navy's global model comparable to the entire North American radiosonde network (see Ralph et al., 2020 for a summary of some other recent results).

An even more recent study by the THORPEX team of adaptive observations (Parsons et al. 2017) have suggested that some neutral results from earlier studies may become positive with the use of more advanced DA schemes in numerical models that allow for a greater in-depth assessment of earlier observations. Further, recent advances in the use of a ‘dead-reckoning’ sonde-positioning estimation scheme in place of using a single position at sonde deployment, may also improve the impact of some targeted observations. An even more robust development was implemented in 2018 with the transmission from aircraft to modeling centers of the full high resolution sonde data via BUFR format by the NOAA G-IV aircraft. This development will allow each model DA system to use its own system for data thinning in place of the arbitrary breakpoints used in the TEMP DROP messages. Successful data transmission experiments have recently been accomplished and all sonde data from recent Hurricane Lane (August 2018) NOAA WP-3D and G-IV aircraft was successfully transmitted in the new BUFR format for the first time, along with the legacy WMO TEMP DROP text messages. These improvements come just as the sonde itself has undergone redesign, designated as the RD-41. It is scheduled to replace the existing RD-94 (Wick et al. 2018b) sonde in mid-2018 just as the use of BUFR-formatted data comes online for the NOAA G-IV. Updates on the use of the new BUFR format and the new RD-41 are provided by the archive of presentations from the NCAR/ EOL 2018 AVAPS Users Conference, Boulder, CO in Vömel (2018a,b).

With the development of better satellite data, combined with new and improved data assimilation schemes, the contribution of these targeted data to the global models has been questioned. Due to this uncertainty and the large cost associated with obtaining these data during remote deployments, operations in the Pacific basin have been suspended, following directives of NOAA National Weather Service (NWS) management. WSR operations are continuing for the Gulf of Mexico and Western Atlantic.

Additional studies continue to be conducted to assess how effective targeted observations are on improving global-model prediction of major winter weather events. Since 2014, the Pacific focus has shifted to Atmospheric River (AR) airborne observations and forecasting the impacts of the observations. Earlier studies of AR's have been summarized by Ralph et al. (2005). The AR studies have employed Air Force Reserve WC-130, NOAA G-IV and NASA/NOAA Global Hawk aircraft primarily for targeted dropwindsonde measurements over customized flight tracks near ARs, from the ITCZ to near coastal North America. New data-assimilation and targeting schemes are also being evaluated, both for winter seasons and tropical cyclones (e.g. Zhang et al. 2016; Dunion et al. 2018). Results from these investigations will help justify whether or not the Pacific WSR program should be resumed. They will also be used to determine if Gulf and Western Atlantic operations should be maintained. This plan includes information about them in case they are reinstated in the future.

Recent investigations during the ENRR project in February, 2016 by Kren et al. (2018) have shown positive forecast impacts. In cases where Global Hawk (GH) deployed dropsondes over the ENP, positive downstream impacts were found in severe weather parameters over the southeast U.S. (SEUS). During the third ENRR flight, which sampled a rapidly intensifying storm system in the central North Pacific, the largest impacts were found to be over the southeastern United States. During this time, a severe weather outbreak occurred over Louisiana, Mississippi, Florida, and Georgia, with a total of 52 tornado reports during the evening of 23-24 February 2016. Sampling the central North Pacific with GH dropsondes improved the downstream low-level storm environment with reduced RMSE in the 0-6 km AGL bulk wind shear. RMSE was also reduced under both satellite scenarios between 4-5% in 850-hPa relative humidity, 2-3% in 850-hPa wind, 5-7% in 850-hPa temperature, and 6-8% in SLP over the 24-72-hr lead times. Forecast increments between GH and CTL for the third ENRR flight indicated a more unstable environment with the assimilation of dropsondes.

