

Advisory Circular

Subject: Aviation Weather Services

Date: 1/8/18

AC No: 00-45H

Initiated by: AFS-400

Change: 1

- 1 PURPOSE OF THIS ADVISORY CIRCULAR (AC).** This AC explains U.S. aviation weather products and services. It provides details when necessary for interpretation and to aid usage. This publication supplements its companion manual, AC 00-6, Aviation Weather, which documents weather theory and its application to aviation. The objective of this AC is to bring the pilot and operator up-to-date on new and evolving weather information and capabilities to help plan a safe and efficient flight, while also describing the traditional weather products that remain.
- 2 PRINCIPAL CHANGES.** This change adds guidance and information on Graphical Forecast for Aviation (GFA), Localized Aviation Model Output Statistics (MOS) Program (LAMP), Terminal Convective Forecast (TCF), Polar Orbiting Environment Satellites (POES), Low-Level Wind Shear Alerting System (LLWAS), and Flight Path Tool graphics. It also updates guidance and information on Direct User Access Terminal Service (DUATS II), Telephone Information Briefing Service (TIBS), and Terminal Doppler Weather Radar (TDWR). This change removes information regarding Area Forecasts (FA) for the Continental United States (CONUS).

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John S. Duncan
Executive Director, Flight Standards Service



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The Federal Aviation Administration (FAA) publishes Advisory Circular (AC) 00-45, Aviation Weather Services. This publication supplements its companion manual, AC [00-6](#), Aviation Weather, which documents weather theory and its application to aviation.

Revision H of AC 00-45 (AC 00-45H) provides an improved organization of aviation weather information. The document is organized using the FAA's three distinct types of weather information: observations, analyses, and forecasts. Within this construct, AC 00-45H explains U.S. aviation weather products and services. It provides details when necessary for interpretation and to aid usage.

In the past decade, access to aviation weather products has greatly improved with the increase of flight planning services and weather websites. The experience of listening to a weather briefing over a phone while trying to write down pertinent weather information becomes less tolerable when the reports are easily obtainable on a home computer, tablet computer, or even a smart phone. To see weather along your route using a graphic of plotted weather reports combined with radar and satellite is preferable to trying to mentally visualize a picture from verbalized reports.

Although most of the traditional weather products, which rolled off the teletype and facsimile machines decades ago, are still available, some are being phased out by the National Weather Service (NWS) in favor of new, Web-based weather information.

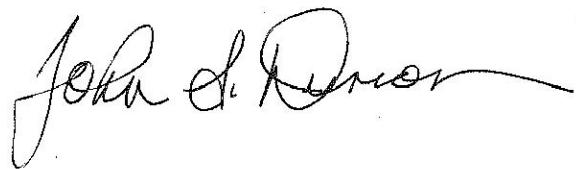
It is the objective of AC 00-45H to bring the pilot and operator up to date on new and evolving weather information and capabilities to help plan a safe and efficient flight, while also describing the traditional weather products that remain.

Online aviation weather information is easy to access, and so are references explaining the information. That is why AC 00-45H contains fewer illustrations and less detail for products available online. This AC will give an overview and direct the pilot where to find more weather information and explanatory details. Product examples and explanations are taken primarily from the National Oceanic and Atmospheric Administration (NOAA) NWS Aviation Weather Center's (AWC) website (<http://www.aviationweather.gov>) and other pertinent NWS websites. Due to the fluid nature of Web addresses, this AC minimizes the inclusion of website links. Instead, it provides the name of the website which can be easily found using Internet search tools.

An online version of this document (including digital images) can be found at <http://rgl.faa.gov/>.

AC 00-45H cancels AC 00-45G, Change 2, published October 2014.

If you have suggestions for improving this AC, you may use the Advisory Circular Feedback Form at the end of this AC.

A handwritten signature in black ink, appearing to read "John S. Duncan".

John S. Duncan
Director, Flight Standards Service

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CHAPTER 1. AVIATION WEATHER SERVICE PROGRAM

The aviation weather service program is a joint effort of the National Weather Service (NWS), the Federal Aviation Administration (FAA), the Department of Defense (DOD), and other aviation-oriented groups and individuals. This chapter discusses the civilian agencies of the U.S. Government and their observation, communication, and forecast services to the aviation community.

1.1 National Oceanic and Atmospheric Administration (NOAA).

NOAA is an agency of the Department of Commerce (DOC). NOAA conducts research and gathers data about the global oceans, atmosphere, space, and sun, and applies this knowledge to science and service, which touches the lives of all Americans. Among its six major divisions are the National Environmental Satellite, Data, and Information Service (NESDIS) and the NWS.

1.1.1 National Environmental Satellite, Data, and Information Service (NESDIS).

The NESDIS manages the U.S. civil operational remote-sensing satellite systems, as well as other global information for meteorology, oceanography, solid-earth geophysics, and solar-terrestrial sciences. NESDIS provides this data to NWS meteorologists and a wide range of other users for operational weather forecasting.

1.1.1.1 Satellite Analysis Branch (SAB).

NESDIS' SAB serves as the operational focal point for real-time imagery products and multi-disciplinary environmental analyses. The SAB's primary mission is to support disaster mitigation and warning services for U.S. Federal agencies and the international community. Routine environmental analyses are provided to forecasters and other environmental users, and are used in the numerical models of the NWS. The SAB schedules and distributes real-time satellite imagery products from global geostationary and polar orbiting satellites to environmental users. The SAB coordinates the satellite and other information for the NOAA Volcanic Hazards Alert Program, under an agreement with the FAA, and works with the NWS as part of the Washington, D.C. Volcanic Ash Advisory Center (VAAC). The Washington, D.C. VAAC Area of Responsibility (AOR) includes the continental United States (CONUS), the Gulf of Mexico, the Oakland Flight Information Region (FIR), and the New York FIR.

1.1.2 National Weather Service (NWS).

NWS provides weather data, forecasts, and warnings for the United States, its territories, adjacent waters, and ocean areas for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure that can be used by other government agencies, the private sector, the public, and the global community. The following is a description of NWS offices associated with aviation weather:

1.1.2.1 National Centers for Environmental Prediction (NCEP).

NCEP is where virtually all global meteorological data is collected and

analyzed. NCEP then provides a wide variety of national and international weather guidance products to NWS field offices, government agencies, emergency managers, private sector meteorologists, and meteorological organizations and societies throughout the world. NCEP is a critical resource in national and global weather prediction and is the starting point for nearly all weather forecasts in the United States.

NCEP is comprised of nine distinct centers and the Office of the Director. Each center has its own specific mission. The following NCEP centers provide aviation weather products and services:

1.1.2.1.1 NCEP Central Operations (NCO).

The NCO in College Park, MD, sustains and executes the operational suite of the numerical analysis and forecast models and prepares NCEP products for dissemination. It also links all nine of the national centers together via computer and communications-related services.

1.1.2.1.2 Aviation Weather Center (AWC).

The AWC in Kansas City, MO, issues a suite of aviation weather forecasts in support of the National Aerospace System (NAS) including: Airman's Meteorological Information (AIRMET), significant meteorological information (SIGMET), Convective SIGMETs, Area Forecasts (FA), Significant Weather Prognostic Charts (low, middle, and high), National Convective Weather Forecast (NCWF), Current Icing Product (CIP), Forecast Icing Product (FIP), Graphical Turbulence Guidance (GTG), and Ceiling and Visibility Analysis (CVA) product. The AWC is a Meteorological Watch Office (MWO) for the International Civil Aviation Organization (ICAO).

The website for the AWC is <http://www.aviationweather.gov>. The AWC's website provides the aviation community with textual, digital, and graphical forecasts, analyses, and observations of aviation-related weather variables. Additionally, the website provides information for international flights through the World Area Forecast System (WAFS) Internet File Service (WIFS).

The AWC's website also provides a flight path tool that allows the user to view data along a specific route of flight. Using the flight path tool, a user can view icing, turbulence, temperature, winds, humidity, AIRMETs/SIGMETs, Aviation Routine Weather Report (METAR)/Special Weather Report (SPECI), Terminal Aerodrome Forecast (TAF), etc. both horizontally and vertically. The flight path tool also allows many overlay options, including Air Route Traffic Control Center (ARTCC) boundaries, counties, highways, and rivers. Product animation is also possible on the AWC JavaScript image.

1.1.2.1.3 Weather Prediction Center (WPC).

The WPC in College Park, MD, provides analysis and forecast products specializing in multi-day, quantitative precipitation forecasts and weather

forecast guidance, weather model diagnostics discussions, and surface pressure and frontal analyses.

1.1.2.1.4 Storm Prediction Center (SPC).

The SPC in Norman, OK, provides tornado and severe weather watches for the CONUS along with a suite of hazardous weather forecasts.

1.1.2.1.5 National Hurricane Center (NHC).

The NHC in Miami, FL, provides official NWS forecasts of the movement and strength of tropical weather systems and issues the appropriate watches and warnings for the CONUS and surrounding areas. It also issues a suite of marine products covering the tropical Atlantic, Caribbean, Gulf of Mexico, and tropical eastern Pacific. In support of ICAO/World Meteorological Organization (WMO), the NHC is also referred to as the Tropical Cyclone Advisory Center (TCAC).

1.1.2.1.6 Space Weather Prediction Center (SWPC).

The SWPC in Boulder, CO, provides space weather information (e.g., current activity and forecasts) to a wide variety of users. SWPC issues alerts, watches, and warnings for space weather events affecting, or expected to affect, Earth's environment.

1.1.2.2 Alaska Aviation Weather Unit (AAWU).

The AAWU, located in Anchorage, AK, is an MWO for ICAO. The AAWU is responsible for the entire Anchorage FIR. They issue a suite of aviation weather products for the airspace over Alaska and adjacent coastal waters, including: AIRMETs, SIGMETs, FAs, Graphic FAs, and Significant Weather Prognostic Charts.

The AAWU is also designated as the Anchorage VAAC. The VAAC AOR includes the Anchorage FIR and Far Eastern Russia and is responsible for the issuance of Volcanic Ash Advisories (VAA).

1.1.2.3 Center Weather Service Unit (CWSU).

CWSUs are units of NWS meteorologists under contract with the FAA that are stationed at, and support, the FAA's ARTCC.

CWSUs provide timely weather consultation, forecasts, and advice to managers within ARTCCs and to other supported FAA facilities. This information is based on monitoring, analysis, and interpretation of real-time weather data at the ARTCC through the use of all available data sources including radar, satellite, Pilot Weather Reports (PIREP), and various NWS products, such as TAFs and inflight advisories.

Special emphasis is given to those weather conditions that are hazardous to aviation or which could impede the flow of air traffic within the NAS. CWSU meteorologists issue the following products in support of their respective

ARTCC: Center Weather Advisories (CWA) and Meteorological Impact Statements (MIS).

1.1.2.4 Weather Forecast Office (WFO).

An NWS WFO is a multi-purpose, local weather forecast center that produces, among its suite of services, aviation-related products. In support of aviation, WFOs issue TAFs, with some offices issuing Airport Weather Warnings and Soaring Forecasts.

The Honolulu WFO is unique among NWS WFOs in that it provides multiple services beyond the typical WFO. WFO Honolulu is also designated as an MWO for ICAO. As a result of this unique designation, WFO Honolulu is the only WFO to issue the following text products: AIRMETs, SIGMETs, and Route Forecasts (ROFOR). WFO Honolulu is co-located with the Central Pacific Hurricane Center (CPHC). CPHC provides official NWS forecast of the movement and strength of tropical weather systems and issues the appropriate watches and warnings for the central Pacific, including the state of Hawaii. WFO Honolulu also issues a suite of marine products covering a large portion of the Pacific Ocean. In support of ICAO/WMO, the NHC is also referred to as the TCAC.

1.2 Federal Aviation Administration (FAA).

The FAA, a part of the Department of Transportation (DOT), provides a safe, secure, and efficient airspace system that contributes to national security and the promotion of U.S. aerospace safety. As the leading authority in the international aerospace community, the FAA is responsive to the dynamic nature of user needs, economic conditions, and environmental concerns.

The FAA provides a wide range of services to the aviation community. The following is a description of those FAA facilities that are involved with aviation weather and pilot services:

1.2.1 Air Traffic Control Systems Command Center (ATCSCC).

The ATCSCC is located in Vint Hill, VA. The ATCSCC has the mission of balancing air traffic demand with system capacity. This ensures maximum safety and efficiency for the NAS, while minimizing delays. The ATCSCC utilizes the Traffic Management System (TMS), aircraft situation display, monitor alert, the follow on functions, and direct contact with ARTCC, and Terminal Radar Approach Control (TRACON) facility Traffic Management Units (TMU) to manage flow on a national level.

Because weather is the most common reason for air traffic delays and re-routings, NWS meteorologists support the ATCSCC. These meteorologists, called National Aviation Meteorologists (NAM), coordinate NWS operations in support of traffic flow management within the NAS.

1.2.2 Air Route Traffic Control Center (ARTCC).

An ARTCC is a facility established to provide air traffic control (ATC) service to aircraft

operating on instrument flight rules (IFR) flight plans within controlled airspace, principally during the en route phase of flight. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to visual flight rules (VFR) aircraft.

En route controllers become familiar with pertinent weather information and stay aware of current weather information needed to perform ATC duties. En route controllers advise pilots of hazardous weather that may impact operations within 150 nautical miles (NM) of the controller's assigned sector(s), and may solicit PIREPs from pilots.

1.2.3 Airport Traffic Control Tower (ATCT) and Terminal Radar Approach Control (TRACON).

An ATCT is a terminal facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport or on the movement area.

Terminal controllers become familiar with pertinent weather information and stay aware of current weather information needed to perform ATC duties. Terminal controllers advise pilots of hazardous weather that may impact operations within 150 NM of the controller's assigned sector or area of jurisdiction and may solicit PIREPs from pilots. ATCTs and TRACONs may opt to broadcast hazardous weather information alerts only when any part of the area described is within 50 NM of the airspace under the ATCT's jurisdiction.

The tower controllers are also properly certified and act as official weather observers, as required.

An automated terminal information service (ATIS) is a continuous broadcast of recorded information in selected terminal areas. Its purpose is to improve controller effectiveness and to relieve frequency congestion by automating the repetitive transmission of non-controlled airport/terminal area and meteorological information.

1.2.4 Flight Service Station (FSS).

FSSs provide pilot weather briefings, en route weather, receive and process IFR and VFR flight plans, solicit and disseminate pilot reports and urgent pilot reports, relay ATC clearances, and issue Notices to Airmen (NOTAM). They also provide assistance to lost aircraft and aircraft in emergency situations, as well as conduct VFR search and rescue services.

1.3 Dissemination of Aviation Weather Products.

The ultimate users of aviation weather services are pilots, aircraft dispatchers, and air traffic management (ATM) and air traffic controllers. Maintenance personnel may use the service to keep informed of weather that could cause possible damage to unprotected aircraft.

Pilots contribute to and use aviation weather services. PIREPs help other pilots, dispatchers, briefers, and forecasters as an observation of current conditions.

In the interest of safety and in compliance with Title 14 of the Code of Federal Regulations (14 CFR), all pilots should get a complete weather briefing before each flight. The pilot is responsible for ensuring he or she has all information needed to make a safe flight.

1.3.1 Weather Briefings.

Prior to every flight, pilots should gather all information vital to the nature of the flight. This includes a weather briefing obtained by the pilot from an approved weather source, via the Internet, and/or from an FSS specialist.

The FSS' purpose is to serve the aviation community. Pilots should not hesitate to ask questions and discuss factors they do not fully understand. The briefing should be considered complete only when the pilot has a clear picture of what weather to expect. Pilots should also make a final weather check immediately before departure, when possible.

To provide an appropriate weather briefing, specialists need to know which of the three types of briefings is needed—standard, abbreviated, or outlook. Other necessary information includes whether the flight will be conducted with VFR or IFR, aircraft identification and type, departure point, estimated time of departure, flight altitude, route of flight, destination, and estimated time en route. If the briefing updates previously received information, the time of the last briefing is also important. This allows the briefer to provide only pertinent data.

The briefer enters this information into the FAA's flight plan system. The briefer also notes the type of weather briefing provided. If necessary, the information can be referenced later to file or amend a flight plan. It is also used when an aircraft is overdue or is reported missing. Internet data is time-stamped and archived for 15 days. Voice recordings are retained for 45 days.

1.3.1.1 **Standard Briefing.**

A standard briefing provides a complete weather picture and is the most detailed of all briefings. This type of briefing should be obtained prior to the departure of any flight and should be used during flight planning. A standard briefing provides the following information (if applicable to the route of flight) in sequential order:

- **Adverse Conditions.** This includes information about adverse conditions that may influence a decision to cancel or alter the route of flight. Adverse conditions include significant weather (e.g., thunderstorms, aircraft icing, turbulence, windshear, mountain obscuration, and areas of current and forecasted IFR conditions) and other important items, such as airport/runway closings, air traffic delays, and temporary flight restrictions (TFR).
- **VFR Flight NOT RECOMMENDED (VNR).** If the weather for the route of flight is below VFR minimums, or if it is doubtful the flight can be made under VFR conditions due to the forecasted weather, the briefer

may state that VFR is not recommended. The pilot can then decide whether or not to continue the flight under VFR, but this advisory should be weighed carefully. This advisory is not provided via the Internet.

- **Synopsis.** The synopsis is an overview of the larger weather picture. Fronts and major weather systems along or near the route of flight and weather that may affect the flight are provided.
- **Current Conditions.** This portion of the briefing contains the current surface weather observations, PIREPs, and satellite and radar data along the route of flight. If the departure time is more than 2 hours away, current conditions will not be included in the briefing.
- **En Route Forecast.** The en route forecast is a summary of the weather forecast for the proposed route of flight.
- **Destination Forecast.** The destination forecast is a summary of the expected weather for the destination airport at the estimated time of arrival (ETA).
- **Winds and Temperatures Aloft.** Winds and temperatures aloft is a forecast of the winds at specific altitudes along the route of flight. However, the temperature information is provided only on request.
- **NOTAMs.** This portion supplies NOTAM information that has not been published in the NOTAM publication, but is pertinent to the route of flight. Published NOTAM information is provided during the briefing only on request.
- **Prohibited Areas and Special Flight Rules Areas (SFRA).** Information on Prohibited Areas P-40 and P-56, and the SFRA for Washington, D.C. are given when appropriate to the route of flight.
- **ATC Delays.** This is an advisory of any known ATC delays that may affect the flight.
- **Other Information.** Any additional information requested is also provided at this time.

1.3.1.2

Abbreviated Briefing.

An abbreviated briefing is a shortened version of the standard briefing. It should be requested when a departure has been delayed or when specific weather information is needed to update a previous standard briefing. When this is the case, the weather specialist needs to know the time and source of the previous briefing so he or she does not inadvertently omit the necessary weather information.

1.3.1.3

Outlook Briefing.

An outlook briefing should be requested when a planned departure is 6 or more hours away. It provides initial forecast information that is limited in scope due to the timeframe of the planned flight. This type of briefing is a

good source of flight planning information that can influence decisions regarding route of flight, altitude, and ultimately the “go, no-go” decision. A follow-up standard briefing prior to departure is advisable, since an outlook briefing generally only contains information based on weather trends and existing weather in geographical areas at or near the departure airport.

1.3.2 Pilot Briefing via the Internet.

1.3.2.1 Direct User Access Terminal Service (DUATS II).

DUATS II, an approved FAA preflight briefing source, allows any pilot to access NWS weather information and to file a flight plan online. Airmen can access DUATS II at <http://www.duats.com>, <http://www.duatsii.com>, or <http://www.1800wxbrief.com>. The current vendors of DUATS II service and the associated phone numbers are listed in the [Aeronautical Information Manual \(AIM\)](#), Chapter 7, Safety of Flight.

1.3.2.2 Aviation Digital Data Service (ADDS).

ADDS is a joint effort of the FAA, NOAA, and the National Center for Atmospheric Research (NCAR). ADDS provides text, digital, and graphical forecasts, analyses, and observations of aviation-related weather variables.

1.3.3 Telephone Information Briefing Service (TIBS).

TIBS is a service prepared and disseminated by Flight Service. It provides continuous telephone recordings of meteorological and aeronautical information. Specifically, TIBS provides area and route briefings, as well as airspace procedures and special announcements, if applicable. It is designed to be a preliminary briefing tool and is not intended to replace a standard briefing. The TIBS service is available 24 hours a day and is updated when conditions change. The order and content of the TIBS recording is as follows:

1. Introduction. Includes the preparation time and the route and/or the area of coverage. The service area may be configured to meet the individual facility’s needs.
2. Weather Advisories. A summary of in-flight advisories and any other available information that may adversely affect flight in the route/area.

TIBS services may be reduced during the hours of 1800 to 0600, local time only. Resumption of full broadcast service is adjusted seasonally to coincide with daylight hours. During the period of reduced broadcast, a recorded statement may indicate when the broadcast will be resumed and to contact Flight Service via the Internet or by telephone for weather briefing and other services.

For those pilots already in flight and needing weather information and assistance, the following services are provided by FSSs.

1.3.4 Hazardous In-flight Weather Advisory Service (HIWAS).

HIWAS is a national program for broadcasting hazardous weather information

continuously over selected Navigational Aids (NAVAID). The broadcasts include advisories such as AIRMETs, SIGMETs, Convective SIGMETs, and urgent PIREPs. These broadcasts are only a summary of the information, and pilots should contact an FSS for detailed information.

The HIWAS broadcast area is defined as the area within 150 NM of HIWAS outlets.

HIWAS broadcasts are not interrupted or delayed, except for emergency situations, when an aircraft requires immediate attention, or for reasonable use of the voice override capability on specific HIWAS outlets in order to use the limited remote communications outlet (RCO) to maintain en route communications. The service is provided 24 hours a day. An announcement is made for no hazardous weather advisories.

Hazardous weather information is recorded if it is occurring within the HIWAS broadcast area. The broadcast includes the following elements:

- A statement of introduction including the appropriate area(s) and a recording time.
- A summary of Convective SIGMETs, SIGMETs, AIRMETs, Urgent PIREPs, Aviation Watch Notification Messages (SAW), Center Weather Advisories, and any other weather, such as isolated thunderstorms that are rapidly developing and increasing in intensity, or low ceilings and visibilities that are becoming widespread, which are considered significant and are not included in a current hazardous weather advisory.
- A request for PIREPs, if applicable.
- A recommendation to contact FSS for additional details concerning hazardous weather.

Once the HIWAS broadcast is updated, an announcement will be made once on all communications/NAVAID frequencies, except emergency and navigational frequencies already dedicated to continuous broadcast services. In the event a HIWAS broadcast area is out of service, an announcement is made on all communications/NAVAID frequencies, except on emergency and navigational frequencies already dedicated to continuous broadcast services.

1.3.5 Flight Information Service-Broadcast (FIS-B).

FIS-B is a ground-based broadcast service provided through the FAA's Automatic Dependent Surveillance-Broadcast (ADS-B) Services Universal Access Transmitter (UAT) network. The service provides users with a 978 megahertz (MHz)F data link capability when operating within range and line of sight of a transmitting ground station. FIS-B enables users of properly-equipped aircraft to receive and display a suite of broadcast weather and aeronautical information products.

The following list represents the initial suite of textual and graphical products available through FIS-B and provided free-of-charge. This advisory circular (AC) and AC [00-63](#), Use of Cockpit Displays of Digital Weather and Aeronautical Information, contain detailed information concerning FIS-B meteorological products. AIM Chapter 3,

Airspace; Chapter 4, Air Traffic Control; and Chapter 5, Air Traffic Procedures contain information on Special Use Airspace (SUA), TFR, and NOTAM products.

- Text: METAR and SPECI;
- Text: PIREP;
- Text: Winds and Temperatures Aloft;
- Text: TAF;
- Text: NOTAM Distant and Flight Data Center;
- Text/Graphic: AIRMET;
- Text/Graphic: SIGMET;
- Text/Graphic: Convective SIGMET;
- Text/Graphic: SUA;
- Text/Graphic: TFR NOTAM; and
- Graphic: Next generation weather radar (NEXRAD) Composite Reflectivity Products (Regional and National).

Users of FIS-B should familiarize themselves with the operational characteristics and limitations of the system, including: system architecture, service environment, product lifecycles, modes of operation, and indications of system failure.

Update intervals are defined as the rate at which the product data is available from the source for transmission. Transmission intervals are defined as the amount of time within which a new or updated product transmission must be completed and/or the rate or repetition interval at which the product is rebroadcast. Table [1-1](#), FIS-B Over UAT Product Update and Transmission Intervals, provides update and transmission intervals for each product.

Where applicable, FIS-B products include a look-ahead range expressed in nautical miles for three service domains: Airport Surface, Terminal Airspace, and En route/Gulf of Mexico. Table [1-2](#), Product Parameters for Low/Medium/High Altitude Tier Radios, provides service domain availability and look-ahead ranging for each FIS-B product.

Prior to using this capability, users should familiarize themselves with the operation of FIS-B avionics by referencing the applicable user's guides. Users should obtain guidance concerning the interpretation of information displayed from the appropriate avionics manufacturer.

Users should report FIS-B malfunctions not attributed to aircraft system failures or covered by active NOTAM via the ADS-B/Traffic Information Services-Broadcast (TIS-B)/FIS-B Problem Report on the following website:

<http://www.faa.gov/exit/?pageName=this%20form&pgLnk=http%3A%2F%2Fgoo%2Egl%2Fforms%2FisWDKYpYYv>. Users may also report malfunctions by submitting

FAA Form 8740-5, Safety Improvement Report, via mail, fax, or email to your local Flight District Standards Office (FSDO) Safety Program Manager (SPM).

Table 1-1. FIS-B Over UAT Product Update and Transmission Intervals

Product	FIS-B Over UAT Service Update Interval ¹	FIS-B Service Transmission Interval ²
AIRMET	As available	5 minutes
Convective SIGMET	As available	5 minutes
METARS/SPECIs	1 minute/as available	5 minutes
NEXRAD Composite Reflectivity (CONUS)	15 minutes	15 minutes
NEXRAD Composite Reflectivity (Regional)	5 minutes	2.5 minutes
NOTAMs-D/FDC/TFR	As available	10 minutes
PIREP	As available	10 minutes
SIGMET	As available	5 minutes
Special Use Airspace Status	As available	10 minutes
TAF/AMEND	8 hours/as available	10 minutes
Temperature Aloft	12 hours	10 minutes
Winds Aloft	12 hours	10 minutes

1. *The Update Interval is the rate at which the product data is available from the source.*

2. *The Transmission Interval is the amount of time within which a new or updated product transmission must be completed and the rate or repetition interval at which the product is rebroadcast.*

Table 1-2. Product Parameters for Low/Medium/High Altitude Tier Radios

Product	Surface Radios	Low Altitude Tier	Medium Altitude Tier	High Altitude Tier
CONUS NEXRAD	N/A	CONUS NEXRAD not provided	CONUS NEXRAD imagery	CONUS NEXRAD imagery
Winds & Temps Aloft	500 NM look-ahead range	500 NM look-ahead range	750 NM look-ahead range	1,000 NM look-ahead range
METAR	100 NM look-ahead range	250 NM look-ahead range	375 NM look-ahead range	CONUS: CONUS Class B & C airport METARs and 500 NM look-ahead range Outside of CONUS: 500 NM look-ahead range
TAF	100 NM look-ahead range	250 NM look-ahead range	375 NM look-ahead range	CONUS: CONUS Class B & C airport TAFs and 500 NM look-ahead range Outside of CONUS: 500 NM look-ahead range
AIRMET, SIGMET, PIREP and Special Use Airspace/SAA	100 NM look-ahead range. PIREP/SUA is N/A	250 NM look-ahead Range	375 NM look-ahead range	500 NM look-ahead range
Regional NEXRAD	150 NM look-ahead range	150 NM look-ahead range	200 NM look-ahead range	250 NM look-ahead range
NOTAMs-D/FDC/TFR	100 NM look-ahead range	100 NM look-ahead range	100 NM look-ahead range	100 NM look-ahead range

Users should obtain guidance concerning the content, format, and symbology of individual FIS-B products from the manufacturer of the avionics equipment used to receive and display them.