H.2.1. Summary of Sensing Hazards with Operational Unmanned Technology (SHOUT) ENRR Aircraft Project

The specific goal of the 2016 SHOUT ENRR (Wick et al. 2018a) campaign was to improve forecasts at a two to three-day lead time for high impact weather events that bring extreme precipitation and/or high winds to the West Coast of the continental U.S. or the coast of Alaska. Flight tracks for high impact storm targets were developed with the assistance of models that targeted regions most sensitive to the environmental conditions. Model forecast sensitivity calculations were performed multiple times per day by the team at NOAA/AOML led by Lidia Cucurull. Sensitivity maps were automatically uploaded to a web page where they were accessible by SHOUT mission scientists. Figure 2b-c in Kren et al. (2018) shows a sample sensitivity map that originally focused on a predefined target region centered on California, but was then expanded to include the southeastern United States to provide guidance for a potential severe weather outbreak.

The design of Global Hawk flight plans was made using the sensitivity calculations to identify key meteorological features to sample (Dunion et al. 2018; Kren et al. 2018). This approach differs from simply trying to maximize the sampling of the regions of active weather because it also incorporates targeting of actual atmospheric features. The approach was adopted to facilitate modification of the flight plan in real time while conditions evolved. Comparison of the sensitivity graphics between successive model runs demonstrated that the spatial extent and patterns of the sensitive regions would evolve as features in the forecast fields changed. Targeting meteorological features also provided an effective way of combining the input from the different approaches which would often highlight similar features but with different spatial extents.

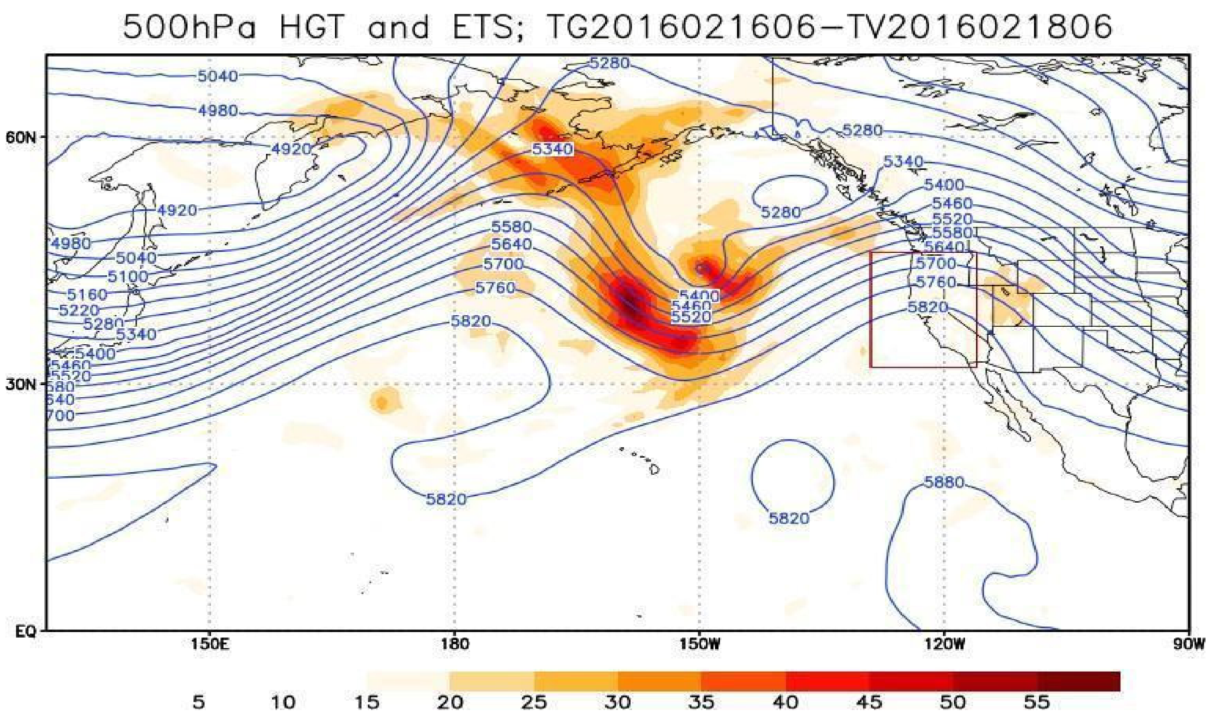


Figure H-1. Example of the forecast sensitivity calculations employed for Global Hawk mission targeting during the 2016 SHOUT ENRR campaign. This graphic was generated from the 1800 UTC forecast run on 14 February and highlights potential sampling on 16 February 0600 UTC to improve a forecast valid on 18 February 0600 UTC. Warm colored contours indicate regions of greatest sensitivity to GPS dropsonde observations. The red box illustrates the target region for which the improved forecast is desired. This output was used in the planning of the 15 February SHOUT ENRR mission. Graphic provided by Drs. Hongli Wang and Andrew Kren