1.3.6 Operational Use of FIS-B Products.

FIS-B information may be used by the pilot for the safe conduct of flight and aircraft movement. However, FIS-B does not replace a preflight briefing from an FSS via the phone, a Lockheed Martin Flight Services or DUATS II via the Internet, or dispatch/System Operations Control (SOC) (if applicable). A pilot should be particularly alert and understand the limitations and quality assurance issues associated with individual products. This includes graphical representation of NEXRAD imagery and NOTAMs/TFR.

CHAPTER 2. AVIATION WEATHER PRODUCT POLICY

The demand for new and improved aviation weather products continues to grow, and with new products introduced to meet the demand, some confusion has resulted in the aviation community regarding the relationship between regulatory requirements and new weather products.

This chapter will clarify that relationship by providing:

- Policy guidance for using aviation weather products,
- Descriptions of the types of aviation weather information, and
- Categorization of the sources of aviation weather information.

2.1 Use of Aviation Weather Products.

This AC describes the weather products distributed by the NWS. Pilots and operators using the Internet to access weather from a third-party vendor should request and/or review an appropriate description of services and provider disclosure. This should include, but is not limited to, the type of weather product (i.e., current weather or forecasted weather), the currency of the product (i.e., product issue and valid times) and the relevance of the product. Pilots and operators should be cautious when using unfamiliar weather products. When in doubt, consult with a Flight Service Specialist. Note that the FAA does not approve or qualify Internet providers of aviation weather service.

The development of new weather products, coupled with the termination of some legacy textual and graphical products, may create confusion between regulatory requirements and the new products. All flight-related aviation weather decisions must be based on all available pertinent weather products. As every flight is unique and the weather conditions for that flight vary hour-by-hour, day-to-day, multiple weather products may be necessary to meet aviation weather regulatory requirements. Many new weather products have a precautionary use statement displayed that details the proper use or application of the specific product.

2.2 Types of Aviation Weather Information.

The FAA has identified the following three distinct types of weather information that may be needed to conduct aircraft operations: observations, analyses, and forecasts.

2.2.1 Observations.

Observations are raw weather data collected by sensor(s). The observations can either be in situ (i.e., surface or airborne) or remote (i.e., weather radar, satellite, profiler, and lightning).

2.2.2 Analyses.

Analyses of weather information are an enhanced depiction and/or interpretation of observed weather data. Examples of these types of analyses can be seen in paragraph [4.1.1](#). Another type of analysis is the representation of an atmospheric variable (e.g., temperature, ceiling height, and visibility) derived from a finite set of irregularly

distributed observations onto a regular grid. See the figures in paragraph [4.2](#) for examples.

2.2.3 Forecasts.

Forecasts are the predictions of the development and/or movement of weather phenomena based on meteorological observations and various mathematical models.

In-flight weather advisories, including Terminal Aerodrome Forecast (TAF), significant meteorological information (SIGMET), Convective SIGMETs, Airman's Meteorological Information (AIRMET), Center Weather Advisories (CWA), and Meteorological Impact Statements (MIS) are considered forecast weather information products.

2.3 Categorizing Aviation Weather Sources.

The regulations pertaining to aviation weather reflect that, historically, the Federal Government was the only source of aviation weather information. That is, the FAA and NWS, or their predecessor organizations, were solely responsible for the collection and dissemination of weather data, including forecasts. Thus, the term “approved source(s)” referred exclusively to the Federal Government. The Federal Government is no longer the only source of weather information, due to the growing sophistication of aviation operations and scientific and technological advances.

Since all three types of weather information defined in paragraph [2.2](#) are not available from all sources of aviation weather information, the FAA has categorized the sources as follows: Federal Government and commercial weather information providers.

2.3.1 Federal Government.

The FAA and NWS collect weather observations. The NWS analyzes the observations and produces forecasts, including in-flight aviation weather advisories (e.g., SIGMETs). The FAA and NWS disseminate meteorological observations, analyses, and forecast products through a variety of systems. The Federal Government is the only approval authority for sources of weather observations (e.g., contract towers and airport operators).

Commercial weather information providers contracted by the FAA to provide weather observations (e.g., contract towers, Lockheed Martin, Direct User Access Terminal System (DUATS II)) are included in the Federal Government category of approved sources by virtue of maintaining required technical and quality assurance standards under FAA and NWS oversight.

2.4 Commercial Weather Information Providers.

Commercial weather information providers are a major source of weather products for the aviation community. In general, they produce proprietary weather products based on NWS information with formatting and layout modifications, but no material changes to the weather information itself. This is also referred to as “repackaging.”

In other cases, commercial providers produce forecasts, analyses, and other proprietary weather products which may substantially differ from the information contained in NWS-produced products. Operators who desire to use products prepared by a commercial weather provider, as opposed to using products that are simply repackaged, may require

FAA approval. This approval is granted under the provisions in Operations Specification (OpSpec) paragraph A010. Please provide which services and products you are contemplating using, to include the appropriate description of the service. This should include, but is not limited to:

- The type of weather product (e.g., current weather or forecast weather);
- The currency of the product (i.e., product issue and valid times); and
- The relevance of the product.

Pilots and operators should be cautious when using unfamiliar products, or products not supported by FAA/NWS technical specifications.

CHAPTER 3. OBSERVATIONS

The first of three distinct types of weather (meteorological) information is observations. Observations are weather data collected by one or more sensors, and are the basic information upon which forecasts and advisories are made in support of a wide range of weather-sensitive activities within the public and private sectors, including aviation. Chapter 3 describes and discusses surface observations, aircraft observations, radar observations, and satellite observations (e.g., imagery).

3.1 Aviation Routine Weather Reports (METAR) and Special Weather Reports (SPECI).

Surface weather observations are fundamental to all meteorological services. Aviators typically view surface observations through METARs and SPECIs. Although the METAR/SPECI code is used worldwide, there are some code differences among countries. Each country is allowed to make modifications to the code for use in their particular country, as long as they notify the International Civil Aviation Organization (ICAO). These paragraphs will focus on the METAR/SPECI code as used in the United States.

3.1.1 Aviation Routine Weather Report (METAR).

The METAR report has been adopted by the United States to provide surface observations in support of aviation for the terminal. A METAR report includes the airport identifier, time of observation, wind, visibility, Runway Visual Range (RVR), present weather phenomena, sky conditions, temperature, dewpoint, and altimeter setting. Excluding the airport identifier and the time of observation, this information is collectively referred to as the “body” of the report. Coded and/or plain language information elaborating on data in the body may be appended to the end of the METAR as “remarks.” The contents of the remarks section varies with the type of reporting station. At some designated stations, the METAR may be abridged to include only a few of the mentioned elements.

3.1.2 Special Weather Report (SPECI).

A SPECI is an unscheduled report taken when any of the criteria given in Table [3-1](#), SPECI Criteria, are observed during the period between hourly reports. SPECIs contain all data elements found in a METAR. All SPECIs are issued as soon as possible when relevant criteria are observed.

Whenever SPECI criteria are met at the time of the routine METAR, a METAR is issued.

Table 3-1. SPECI Criteria

1	Wind Shift	Wind direction changes by 45 degrees or more, in less than 15 minutes and the wind speed is 10 knots or more throughout the wind shift.
2	Visibility	Surface visibility, as reported in the body of the report, decreases to less than, or if below, increases to equal to or exceeding: <ul style="list-style-type: none"> • miles • miles • 1 mile • The lowest standard instrument approach procedure minimum as published in the National Ocean Service (NOS) U.S. Instrument Procedures. If none published, use $\frac{1}{2}$ mile
3	Runway Visual Range (RVR)	The highest value from the designated RVR runway decreases to less than, or if below, increases to equal to or exceeding 2,400 feet during the preceding 10 minutes. U.S. military stations may not report a SPECI based on RVR.
4	Tornado, Funnel Cloud, or Waterspout	<ul style="list-style-type: none"> • Is observed • Disappears from sight, or ends
5	Thunderstorm	<ul style="list-style-type: none"> • Begins (a SPECI is not required to report the beginning of a new thunderstorm if one is currently reported) • Ends
6	Precipitation	<ul style="list-style-type: none"> • Hail begins or ends • Freezing precipitation begins, ends or changes intensity • Ice pellets begin, end or change intensity
7	Squalls	When a squall occurs.
8	Ceiling	The ceiling (rounded to reportable values) forms or dissipates below, decreases to less than, or if below, increases to equal to or exceeding: <ul style="list-style-type: none"> • 3,000 feet • 1,500 feet • 1,000 feet • 500 feet • <i>The lowest standard instrument approach procedure minimum as published in the National Ocean Service (NOS) U.S. Instrument Procedures. If none published, use 200 feet.</i>
9	Sky Condition	A layer of clouds or obscurations aloft is present below 1,000 feet and no layer aloft was reported below 1,000 feet in the preceding METAR or SPECI.
10	Volcanic Eruption	When an eruption is first noted.
11	Aircraft Mishap	Upon notification of an aircraft mishap, unless there has been an intervening observation.
12	Miscellaneous	Any other meteorological situation designated by the responsible agency of which, in the opinion of the observer, is critical.

The information in Table 3-1 can be found in the [Federal Meteorological Handbook No. 1 \(FMH-1\)](#), Section 2.5.2, Aviation Selected Special Weather Report (SPECI).

3.1.3 General Types of Observations.

There are three general types of surface observations:

- **Manual Observation.** Weather observations done by a human weather observer who is certified by the NWS or the FAA.
- **Automated Observation.** Automated observations are derived from instruments and algorithms without human input or oversight. In the United States, there are two main kinds of automated observing systems: the automated surface observing system (ASOS) and the Automated Weather Observing System (AWOS). Detailed information on ASOS and AWOS can be found in the [Aeronautical Information Manual \(AIM\)](#), Chapter 7, Safety of Flight, Section 1, Meteorology. Automated METARs and SPECIs contain AUTO in the report (see paragraph [3.1.5.4](#)).
- **Augmented Observation.** At select airports in the United States, the automated observing system will have input and oversight by human weather observers or tower controllers certified in weather observing. These are referred to as augmented stations. Human observers report weather elements that are beyond the capabilities of the automated system and/or are deemed operationally significant. The weather elements observed and reported by the human observer vary, depending on the selected airport. AUTO is not used in augmented reports.

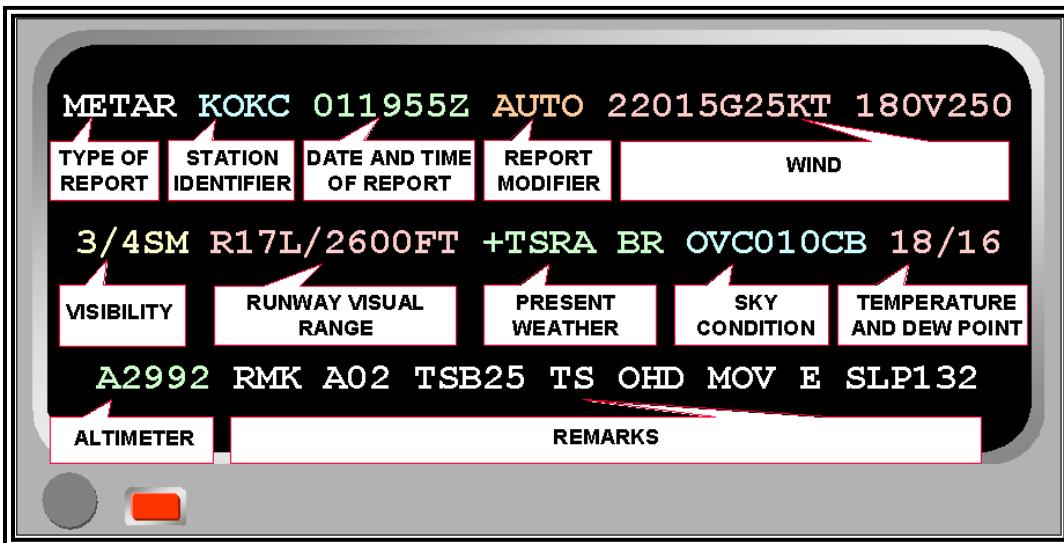
Whereas manual stations were most common prior to the mid-1990s in the United States, the vast majority of today's METARs and SPECIs are from fully-automated stations.

3.1.4 Recency of Observed Elements at Automated Stations.

For those elements that the human observer evaluates using spatial averaging techniques (e.g., sky cover and visibility), the automated station substitutes time averaging of sensor data. Therefore, in an automated observation, sky condition is an evaluation of sensor data gathered during the 30-minute period ending at the actual time of the observation. All other elements are based on sensor data that is within 10 minutes or less of the actual time of the observation.

3.1.5 Format.

Figure 3-1. METAR/SPECI Coding Format



A U.S. METAR/SPECI has two major sections: the body (consisting of a maximum of 11 groups) and the remarks (consisting of 2 categories). When an element does not occur, or cannot be observed, the corresponding group is omitted from that particular report.

3.1.5.1 Type of Report.

METAR KOKC 011955Z AUTO 22015G25KT 180V250 3/4SM
R17L/2600FT +TSRA BR OVC010CB 18/16 A2992 RMK AO2
TSB25 TS OHD MOV E SLP132

The type of report, **METAR** or **SPECI**, precedes the body of all reports, but may not be shown or displayed on all aviation weather websites.

3.1.5.2 Station Identifier.

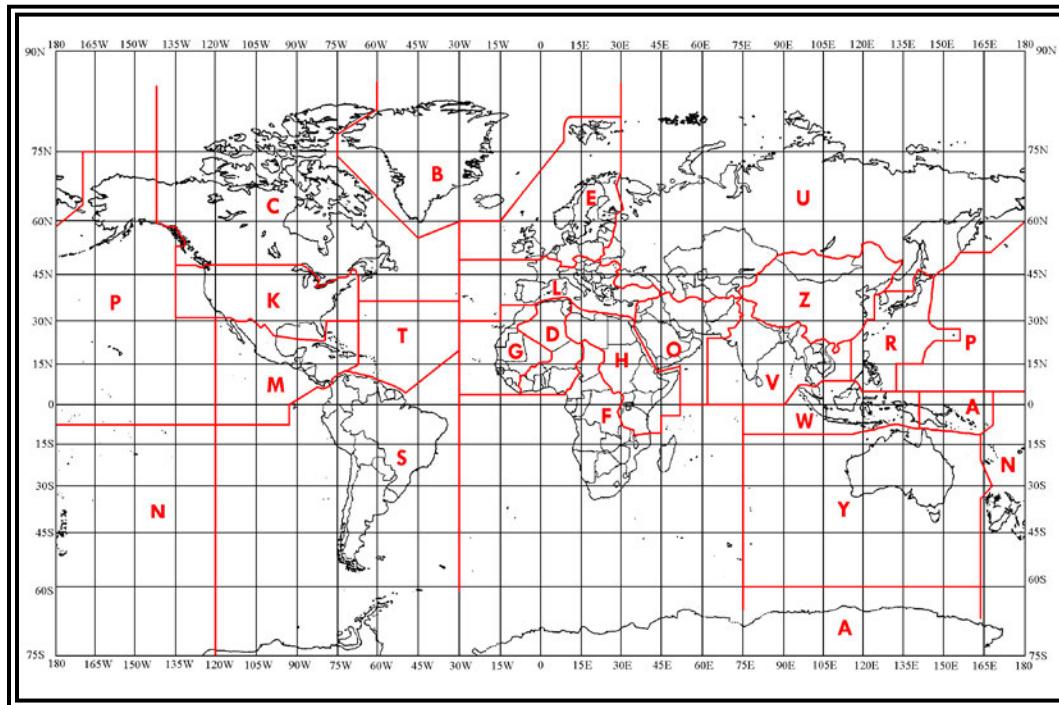
METAR **KOKC** 011955Z AUTO 22015G25KT 180V250 3/4SM
R17L/2600FT +TSRA BR OVC010CB 18/16 A2992 RMK AO2
TSB25 TS OHD MOV E SLP132

The station identifier, in ICAO format, is included in all reports to identify the station to which the coded report applies.

The ICAO airport code is a four-letter alphanumeric code designating each airport around the world. The ICAO codes are used for flight planning by pilots and airline operation departments. These codes are not the same as the International Air Transport Association (IATA) codes encountered by the general public used for reservations, baggage handling, and in airline timetables.

Unlike the IATA codes, the ICAO codes have a regional structure. The first letter identifies the region and country (see Figure 3-2, ICAO Continental Codes). In some regions, the second letter identifies the country. ICAO station identifiers in Alaska begin with PA, Hawaii begins with PH, Guam begins with PG, and Puerto Rico begins with TS. For example, the San Juan Puerto Rico IATA identifier “SJU” becomes the ICAO identifier “TSJU.” The remaining letters are used to identify each airport.

Figure 3-2. ICAO Continental Codes



In the continental United States (CONUS), ICAO station identifiers are coded **K**, followed by the three-letter IATA identifier. For example, the Seattle, WA IATA identifier SEA becomes the ICAO identifier KSEA.

ICAO station identifiers in Alaska, Hawaii, and Guam begin with the continent code **P**.

For a list of all U.S. identifiers, refer to FAA Order [7350.9](#), Location Identifiers. For a complete worldwide listing, refer to ICAO Document [7910](#), Location Indicators. Both are available online.

3.1.5.3 Date and Time of Report.

METAR KOKC **011955Z** AUTO 22015G25KT 180V250 3/4SM
R17L/2600FT +TSRA BR OVC010CB 18/16 A2992 RMK AO2
TSB25 TS OHD MOV E SLP132

The date and time are coded in all reports as follows: the day of the month is the first two digits (**01**), followed by the hour (**19**) and the minutes (**55**).

The coded time of observations is the actual time of the report, or when the criteria for a SPECI is met or noted.

If the report is a correction to a previously disseminated report, the time of the corrected report is the same time used in the report being corrected.

The date and time group always ends with a **Z**, indicating Zulu time (or Coordinated Universal Time (UTC)).

For example, METAR KOKC 011955Z would be disseminated as the 2000 hour routine report for station KOKC, taken on the 1st of the month at 1955 UTC.

3.1.5.4 Report Modifier (As Required).

METAR KOKC 011955Z **AUTO** 22015G25KT 180V250 3/4SM
R17L/2600FT +TSRA BR OVC010CB 18/16 A2992 RMK AO2
TSB25 TS OHD MOV E SLP132

The report modifier **AUTO** identifies the METAR/SPECI as a fully-automated report with no human intervention or oversight. In the event of a corrected METAR or SPECI, the report modifier COR is substituted for AUTO.

3.1.5.5 Wind Group.

METAR KOKC 011955Z AUTO **22015G25KT 180V250 3/4SM**
R17L/2600FT +TSRA BR OVC010CB 18/16 A2992 RMK AO2
TSB25 TS OHD MOV E SLP132

Wind is the horizontal motion of air past a given point. It is measured in terms of velocity, which is a vector that includes direction and speed. It indicates the direction the wind is coming from.

In the wind group, the wind direction is coded as the first three digits (**220**) and is determined by averaging the recorded wind direction over a 2-minute period. It is coded in tens of degrees relative to true north using three figures. Directions less than 100 degrees are preceded with a 0. For example, a wind direction of 90 degrees is coded as 090. A wind from the north is coded as 360.

Immediately following the wind direction is the wind speed coded in two or three digits (**15**). Wind speed is determined by averaging the speed over a 2-minute period and is coded in whole knots (kts) using the units, tens digits, and, when required, the hundreds digit. When wind speeds are less than 10 kts, a leading 0 is used to maintain at least a two-digit wind code. For example, a wind speed of 8 kts will be coded **08KT**. The wind group is

always coded with a **KT** to indicate wind speeds are reported in knots. Other countries may use kilometers per hour (KPH) or meters per second (MPS) instead of knots.

Examples:

- 05008KT Wind 50 degrees at 8 kts
- 15014KT Wind 150 degrees at 14 kts
- 340112KT Wind 340 degrees at 112 kts

3.1.5.5.1 Wind Gust.

Wind speed data for the most recent 10 minutes is examined to evaluate the occurrence of gusts. Gusts are defined as rapid fluctuations in wind speed with a variation of 10 kts or more between peaks and lulls. The coded speed of the gust is the maximum instantaneous wind speed.

Wind gusts are coded in two or three digits immediately following the wind speed. Wind gusts are coded in whole knots using the units, tens, and, if required, the hundreds digit. For example, a wind out of the west at 20 kts with gusts to 35 kts would be coded **27020G35KT**.

3.1.5.5.2 Variable Wind Direction (speed 6 kts or less).

Wind direction may be considered variable when, during the previous 2-minute evaluation period, the wind speed was 6 kts or less. In this case, the wind may be coded as **VRB** in place of the three-digit wind direction. For example, if the wind speed was recorded as 3 kts, it would be coded **VRB03KT**.

3.1.5.5.3 Variable Wind Direction (speed greater than 6 kts).

Wind direction may also be considered variable when, during the 2-minute evaluation period, it varies by 60 degrees or more and the speed is greater than 6 kts. In this case, a variable wind direction group immediately follows the wind group. The directional variability is coded in a clockwise direction and consists of the extremes of the wind directions separated by a **V**. For example, if the wind is variable from 180 degrees to 240 degrees at 10 kts, it would be coded **21010KT 180V240**.

3.1.5.5.4 Calm Wind.

When no motion of air is detected, the wind is reported as calm. A calm wind is coded as **00000KT**.

3.1.5.6 Visibility Group.

METAR KOKC 011955Z AUTO 22015G25KT 180V250 **3/4SM**
R17L/2600FT +TSRA BR OVC010CB 18/16 A2992 RMK AO2
TSB25 TS OHD MOV E SLP132

Visibility is a measure of the opacity of the atmosphere. It is defined as the greatest horizontal distance at which selected objects can be seen and identified or its equivalent derived from instrumental measurements.

Precipitating visibility is the reported visibility considered representative of recorded visibility conditions at the manual station during the time of observation. It is the greatest distance that can be seen throughout at least half of the horizon circle, not necessarily continuous.

Surface visibility is the prevailing visibility from the surface at manual stations or the visibility derived from sensors at automated stations.

The visibility group is coded as the surface visibility in statute miles (sm). A space is coded between whole numbers and fractions of reportable visibility values. The visibility group ends with **SM** to indicate that the visibility is in statute miles. For example, a visibility of 1½ sm is coded **1 1/2SM**. Most other countries use meters (m).

U.S. automated stations use an **M** to indicate “less than.” For example, **M1/4SM** means a visibility of less than ¼ sm.

3.1.5.7 Runway Visual Range (RVR) Group.

METAR KOKC 011955Z AUTO 22015G25KT 180V250 3/4SM
R17L/2600FT +TSRA BR OVC010CB 18/16 A2992 RMK AO2
TSB25 TS OHD MOV E SLP132

The RVR is an instrument-derived value representing the horizontal distance a pilot may see down the runway.

RVR is reported whenever the station has RVR equipment and prevailing visibility is 1 sm or less and/or the RVR for the designated instrument runway is 6,000 feet (ft) or less. Otherwise the RVR group is omitted.

RVR is coded in the following format: the initial **R** is code for runway and is followed by the runway number. When more than one runway is defined with the same runway number, a directional letter is coded on the end of the runway number. Next is a solidus (/) followed by the visual range in feet and then **FT** completes the RVR report. For example, an RVR value for Runway 01L of 800 ft would be coded **R01L/0800FT**. Most other countries use meters.

In the United States, RVR values are coded in increments of 100 ft up to 1,000 ft, increments of 200 ft from 1,000 ft to 3,000 ft, and increments of 500 ft from 3,000 ft to 6,000 ft. Manual RVR is not reported below 600 ft.

For U.S. airports only, the touchdown zone's (TDZ) RVR is reported. For U.S. airports with multiple runways, the operating runway with the lowest

touchdown RVR is reported. RVR may be reported for up to four designated runways in other countries.

When the RVR varies by more than one reportable value, the lowest and highest values will be shown with **V** between them, indicating variable conditions. For example, the 10-minute RVR for Runway 01L varying between 600 ft and 1,000 ft would be coded **R01L/0600V1000FT**.

If RVR is less than its lowest reportable value, the visual range group is preceded by **M**. For example, an RVR for Runway 01L of less than 600 ft is coded **R01L/M0600FT**.

If RVR is greater than its highest reportable value, the visual range group is preceded by a **P**. For example, an RVR for Runway 27 of greater than 6,000 ft will be coded **R27/P6000FT**.

3.1.5.8 Present Weather Group.

METAR KOKC 011955Z AUTO 22015G25KT 180V250 3/4SM
R17L/2600FT +**TSRA BR** OVC010CB 18/16 A2992 RMK AO2
TSB25 TS OHD MOV E SLP132

Present weather includes precipitation, obscurations, and other weather phenomena. The appropriate notations found in Table [3-2](#), METAR/SPECI Notations for Reporting Present Weather, are used to code present weather.

Table 3-2. METAR/SPECI Notations for Reporting Present Weather¹

QUALIFIER		WEATHER PHENOMENA				
INTENSITY OR PROXIMITY	DESCRIPTOR	PRECIPITATION		OBSCURATION		OTHER
1	2	3	4	5		
-	Light	MI Shallow	DZ Drizzle	BR Mist	PO	Dust/Sand Whirls
	Moderate ²	PR Partial	RA Rain	FG Fog	SQ	Squalls
+	Heavy	BC Patches	SN Snow	FU Smoke	FC	Funnel Cloud, Tornado or Waterspout ⁴
VC In the Vicinity ³	DR Low Drifting	SG Snow Grains	VA Volcanic Ash	SS	Sandstorm	
	BL Blowing	IC Ice Crystals (Diamond Dust)	DU Widespread Dust	DS	Duststorm	
	SH Shower(s)	PL Ice Pellets	SA Sand			
	TS Thunderstorms	GR Hail	HZ Haze			
	FZ Freezing	GS Small Hail and/or Snow Pellets	PY Spray			
		UP Unknown Precipitation				

1. The weather groups are constructed by considering columns 1 through 5 in the table above in sequence, i.e., intensity followed by description, followed by weather phenomena, e.g., heavy rain shower(s) is coded as +SHRA.

2. To denote moderate intensity no entry or symbol is used.

3. See text for vicinity definitions.

4. Tornadoes and waterspouts are coded as +FC.

Separate groups are used for each type of present weather. Each group is separated from the other by a space. METAR/SPECI reports contain no more than three present weather groups.

When more than one type of present weather is reported at the same time, present weather is reported in the following order:

- Tornadic activity (tornado, funnel cloud, or waterspout).
- Thunderstorm(s) (with and without associated precipitation).
- Present weather in order of decreasing dominance (i.e., the most dominant type reported first).
- Left-to-right in Table [3-2](#) (columns 1 through 5).

Qualifiers may be used in various combinations to describe weather phenomena. Present weather qualifiers fall into two categories: intensity (see paragraph 3.1.5.8.1) or proximity (see paragraph 3.1.5.8.2) and descriptors (see paragraph [3.1.5.8.3](#)).

3.1.5.8.1 Intensity Qualifier.

The intensity qualifiers are light, moderate, and heavy. They are coded with precipitation types, except ice crystals (**IC**) and hail (**GR** or **GS**), including those associated with a thunderstorm (**TS**) and those of a showery nature (**SH**). Tornadoes and waterspouts are coded as heavy (+**FC**). No intensity is ascribed to the obscurations of blowing dust (**BLDU**), blowing sand (**BLSA**), and blowing snow (**BLSN**). Only moderate or heavy intensity is ascribed to sandstorm (**SS**) and duststorm (**DS**).

When more than one form of precipitation is occurring at a time, or precipitation is occurring with an obscuration, the reported intensities are not cumulative. The reported intensity will not be greater than the intensity for each form of precipitation. For example, -**FZRAPL** is light freezing rain and light ice pellets, **not** light freezing rain and moderate ice pellets.