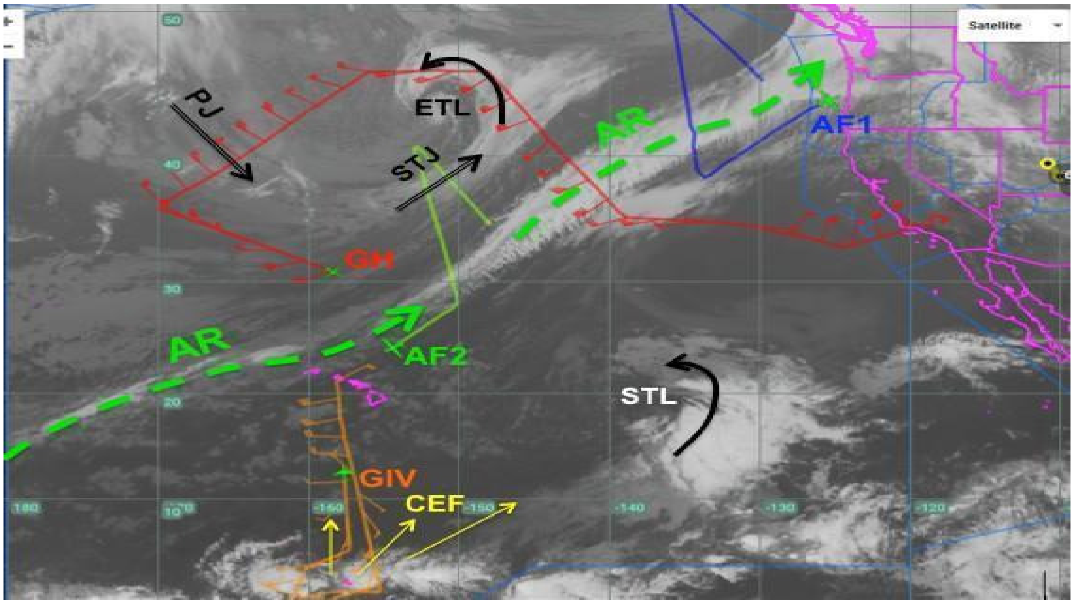


Figure H-2. Schematic of cloud features during a 2016 SHOUT ENRR Global Hawk Mission #2 on 15-16 February (red curve). Coordinated missions with two Air Force WC-130J aircraft (blue and green curves) and the NOAA G-IV jet (orange curve) are also shown. An atmospheric river (AR; thick green curve), atmospheric jet features (black arrows) associated with a polar jet (PJ), subtropical jet (SJ), extratropical low (ETL), and subtropical low (STL), and an area of upper-level cross equatorial flow (CEF; yellow arrows) are indicated.