3.1.5.8.2 Proximity Qualifier.

Weather phenomena occurring beyond the point of observation (between 5 and 10 sm) are coded as in the vicinity (**VC**). **VC** can be coded in combination with thunderstorm (**TS**), fog (**FG**), shower(s) (**SH**), well-developed dust/sand whirls (**PO**), blowing dust (**BLDU**), blowing sand (**BLSA**), blowing snow (**BLSN**), sandstorm (**SS**), and duststorm (**DS**). Intensity qualifiers are not coded in conjunction with **VC**.

For example, **VCFG** can be decoded as meaning some form of fog is between 5 and 10 sm of the point of observation. If **VCSH** is coded, showers are occurring between 5 and 10 sm of the point of observation.

Weather phenomena occurring at the point of observation (at the station) or in the vicinity of the point of observation are coded in the body of the report.

Weather phenomena observed beyond 10 sm from the point of observation (at the station) is not coded in the body, but may be coded in the remarks section (see paragraph [3.1.5.12](#)).

3.1.5.8.3 Descriptor Qualifier

Descriptors are qualifiers that further amplify weather phenomena and are used in conjunction with some types of precipitation and obscurations. The descriptor qualifiers are: shallow (**MI**), partial (**PR**), patches (**BC**), low drifting (**DR**), blowing (**BL**), shower(s) (**SH**), thunderstorm (**TS**), and freezing (**FZ**).

Only one descriptor is coded for each weather phenomena group (e.g., **FZDZ**).

The descriptors shallow (**MI**), partial (**PR**), and patches (**BC**) are only coded with fog (**FG**) (e.g., **MIFG**). Mist (**BR**) is not coded with any descriptor.

The descriptors low drifting (**DR**) and blowing (**BL**) will only be coded with dust (**DU**), sand (**SA**), and snow (**SN**) (e.g., **BLSN** or **DRSN**). **DR** is coded with **DU**, **SA**, or **SN** for raised particles drifting less than 6 ft above the ground.

When blowing snow is observed with snow falling from clouds, both phenomena are reported (e.g., **SN BLSN**). If blowing snow is occurring and the observer cannot determine whether or not snow is also falling, then **BLSN** is reported. Spray (**PY**) is coded only with blowing (**BL**).

The descriptor for showery-type precipitation (**SH**) is coded only with one or more of the precipitation qualifiers for rain (**RA**), snow (**SN**), ice pellets (**PL**), small hail (**GS**), or large hail (**GR**). When any type of precipitation is coded with **VC**, the intensity and type of precipitation is not coded.

The descriptor for thunderstorm (**TS**) may be coded by itself when the thunderstorm is without associated precipitation. A thunderstorm may also be coded with the precipitation types of rain (**RA**), snow (**SN**), ice pellets (**PL**), small hail and/or snow pellets (**GS**), or hail (**GR**). For example, a thunderstorm with snow and small hail and/or snow pellets would be coded as **TSSNGS**. **TS** is not coded with **SH**.

The descriptor freezing (**FZ**) is only coded in combination with fog (**FG**), drizzle (**DZ**), or rain (**RA**) (e.g., **FZRA**). **FZ** is not coded with **SH**.

3.1.5.8.4 Precipitation

Precipitation is any form of water particle, whether liquid or solid, that falls from the atmosphere and reaches the ground. The precipitation types are: drizzle (**DZ**), rain (**RA**), snow (**SN**), snow grains (**SG**), ice crystals (**IC**), ice pellets (**PL**), hail (**GR**), small hail and/or snow pellets (**GS**), and unknown precipitation (**UP**). **UP** is reported if an automated station detects the occurrence of precipitation, but the precipitation sensor cannot recognize the type.

Up to three types of precipitation may be coded in a single present weather group. They are coded in order of decreasing dominance based on intensity.

3.1.5.8.5 Obscuration.

Obscurations are any phenomenon in the atmosphere, other than precipitation, that reduces the horizontal visibility in the atmosphere. The obscuration types are: mist (**BR**), fog (**FG**), smoke (**FU**), volcanic ash (**VC**), widespread dust (**DU**), sand (**SA**), haze (**HZ**), and spray (**PY**). Spray (**PY**) is coded only as **BLPY**.

With the exception of volcanic ash, low drifting dust, low drifting sand, low drifting snow, shallow fog, partial fog, and patches (of) fog, an obscuration is coded in the body of the report if the surface visibility is less than 7 miles (mi), or considered operationally significant. Volcanic ash is always reported when observed.

3.1.5.8.6 Other Weather Phenomena.

Other weather phenomena types include: well-developed dust/sand whirls (**PO**), sandstorms (**SS**), duststorms (**DS**), squalls (**SQ**), funnel clouds (**FC**), and tornados and waterspouts (+**FC**).

Examples:

-DZ	Light drizzle
-RASN	Light rain and (light) snow
SN BR	(Moderate) snow, mist
-FZRA FG	Light freezing rain, fog
SHRA	(Moderate) rain shower
VCBLSA	Blowing sand in the vicinity
-RASN FG HZ	Light rain and (light) snow, fog, haze
TS	Thunderstorm (without precipitation)
+TSRA	Thunderstorm, heavy rain
+FC TSRAGR BR	Tornado, thunderstorm, (moderate) rain, hail, mist

3.1.5.9 Sky Condition Group.

METAR KOKC 011955Z AUTO 22015G25KT 180V250 3/4SM
R17L/2600FT +TSRA BR **OVC010CB** 18/16 A2992 RMK AO2
TSB25 TS OHD MOV E SLP132

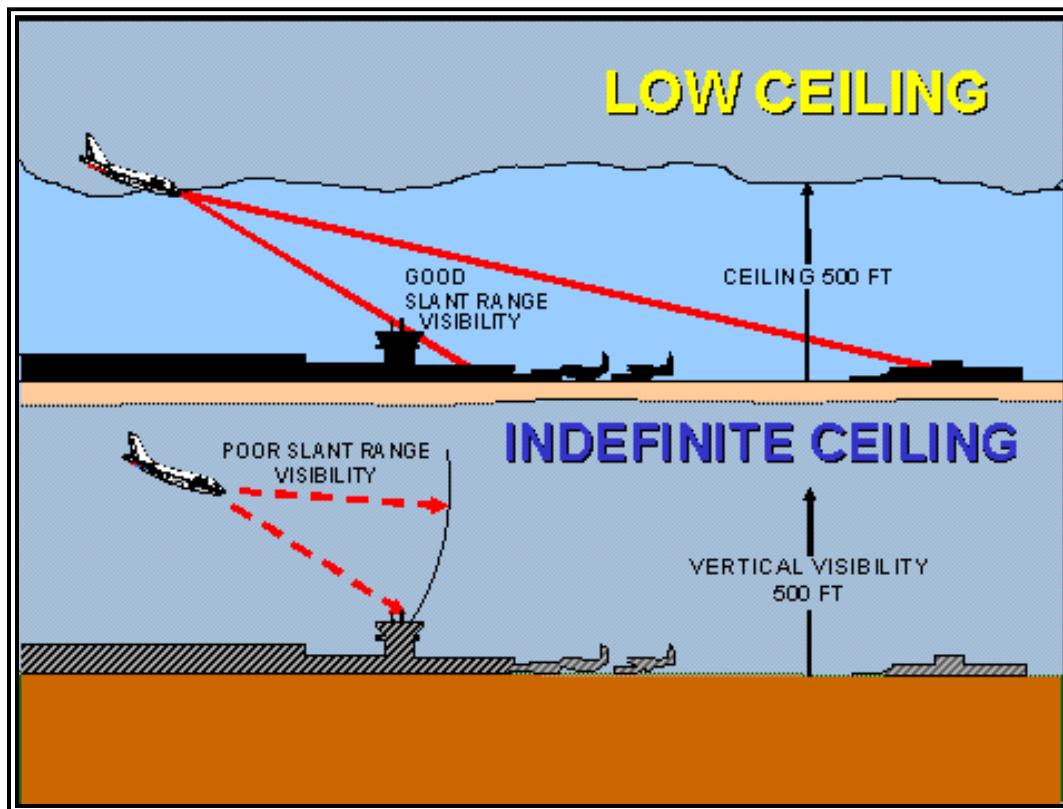
Sky condition is a description of the appearance of the sky. It includes either cloud cover, vertical visibility, or clear skies.

The sky condition group is based on the amount of cloud cover (the first three letters) followed by the height of the base of the cloud cover (final three digits). No space is between the amount of cloud cover and the height of the layer. The height of the layer is recorded in feet above ground level (AGL).

Sky condition is coded in ascending order and ends at the first overcast layer. At mountain stations, if the layer is below station level, the height of the layer will be coded as ///.

Vertical visibility is coded as VV, followed by the vertical visibility into the **indefinite ceiling**. An indefinite ceiling is a ceiling classification applied when the reported ceiling value represents the vertical visibility upward into surface-based obscuration. No space is between the group identifier and the vertical visibility. Figure 3-3, Obscuration Effects on Slant Range Visibility, illustrates the effect of an obscuration on the vision from a descending aircraft.

Figure 3-3. Obscuration Effects on Slant Range Visibility



The ceiling is 500 ft in both examples, but the indefinite ceiling example (bottom) produces a more adverse impact to landing aircraft. This is because an obscuration (e.g., fog, blowing dust, snow) limits runway acquisition due to reduced slant range visibility. This pilot would be able to see the ground, but not the runway. If the pilot was at approach minimums, the approach could not be continued and a missed approach must be executed.

Clear skies are coded in the format **SKC** or **CLR**. When **SKC** is used, an observer indicates no layers are present; **CLR** is used by automated stations to indicate no layers are detected at or below 12,000 ft.

Each coded layer is separated from the others by a space. Each layer reported is coded by using the appropriate reportable contraction seen in Table 3-3, METAR/SPECI Contractions for Sky Cover. A report of clear skies (**SKC** or **CLR**) is a complete layer report within itself. The abbreviations **FEW**, **SCT**, **BKN**, and **OVC** will be followed (without a space) by the height of the layer.

Table 3-3. METAR/SPECI Contractions for Sky Cover

Reportable Contraction	Meaning	Summation Amount of Layer
VV	Vertical Visibility	8/8
SKC or CLR1	Clear	0
FEW2	Few	1/8 – 2/8
SCT	Scattered	3/8 – 4/8
BKN	Broken	5/8 – 7/8
OVC	Overcast	8/8

1. The abbreviation **CLR** will be used at automated stations when no layers at or below 12,000 ft are reported; the abbreviation **SKC** will be used at manual stations when no layers are reported.

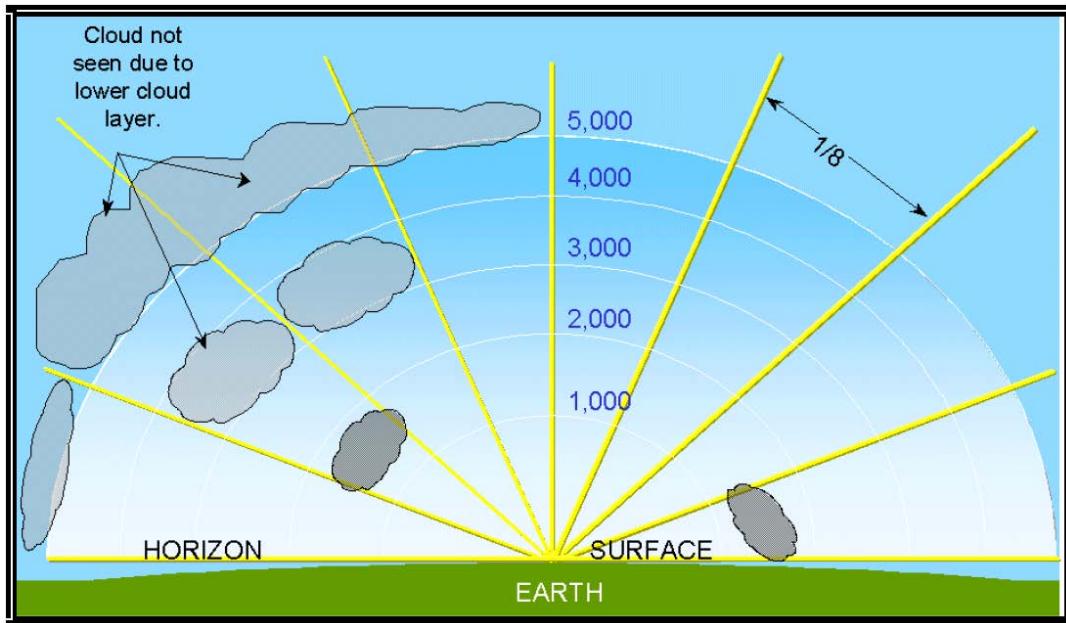
2. Any layer amount less than 1/8 is reported as **FEW**.

The height is coded in hundreds of feet above the surface using three digits in accordance with Table 3-4, METAR/SPECI Increments of Reportable Values of Sky Cover Height.

Table 3-4. METAR/SPECI Increments of Reportable Values of Sky Cover Height

Range of Height Values (feet)	Reportable Increment (feet)
Less than or equal to 5,000	To nearest 100
5,001 to 10,000	To nearest 500
Greater than 10,000	To nearest 1,000

The ceiling is the lowest layer aloft reported as broken or overcast. If the sky is totally obscured with ground-based clouds, the vertical visibility is the ceiling.

Figure 3-4. METAR/SPECI Sky Condition Coding

Clouds at 1,200 ft obscure 2/8ths of the sky (FEW). Higher clouds at 3,000 ft obscure an additional 1/8th of the sky, and because the observer cannot see above the 1,200-ft layer, he is to assume that the higher 3,000-ft layer also exists above the lower layer (SCT). The highest clouds at 5,000 ft obscure 2/8ths of the sky, and again since the observer cannot see past the 1,200 and 3,000-ft layers, he is to assume the higher 5,000-ft layer also exists above the lower layers (BKN). The sky condition group would be coded as: FEW012 SCT030 BKN050.

At manual stations, cumulonimbus (CB) or towering cumulus (TCU) is appended to the associated layer. For example, a scattered layer of towering cumulus at 1,500 ft would be coded **SCT015TCU**, and would be followed by a space if there were additional higher layers to code.

Examples:

SKC	No layers are present
CLR	No layers are detected at or below 12,000 ft AGL
FEW004	Few at 400 ft AGL
SCT023TCU	Scattered layer of towering cumulus at 2,300 ft
BKN100	Broken layer (ceiling) at 10,000 ft
OVC250	Overcast layer (ceiling) at 25,000 ft
VV001	Indefinite ceiling with a vertical visibility of 100 ft
FEW012 SCT046	Few clouds at 1,200 ft, scattered layer at 4,600 ft

SCT033 BKN085	Scattered layer at 3,300 ft, broken layer (ceiling) at 8,500 ft
SCT018 OVC032CB	Scattered layer at 1,800 ft, overcast layer (ceiling) of cumulonimbus at 3,200 ft
SCT009 SCT024 BKN048	Scattered layer at 900 ft, scattered layer at 2,400 ft, broken layer (ceiling) at 4,800 ft

3.1.5.10 Temperature/Dewpoint Group.

METAR KOKC 011955Z AUTO 22015G25KT 180V250 3/4SM
R17L/2600FT +TSRA BR OVC010CB **18/16** A2992 RMK AO2
TSB25 TS OHD MOV E SLP132

Temperature is the degree of hotness or coldness of the ambient air, as measured by a suitable instrument. Dewpoint is the temperature to which a given parcel of air must be cooled at constant pressure and constant water vapor content for the air to become fully saturated.

Temperature and dewpoint are coded as two digits rounded to the nearest whole degree Celsius. For example, a temperature of 0.3 °C would be coded as **00**. Sub-zero temperatures and dewpoints are prefixed with an **M**. For example, a temperature of 4 °C with a dewpoint of -2 °C would be coded as **04/M02**; a temperature of -2 °C would be coded as **M02**.

If temperature is not available, the entire temperature/dewpoint group is not coded. If dewpoint is not available, temperature is coded followed by a solidus (/) and no entry is made for dewpoint. For example, a temperature of 1.5 °C and a missing dewpoint would be coded as **02/**.

3.1.5.11 Altimeter.

METAR KOKC 011955Z AUTO 22015G25KT 180V250 3/4SM
R17L/2600FT +TSRA BR OVC010CB 18/16 **A2992** RMK AO2
TSB25 TS OHD MOV E SLP132

The altimeter setting group codes the current pressure at elevation. This setting is then used by aircraft altimeters to determine the true altitude above a fixed plane of mean sea level (MSL).

The altimeter group always starts with an **A** and is followed by the four-digit group representing the pressure in tens, units, tenths, and hundredths of inches (in) of mercury. The decimal point is not coded. For example, an altimeter setting of 29.92 in of Mercury would be coded as **A2992**.

3.1.5.12 Remarks (RMK).

METAR KOKC 011955Z AUTO 22015G25KT 180V250 3/4SM
R17L/2600FT +TSRA BR OVC010CB 18/16 A2992 **RMK AO2**
TSB25 TS OHD MOV E SLP132

Remarks are included in METAR and SPECI, when appropriate.

Remarks are separated from the body of the report by the contraction **RMK**. When no remarks are necessary, the contraction **RMK** is not required.

METAR/SPECI remarks fall into two categories: (1) Automated, Manual, and Plain Language, and (2) Additive and Automated Maintenance Data.

Table 3-5. METAR/SPECI Order of Remarks

Automated, Manual, and Plain Language				Additive and Automated Maintenance Data	
1. Volcanic Eruptions	14. Hailstone Size	27.	Precipitation amount within a specified time period*		
2. Funnel Cloud	15. Virga	28.	Cloud Types*		
3. Type of Automated Station	16. Variable Ceiling Height	29.	Duration of Sunshine*		
4. Peak Wind	17. Obscurations	30.	Hourly Temperature and Dewpoint		
5. Wind Shift	18. Variable Sky Condition	31.	6-Hourly Maximum Temperature*		
6. Tower or Surface Visibility	19. Significant Cloud Types	32.	6-Hourly Minimum Temperature*		
7. Variable Prevailing Visibility	20. Ceiling Height at Second Location	33.	24-Hour Maximum and Minimum Temperature*		
8. Sector Visibility	21. Pressure Rising or Falling Rapidly	34.	3-Hourly Pressure Tendency*		
9. Visibility at Second Location	22. Sea-Level Pressure	35.	Sensor Status Indicators		
10. Lightning	23. Aircraft Mishap	36.	Maintenance Indicator		
11. Beginning and Ending of Precipitation	24. No SPECI Reports Taken	Note: Additive data is primarily used by the National Weather Service for climatological purposes.			
12. Beginning and Ending of Thunderstorms	25. Snow Increasing Rapidly	*These groups should have no direct impact on the aviation community and will not be discussed in this document.			
13. Thunderstorm Location	26. Other Significant Information				

Remarks are made in accordance with the following:

- Time entries are made in minutes past the hour if the time reported occurs during the same hour the observation is taken. Hours and minutes are used if the hour is different.
- Present weather coded in the body of the report as **VC** may be further described (e.g., direction from the station, if known). Weather phenomena beyond 10 sm of the point(s) of observation are coded as distant (**DSNT**) followed by the direction from the station. For example, precipitation of unknown intensity within 10 sm east of the station would be coded as **VCSH E**; lightning 25 sm west of the station would be coded as **LTG DSNT W**.

- Distance remarks are in statute miles except for automated lightning remarks, which are in nautical miles (NM).
- Movement of clouds or weather, when known, is coded with respect to the direction toward which the phenomena are moving. For example, a thunderstorm moving toward the northeast would be coded as **TS MOV NE**.
- Directions use the eight points of the compass coded in a clockwise order.
- Insofar as possible, remarks are entered in the order they are presented in the following paragraphs (and Table [3-5](#), METAR/SPECI Order of Remarks).

3.1.5.13 Automated, Manual, and Plain Language Remarks.

These remarks generally elaborate on parameters reported in the body of the report. An automated station or observer may generate automated and manual remarks. Only an observer can provide plain language remarks.

3.1.5.13.1 Volcanic Eruptions (Plain Language).

Volcanic eruptions are coded in plain language and contain the following, when known:

- **Name** of volcano;
- **Latitude and longitude** or the direction and approximate distance from the station;
- **Date/Time** (UTC) of the eruption;
- **Size description**, approximate height, and direction of movement **of the ash cloud**; and
- Any **other pertinent data** about the eruption.

For example, a remark on a volcanic eruption would look like the following:

RMK MT. AUGUSTINE VOLCANO 70 MILES SW ERUPTED AT 231505 LARGE ASH CLOUD EXTENDING TO APRX 30000 FEET MOVING NE.

Pre-eruption volcanic activity is not coded. Pre-eruption refers to unusual and/or increasing volcanic activity which could presage a volcanic eruption.

3.1.5.13.2 Funnel Cloud.

At manual stations, tornadoes, funnel clouds, and waterspouts are coded in the following format: tornadic activity, **TORNADO**, **FUNNEL CLOUD**, or **WATERSPOUT**, followed by the beginning and/or ending time, followed by the location and/or direction of the phenomena from the station, and/or movement, when known. For example, **TORNADO B13 6 NE** would indicate

that a tornado began at 13 minutes past the hour and was 6 sm northeast of the station.

3.1.5.13.3 Type of Automated Station.

AO1 or **AO2** is coded in all METAR/SPECI from automated stations. Automated stations without a precipitation discriminator are identified as **AO1**; automated stations with a precipitation discriminator are identified as **AO2**.

3.1.5.13.4 Peak Wind.

Peak wind is coded in the following format: the remark identifier **PK WND**, followed by the direction of the wind (first three digits), peak wind speed (next two or three digits) since the last METAR, and the time of occurrence. A space is between the two elements of the remark identifier and the wind direction/speed group; a solidus (/), without spaces, separates the wind direction/speed group and the time. For example, a peak wind of 45 kts from 280 degrees that occurred at 15 minutes past the hour is coded **PK WND 28045/15**.

3.1.5.13.5 Wind Shift.

Wind shift is coded in the following format: the remark identifier **WSHFT**, followed by the time the wind shift began. The contraction **FROPA** is entered following the time if there is reasonable data to consider the wind shift was the result of a frontal passage. A space is between the remark identifier and the time and, if applicable, between the time and the frontal passage contraction. For example, a remark reporting a wind shift accompanied by a frontal passage that began at 30 minutes after the hour would be coded **WSHFT 30 FROPA**.

3.1.5.13.6 Tower or Surface Visibility.

Tower or surface visibility is coded in the following format: tower (**TWR VIS**) or surface (**SFC**), followed by the observed tower/surface visibility value. A space is coded between each of the remark elements. For example, the control tower visibility of 1½ sm would be coded **TWR VIS 1 1/2**.

3.1.5.13.7 Variable Prevailing Visibility.

Variable prevailing visibility is coded in the following format: the remark identifier **VIS**, followed by the lowest and highest visibilities evaluated, separated by the letter **V**. A space follows the remark identifier and no spaces are between the letter **V** and the lowest/highest values. For example, a visibility that was varying between ½ and 2 sm would be coded **VIS 1/2V2**.

3.1.5.13.8 Sector Visibility (Plain Language).

Sector visibility is coded at manual stations in the following format: the remark identifier **VIS**, followed by the sector referenced to eight points of the

compass, and the sector visibility in statute miles. For example, a visibility of 2½ sm in the northeastern octant is coded **VIS NE 2 1/2**.

3.1.5.13.9 Visibility at Second Location

At designated automated stations, the visibility at a second location is coded in the following format: the remark identifier **VIS**, followed by the measured visibility value and the specific location of the visibility sensor(s) at the station. This remark will only be generated when the condition is lower than that contained in the body of the report. For example, a visibility of 2½ sm measured by a second sensor located at Runway 11 is coded **VIS 2 1/2 RWY11**.

3.1.5.13.10 Lightning

When lightning is observed at a manual station, the frequency, type of lightning, and location are reported. The contractions for the type and frequency of lightning are based on Table 3-6, METAR/SPECI Type and Frequency of Lightning, for example, **OCNL LTGICCG NW, FRQ LTG VC, or LTG DSNT W**.

When lightning is detected by an automated system:

- Within 5 NM of the Airport Location Point (ALP), it is reported as TS in the body of the report with no remark.
- Between 5 and 10 NM of the ALP, it is reported as VCTS in the body of the report with no remark.
- Beyond 10 but less than 30 NM of the ALP, it is reported in remarks only as LTG DSNT followed by the direction from the ALP.

Table 3-6. METAR/SPECI Type and Frequency of Lightning

Type of Lightning		
Type	Contraction	Definition
Cloud-ground	CG	Lightning occurring between cloud and ground
In-cloud	IC	Lightning which takes place within the cloud
Cloud-cloud	CC	Streaks of lightning reaching from one cloud to another
Cloud-air	CA	Streaks of lightning which pass from a cloud to the air, but do not strike the ground
Frequency of Lightning		
Frequency	Contraction	Definition
Occasional	OCNL	Less than 1 flash/minute
Frequent	FRQ	About 1 to 6 flashes/minute
Continuous	CONS	More than 6 flashes/minute

3.1.5.13.11 Beginning and Ending of Precipitation.

At designated stations, the beginning and ending times of precipitation are coded in the following format: the type of precipitation, followed by either a **B** for beginning or an **E** for ending, and the time of occurrence. No spaces are coded between the elements. The coded times of the precipitation start and stop times are found in the remarks section of the next METAR. The times are not required to be in the SPECI. The intensity qualifiers are coded. For example, if rain began at 0005 and ended at 0030, and then snow began at 0020 and ended at 0055, the remarks would be coded

RAB05E30SNB20E55. If the precipitation was showery, the remark is coded **SHRAB05E30SHSNB20E55**. If rain ended and snow began at 0042, the remark would be coded as **RAESNB42**.

3.1.5.13.12 Beginning and Ending of Thunderstorms.

The beginning and ending times of thunderstorms are coded in the following format: The thunderstorm identifier **TS**, followed by either a **B** for beginning or an **E** for ending, and the time of occurrence. No spaces are between the elements. For example, if a thunderstorm began at 0159 and ended at 0230, the remark is coded **TSB0159E30**.

3.1.5.13.13 Thunderstorm Location.

Thunderstorm locations are coded in the following format: the thunderstorm identifier **TS**, followed by the location of the thunderstorm(s) from the station, and the direction of movement, when known. For example, a thunderstorm southeast of the station and moving toward the northeast is coded **TS SE MOV NE**.

3.1.5.13.14 Hailstone Size.

At designated stations, the hailstone size is coded in the following format: the hail identifier **GR**, followed by the size of the largest hailstone. The hailstone size is coded in $\frac{1}{4}$ in increments. For example, **GR 1 3/4** would indicate that the largest hailstones were $1\frac{3}{4}$ in. in diameter. If small hail or snow pellets, **GS**, are coded in the body of the report, no hailstone size remark is required.

3.1.5.13.15 Virga.

At designated stations, Virga is coded in the following format: the identifier **VIRGA**, followed by the direction from the station. The direction of the phenomena from the station is optional, e.g., **VIRGA** or **VIRGA SW**.

3.1.5.13.16 Variable Ceiling Height.

The variable ceiling height is coded in the following format: the identifier **CIG**, followed by the lowest ceiling height recorded, **V** denoting variability between two values, and ending with the highest ceiling height. A single space follows the identifier with no other spaces between the letter **V** and the lowest/highest ceiling values. For example, **CIG 005V010** would indicate a ceiling is variable between 500 ft and 1,000 ft.

3.1.5.13.17 Obscurations.

Obscurations, surface-based or aloft, are coded in the following format: the weather identifier causing the obscuration at the surface or aloft, followed by the sky cover of the obscuration aloft (FEW, SCT, BKN, OVC) or at the surface (FEW, SCT, BKN), and the height. Surface-based obscurations have a height of 000. A space separates the weather causing the obscuration and the sky cover; no space is between the sky cover and the height. For example, fog hiding 3/8 to 4/8 of the sky is coded **FG SCT000**; a broken layer at 2,000 ft composed of smoke is coded **FU BKN020**.

3.1.5.13.18 Variable Sky Condition.

Variable sky condition remarks are coded in the following format: the two operationally significant sky conditions (FEW, SCT, BKN, and OVC), separated by spaces, and **V** denoting the variability between the two ranges. If several layers have the same condition amount, the layer height of the variable layer is coded. For example, a cloud layer at 1,400 ft varying between broken and overcast is coded **BKN014 V OVC**.

3.1.5.13.19 Significant Cloud Types.

At manual stations, significant cloud type remarks are coded in all reports.

3.1.5.13.20 Cumulonimbus.

Cumulonimbus not associated with thunderstorms is coded as **CB**, followed by the direction from the station, and the direction of movement, when known. The location, direction, and direction of movement entries are separated from each other by a space. For example, a CB up to 10 sm west of the station moving toward the east would be coded **CB W MOV E**. If the CB was more than 10 sm to the west, the remark is coded **CB DSNT W**.

Cumulonimbus (CB) always evolves from the further development of towering cumulus (TCU). The unusual occurrence of lightning and thunder within or from a CB leads to its popular title, thunderstorm. A thunderstorm usually contains severe or greater turbulence, severe icing, and Low-Level Wind Shear (LLWS).

3.1.5.13.21 Towering Cumulus.

Towering cumulus clouds are coded in the following format: the identifier **TCU**, followed by the direction from the station. The cloud type and direction entries are separated by a space. For example, a towering cumulus cloud up to 10 sm west of the station is coded **TCU W**.

3.1.5.13.22 Standing Lenticular or Rotor Clouds.

Stratocumulus (**SCSL**), altocumulus (**ACSL**), cirrocumulus (**CCSL**), or rotor clouds are coded in the following format: the cloud type followed by the direction from the station. The cloud type and direction entries are separated by a space. For example, altocumulus standing lenticular clouds observed southwest through west of the station are coded **ACSL SW-W**; an apparent

rotor cloud 5 to 10 sm northeast of the station is coded **APRNT ROTOR CLD NE**; and cirrocumulus clouds south of the station are coded **CCSL S**.

3.1.5.13.23 Ceiling Height at Second Location.

At designated stations, the ceiling height at a second location is coded in the following format: the identifier **CIG**, followed by the measured height of the ceiling and the specific location of the ceilometer(s) at the station. This remark is only generated when the ceiling is lower than that contained in the body of the report. For example, if the ceiling measured by a second sensor located at Runway 11 is broken at 200 ft, the remark would be coded **CIG 002 RWY11**.

3.1.5.13.24 Pressure Rising or Falling Rapidly.

At designated stations, the reported pressure is evaluated to determine if a pressure change is occurring. If the pressure is rising or falling at a rate of at least 0.06 in per hour and the pressure change totals 0.02 in or more at the time of the observation, a pressure change remark is reported. When the pressure is rising or falling rapidly at the time of observation, the remark pressure rising rapidly (**PRESRR**) or pressure falling rapidly (**PRESFR**) is included in the remarks.

3.1.5.13.25 Sea-Level Pressure.

At designated stations, the sea-level pressure is coded in the following format: the identifier **SLP**, immediately followed by the sea-level pressure in millibars (mb)¹. The hundreds and thousands units are not coded and must be inferred. For example, a sea-level pressure of 998.2 mb is coded **SLP982**. A sea-level pressure of 1,013.2 mb would be coded **SLP132**. For a METAR, if sea-level pressure is not available, it is coded **SLPNO**.

3.1.5.13.26 Aircraft Mishap.

If a SPECI report is taken to document weather conditions when notified of an aircraft mishap, the remark **ACFT MSHP** is coded in the report, but the SPECI is not transmitted.

3.1.5.13.27 No SPECI Reports Taken (Plain Language).

At manual stations where SPECIs are not taken, the remark **NOSPECI** is coded to indicate no changes in weather conditions will be reported until the next METAR.

3.1.5.13.28 Snow Increasing Rapidly.

At designated stations, the snow increasing rapidly remark is reported in the next METAR whenever the snow depth increases by 1 in or more in the past hour. The remark is coded in the following format: the remark indicator

¹ Although the international unit of pressure measurement is now the Pascal, we will use the term millibar in this document version because, at this time, it is felt the reader is probably more familiar with millibars. Increasingly in meteorology literature, however, the term hectopascal (hPa) has replaced the term millibar to conform to international standards and because 1 hPa = 1 mb.

SNINCR, the depth increase in the past hour, and the total depth of snow on the ground at the time of the report. The depth of snow increase in the past hour and the total depth on the ground are separated from each other by a solidus (/). For example, a snow depth increase of 2 in. in the past hour with a total depth on the ground of 10 in is coded **SNINCR 2/10**.

3.1.5.13.29 Other Significant Information (Plain Language).

Agencies may add to a report other information significant to their operations, such as information on fog dispersal operations, runway conditions, **FIRST** or **LAST** reports from station, etc.

3.1.5.13.30 Additive and Automated Maintenance Data.

Additive data groups (see Table 3-5) are only reported at designated stations and are primarily used by the NWS for climatological purposes. Most have no direct impact on the aviation community, but a few are discussed below.

3.1.5.13.31 Hourly Temperature and Dewpoint.

At designated stations, the hourly temperature and dewpoint group are further coded to the tenth of a degree Celsius. For example, a recorded temperature of +2.6 °C and dewpoint of -1.5 °C would be coded **T00261015**.

The format for the coding is as follows:

T Group indicator

0 Indicates the following number is positive; a **1** would be used if the temperature was reported as negative at the time of observation

026 Temperature disseminated to the nearest tenth and read as 02.6

1 Indicates the following number is negative; a **0** would be used if the number was reported as positive at the time of observation

015 Dewpoint disseminated to the nearest tenth and read as 01.5

No spaces are between the entries. For example, a temperature of 2.6 °C and dewpoint of -1.5 °C is reported in the body of the report as **03/M01** and the hourly temperature and dewpoint group as **T00261015**. If the dewpoint is missing, only the temperature is reported; if the temperature is missing, the hourly temperature and dewpoint group are not reported.

3.1.5.13.32 Maintenance Data Groups.

The following maintenance data groups, Sensor Status Indicators and the Maintenance Indicator, are only reported from automated stations.

3.1.5.14 Sensor Status Indicators.

Sensor status indicators are reported as indicated below:

- If the RVR is missing and would normally be reported, **RVRNO** is coded.
- When automated stations are equipped with a present weather identifier and the sensor is not operating, the remark **PWINO** is coded.
- When automated stations are equipped with a tipping bucket rain gauge and the sensor is not operating, **PNO** is coded.
- When automated stations are equipped with a freezing rain sensor and the sensor is not operating, the remark **FZRANO** is coded.
- When automated stations are equipped with a lightning detection system and the sensor is not operating, the remark **TSNO** is coded.
- When automated stations are equipped with a secondary visibility sensor and the sensor is not operating, the remark **VISNO LOC** is coded.
- When automated stations are equipped with a secondary ceiling height indicator and the sensor is not operating, the remark **CHINO LOC** is coded.

3.1.5.14.1 Maintenance Indicator.

A maintenance indicator (\$) is coded when an automated system detects that maintenance is needed on the system.

3.2 Aircraft Observations and Reports.

There are two kinds of aircraft observations: Pilot Weather Reports (PIREP) and Aircraft Reports, or air-reports (AIREP). Each kind has two types:

- Routine PIREPs and Urgent PIREPs.
- Routine AIREPs and Special AIREPs.

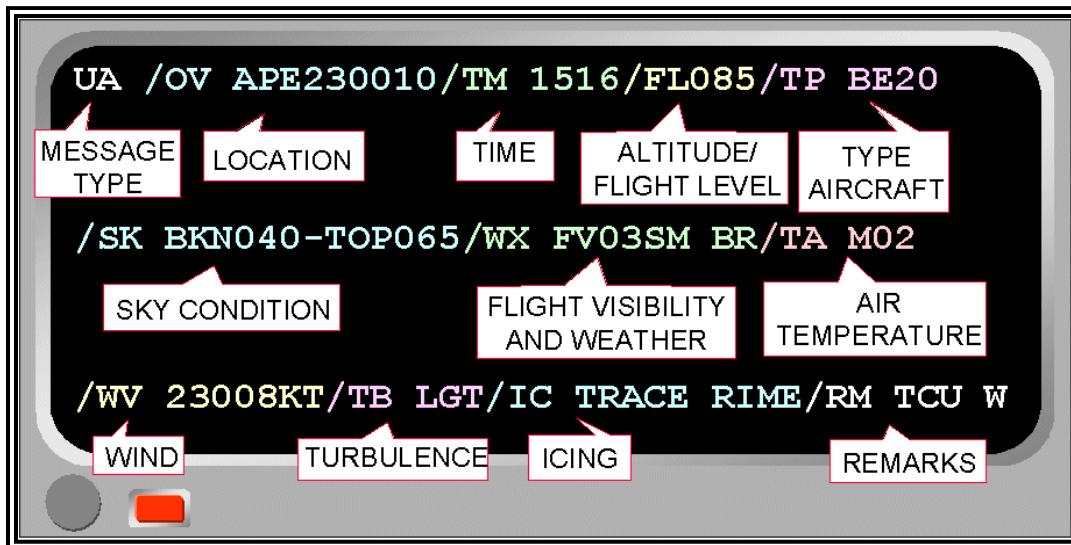
PIREPs are reported by the pilot (or aircrew), while AIREPs can either be reported by the pilot or generated from sensors onboard the aircraft (automated AIREPs). PIREPs and AIREPs are coded differently. The PIREP format is a U.S.-only format. The AIREP format is used worldwide. Automated AIREPs are common over the United States.

3.2.1 Pilot Weather Report (PIREP).

Pilots should report any observation, good or bad, to assist other pilots with flight planning and preparation. If conditions were forecasted to occur but not encountered, a pilot should also report the observed condition. This will help the NWS verify forecast products and create more accurate products for the aviation community.

A PIREP is prepared using a prescribed format (see Figure [3-5](#), Pilot Weather Report (PIREP) Coding Format). Required elements for all PIREPs are: message type, location, time, altitude/flight level, type aircraft, and at least one other element to describe the reported phenomena. The other elements are omitted when no data is reported. All altitude references are MSL unless otherwise noted. Distance for visibility is in statute miles and all other distances are in nautical miles. Time is reported in UTC.

Figure 3-5. Pilot Weather Report (PIREP) Coding Format



3.2.1.1 Message Type (UUA/UA).

The two types of PIREPs are Urgent (UUA) and Routine (UA).

3.2.1.1.1 Urgent PIREPs.

Urgent (UUA) PIREPs contain information about:

- Tornadoes, funnel clouds, or waterspouts;
- Severe or extreme turbulence (including Clear Air Turbulence (CAT));
- Severe icing;
- Hail;
- LLWS within 2,000 ft of the surface. LLWS PIREPS are classified as UUA if the pilot reports air speed fluctuations of 10 kts or more, or if air speed fluctuations are not reported but LLWS is reported, the PIREP is classified as UUA;
- Volcanic ash clouds; and/or
- Any other weather phenomena reported that are considered by the briefer as being hazardous, or potentially hazardous, to flight operations.

3.2.1.1.2 Routine PIREPs.

Routine PIREPs are issued after receiving a report from a pilot that does not contain any urgent information as listed in paragraph 3.2.1.1.1.

3.2.1.2 Location (/OV).

The Location (/OV) is the position reference where the phenomenon occurred. *It is not the location of the aircraft when the report is submitted.* Location can be referenced either by geographical position or by route segment. A position

reference is preferred by meteorologists to aid forecast precision, monitoring, and verification.

3.2.1.2.1 Location.

Location can be referenced to a very high frequency (VHF) Navigational Aid (NAVAID) or an airport, using either the three-letter IATA or four-letter ICAO identifier. If appropriate, the PIREP is encoded using the identifier, then three digits to define a radial and three digits to define the distance in nautical miles.

Examples:

/OV APE	Over Appleton Very High Frequency Omni-Directional Range Station (VOR)
/OV KJFK	Over John F. Kennedy International Airport, New York, NY
/OV APE230010	230 degrees at 10 NM from the Appleton Very High Frequency Omni-Directional Range Station (VOR)
/OV KJFK107080	107 degrees at 80 NM from John F. Kennedy International Airport, New York, NY

3.2.1.2.2 Route Segment.

A PIREP can also be referenced using two or more fixes to describe a route.

Examples:

/OV KSTL-KMKC	From Lambert-Saint Louis International Airport, MO to Charles B. Wheeler Downtown Airport, Kansas City, MO
/OV KSTL090030-KMKC045015	From 90 degrees at 30 NM from Lambert-Saint Louis International Airport, MO to 45 degrees at 15 NM from Charles B. Wheeler Downtown Airport, Kansas City, MO

3.2.1.3 Time (/TM).

Time (/TM) is the time that the reported phenomenon occurred or was encountered. It is coded in four digits UTC.

Example:

/TM 1315 1315 UTC

3.2.1.4 Altitude/Flight Level (/FL).

The altitude/flight level (/FL) is the altitude in hundreds of feet MSL where the phenomenon was first encountered. If not known, **UNKN** is entered. If the aircraft was climbing or descending, the appropriate contraction (**DURC** or **DURD**) is entered in the remarks (/RM). If the condition was encountered within a layer, the altitude range is entered within the appropriate element that describes the condition.

Examples:

/FL085	8,500 ft MSL
/FL310	Flight level 310
/FLUNKN /RM DURC	Flight level unknown, remarks, during climb

3.2.1.5 Aircraft Type (/TP).

Aircraft type (/TP) is entered. If not known, **UNKN** is entered. Icing and turbulence reports always include aircraft type.

Examples:

/TP BE20	Super King Air 200
/TP SR22	Cirrus 22
/TP P28R	Piper Arrow
/TP UNKN	Type unknown

3.2.1.6 Sky Condition (/SK).

Sky condition (/SK) group is used to report height of cloud bases, tops, and cloud cover. The height of the base of a layer of clouds is coded in hundreds of feet MSL. The top of a layer is entered in hundreds of feet MSL preceded by the word **TOP**. If reported as clear above the highest cloud layer, **SKC** is coded following the reported level.

Examples:

/BKN040-TOP065	Base of broken layer 4,000 ft MSL, top 6,500 ft MSL
/SK OVC100-TOP110/ SKC	Base of an overcast layer 10,000 ft MSL, top 11,000 ft MSL, clear above
/SK OVC015-TOP035/OVC230	Base of an overcast layer 1,500 ft MSL, top 3,500 ft MSL, base of an overcast layer 23,000 ft MSL
/SK OVC-TOP085	Overcast layer, top 8,500 ft MSL

Cloud cover amount ranges are entered with a hyphen separating the amounts, e.g., **BKN-OVC**.

Examples:

/SK SCT-BKN050-TOP100

Base of a scattered to broken layer 5,000 ft MSL, top 10,000 ft MSL

/SK BKN-OVCUNKN-TOP060/BKN120-TOP150/ SKC Base of a broken to overcast layer unknown, top 6,000 ft MSL, base of a broken layer 12,000 ft MSL, top 15,000 ft MSL, clear above

Unknown heights are indicated by the contraction **UNKN**.

Examples:

/SK OVC065-TOPUNKN

Base of an overcast layer 6,500 ft MSL, top unknown. If a pilot indicates he/she is in the clouds, IMC is entered.

/SK OVC065-TOPUNKN /RM IMC

Base of an overcast layer 6,500 ft MSL, top unknown, remark, in the clouds. When more than one layer is reported, layers are separated by a solidus (/).

3.2.1.7 Flight Visibility and Weather (**/WX**).

The pilot reports the weather conditions he or she encounters as follows: Flight visibility, when reported, is entered first in the **/WX** field. It is coded **FV** followed by a two-digit visibility value rounded down, if necessary, to the nearest whole statute mile and appended with **SM (FV03SM)**. If visibility is reported as unrestricted, **FV99SM** is entered.

Flight weather types are entered using one or more of the surface weather reporting phenomena contained in Table [3-2](#).

Example:

/WX FV01SM +DS000-TOP083/SKC /RM DURC

Flight visibility 1 sm, base heavy duststorm layer at the surface, top 8,300 ft MSL, clear above, remarks, during climb

When more than one form of precipitation is combined in the report, the dominant type is reported first.

Examples:

/WX FV00SM +TSRAGR	Flight visibility 0 sm, thunderstorm, heavy rain, hail
/WX FV02SM BRHZ000-TOP083	Flight visibility 2 sm, base of a haze and mist layer at the surface, top 8,300 ft MSL

If a funnel cloud is reported, it is coded **FC** following **/WX** group and is spelled out as **Funnel Cloud** after **/RM** group. If a tornado or waterspout is reported, it is coded **+FC** following **/WX** group and **TORNADO** or **WATERSPOUT** is spelled out after the **/RM** group.

Examples:

/WX FC /RM FUNNEL CLOUD	Funnel cloud, remarks, funnel cloud
/WX +FC /RM TORNADO	Tornado, remarks, tornado

When more than one type of weather is reported, they are reported in the following order:

- **TORNADO, WATERSPOUT, or FUNNEL CLOUD.**
- Thunderstorm with or without associated precipitation.
- Weather phenomena in order of decreasing predominance.

No more than three groups are used in a single PIREP.

Weather layers are entered with the base and/or top of the layer when reported. The same format as in the sky condition (**/SK**) group is used.

Example:

/WX FU002-TOP030	Base of a smoke layer, 200 ft MSL, top 3,000 ft MSL
------------------	---

3.2.1.8 Air Temperature (/TA).

Outside air temperature (**/TA**) is reported using two digits in degrees Celsius. Negative temperatures is prefixed with an **M** (e.g., **/TA 08** or **/TA M08**).

3.2.1.9 Wind Direction and Speed (/WV).

Wind direction and speed are encoded using three digits to indicate wind direction, relative to true north, and two or three digits to indicate reported wind speed. When the reported speed is less than 10 kts, a leading 0 is used. The wind group will always have **KT** appended to represent the units in knots.

Examples:

/WV 02009KT	Wind 20 degrees at 9 kts
/WV 28057KT	Wind 280 degrees at 57 kts
/WV 350102KT	Wind 350 degrees at 102 kts

3.2.1.10 Turbulence (/TB).

Turbulence intensity, type, and altitude are reported after wind direction and speed.

Duration (intermittent (**INTMT**), occasional (**OCNL**), or continuous (**CONS**)) is coded first (if reported by the pilot), followed by the intensity (light (**LGT**), moderate (**MOD**), severe (**SEV**), or extreme (**EXTRM**)). Range or variation of intensity is separated with a hyphen (e.g., **MOD-SEV**). If turbulence was forecast, but not encountered, negative (**NEG**) is entered.

Type is coded second. Clear Air Turbulence (**CAT**) or **CHOP** is entered if reported by the pilot. High-level turbulence not associated with clouds (including thunderstorms) is reported as **CAT**.

Altitude is reported (last) only if it differs from value reported in the altitude/flight level (/FL) group. When a layer of turbulence is reported, height values are separated with a hyphen. If lower or upper limits are not defined, **BLO** or **ABV** is used.

Examples:

/TB LGT	Light turbulence
/TB LGT 040	Light turbulence at 4,000 ft MSL
/TB OCNL MOD-SEV BLO 080	Occasional moderate to severe turbulence below 8,000 ft MSL
/TB MOD-SEV CAT 350	Moderate to severe CAT at 35,000 ft MSL
/TB NEG 120-180	Negative turbulence between 12,000 ft and 18,000 ft MSL
/TB CONS MOD CHOP 220/NEG 230-280	Continuous moderate chop at 22,000 feet MSL, negative turbulence between 23,000 ft and 28,000 ft MSL
/TB MOD CAT ABV 290	Moderate CAT above 29,000 ft MSL

Turbulence reports should include location, altitude (or range of altitudes), and aircraft type, as well as, when reported, whether in clouds or clear air. The pilot determines the degree of turbulence, intensity, and duration (occasional, intermittent, and continuous). The report should be obtained and disseminated, when possible, in conformance with the Turbulence Reporting Criteria Table in the AIM, Chapter 7, Section 1.

3.2.1.11 Icing (/IC).

Icing intensity, type, and altitude are reported after turbulence.

Intensity is coded first using contractions **TRACE**, light (**LGT**), moderate (**MOD**), or severe (**SEV**). Reports of a range or variation of intensity is separated with a hyphen. If icing was forecast but not encountered, negative (**NEG**) is coded. Icing type is reported second. Reportable types are **RIME**, clear (**CLR**), or mixed (**MX**).

The AIM, Chapter 7, Section 1 provides classification of **icing intensity** according to its operational effects on aircraft, as well as tables of **icing types** and **icing conditions**.

The reported icing/altitude is coded (last) only if different from the value reported in the altitude/flight level (/FL) group. A hyphen is used to separate reported layers of icing. Above (**ABV**) or below (**BLO**) is coded when a layer is not defined.

Pilot reports of icing should also include air temperature (/TA).

Examples:

/IC LGT-MOD MX 085	Light to moderate mixed icing, 8,500 ft MSL
/IC LGT RIME	Light rime icing
/IC MOD RIME BLO 095	Moderate rime icing below 9,500 ft MSL
/IC SEV CLR 035-062	Severe clear icing 3,500 ft to 6,200 ft MSL

3.2.1.12 Remarks (/RM).

The remarks (/RM) group is used to report a phenomenon that is considered important but does not fit in any of the other groups. This includes, but is not limited to, **LLWS** reports, thunderstorm lines, coverage and movement, lightning, sulfur dioxide (SO_2) gas smell, clouds observed but not encountered, and geographical or local descriptions of where the phenomenon occurred. Hazardous weather is reported first. LLWS is described to the extent possible.

3.2.1.12.1 Windshear.

Ten kts or more fluctuations in wind speed (+/-10KTS), within 2,000 ft of the surface, require an Urgent (**UUA**) pilot report. When LLWS is entered in a pilot report, **LLWS** is entered as the first remark in the remarks (**/RM**) group.

Example:

/RM LLWS +/-15 KT SFC-008 DURC RY22 JFK	Remarks, LLWS, air speed fluctuations of plus or minus 15 kts, surface to 800 ft during climb, Runway 22, John F. Kennedy International Airport, NY.
---	--

3.2.1.12.2 FUNNEL CLOUD, TORNADO, and WATERSPOUT.

Funnel cloud, tornado, and waterspout are entered with the direction of movement, when reported.

Example:

/RM TORNADO W MOV E	Remarks, tornado west moving east
---------------------	-----------------------------------

3.2.1.12.3 Thunderstorm.

Thunderstorm coverage is coded as isolated (**ISOL**), few (**FEW**), scattered (**SCT**), numerous (**NMRS**) followed by description as line (**LN**), broken line (**BKN LN**), solid line (**SLD LN**), when reported. This is followed with **TS**, the location and movement, and the type of lightning, when reported.

Example:

/RM NMRS TS S MOV E	Remarks, numerous thunderstorms south moving east
---------------------	---

3.2.1.12.4 Lightning.

Lightning frequency is coded as occasional (**OCNL**) or frequent (**FRQ**), followed by type as lightning in cloud (**LTGIC**), lightning cloud to cloud (**LTGCC**), lightning cloud to ground (**LTGCG**), lightning cloud to air (**LTGCA**), or combinations, when reported.

Example:

/RM OCNL LTGICCG	Remarks, occasional lighting in cloud, cloud to ground
------------------	--

3.2.1.12.5 Electrical Discharge.

For an electrical discharge, **DISCHARGE** is coded followed by the altitude.

Example:

/RM DISCHARGE 120 Remarks, discharge, 12,000 ft MSL

3.2.1.12.6 Clouds

Remarks are used when clouds can be seen but were not encountered and reported in the sky condition group (/SK).

Examples:

/RM CB E MOV N Remarks, cumulonimbus east moving north

/RM OVC BLO Remarks, overcast below

3.2.1.12.7 Plain Language

If specific phraseology is not adequate, plain language is used to describe the phenomena or local geographic locations. Remarks that do not fit in other groups like during climb (DURC), during descent (DURD), reach cruising altitude (RCA), top of climb (TOP or TOC), are included.

Examples:

/RM DONNER SUMMIT PASS

3.2.1.12.8 Volcanic Eruptions

Volcanic ash alone is an Urgent PIREP. A report of volcanic activity includes as much information as possible including the name of the mountain, ash cloud and movement, height of the top and bottom of the ash, etc., is included.

Example:

/UUA/OV ANC240075/TM 2110/FL370/TP DC10/WX VA/RM VOLCANIC ERUPTION 2008Z MT AUGUSTINE ASH 40S MOV SSE

Urgent Pilot Weather Report, 240 degrees at 75 NM from Anchorage International Airport, AK, 2110 UTC, flight level 370, a DC10 reported volcanic ash, remarks, volcanic eruption occurred at 2008 UTC Mount Augustine, ash 40 NM south moving south-southeast.

3.2.1.12.9 SKYSPOTTER

The **SKYSPOTTER** program is a result of a recommendation from the Safer Skies FAA/Industry Joint Safety Analysis and Implementation Teams. The term **SKYSPOTTER** indicates a pilot has received specialized training in observing and reporting in-flight weather phenomenon or PIREPs.

When a PIREP is received from a pilot identifying themselves as a **SKYSPOTTER** aircraft, the additional comment “/AWC” is added at the end of the remarks section of the PIREP.

An AWC-WEB/xxxx in the remarks indicates the pilot report was submitted by an airline dispatcher or Center Weather Service Unit (CWSU) meteorologist directly to the Aviation Weather Center (AWC). The xxxx represents the airline abbreviation or Air Route Traffic Control Center (ARTCC) of the CWSU that submitted the PIREP.

Example:

```
PIREP TEXT/RM REMARKS/AWC
PIREP TEXT/RM REMARKS/AWC-WEB/KZFW
```

3.2.2 Air-Reports (AIREP)

AIREPs are messages from an aircraft to a ground station. AIREPs are normally comprised of the aircraft's position, time, flight level (FL), estimated time of arrival (ETA) over its next reporting point, destination ETA, fuel remaining, and meteorological information. It is beyond the scope of this AC to describe the details of all the elements in the AIREP, but this paragraph will focus on the meteorological information.

The AWC's website provides AIREPs over the CONUS and portions of the Atlantic and Pacific Oceans.

3.2.2.1 AIREP Types and Content.

There are two types of AIREPs, routine or position report (ARP) and special (ARS). AIREPs can be reported by the pilot but the majority of routine AIREPs are automated and downlinked from the aircraft to a service provider, e.g., a flight planning company, for processing and forwarding to an airline and the NWS.

The majority of AIREPs report wind and temperature at selected intervals along the flight route, derived from onboard sensors and probes. Some aircraft are equipped with sensors and probes to measure humidity/water vapor, turbulence, and icing data.

The format for the AIREP is governed by ICAO. The AWC's website includes AIREPs on their PIREP Web page that is formatted for Web display with some weather elements decoded.

3.2.2.2 AIREP Examples.

The following examples are from <http://www.aviationweather.gov>. The actual airline's call sign was replaced with a fictitious call sign and the Special AIREP was created from the routine report.

Routine AIREP Example:

```
ARP XXX836 2443N 15516W 2229 F350 M43 315/128 TB LGT
```

ARP	Routine report
XXX836	Aircraft call sign
2423N 15516W	Location in latitude and longitude, 24 degrees 23 minutes north, 155 degrees 16 minutes west
F350	Flight level or altitude, FL350
M43	Temperature in Celsius, minus 43 °C
315/128	Wind direction (true) and speed, 315 degrees (true) and 128 kts
TB LGT	Light turbulence

Special AIREP Example:

ARS XXX836 2443N 15516W 2229 F350 M43 315/128 TB SEV

ARS Special AIREP

Same as the routine example except:

TB SEV Severe turbulence

3.3 Radar Observations.

3.3.1 Description.

Weather radar observations and their resultant images are graphical displays of precipitation and non-precipitation targets detected by weather radars. Weather Surveillance Radar-1988 Doppler (WSR-88D), also known as next generation weather radar (NEXRAD), displays these targets on a variety of products, which can be found on the websites of all NWS Weather Forecast Offices (WFO), the AWC, Storm Prediction Center (SPC), and various flight planning and weather service providers.