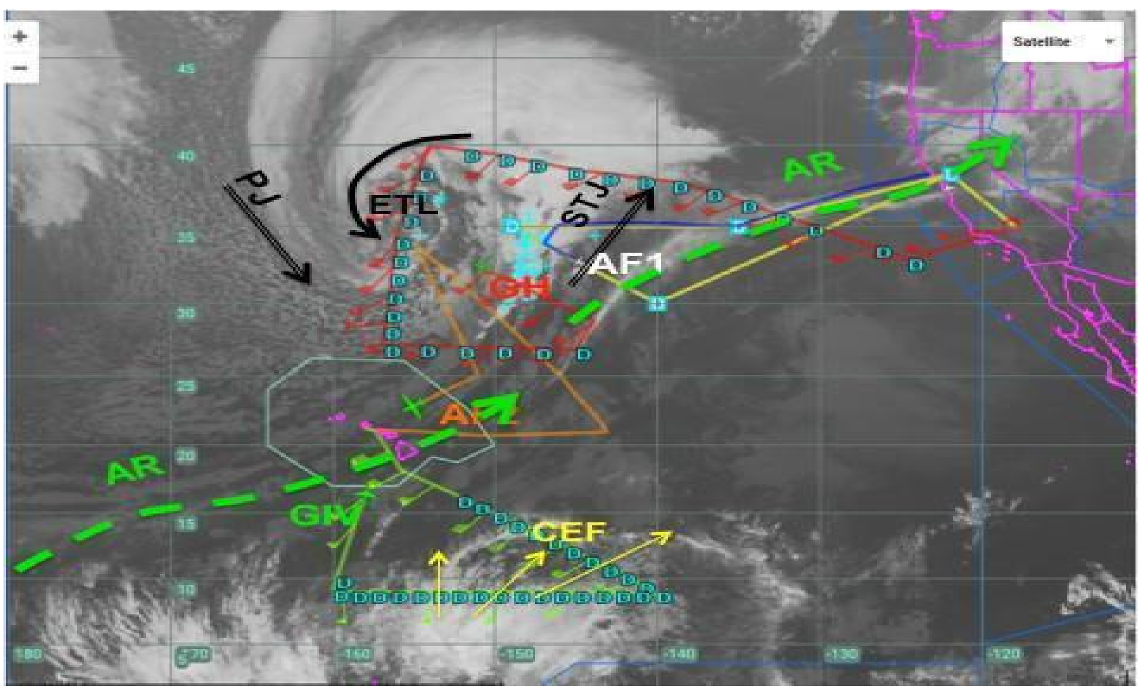


Figure H-3. Same as Figure H-2 except for a 2016 SHOUT ENRR Global Hawk Mission #3 on 21-22 February. 'D' indicates a Global Hawk GPS dropsonde location. Coordinated missions with two Air Force WC-130J aircraft (blue and orange curves) and the NOAA G-IV jet (orange curve) are also shown.

Results from the SHOUT campaign have recently been published in Peevey et al. (2018), English et al. (2018), Kren et al. (2018), and Wick et al. (2018a)

H.2.2. Concluding Assessment of Winter Season and Hurricane Dropsonde Impact.

The NOAA UAS program office successfully conducted three Global Hawk field campaigns consisting of 15 total missions from 2015-2016 in support of its SHOUT project (Wick et al. 2018a). SHOUT's overarching goal was to demonstrate and test a prototype UAS concept for operations that could be used to mitigate the risk of diminished high impact weather forecasts and warnings in the case of polar-orbiting satellite observing gaps. Using this goal as a guide, the NOAA UAS Program focused on two operational forecast-related goals: (1) assess the impact and optimization of UAS data on model forecasts of high impact weather; and (2) perform a cost-operational benefit analysis that quantifies the cost and operational benefit of UAS observing technology for high impact weather prediction. During the three field campaigns, the Global Hawk aircraft proved to be an effective platform for addressing the various SHOUT scientific objectives. Instrument performance was generally quite reliable, and the adaptive sampling techniques for targeting GPS dropsonde sampling that were employed proved effective in helping to guide missions and optimize SHOUT goals. Data that was collected during SHOUT has been extensively used in formal impact studies as documented in Dunion et al. (2018) and Christophersen et al. (2018). Cost benefit analysis of this project has also been carried out as described in Kenul et al. (2018). A companion report on enhanced targeted sampling in the hurricane environment during the SHOUT Hurricane Rapid Response (HRR) portion of the project is provided in Wick et al. (2018a).