3.3.2 Issuance.

WSR-88D radars are continuously generating radar observations. Each radar observation, called a volume scan, consists of 5 to 14 separate elevation “tilts,” and takes between 4 and 11 minutes to generate, depending on the radar’s mode of operation. Once one observation is complete, the next one begins. Radar observation times are not standard, nor are they synchronized with other radars. The valid time of the observation is the time assigned to the product, which is the end of the last radar scan.

3.3.2.1 WSR-88D Radar (NEXRAD) Network.

The WSR-88D radar network consists of 160 radars operated by the NWS, FAA, and Department of Defense (DOD). Figure 3-6, Location of WSR-88D Weather Radar in the CONUS and Their Respective Coverage at 4,000 Feet AGL, 6,000 Feet AGL, and 10,000 Feet AGL, and Figure 3-7, Location of

WSR-88D Weather Radar Outside of the CONUS, show the location of the radars.

Figure 3-6. Location of WSR-88D Weather Radar in the CONUS and Their Respective Coverage at 4,000 Feet AGL, 6,000 Feet AGL, and 10,000 Feet AGL

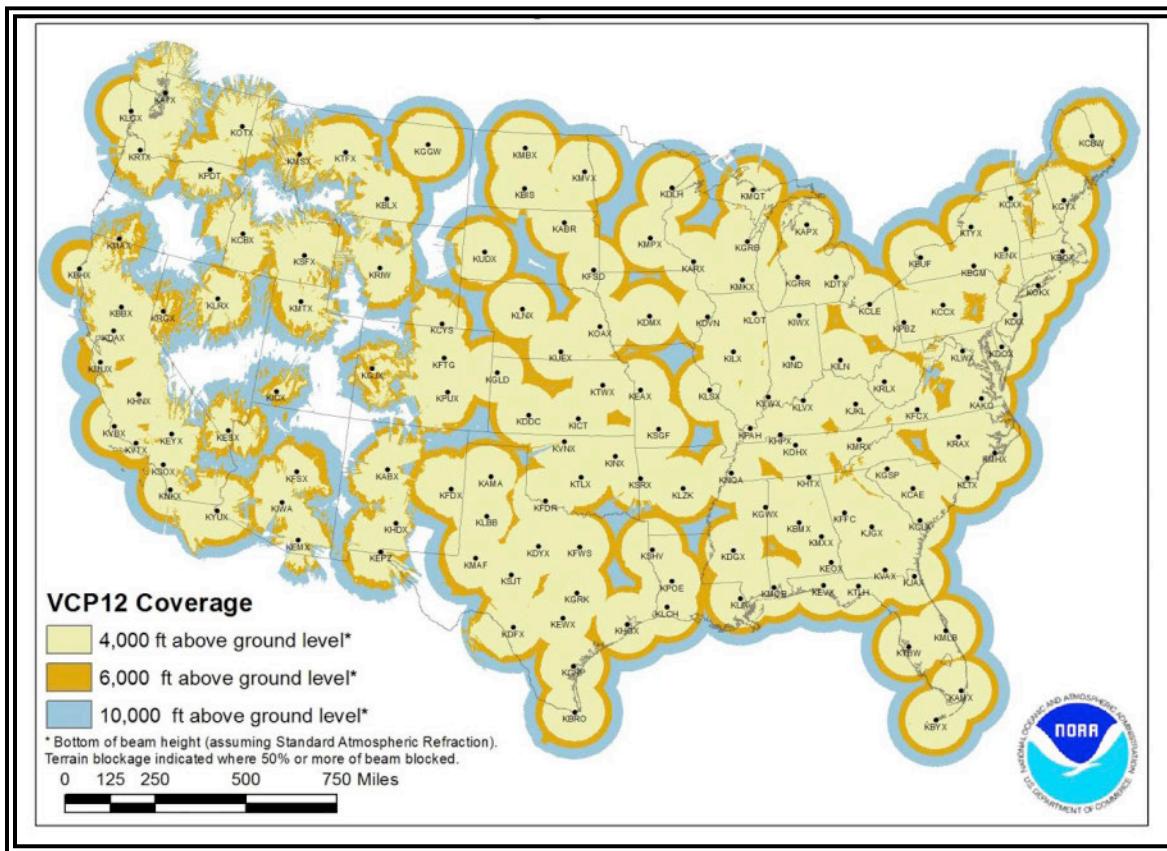
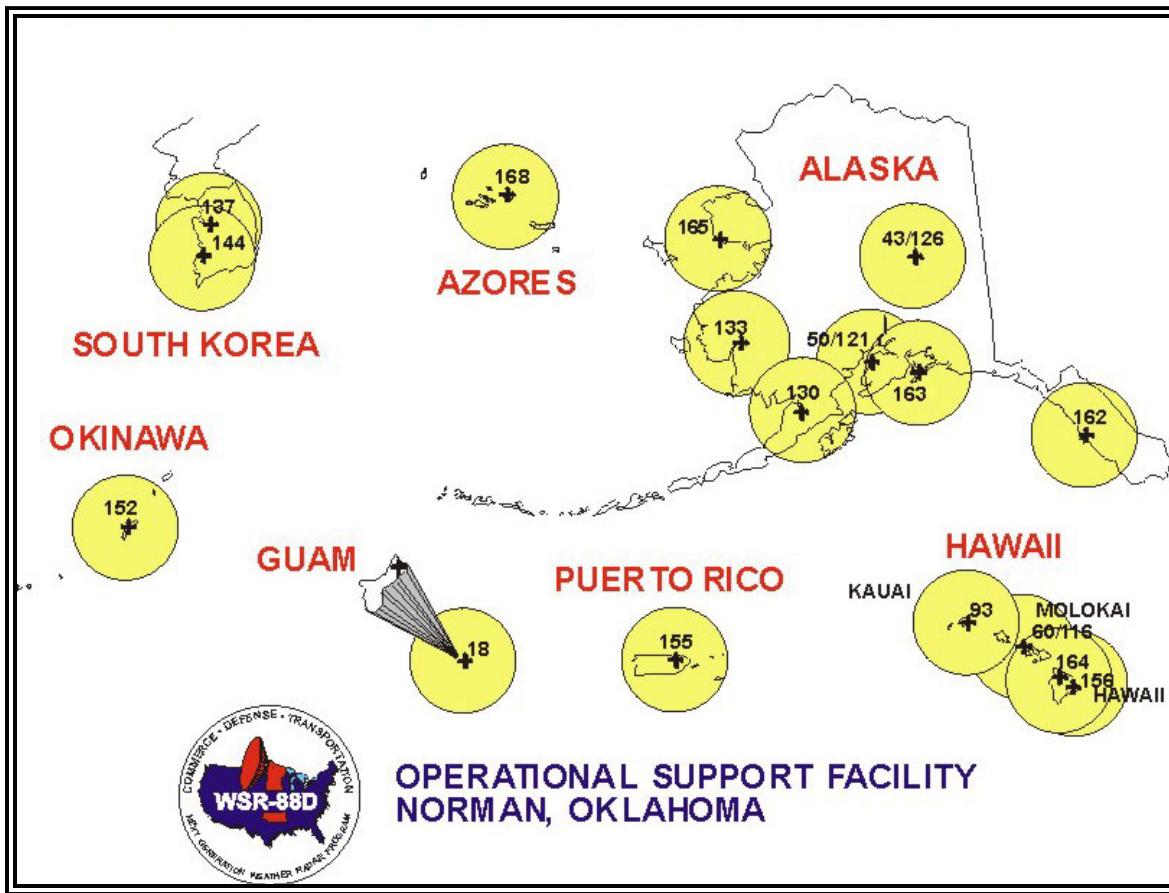


Figure 3-7. Location of WSR-88D Weather Radar Outside of the CONUS



3.3.2.2 Coverage.

Figure 3-6 depicts the radar coverage over the CONUS at 4,000 ft AGL, 6,000 ft AGL, and 10,000 ft AGL (i.e., above the height of the radar). Several WSR-88D radars are located in mountainous areas, such as the western United States. For example, the radar in southern Utah (near Cedar City) is on top of a 10,000-foot mountain. This means that the coverage begins at 10,000 ft AGL in that area. Any precipitation from low-topped clouds would not be detected by this radar due to overshooting of the radar beam (see paragraph 3.3.7.1).

3.3.3 Modes of Operation.

The WSR-88D employs scanning strategies in which the antenna automatically raises to higher and higher preset angles, or elevation scans, as it rotates. These elevation scans comprise a **volume coverage pattern** (VCP). Once the radar sweeps through all elevation slices, a volume scan is complete. The WSR-88D radar can use several VCPs.

There are two main classes of VCPs, which are commonly referred to as **Clear Air** and **Precipitation** Modes.

3.3.3.1 Clear Air Mode.

In Clear Air Mode, the radar is in its most sensitive operation. This mode has the slowest antenna rotation rate, which permits the radar to sample the atmosphere longer. This slower sampling increases the radar's sensitivity and ability to detect smaller objects in the atmosphere. The term "clear air" does not imply "no precipitation" mode. Even in Clear Air Mode, the WSR-88D can detect light, stratiform precipitation (e.g., snow) due to the increased sensitivity.

Many of the radar returns in Clear Air Mode are airborne dust and particulate matter. The WSR-88D images are updated approximately every 10 minutes when operating in this mode.

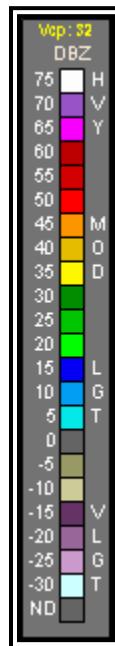
3.3.3.2 Precipitation Mode.

Precipitation targets typically provide stronger return signals to the radar than non-precipitation targets. Therefore, the WSR-88D is operated in Precipitation Mode when precipitation is present, although some non-precipitation echoes can still be detected in this operating mode.

The faster rotation of the WSR-88D in Precipitation Mode allows images to update at a faster rate approximately every 4 to 6 minutes.

3.3.4 Echo Intensities.

Figure 3-8. WSR-88D (NEXRAD) Weather Radar Echo Intensity Legend



The colors on radar images represent the reflective power of the precipitation target. In general, the amount of radar power received is proportional to the intensity of the precipitation. This reflective power, commonly referred to by meteorologists as

“reflectivity,” is measured in terms of decibels (dBZ). A decibel is a unit that describes the change of power emitted versus the power received. Since the power emitted is constant, the power received is related to the intensity of the precipitation target. Each reflectivity image includes a color scale that describes the relationship among reflectivity value, color on the radar image, and precipitation intensity. Figure 3-8, WSR-88D (NEXRAD) Weather Radar Echo Intensity Legend, depicts the correlations for most NWS radar images. The scale ranges from -30 dBZ to greater than 75 dBZ. The scale also includes **ND** correlated to black, which indicates no data was measured. The colors and decibel scale can vary depending on the service provider and website.

Reflectivity is correlated to intensity of precipitation. For example, in Precipitation Mode, when the decibel value reaches 15, light precipitation is present. The higher the indicated reflectivity value, the higher the rainfall rate. The interpretation of reflectivity values is the same for both Clear Air and Precipitation Modes.

Reflectivity is also correlated with intensity terminology (phraseology) for air traffic control (ATC) purposes. Table 3-7, WSR-88D Weather Radar Precipitation Intensity Terminology, defines this correlation.

Table 3-7. WSR-88D Weather Radar Precipitation Intensity Terminology

Reflectivity (dBZ) Ranges	Weather Radar Echo Intensity Terminology
<30 dBZ	Light
30-40 dBZ	Moderate
>40-50 dBZ	Heavy
50+ dBZ	Extreme

Note: En route ATC radar's weather and radar processor (WARP) does not display light precipitation.

Values below 15 dBZ are typically associated with clouds. However, they may also be caused by atmospheric particulate matter such as dust, insects, pollen, or other phenomena. The scale **cannot** reliably be used to determine the intensity of snowfall. However, snowfall rates generally increase with increasing reflectivity.

3.3.5 Radar Products.

The NWS produces many radar products that serve a variety of users. Some of these products are of interest to the aviation community. This paragraph will discuss **radar mosaics**, **Composite Reflectivity**, **Base Reflectivity**, and the **radar coded message** products.

3.3.5.1 **Radar Mosaic.**

A radar mosaic consists of multiple single-site radar images combined to produce a radar image on a regional or national scale. Regional and national mosaics can be found on the websites of NWS, AWC, all NWS WFOs, as well as commercial aviation weather providers.

Radar mosaics can be assembled from either **Composite Reflectivity** (see paragraph [3.3.5.2](#)) or **Base Reflectivity** (see paragraph [3.3.5.3](#)), depending on the website or data provider. At this time, NWS national (see Figure 3-9, NWS National Radar Mosaic Example, Which Utilizes NEXRAD Base Reflectivity) and regional (see Figure [3-10](#), NWS Regional Radar Mosaic Sector Example, Which Utilizes NEXRAD Base Reflectivity), and Alaska (see Figure [3-11](#), Alaska Radar Mosaic Example) radar mosaic sectors are assembled using *only* **Base Reflectivity** data (0.5° radar beam angle with a 124 NM range) and are set up to display all echoes (precipitation and non-precipitation). Most commercial aviation weather providers use **Composite Reflectivity** for their mosaics and configure the display to eliminate most non-precipitation echoes. NEXRAD radar data data-linked to aircraft cockpit displays via FAA Flight Information Service-Broadcast (FIS-B) use the **Composite Reflectivity** data for their radar mosaics.

Figure 3-9. NWS National Radar Mosaic Example, Which Utilizes NEXRAD Base Reflectivity

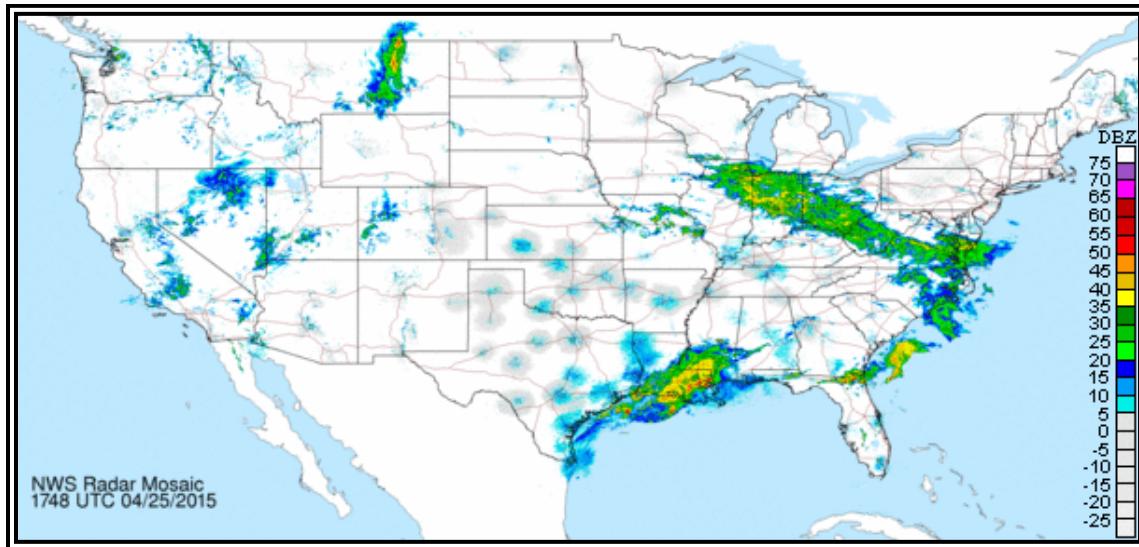


Figure 3-10. NWS Regional Radar Mosaic Sector Example, Which Utilizes NEXRAD Base Reflectivity

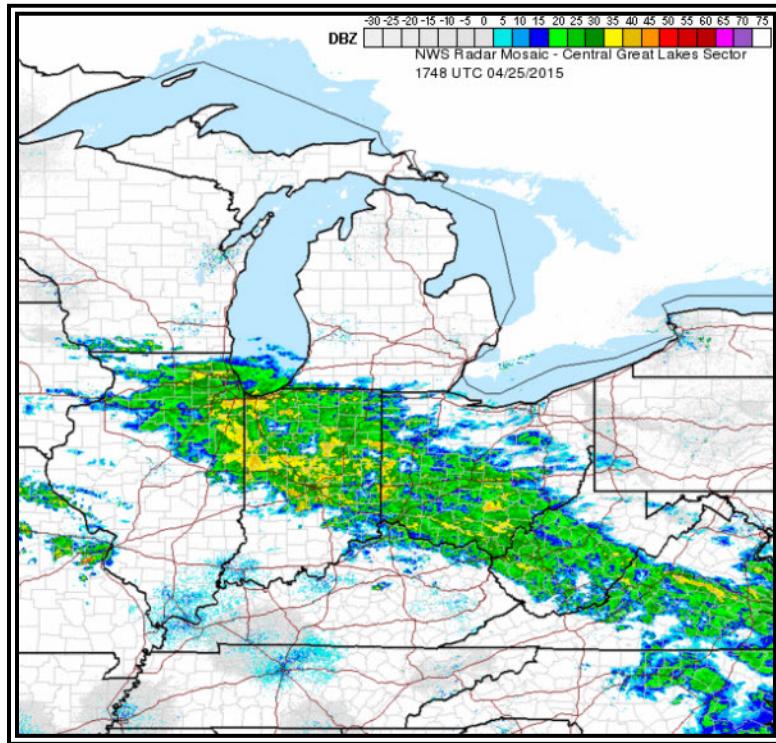
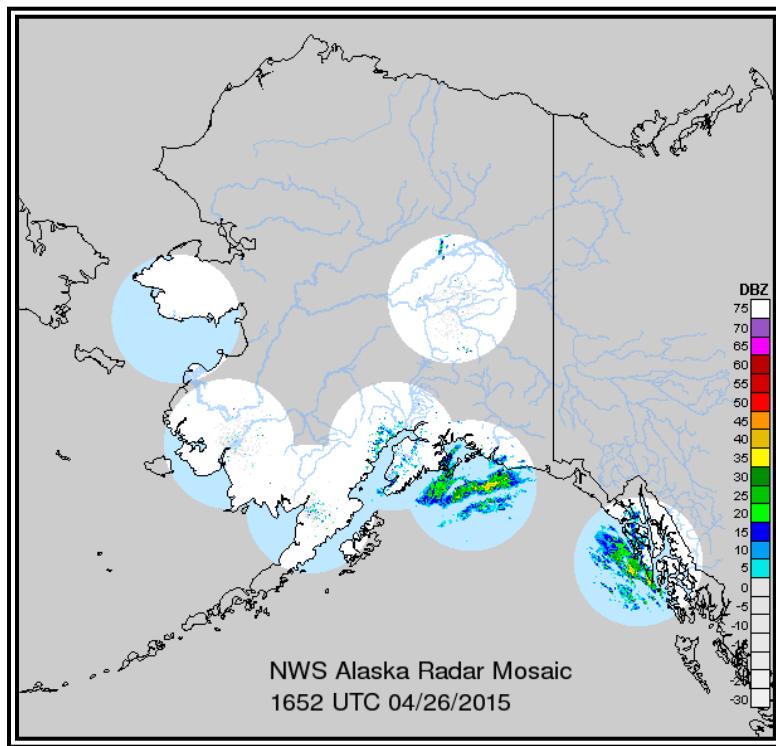


Figure 3-11. Alaska Radar Mosaic Example



Many areas of Alaska do not have radar coverage. These areas are shaded gray.

3.3.5.2 Composite Reflectivity.

Because the highest precipitation intensity can be at any altitude, the **Composite Reflectivity** product (see Figure 3-12, WSR-88D Weather Radar Composite Reflectivity, Single-Site Product Example) is needed. **Composite Reflectivity** is the maximum echo intensity (reflectivity) detected within a column of the atmosphere above a location. During its tilt sequence, the radar scans through all of the elevation slices to determine the highest decibel value in the vertical column (see Figure 3-13, Creation of a Composite Reflectivity, Single-Site Product), then displays that value on the product. When compared with **Base Reflectivity**, the **Composite Reflectivity** can reveal important storm structure features and intensity trends of storms (see Figure 3-14, Weather Radar 0.5° Base Reflectivity (left) versus Composite Reflectivity (right) Comparison).

NEXRAD radar displays on airplane avionics use the **Composite Reflectivity** data for their radar mosaics.

Figure 3-12. WSR-88D Weather Radar Composite Reflectivity, Single-Site Product Example

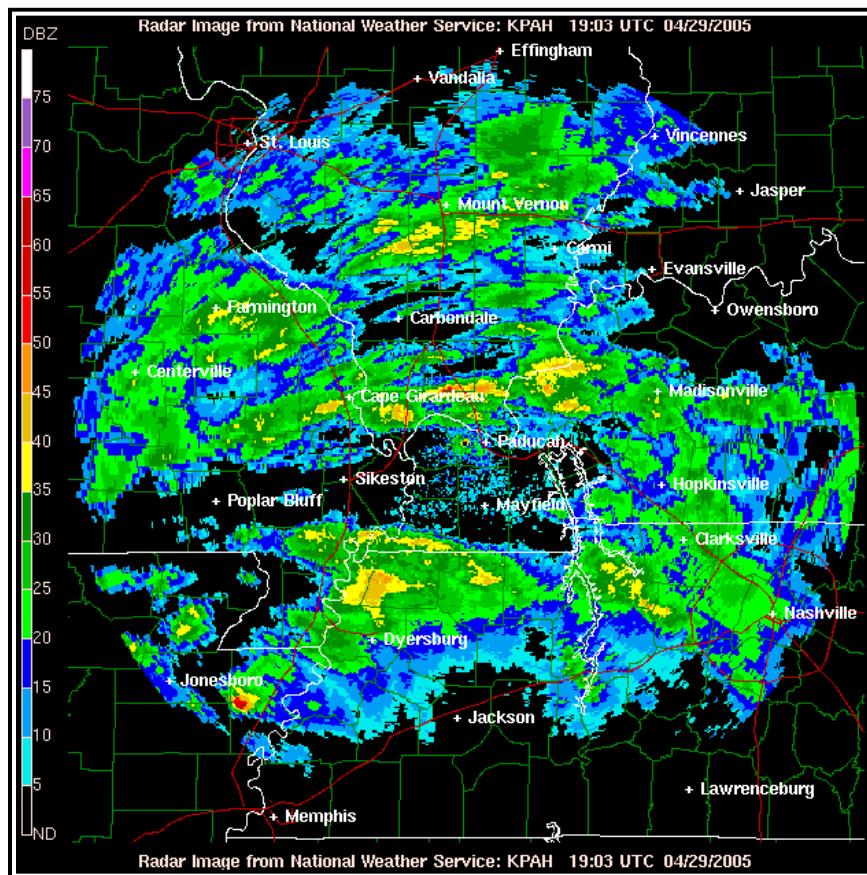
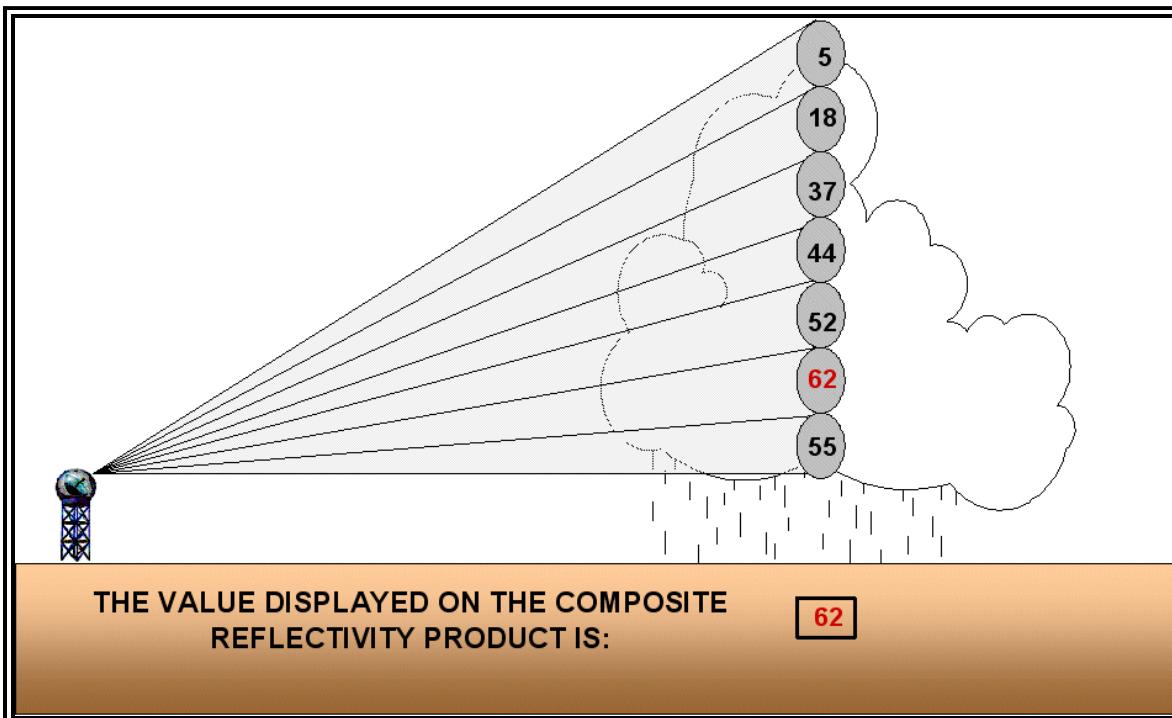
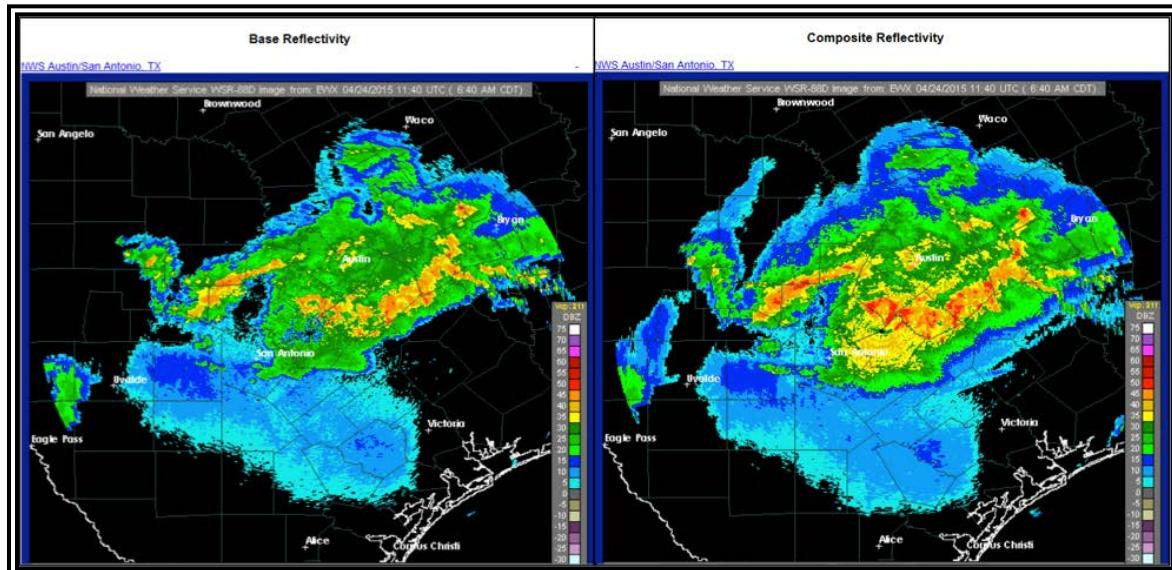


Figure 3-13. Creation of a Composite Reflectivity, Single-Site Product



The Composite Reflectivity product displays the highest reflectivity of all elevation scans.

Figure 3-14. Weather Radar 0.5° Base Reflectivity (left) versus Composite Reflectivity (right) Comparison



This Composite Reflectivity shows that in many locations the highest precipitation intensity occurs at an altitude higher than precipitation detected at the elevation of the base elevation angle.

3.3.5.3 Base Reflectivity.

Base Reflectivity product is a display of both the location and intensity of reflectivity data from the lowest elevation angle, or 0.5° above the horizon.

The **Base Reflectivity** product is one elevation scan, whereas **Composite Reflectivity** looks at **all** elevation scans. **Base Reflectivity** products are available several minutes sooner than **Composite Reflectivity** products.

Precipitation at any location may be heavier than depicted on the **Base Reflectivity** image because it is occurring above the lowest elevation angle. Both a short-range (see Figure 3-15, WSR-88D Weather Radar Short-Range (124 NM) Base Reflectivity, Single Site Product Example) and long-range (see Figure 3-16, WSR-88D Weather Radar Long-Range (248 NM) Base Reflectivity, Single Site Product Example) image are available from the 0.5° **Base Reflectivity** product. The maximum range of the short-range, single-site radar **Base Reflectivity** product is 124 NM from the radar location. Long-range, single-site, **Base Reflectivity** product's range is 248 NM from the radar location.

When using a single-site radar, i.e., not using a radar mosaic, echoes farther than 124 NM (short-range) or 248 NM (long-range) from the radar site will not be displayed, even if precipitation may be occurring at these greater distances.

Figure 3-15. WSR-88D Weather Radar Short-Range (124 NM) Base Reflectivity, Single-Site Product Example

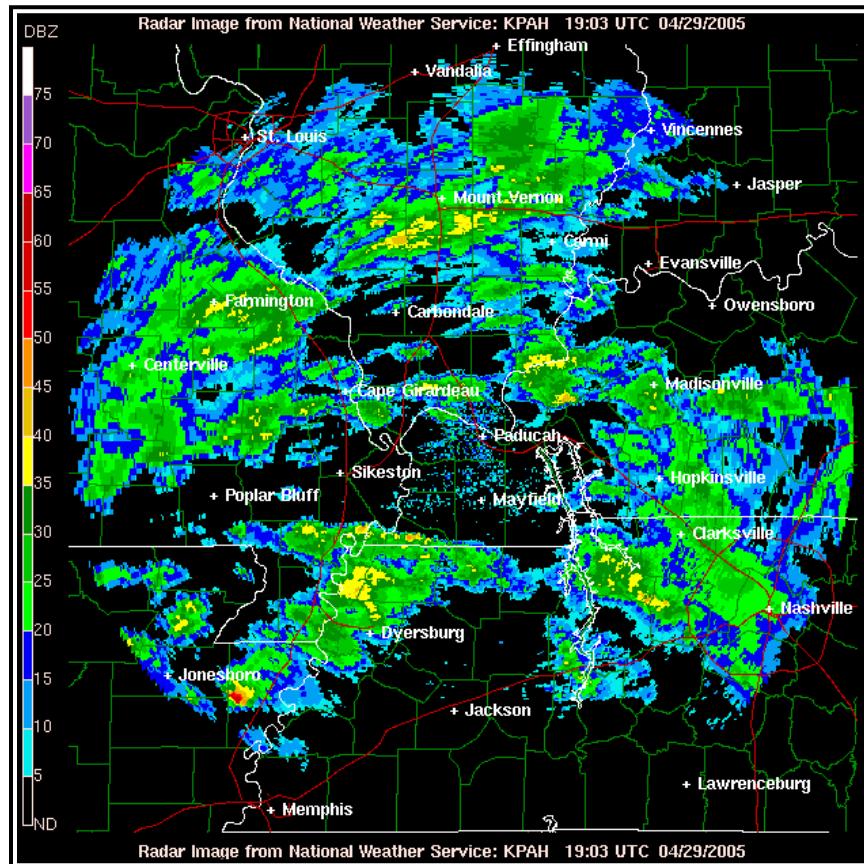
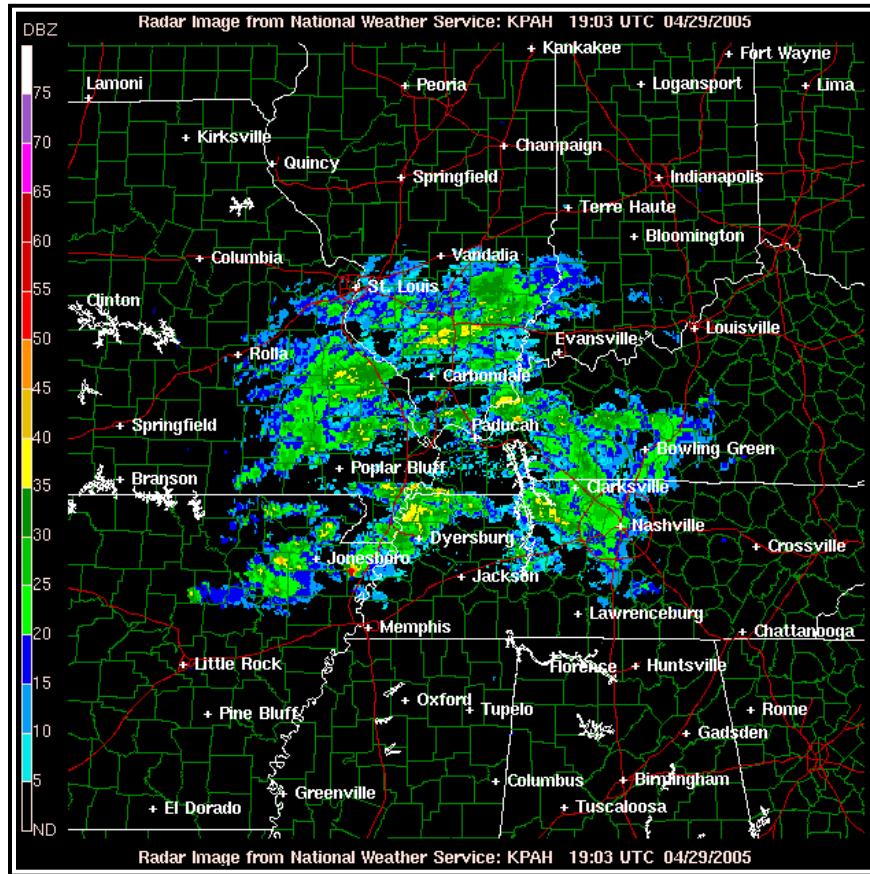


Figure 3-16. WSR-88D Weather Radar Long-Range (248 NM) Base Reflectivity, Single-Site Product Example



3.3.5.4 Radar Coded Message (RCM).

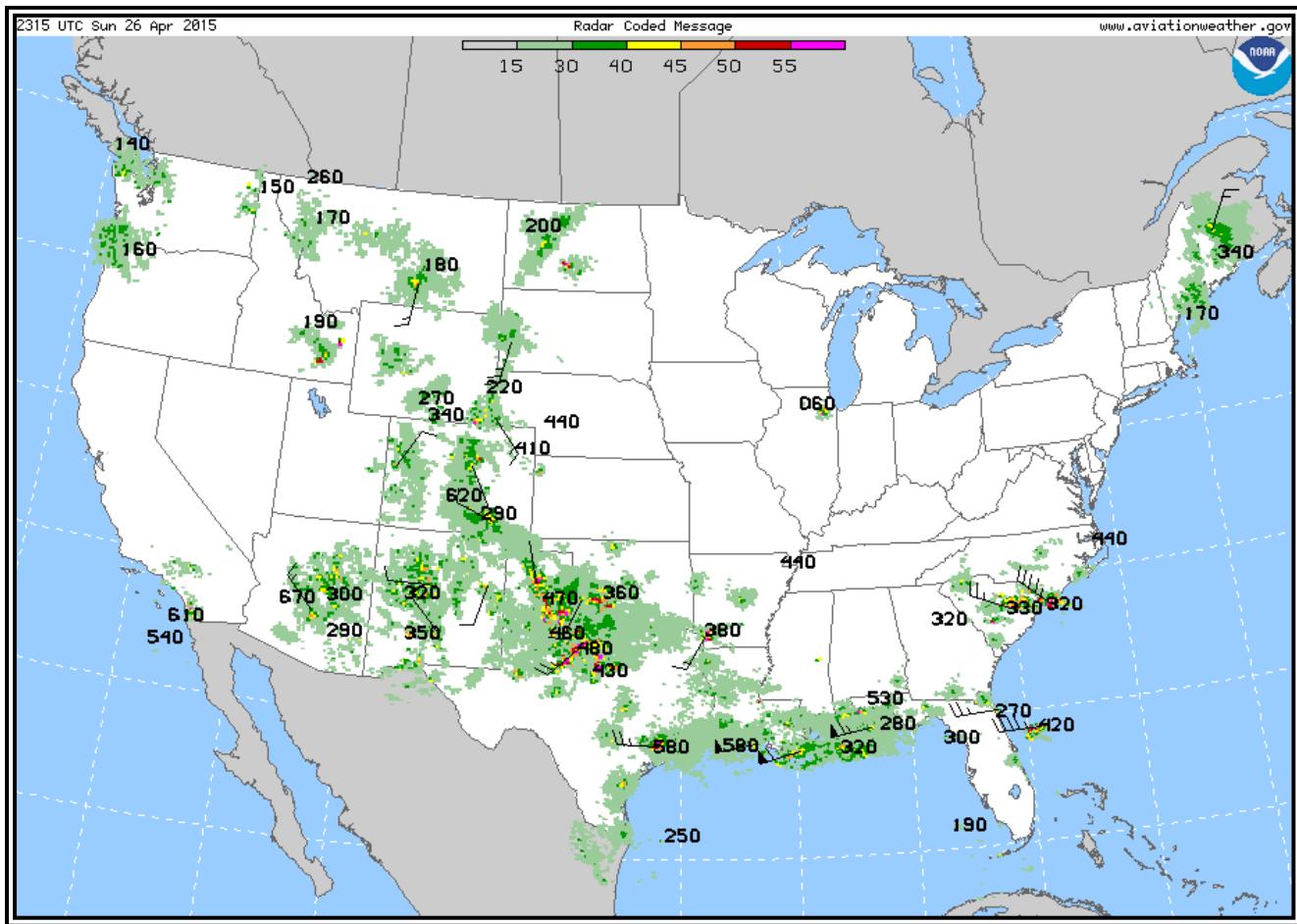
With the deployment of the WSR-88D (NEXRAD) radar network in the 1990s, the manual radar observations, known by the acronyms ROB, SD, and RAREP, was replaced by the RCM. The RCM is the encoded and transmitted report of radar features observed by a WSR-88D radar. The RCM is generated automatically and has no human input or oversight.

The actual RCM is highly detailed, complicated, and not intended for use by the pilot or operator in raw format. However, the RCM is used to generate certain radar charts or displays, such as “The Current RCM Radar Plot,” available on <http://www.aviationweather.gov> (see Figure 3-17, Radar Coded Message (RCM) Display), as well as other weather service provider’s websites.

The RCM display is updated every 30 minutes. The display is an image representation of the NEXRAD radar **Composite Reflectivity** overlaid with cloud and echo tops and centroid movement. The RCM display includes the maximum echo top for each radar’s area of coverage. The other tops shown on the display are derived from the satellite images.

The echo tops shown on the display can be erroneous in some cases. The algorithm computes echo tops (the altitude of echoes greater than or equal to 18 dBZ) within the range of the radar. This can lead to spurious values when precipitation is far from the site. Values greater than 50,000 ft (500 ft on the plot) can be disregarded, especially if their locations do not correspond to any precipitation.

Figure 3-17. Radar Coded Message (RCM) Display



The display is an image representation of the NEXRAD radar Composite Reflectivity overlaid with cloud and echo tops and centroid movement.

3.3.6 Precipitation.

3.3.6.1 **Convective Precipitation.**

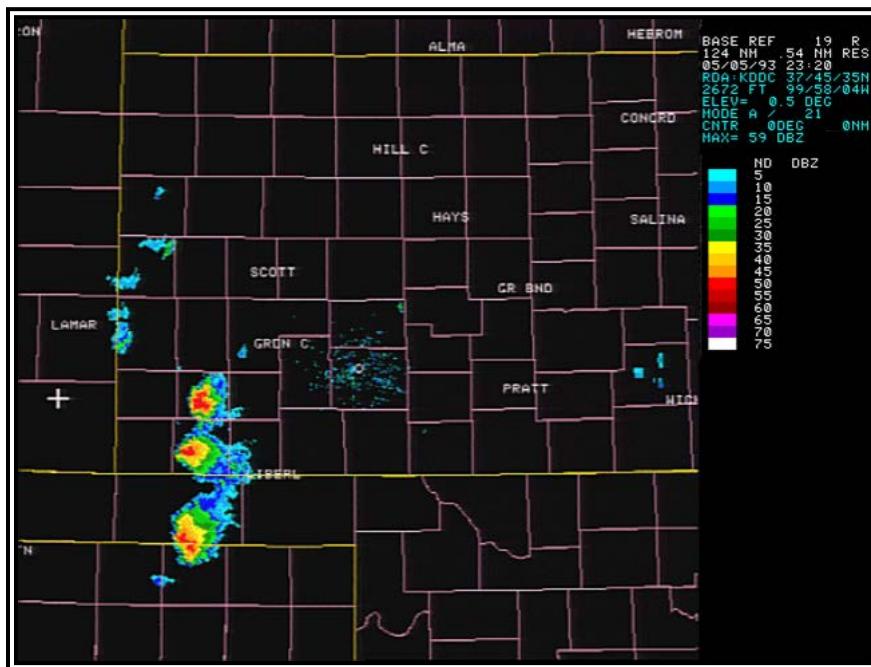
Convective precipitation (see Figure 3-18, WSR-88D Weather Radar Convective Precipitation on the 0.5° Base Reflectivity Product Example) is distinguished by the following radar characteristics:

- Echoes tend to form as lines or cells,
- Reflectivity gradients are strong,

- Precipitation intensities generally vary from moderate to extreme,
 - Occasionally precipitation intensities can be light, and
 - Echo patterns change rapidly when animating the image.

Numerous hazards are associated with Convective precipitation. They include: turbulence, LLWS, strong and gusty surface winds, icing above the freezing level, hail, lightning, tornadoes, and localized instrument flight rules (IFR) conditions below the cloud base due to heavy precipitation.

Figure 3-18. WSR-88D Weather Radar Convective Precipitation on the 0.5° Base Reflectivity Product Example

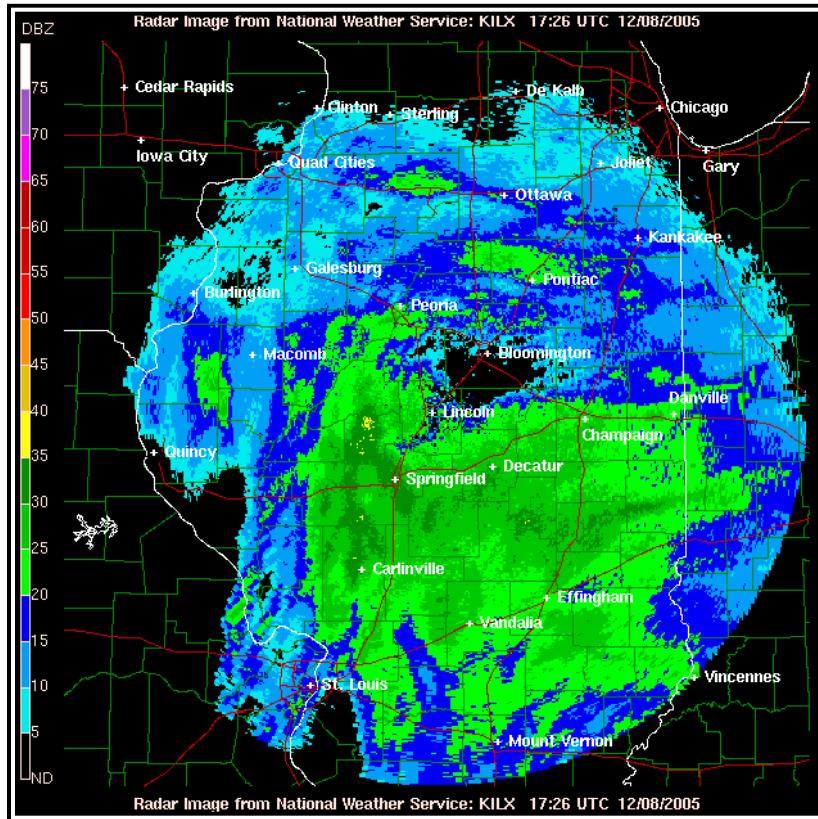


3.3.6.2 Stratiform Precipitation.

Stratiform precipitation (see Figure 3-19, WSR-88D Weather Radar Stratiform Precipitation on the 0.5° Base Reflectivity Product Example) has the following radar characteristics:

- Widespread in aerial coverage;
 - Weak reflectivity gradients;
 - Precipitation intensities are generally light or moderate (39 dBZ or less);
 - Occasionally, precipitation intensities can be stronger; and
 - Echo patterns change slowly when animating the image.

Figure 3-19. WSR-88D Weather Radar Stratiform Precipitation on the 0.5° Base Reflectivity Product Example



Hazards associated with stratiform precipitation include possible widespread icing above the freezing level, low ceilings, and reduced visibilities.

3.3.7 Limitations.

Limitations associated with **Composite Reflectivity** and **Base Reflectivity** include:

- The radar beam may overshoot or undershoot targets, and
- The image may be contaminated by:
 - Beam blockage,
 - Ground clutter,
 - Anomalous Propagation (AP),
 - Ghosts,
 - Angels, and/or
 - Other non-meteorological phenomena.

3.3.7.1 **Radar Beam Overshooting and Undershooting.**

Radar beam overshooting may occur because the lowest radar beam (typically the 0.5 degree elevation) can be higher than the top of precipitation. This will most likely occur with stratiform precipitation and low-topped convection. For

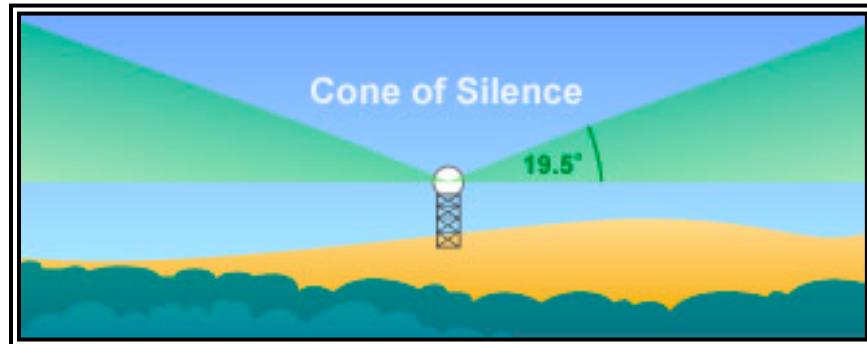
example, at a distance of 124 NM from the radar, the 0.5° radar beam is at an altitude of approximately 18,000 ft; at 248 NM the beam height is approximately 54,000 ft. Any precipitation with tops below these altitudes and distances will **not** be displayed on a single-site radar image. Therefore, it is quite possible that precipitation may be occurring where none appears on the single-site radar image.

Radar overshooting occurs more often in the mountainous western United States where some radars are located on a mountain top (e.g., the WSR-88D near Cedar City, UT).

Radar undershooting occurs when precipitation occurs above **Base Reflectivity** beam, usually with high-cloud based precipitation near the radar site. This often occurs in the western United States during the summer months.

Undershooting may occur at and near the radar site even in **Composite Reflectivity** products when the precipitation is above the highest elevation angle. This region above the radar is known as the “cone of silence” (see Figure 3-20, Cone of Silence).

Figure 3-20. Cone of Silence

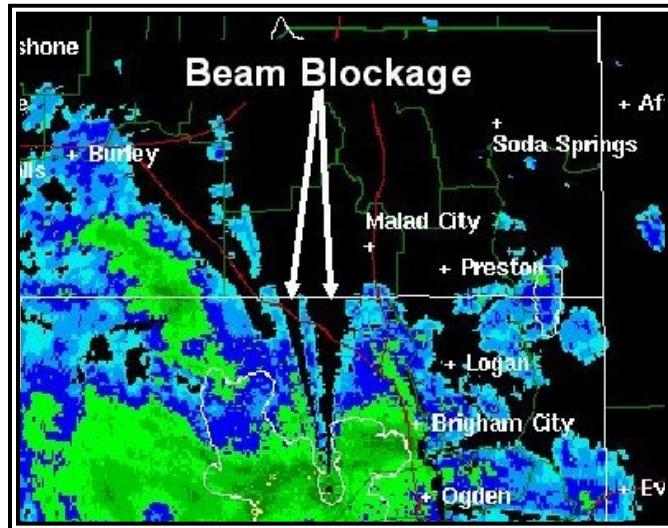


3.3.7.2 **Beam Blockage.**

Beam blockage (see Figure 3-21, WSR-88D Weather Radar Beam Blockage on Base Reflectivity Product Example) occurs when the radar beam is blocked by terrain and is particularly predominant in mountainous terrain.

Beam blockage is most easily seen on the 0.5° **Base Reflectivity** images where it appears as a pie-shaped area (or areas) perpetually void of echoes. When animating the imagery, the beam blockage area will remain clear of echoes even as precipitation and other targets pass through. In many cases, the beam blockage effect seen on a single-site radar can be minimized by viewing **mosaic** images.

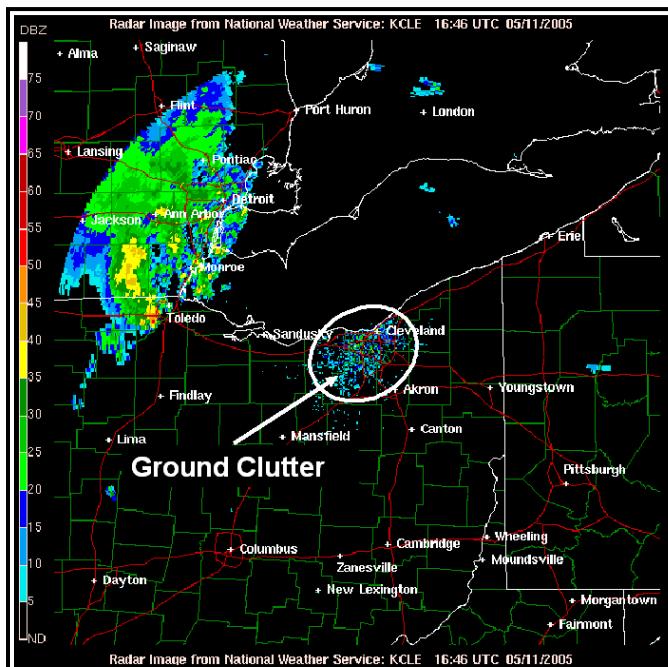
Figure 3-21. WSR-88D Weather Radar Beam Blockage on Base Reflectivity Product Example



3.3.7.3 Ground Clutter.

Ground clutter (see Figure 3-22, WSR-88D Weather Radar Ground Clutter Example) is radar echoes' returns from trees, buildings, or other objects on the ground. It appears as a roughly circular region of high reflectivity at ranges close to the radar. Ground clutter appears stationary when animating images and can mask precipitation located near the radar. Most ground clutter is automatically removed from WSR-88D imagery, so typically it is does not interfere with image interpretation.

Figure 3-22. WSR-88D Weather Radar Ground Clutter Example

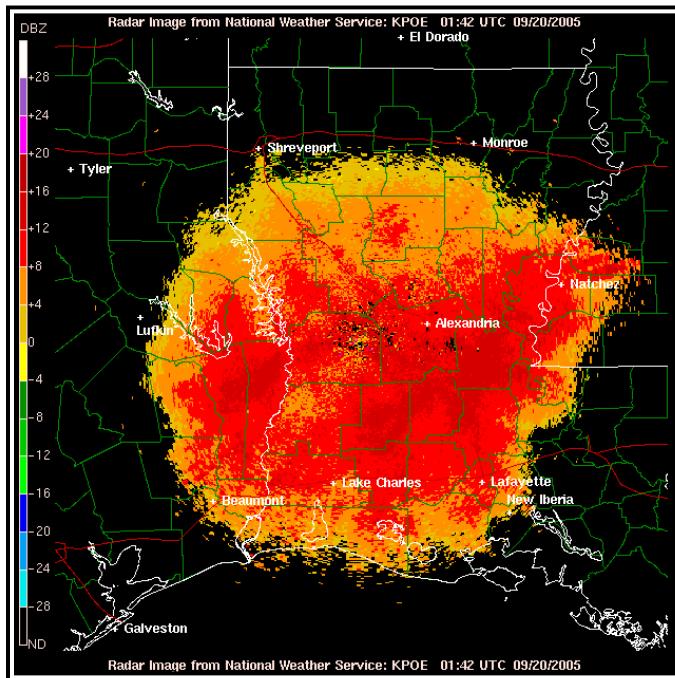


3.3.7.4 Ghost.

A ghost (see Figure 3-23, WSR-88D Weather Radar Ghost Example) is a diffused echo in apparently clear air caused by a “cloud” of point targets, such as insects or by refraction returns of the radar beam in truly clear air.

The latter case commonly develops at sunset due to super-refraction during the warm season. The ghost develops as an area of low reflectivity echoes (typically less than 15 dBZ) near the radar site and quickly expands. When animating the imagery, the ghost echo shows little movement.

Figure 3-23. WSR-88D Weather Radar Ghost Example

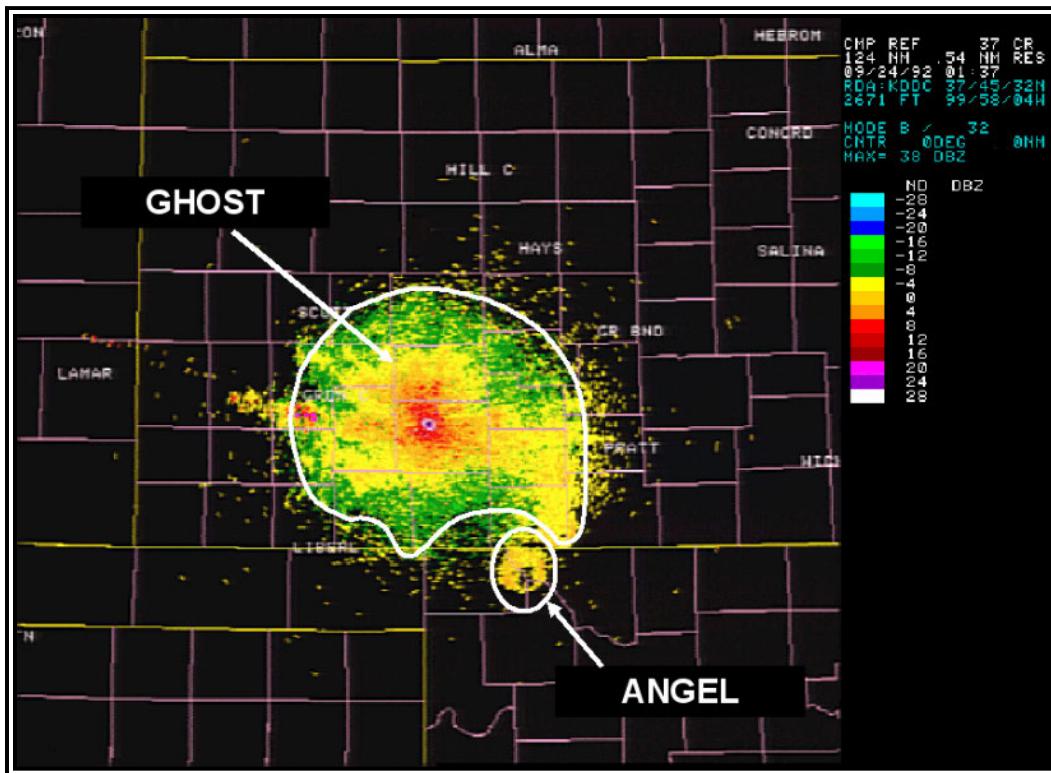


3.3.7.5 Angels.

Angels are echoes caused by a physical phenomenon not discernible by the eye at the radar site. They are usually caused by bats, birds, or insects. Angels typically appear as a donut-shaped echo with low reflectivity values (see Figure 3-24, WSR-88D Weather Radar Angel Example). When animated, the echo expands and becomes more diffuse with time.