NOAA/EMC's analyses of the impact of Global Hawk GPS dropsondes on the GFS model were particularly significant, demonstrating multi-storm average track skill improvements exceeding 10% and improvements for individual storms of over 20% depending on forecast lead time (Sippel et al. 2018). The results also showed improvements in the track forecasts of concurrent Pacific cyclones based on observations of the Atlantic storms, suggesting that the observations could have positive larger-scale and global impacts. These results indicate that the SHOUT field campaigns and Global Hawk missions that were flown have provided significant advancements for optimizing the Global Hawk UAS to study and improve forecasts of high impact weather. The wealth of lessons learned from those missions have helped provide operational experience applicable to potential future NOAA field campaigns. Results from these investigations will help justify whether or not the Pacific WSR program should be resumed.

H.3 Concept Of Operations Details.

The program implementation template would follow those used for deployment of NOAA Gulfstream-IV (G-IV) and AFRC WC-130J aircraft to Hawaii for hurricane threat surveillance. These procedures are outlined in the 2018 HRD Field Program Plan under 'Operations' and 'Appendix B, Decision and Notification Process.' These procedures have already been well defined and vetted for both the WC-130J and the G-IV. Therefore, the new plan for NWSOP would simply become a new application for previously implemented procedures that are already in place.

In the past, this CONcept of OPerationS (CONOPS) as applied to Winter Storms was not possible, requiring deployment of aircraft assets to WPAC, CNP and ENP West Coast staging basis for fixed periods of time of 6-8 weeks, made necessary due to poor long range forecast quality that did not allow for a reliable rapid response. The key change to the deployment strategy for this plan would be to deploy resources only when the need can be anticipated in the 5-7 day range, and to eliminate long-term deployments of 6-8 weeks. A winter season on order of 6-8 weeks would still need to be declared to arrange for the availability of aircraft assets, and enough time to capture 3-4 events. However, actual deployments to West Coast, Hawaii or Alaska staging basis would not need to be implemented until the perceived need arose. This approach would reduce overall costs compared to the past (possibly by up to 60% as was the case for normalized El-Nino Rapid Response (ENRR) and Hurricane Rapid Response (HRR) estimates (Kenul et al. 2018), and greatly improve efficiency of operations. The template for this approach for operational implementation would thus be the deployment strategy used by NWS NHC and CPHC forecast centers for the deployment of G-IV and WC-130J assets to Hawaii for hurricane surveillance missions to sample regions of high ensemble forecast uncertainty associated with the storm itself as well as surrounding environmental features, an operation conducted many times in the course of a typical hurricane season.

Three main components to this plan are envisioned: A) deployment of the NOAA G-IV and two AFRC WC-130J aircraft to bases in Hawaii, Alaska or U.S. West coast, depending on target location with the intent of flying the G-IV and one WC-130J aircraft on a twice per day basis (targeting 00Z and 12Z model runs), with the second WC-130J providing backup capability as needed, B) deployment of the NOAA G-IV and one WC-130J on a once per day basis targeting either the 00Z or 12Z model runs and C) deployment of either G-IV or WC-130J to fly targeted flight patterns into developing East Coast storm systems, especially those expected to undergo Rapid Intensification (RI), sometimes referred to as 'BOMB' cyclones. For Plan A, 3 flight crews and maintenance crews would be required to support twice per day operations, whereas for Plan B two flight and maintenance crews would be required (one set of crews for backup and/or alternating crewing on successive days. Each plan is envisioned to consist of an operating period of 3-4 days, possibly longer if routine maintenance is required.

The main factors constituting the rationale for executing this innovative plan are: (1) the use of an improved targeting system focused on uncertainty areas relative to the features of interest such as developing short wave troughs, and associated polar and subtropical jet streaks as well as Atmospheric River Complexes which would be defined by one or more current and new generation ensemble models to replace the previous approach of laying arbitrary geographically fixed flight patterns; (2) the use of new data transmission formats such as BUFR and sonde trajectory estimation together with existing TEMPDROP messages to transmit more representative sonde data profiles than was possible in the past; and (3) the use of a new generation of dropsonde, the RD-41 which will usher in an era of improved data response to changes in atmospheric variables, especially at sonde launch to provide initial sonde profile data at higher levels closer to the aircraft, and improved humidity measurements with no dry bias noted in the past.

The more impactful strategy would be to fly the aircraft according to Plan A, i.e., twice per day allowing sonde data assimilation inputs for all four modeling cycles at 00Z, 06Z, 12Z and 18Z. Plan A would have higher probability of a positive impact than simply once per day, which leaves gaps in the data assimilation (e-folding time for sonde impact is approximately 18 hours) that may very well reduce the impact of subsequent new observations. However, if Plan A is not feasible due to funding or maintenance issues, Plan B would still serve as a worthwhile alternative as it would still contain the benefits of the three improvements listed above.

The key objectives of these flights would be to enhance forecast accuracy in downstream regions of Alaska and the CONUS, including the southeast U.S., Gulf of Mexico and the U.S. East Coast, in a manner similar to that described recently in Kren et al. (2018). In order to achieve these goals, the aircraft surveillance regions will need to be more focused and include more sophisticated targeting strategies than what was employed in the past. In addition, new and innovative improvements to NCEP model data assimilation (DA) systems will be relied upon to make more efficient use of dropsonde data in an updated and more detailed format than available in the past.

The focus would thus be on improving forecasts of West Coast and Alaska heavy rain events, downstream squall line development and severe weather development in the 2-3 day range over the southeastern U.S. and East Coast. Improvement in downstream prediction in this intermediate range is anticipated based on observations deployed over incipient upper level features in the CNP and ENP regions. Direct sampling in the Gulf and along the U.S. East Coast in rapidly developing offshore BOMBs using targeting strategies would serve to provide forecasters with real time-intensity and structure observations to help improve near term advisories. Additional efforts are needed to document impacts of these type of flights in model predictions of these events. Sampling the data void regions, which are also upstream from frequent blocking situations over western CONUS, would focus assessment of the value of enhanced dropsonde observations where impacts may be expected on the global models in the 24 to 72-hr time frame over downstream CONUS locations.

Another major change to previous WSR Surveillance programs would be to eliminate pre planned fixed flight tracks and replace them with a targeting strategy similar to that used in the SHOUT/ENRR program, as outlined above. Templates of proposed flight tracks will be drawn out and made available for selection depending on specific scenarios relative to regions of enhanced uncertainty and key atmospheric features. These plans would be selected and adapted to each situation 5 days prior to planned operations. Then the ‘Big Box’ theory would be applied where initial regions containing the proposed flight plans would be defined and passed to Air Traffic Control (ATC). Then within 3 working days of planned operations, the regions would be modified one day ahead, with an enclosing 'NOTAM box' for the AOC and for the AFRC as needed and detailed flight plans, including turn points and drop points, would be relayed to ATC.

Prior to each winter season, a satellite data plan will be developed that outlines the specific observation types need to be utilized based on satellite sensor resources available and how they should be optimally used in conjunction with aircraft dropsonde data. A data plan will be formulated that outlines the U.S. satellite capability and how various satellite products can be most effectively used in conjunction with in-situ aircraft dropsonde sampling strategies.

An additional change introduced in this new winter season plan is the elimination of the deployment plan for drifting buoys such as used in CBLAST and ITOP projects. These type of deployments are no longer supported on an operational bases and have been replaced by new and less expensive sensor suites and observational strategies that do not require additional dedicated aircraft assets for low-level releases. A detailed plan will be developed for future use in which modern airborne oceanographic sensors will be released from WC-130J aircraft at the maximum altitude required of sonde deployments. They will use a new chute being developed by the 53rd WRS for probe deployment at all altitudes and the deployment template currently being tested on key WC-130J operational hurricane flights by the TROPIC program headed by the Office of Naval Research, the Naval Research Lab and the U.S. Naval Academy, replacing the system currently used that is limited to 700 mb and below. AXBT ocean probes and Alamo profiling floats deployed over the past six year by this program have demonstrated real time benefit to coupled air-sea TC models that will soon become operational. This offers the potential in the future of monitoring ocean conditions responding to climate change forcing over areas of the CEP and ENP regions to be sampled in a targeted fashion by G-IV and WC-130J aircraft deploying arrays of new dropsondes, floats and AXBTs. To help address ocean impact on Climate Change, it would be a natural add-on to the winter season program. But it would need to be implemented with modern resources and instruments such as those now undergoing real-time testing.

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