Angels typically only appear when the radar is in Clear Air Mode because of their weak reflectivity. Echoes caused by birds are typically detected in the morning, when they take flight for the day. Echoes caused by bats are typically detected in the evening, when they are departing from caves.

Figure 3-24. WSR-88D Weather Radar Angel Example



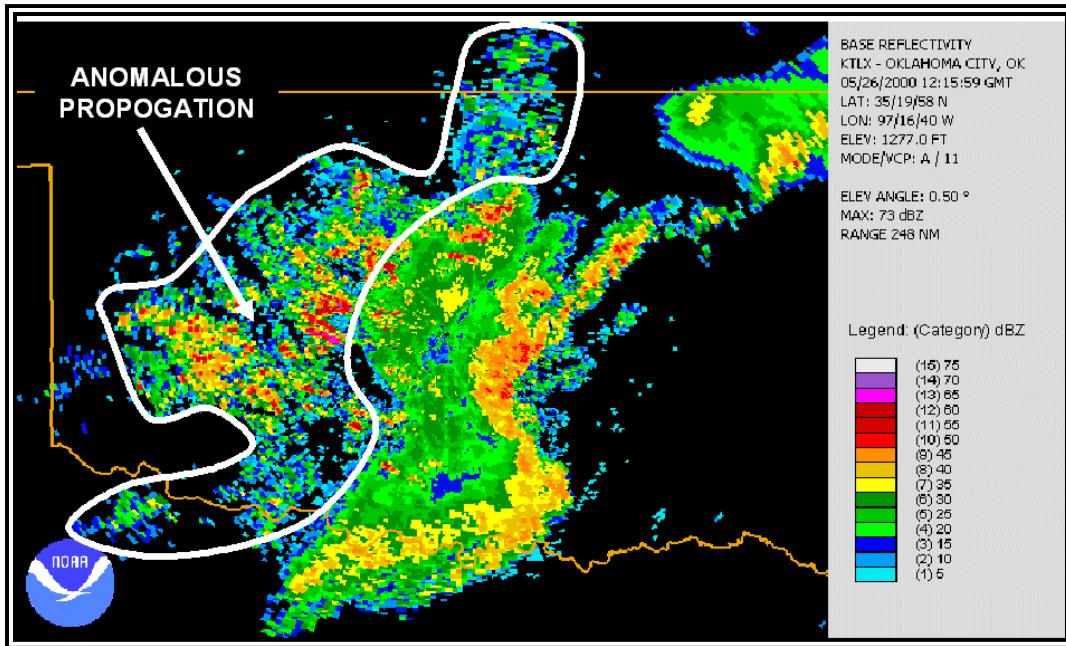
This angel was caused by bats departing Selman Bat Cave at Alabaster Caverns State Park, OK around sunset.

3.3.7.6 Anomalous Propagation (AP).

AP (see Figure 3-25, WSR-88D Weather Radar Anomalous Propagation (AP) Example) is an extended pattern of ground echoes caused by superrefraction of the radar beam. Superrefraction causes the radar beam to bend downward and strike the ground. It differs from ground clutter because it can occur anywhere within the radar's range, not just at ranges close to the radar.

AP typically appears as speckled or blotchy, high-reflectivity echoes. When animating images, AP tends to “bloom up” and dissipate, and has no continuity of motion. AP can sometimes be misinterpreted as thunderstorms; differentiating between the two is determined by animating the images. Thunderstorms move with a smooth, continuous motion while AP appears to “bloom up” and dissipate randomly.

Figure 3-25. WSR-88D Weather Radar Anomalous Propagation (AP) Example

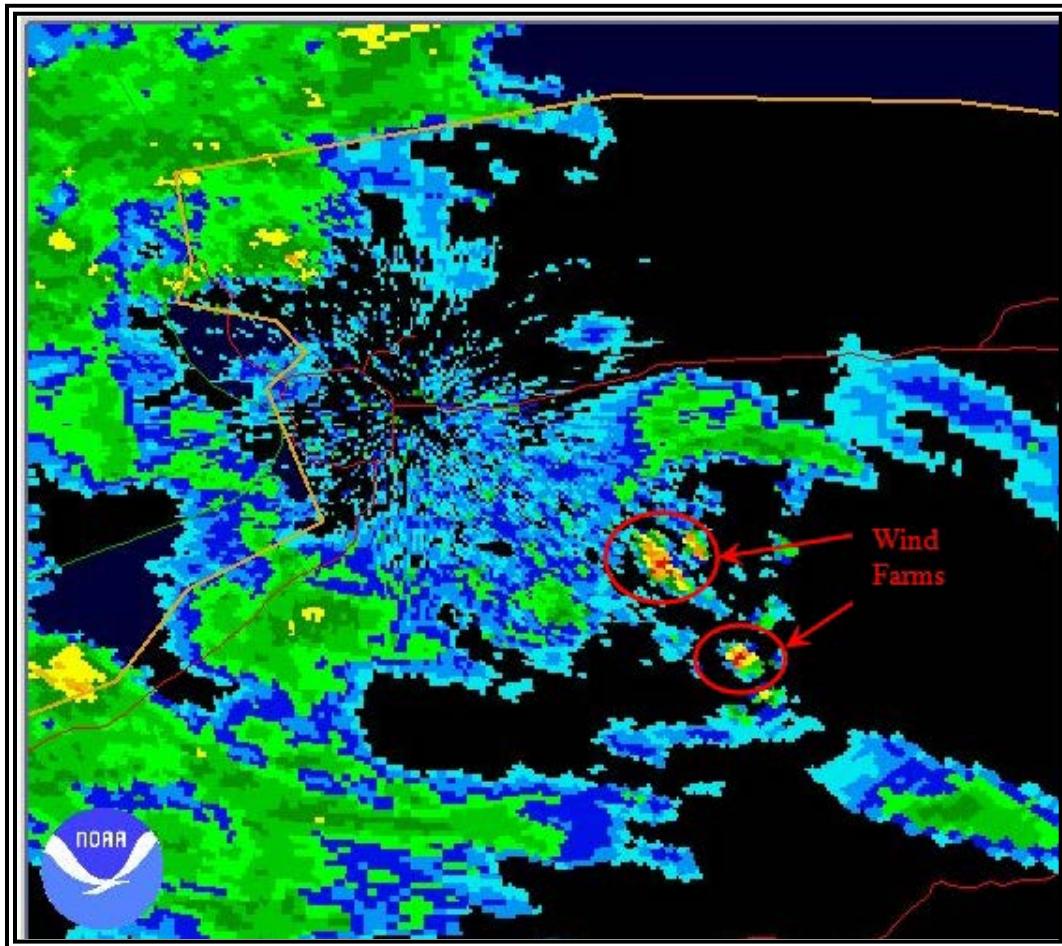


3.3.7.7 Other Non-Meteorological Phenomena.

3.3.7.7.1 Wind Farms.

Wind farms can affect the return signal of the radar beam. Depending on the proximity of the wind farm to the radar site (generally within 10 NM), wind farm turbines can result in beam blockage, false echoes, or high reflectivity values (see Figure 3-26, Wind Farms Have Been Known to Make Benign Echoes Appear as Small Storms. This Example Is from the Buffalo Radar).

Figure 3-26. Wind Farms Have Been Known to Make Benign Echoes Appear as Small Storms. This Example Is from the Buffalo Radar



3.3.8 Use.

Radar mosaic products based on Composite Reflectivity radar data provide a more complete depiction of precipitation than mosaics based on Base Reflectivity data.

3.3.9 Future Products.

The NWS is working on two new types of radar displays that are not available for description in time for publication.

3.3.9.1 Product Update Rate.

Today, composite radar images are updated after volume scans are complete (about every 5 minutes). In the future, composite radar products will be updated with every tilt sweep.

3.3.9.2 Mosaicked Composite Reflectivity.

The NWS will add mosaics of Composite Reflectivity. This is especially important for aviation as the heaviest precipitation at any altitude in the

vertical will be depicted in mosaics. Today, only the base elevation angle (i.e., closest to the ground) contributes to the mosaic.

3.3.9.3 **Hydrometeorological classification.**

The implementation of dual polarization radar across the NEXRAD system means more information about detected targets can be observed. For more information on what dual polarization is, refer to Dual-Polarization Radar Training for NWS Partners provided by the NWS Warning Decision Training Division at <http://www.wdtb.noaa.gov/courses/dualpol/Outreach/>.

Dual polarization allows the NWS to make a best guess at the precipitation type detected from a pre-defined list. The precipitation types of interest to aviation include:

- **Graupel (also known as snow pellets).** Graupel is ice crystals encased in a layer of ice. When graupel hits the ground, you can sometimes see it bounce. Graupel is formed when small cores of ice crystals fall through a region of supercooled (below freezing) liquid water droplets. These conditions are also favorable for airframe icing, thus detection of graupel implies potential icing conditions above the freezing level.
- **Hail (or hail mixed with rain).** Research is continuing to identify hail size from dual-polarization radar information.

3.4 Terminal Doppler Weather Radar (TDWR).

The TDWR network is a Doppler weather radar system operated by the FAA, which is used primarily for the detection of hazardous windshear conditions, precipitation, and winds aloft on and near major airports situated in climates with great exposure to thunderstorms in the United States. The National Centers for Environmental Information (NCEI) archives the products produced by the NWS Supplemental Product Generator (SPG) (called Level III) which are in the same data format as NEXRAD Level III. NCEI does not archive the base data (called Level II).

3.4.1 History.

TDWR was developed in the early 1990s at Lincoln Laboratory, which is part of the Massachusetts Institute of Technology (MIT). The TDWR system was funded by the FAA to assist air traffic controllers by providing real-time windshear detection and high-resolution precipitation data.

In 2004, the NWS established the policy with the FAA to allow the operational use of TDWR data and began to develop the SPG. Initial deployment of the SPG began in 2005 and finished in 2008.

As of 2016, there were 47 operational TDWR-SPG radar systems in major metropolitan locations across the United States and Puerto Rico.

3.4.2 Data Access.

3.4.2.1 Radar Data Access.

Weather radar data at NCEI are stored on a tape archive system and are accessed by placing orders through the NCEI website. There are several ordering systems available, optimized for different situations, including small orders, multisite and multiday orders, and large bulk orders. Currently, TDWR-SPG data are only available from the “Select by Site” and “Select by File” ordering systems. Small orders are typically completed in less than 15 minutes.

There are occasional gaps and missing data for each site in the archive. These gaps are caused by a number of reasons, including scheduled maintenance at the radar sites, unplanned downtime due to severe weather, communications problems, or archival problems. The data access web pages include lists or visualizations of file availability.

3.4.3 Products.

3.4.3.1 TDWR-SPG Products.

This complete list of all available data products (called Level-III products) includes descriptions and possible uses. There are 26 TDWR-SPG Level-III products routinely available from NCEI, including precipitation estimates, storm relative velocity, and echo tops.

3.4.3.2 Comparison of the TDWR to the WSR-88D.

The range resolution of the TDWR is finer than what is available in the WSR-88D or any other FAA radar that has weather channel capability. The TDWR utilizes a range gate resolution of 150 m for Doppler data. It has a resolution of 150 m for reflectivity data within 135 kilometers (km) and 300 m from beyond 135 km to 460 km. By contrast, the WSR-88D employed by the NWS, FAA, and DOD has a maximum range gate resolution of 250 m for Doppler and 1 km for surveillance data.

The angular (azimuth) resolution of the TDWR is nearly twice what is available in the WSR-88D. Each radial in the TDWR has a beam width of 0.55 degrees. The average beam width for the WSR-88D is 0.95 degrees. The following table shows a comparison of technical specifications between the TDWR and the WSR-88D.

Table 3-8. Technical Specifications: WSR-88D vs. TDWR

	WSR-88D	TDWR
Wavelength	10 cm	5 cm
Volume Scan Time	4 minutes in Volume Coverage Pattern (VCP) 12	1 min 0.2 degree, Hazard (HAZ)
Beam Width	1.25 degrees	0.5 degrees
Range Gate	0.13 NM in velocity 0.54 NM in reflectivity	0.067 NM
Max Unambiguous Velocity	Up to 62 kts	20–30 kts
Max Doppler Range	230 km	90 km

The National Oceanic and Atmospheric Administration's (NOAA) Radar Operations Center (ROC) has detailed information (<http://www.roc.noaa.gov/>).

3.4.4 How Does the Radar Collect Data?

The FAA designed the TDWR to look for low-altitude phenomena, such as wind shifts over the runways, windshear along the immediate approach and departure corridors, and downbursts. These radars are located close to major airports with the scanning strategy optimized to sample the atmosphere over its associated airport. The TDWR employs a scanning strategy called monitor mode, which is similar to the WSR-88D clear-air mode. The TDWR remains in monitor mode until one of the two following conditions are recognized:

1. A region of 20 dBZ echoes located within 24.3 NM from the associated airport with a nominal areal extent of 1.3 NM and an altitude of at least 1.3 NM AGL, or
2. The radar detects windshear or a microburst.

This is a departure from the WSR-88D operations that can switch from clear-air mode to precipitation mode if the areal coverage of precipitation exceeds an adaptable parameter anywhere on the scope. The TDWR ties its decision on the area of influence directly to its associated airport.

3.4.5 Volume Coverage Pattern (VCP) 90.

VCP 90 is the TDWR monitor mode (clear air) and consists of 17 scans in about 6 minutes. The first cut is always a low Pulse Repetition Frequency (PRF), long-range scan (276 km). All remaining scans are short range (90 km). There is a small variation in the elevation angles of the lower scans, but all scans above 5 degrees are the same in all systems. Cuts two and three employ a split cut strategy. Cut two contains no dealiased Doppler data. Cut three (at the same elevation as cut two) is the first cut to contain dealiased Doppler velocity data. The first three cuts are used to initialize wind field models and velocity unfolding algorithms.

3.4.6 Volume Coverage Pattern (VCP) 80.

VCP 80 is the TDWR hazardous mode (precipitation mode). The first cut is always a low PRF, long-range scan (276 km). Cuts two and three are the short-range, split cut scans used to collect information for unfolding and clutter migration algorithms. The first cut with dealiased Doppler data is cut three. There are two sub-volumes or aloft scans contained in each full volume, as denoted by the use of red and orange. Every fourth scan, the TDWR provides a short-range elevation scan at the same elevation as cuts two and three.

3.4.7 Where Can I Get Details on TDWR-SPG?

1. NOAA's ROC maintains papers, presentations, and detailed information on the TDWR-SPG system (<https://www.roc.noaa.gov/spg/default.aspx>).
2. Details on a subset of the TDWR-SPG products are available in the [Federal Meteorological Handbook No. 11 \(FMH-11\)](#), Doppler Radar Meteorological Observations (WSR-88D). The handbooks are available for download from the Office of the Federal Coordinator for Meteorology (OFCM) (<http://www.ofcm.gov/>).
3. NCEI provides descriptions and possible uses of radar products generated from the TDWR network operated by the FAA. All data are available digitally at NCEI for free (visit <http://www.ncdc.noaa.gov/nexradinv/>) and paper copies are available for purchase. Certification of the paper data is also available at <https://www.ncdc.noaa.gov/customer-support/certification-data>.

3.4.8 TDWR Level-II (Base) Data.

The TDWR Level-II Base Data is not available from NCEI.

3.4.9 TDWR Level-III Products.

There are 26 TDWR Level-III products routinely available from NCEI. Most Level-III products are available as digital images, color hard copy, grayscale hard copy, or acetate overlay copies. Each copy will include state, county, and city background maps. The Certification of Data page (<https://www.ncdc.noaa.gov/customer-support/certification-data>) has further information on hard copy radar products, pricing, and certification information. A detailed list of Level-III product codes is also available at <http://www1.ncdc.noaa.gov/pub/data/radar/RadarProductsDetailedTable.pdf>.

Brief descriptions and possible uses of these products are included below.

3.4.9.1 General Products.

General products include Base Reflectivity and Base Velocity, as well as graphical products derived from algorithms, including Spectrum Width, Vertically Integrated Liquid, and the Velocity Azimuth Display (VAD) Wind Profile.

3.4.9.1.1 Digital Base Reflectivity (TR0, TR1, TR2/181).

A display of echo intensity measured in decibels. These products are used to detect precipitation, evaluate storm structure, locate boundaries, and

determine hail potential. The three lowest elevation angles are available, with a maximum range of 48 NM.

3.4.9.1.2 Digital Base Velocity (TV0, TV1, TV2/182).

A measure of the radial component of the wind either toward the radar (negative values) or away from the radar (positive values). Cool colors (green) represent negative values and warm colors (red) represent positive values. These products are used to estimate wind speed and direction, locate boundaries, locate severe weather signatures, and identify suspected areas of turbulence. The three lowest elevation angles are available, with a maximum range of 48 NM.

3.4.9.1.3 Long Range Digital Base Reflectivity (T2L/186).

Digital Reflectivity data are measured at an elevation angle of 0.6 degrees with a maximum range of 225 NM.

3.4.9.1.4 Composite Reflectivity (NCR/37).

A display of maximum reflectivity for the total volume within the range of the radar. This product is used to reveal the highest reflectivity in all echoes, examine storm structure features, and determine intensity of storms.

3.4.9.1.5 Vertically Integrated Liquid (NVL/57).

The water content of a 2.2 x 2.2 NM column of air, which is color-coded and plotted on a 124-NM map. This product is used as an effective hail indicator, to locate most significant storms, and to identify areas of heavy rainfall.

3.4.9.1.6 Echo Tops (NET/41).

An image of the echo top heights color-coded in user-defined increments. This product is used for a quick estimation of the most intense Convection and higher echo tops, as an aid in identification of storm structure features, and for pilot briefing purposes.

3.4.9.1.7 VAD Wind Profile (NVW/48).

A graphic display of windbarbs plotted on a height staff in 500-ft or 1,000-ft increments. The current (far right) and up to 10 previous plots may be displayed simultaneously. This product is an excellent tool for meteorologists in weather forecasting, severe weather, and aviation.

3.4.9.2 Precipitation Products.

Precipitation products are estimated ground accumulated rainfall. Estimates are based on a reflectivity and rainfall rate relationship called Z-R (<http://www.srh.noaa.gov/mrx/research/precip/precip.php>).

3.4.9.2.1 One-Hour Precipitation (N1P/78).

A display of estimated 1 hour precipitation accumulation on a 1.1-NM x 1-degree grid using the Precipitation Processing System (PPS) algorithm. This product is used to assess rainfall intensities for flash flood warnings, urban flood statements, and special weather statements.

3.4.9.2.2 Storm Total Precipitation (NTP/80).

The estimated storm total precipitation accumulation on a 1.1-NM x 1-degree grid continuously updated since the precipitation event began. This product uses the PPS algorithm. This product is used to locate flood potential over urban or rural areas, estimate total basin runoff, and provide rainfall data 24 hours a day.

3.4.9.2.3 Digital Precipitation Array (DPA/81).

An array format of estimated 1-hour precipitation accumulations on the $\frac{1}{4}$ Lyon Federal Maybery (LFM) (4.7625 km Hydrologic Rainfall Analysis Project (HRAP)) grid. This is an 8-bit product with 255 possible precipitation values. This product is used to assess rainfall intensities for flash flood warnings, urban flood statements, and special weather statements.

3.4.9.3 **Overlay Products.**

Overlay products provide detailed information for identified storm cells.

3.4.9.3.1 Storm Structure (NSS/62).

A table displaying information on storm attributes, which include maximum reflectivity, maximum velocity at lowest elevation angle, storm overhang, mass weighted storm volume, storm area base and top, storm position, and storm tilt.

3.4.9.3.2 Hail Index (NHI/59).

A product designed to locate storms that have the potential to produce hail. Hail potential is labeled as either probable (hollow green triangle) or positive (filled green triangle). Probable means the storm is probably producing hail and positive means the storm is producing hail.

3.4.9.3.3 Digital Mesocyclone Detection Algorithm (NMD/141).

This product is designed to display information regarding the existence and nature of rotations associated with thunderstorms. Numerical output includes azimuth, range, and height of the mesocyclone.

3.4.9.3.4 Tornadic Vortex Signature (NTV/61).

A product that shows an intense gate-to-gate azimuthal shear associated with tornadic-scale rotation. It is depicted by a red triangle with numerical output of location and height.

3.4.9.3.5 Storm Tracking Information (NST/58).

A product that shows a plot of the past hour's movement, current location, and forecast movement for the next hour or less for each identified thunderstorm cell. This product is used to determine reliable storm movement.

3.4.9.4 **Radar Messages.**

Radar messages provide information about the radar status and special product data.

3.4.9.4.1 General Status Message (GSM/2).

A text message describing the status of the radar site. A reason may be provided if the radar is not transmitting.

3.4.9.4.2 Free Text Message (FTM/5).

A text message describing an upcoming, ongoing, or completed event at the radar site, including downtime, maintenance, and more.

3.4.9.4.3 Radar Status Log (RSL/152).

A running daily log of status, errors, and messages from the Radar Product Generator (RPG) and Radar Data Acquisition (RDA) processing systems.

Discussion Credit: NOAA/NCEI/ROC.

Figure 3-27. WSR-88D vs. TDWR (Image Credit: NWS)

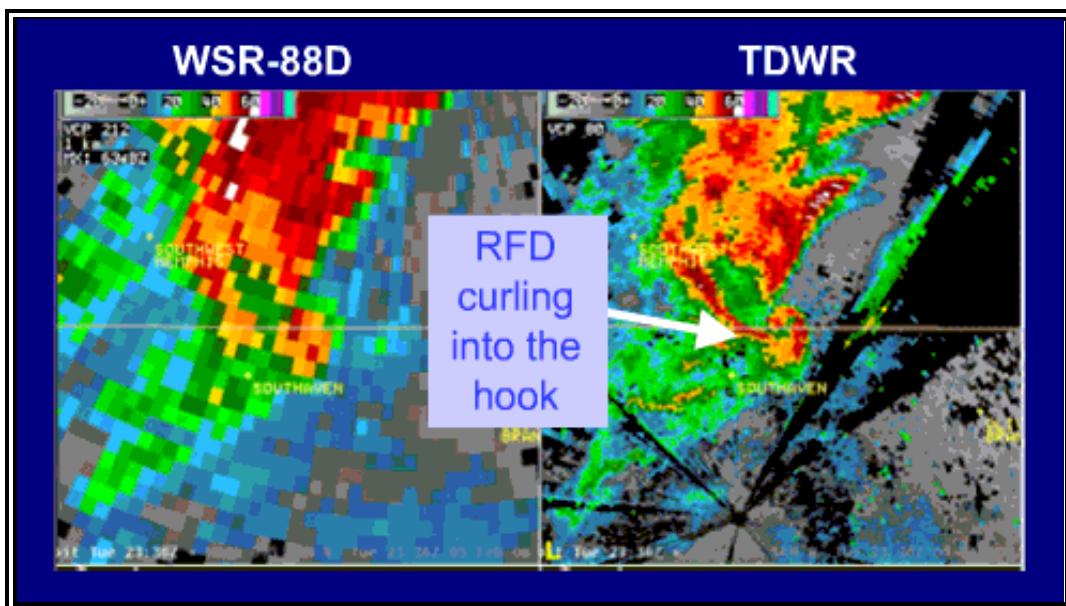
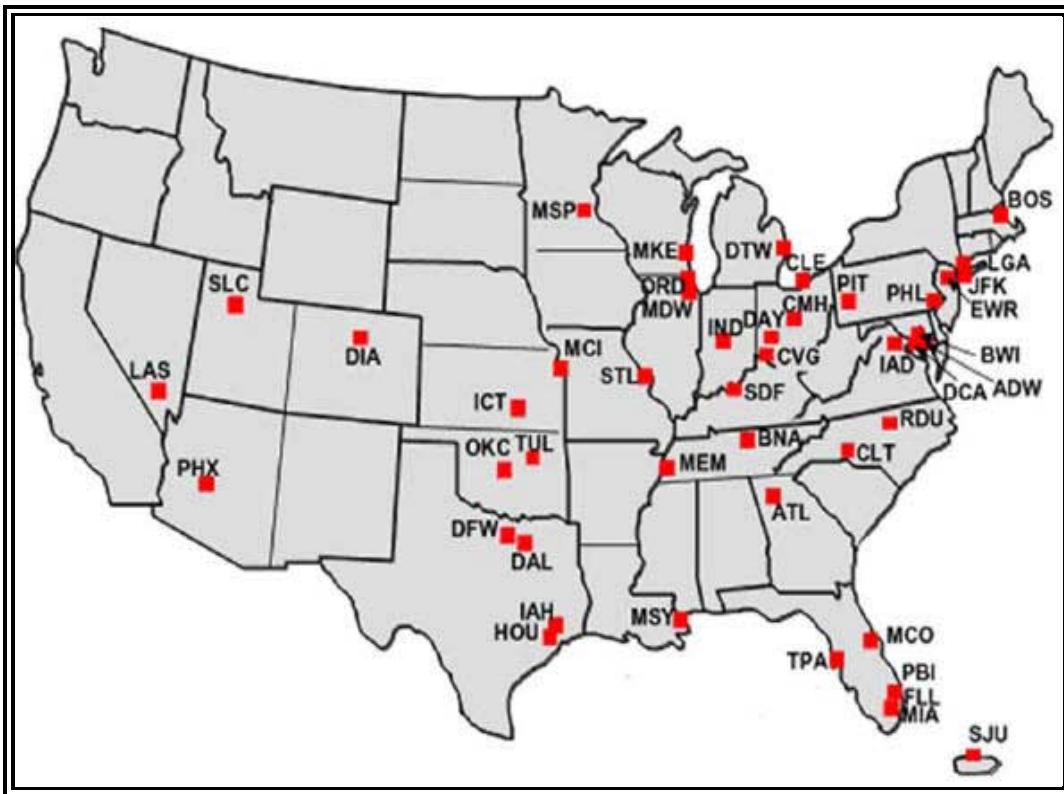


Figure 3-28. TDWR Site Locations (Image Credit: MIT Lincoln Labs)



The image below is a classic thunderstorm producing a microburst. The TDWR radar picture on the left is a vertical cross section of a storm's core. The image on the right is a visual photograph of a similar storm that produced a microburst.

Figure 3-29. Thunderstorm Producing a Microburst (Image Credit: MIT Lincoln Labs)



3.5 Satellite.

3.5.1 Description.

Satellite is perhaps the single most important source of weather data worldwide, particularly over data-sparse regions, such as countries without organized weather data collection and the oceans.

The NOAA's Geostationary Operational Environmental Satellite (GOES) imagery can be found on the AWC's website, as well as all NWS WFO websites. Additional satellite imagery for Alaska can be found on the NWS Alaska Aviation Weather Unit (AAWU) website.

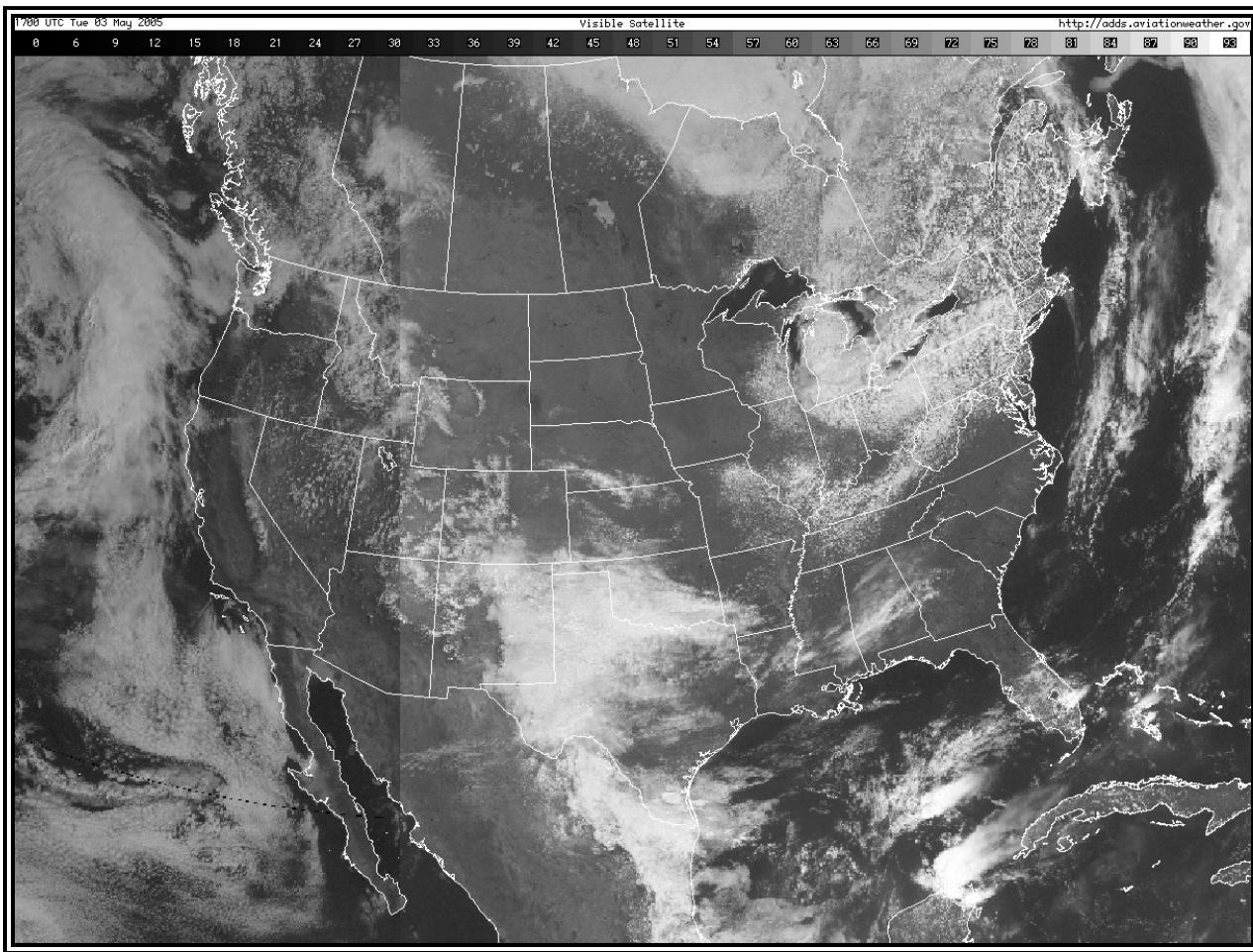
3.5.2 Imagery Types.

Three types of satellite imagery are commonly used: visible, infrared (IR), and water vapor. Visible imagery is only available during daylight hours. IR and water vapor imagery are available day or night.

3.5.2.1 **Visible Imagery.**

Visible imagery (see Figure 3-30, Visible Satellite Image—U.S. Example) displays reflected sunlight from the Earth's surface, clouds, and particulate matter in the atmosphere. Visible satellite images, which look like black and white photographs, are derived from the satellite signals. Clouds usually appear white, while land and water surfaces appear in shades of gray or black.

The visible channel senses reflected solar radiation. Clouds, the Earth's atmosphere, and the Earth's surface all absorb and reflect incoming solar radiation. Since visible imagery is produced by reflected sunlight (radiation), it is only available during daylight.

Figure 3-30. Visible Satellite Image—U.S. Example

3.5.2.1.1 Visible Image Data Legend

The data legend (see Figure 3-31, Visible Satellite Data Legend) on a visible image displays albedo, or reflectance, expressed as a percentage. For example, an albedo of 72 means 72 percent of the sunlight that struck a feature was reflected back to space.

Figure 3-31. Visible Satellite Data Legend

The gray shades (values) represent albedo, or reflectance, expressed as a percentage.

3.5.2.2 Infrared (IR) Imagery.

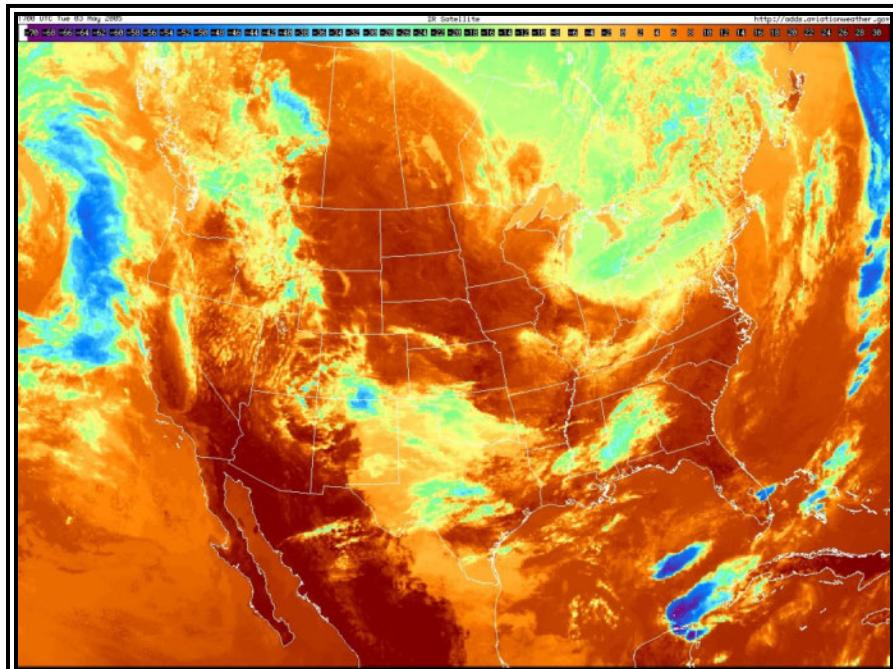
IR images (see Figure 3-32, Infrared (Color) Satellite Image—U.S. Example, and Figure 3-33, Unenhanced Infrared (Black and White) Satellite Image—U.S. Example) display temperatures of the Earth's surface, clouds, and particulate matter. Generally speaking, the warmer an object, the more IR energy it emits. The satellite sensor measures this energy and calibrates it to temperature using a very simple physical relationship.

Clouds that are very high in the atmosphere are generally quite cold (e.g., -50°C), whereas clouds very near the Earth's surface are generally quite warm (e.g., $+5^{\circ}\text{C}$). Likewise, land may be even warmer than the lower clouds (e.g., $+20^{\circ}\text{C}$). Those colder clouds emit much less IR energy than the warmer clouds and the land emits more than those warm clouds.

The data measured by satellite is calibrated and colorized according to the temperature. If the temperature of the atmosphere decreases with height (which is typical), cloud-top temperature can be used to roughly determine which clouds are high-level and which are low-level.

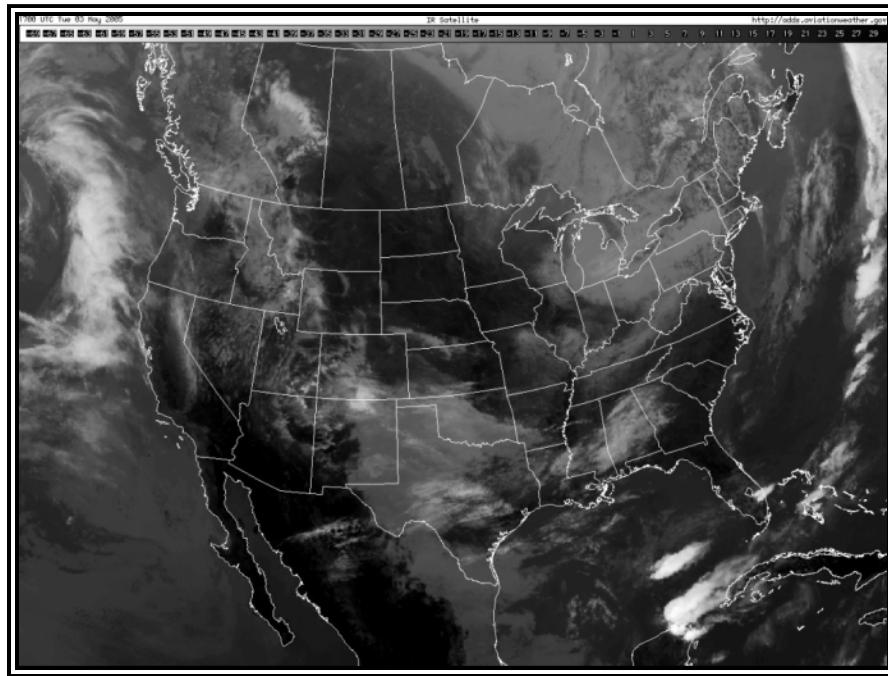
When clouds are present, the temperature displayed on the IR images is that of the tops of clouds. When clouds are not present, the temperature is that of the ground or the ocean. A major advantage of the IR channel is that it can sense energy at night, so this imagery is available 24 hours per day.

Figure 3-32. Infrared (Color) Satellite Image—U.S. Example



The scale is in degrees Celsius. Blue/purple colors indicate colder temperatures, while orange/red colors indicate warmer temperatures.

Figure 3-33. Unenhanced Infrared (Black and White) Satellite Image—U.S. Example

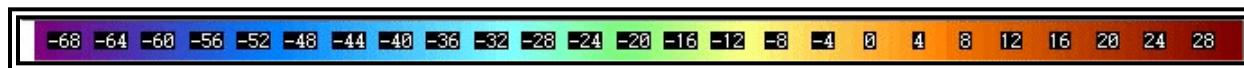


The scale is in degrees Celsius. Lighter gray shades indicate colder temperatures, while darker gray shades indicate warmer temperatures.

3.5.2.2.1 Infrared Image Data Legends.

The data legend (see Figure 3-34, Infrared (Color) Satellite Image Data Legend, and Figure 3-35, Unenhanced Infrared (Black and White) Satellite Image Data Legend) on an IR image is calibrated to temperature expressed in degrees Celsius. The legend may vary based on the satellite image provider.

Figure 3-34. Infrared (Color) Satellite Image Data Legend



The colors (values) represent temperature in degrees Celsius.

Figure 3-35. Unenhanced Infrared (Black and White) Satellite Image Data Legend



The gray shades (values) represent temperature in degrees Celsius.

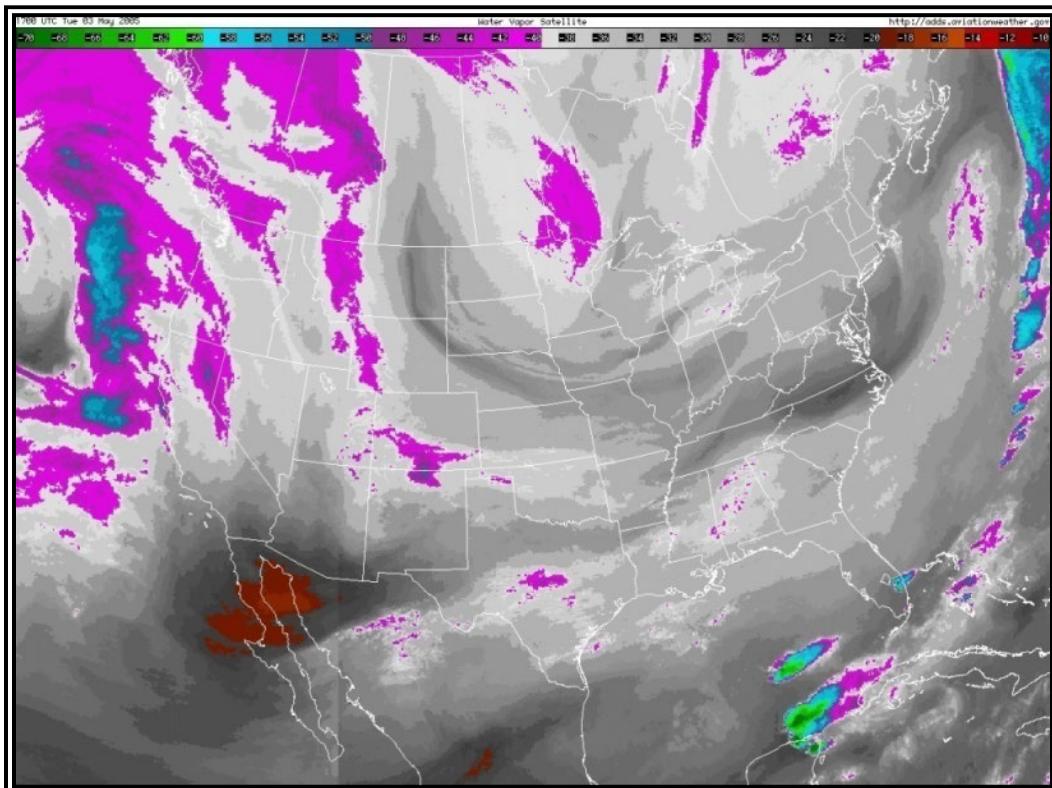
3.5.2.3 Water Vapor Imagery.

The water vapor imagery (see Figure 3-36, Water Vapor Satellite Image—U.S. Example) displays the quantity of water vapor generally located in the middle and upper troposphere within the layer between 700 mb (approximately 10,000 ft MSL) and 200 mb (approximately FL390). The actual numbers displayed on the water vapor images correspond to temperature in degrees Celsius. No direct relationship exists between these values and the temperatures of clouds, unlike IR imagery. Water vapor

imagery does not really “see” clouds, but “sees” high-level water vapor instead.

The most useful information to be gained from the water vapor images is the locations and movements of weather systems, jet streams, and thunderstorms. Another useful tidbit is aided by the color scale used on the images. In general, regions displayed in shades of red are **very** dry in the upper atmosphere and **may** correlate to crisp, blue skies from a ground perspective. On the contrary, regions displayed in shades of blue or green are indicative of a lot of high-level moisture and may also indicate cloudiness. This cloudiness could simply be high-level cirrus types or thunderstorms. That determination cannot be ascertained from this image by itself, but could easily be determined when used in conjunction with corresponding visible and IR satellite images. A major advantage of the water vapor channel is that it can sense energy at night, so this imagery is available 24 hours per day.

Figure 3-36. Water Vapor Satellite Image—U.S. Example



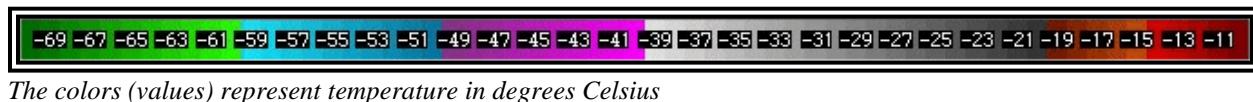
The scale is in degrees Celsius. Blue/green colors indicate moisture and/or clouds in the mid/upper troposphere, while dark gray/orange/red colors indicate dry air in the mid/upper troposphere.

3.5.2.3.1 Water Vapor Image Data Legend.

The data legend (see Figure 3-37, Water Vapor Satellite Image Data Legend) on water vapor images is calibrated to temperature expressed in degrees Celsius. The actual data values on the water vapor images are not particularly

useful. Interpretation of the patterns and how they change over time is more important. The legend may vary depending on the satellite image provider.

Figure 3-37. Water Vapor Satellite Image Data Legend



The colors (values) represent temperature in degrees Celsius

3.5.3 Polar Orbiting Environment Satellites (POES).

POES stands for the Polar Orbiting Environment Satellites, although more recently the U.S. polar satellite program has been rechristened the Joint Polar Satellite System (JPSS).

Polar satellites are not stationary. They track along various orbits around the poles. Typically, they are somewhere between 124 and 1,240 mi above the Earth's surface. The satellites scan the Earth in swaths as they pass by on their tracks.

3.5.3.1 Benefits.

Because they are so much closer to Earth, you can get very high resolution, i.e., better than 0.5 km (or ~5/8 mi). This allows for weather and surface features to be seen in much greater detail.

This is particularly useful over the poles and arctic areas. Quality of geostationary satellite data degrades the further you get from the poles, while polar data provides high resolution in those areas.

3.5.3.2 Shortfalls.

By far the most significant shortfall is the latency, or the time between the satellite scanning the area and the time that the data is available to a user. Because polar satellites are moving, they cannot continuously transmit to a single station. Instead, there are a series of stations around the globe through which the data are collected. Data is then transmitted from those stations to other locations. At times, it can be several hours (or more) old by the time it reaches operational users in the United States (in polar areas it is much quicker). There are some direct ground stations closer to the United States which can cut the latency to ~45 minutes when utilizing the newer polar satellites. For the purpose of the AWC, that is at the limit of usefulness for real-time operations.

Discussion Credit: NOAA/NWS/AWC.

3.6 Upper-Air Observations.

3.6.1 Radiosonde Observations.

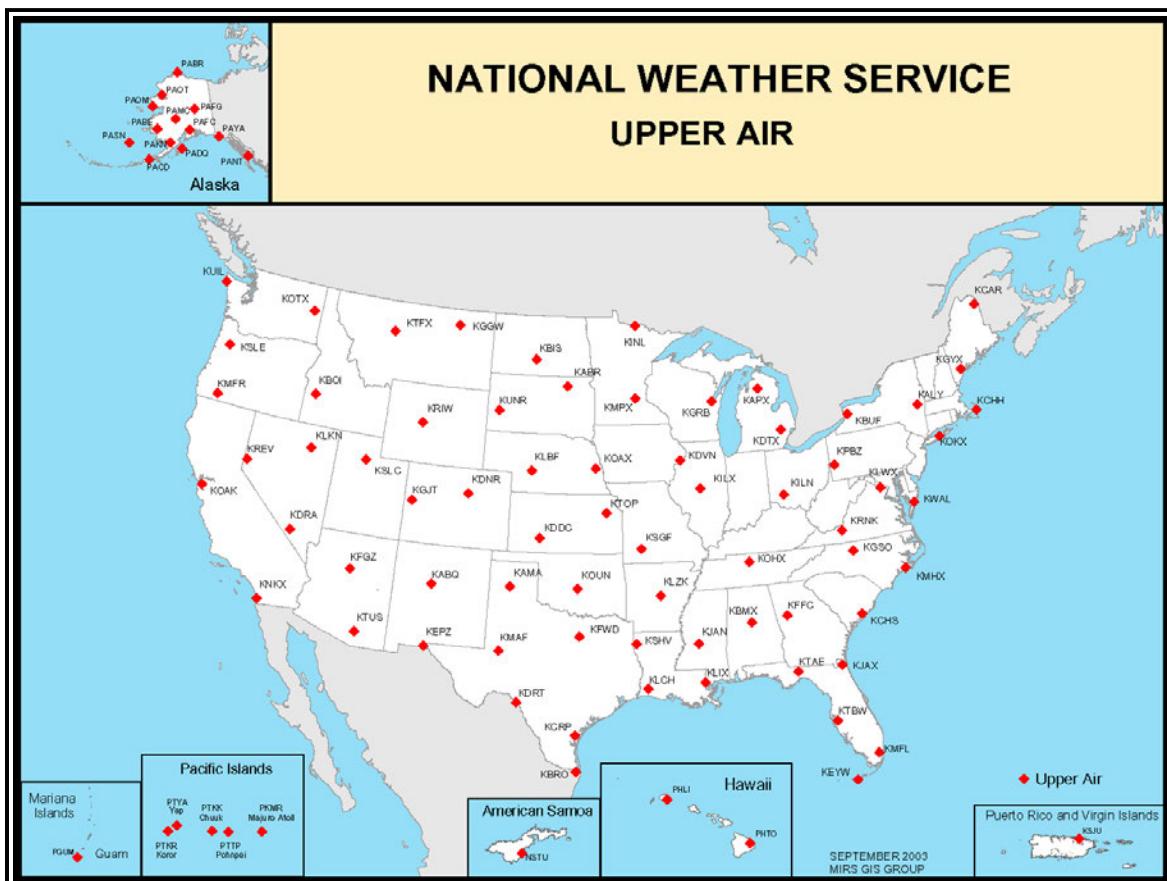
Since the late 1930s, the NWS has taken upper air observations with radiosondes attached to weather balloons. Weather data from the radiosonde are foundational to all computer model forecasts produced by the NWS.

The radiosonde is a small, expendable instrument package (weighing 100 grams (g) to 500 g) that is suspended below a large balloon inflated with hydrogen or helium gas. As the radiosonde rises at about 300 m per minute (about 1,000 ft per minute), sensors on the radiosonde measure profiles of pressure, temperature, and moisture. These sensors are linked to a battery-powered radio transmitter that sends the sensor measurements to a ground tracking antenna. Wind speed and direction aloft are also obtained by tracking the position of the radiosonde in flight using Global Positioning Satellites (GPS).

3.6.1.1 Issuance.

Weather balloons with radiosondes are launched twice a day worldwide from designated locations (see Figure 3-38, U.S. Radiosonde Network, for U.S. locations) at around 1100 UTC and 2300 UTC. It takes approximately 90 minutes for the balloon to reach an altitude of 100,000 ft. The weather data collected is assigned the observation times of 1200 UTC and 0000 UTC. Special radiosondes may be launched at select times for various reasons, including when severe weather is expected in a region.

Figure 3-38. U.S. Radiosonde Network

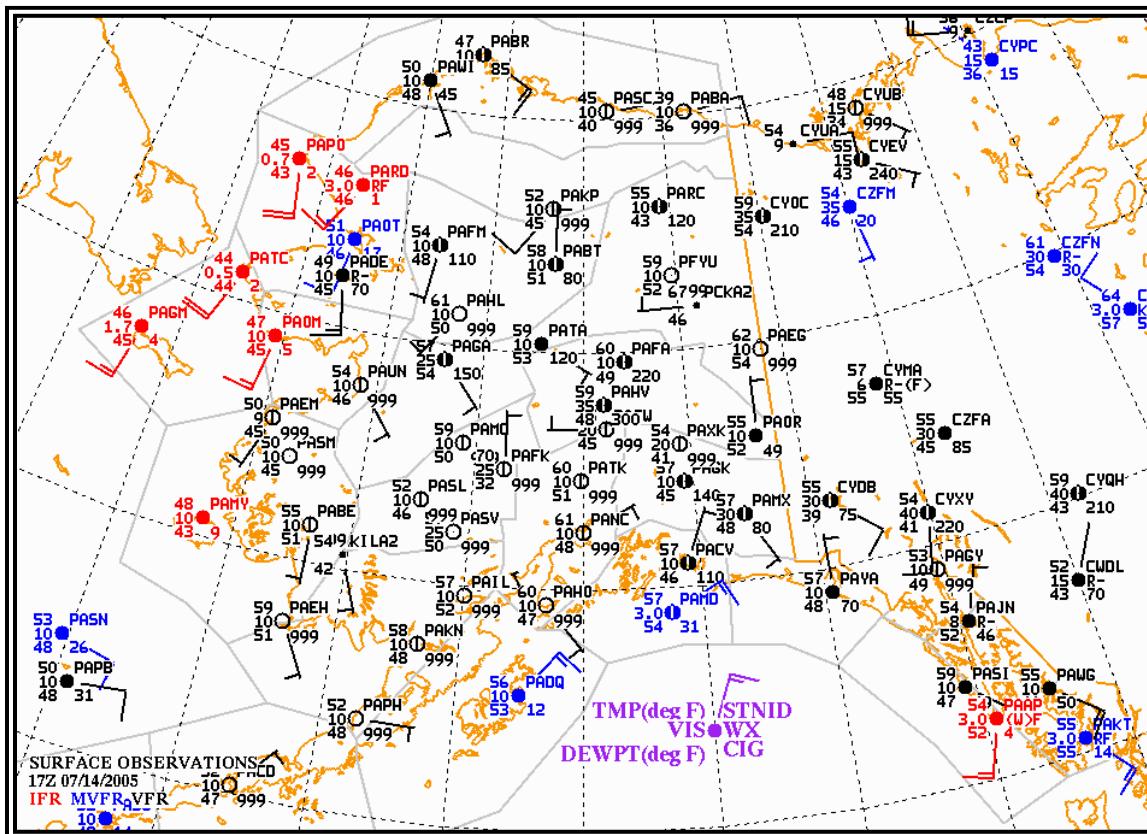


3.7 Graphical Depiction of Surface Observations.

3.7.1 AAWU Surface Observations

A display of color-coded station plots (see Figure 3-39, AAWU Surface Observations Example) from Alaska is produced by the NWS' AAWU. This product shows: surface temperature, dewpoint, ceiling, visibility, and wind direction/speed which have been taken from the METAR report. A key to the station plots is found on each map.

Figure 3-39. AAWU Surface Observations Example



3.7.1.1 Issuance.

The charts are issued hourly and can be found on the AAWU website.

3.7.1.2 Legends.

AAWU Surface Observations depict numerous parameters, including the flying category, sky cover, and wind.

3.7.1.2.1 Flying Category.

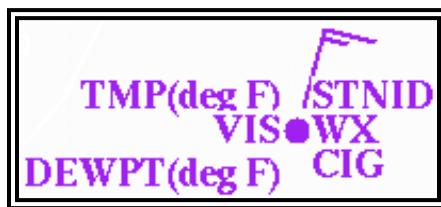
Each station plot is color-coded according to the weather flying category reported (see Table 3-9, AAWU Surface Observations Flying Categories and Criteria). Red indicates IFR, blue indicates Marginal Visual Flight Rules (MVFR), and black is plotted for stations reporting Visual Flight Rules (VFR) ceiling and/or visibility conditions.

Table 3-9. AAWU Surface Observations Flying Categories and Criteria

FLYING CATEGORY	CEILING (feet)	VISIBILITY (miles)
VFR (black)	Greater than 3,000 feet	Greater than 5 miles
MVFR (blue)	1,000 to 3,000 feet	3 to 5 miles
IFR (red)	Less than 1,000 feet	Less than 3 miles

3.7.1.2.2 Station Plot.

METAR elements are plotted for each station in the form of a station plot (see Figure 3-44, Surface Observations—Aviationweather.gov METAR Static Display Example).

Figure 3-40. AAWU Surface Observation Plot Legend**3.7.1.2.3 Sky Cover.**

The sky cover symbol is plotted at the station location and is filled according to the summation total of the sky condition element from the METAR report. For example, if the METAR sky condition element was **SCT030 BKN060 OVC090**, the sky cover would be overcast and have a completely filled circle.

3.7.1.2.4 Station Identifier (STNID).

The four-letter ICAO station identifier is entered to the upper right of the station.

3.7.1.2.5 Wind.

Wind is plotted the same as the NWS surface analysis charts.

3.7.1.2.6 Temperature (TMP deg F).

Temperature in degrees Fahrenheit is plotted to the upper left of the sky cover symbol.

3.7.1.2.7 Visibility (VIS).

Visibility in statute miles is plotted to the left of the sky cover symbol. Decimals are used to represent tenths of miles, when necessary.

3.7.1.2.8 Dewpoint Temperature (DEWPT deg F).

Dewpoint temperature, in degrees Fahrenheit, is plotted to the lower left of the sky cover symbol.

3.7.1.2.9 Ceiling (CIG).

Ceiling is the height from the base of the lowest layer aloft covering more than one-half of the sky. Additionally, vertical visibility into a total surface-based obscuration is defined as a ceiling. For a METAR report, the first broken (BKN) or overcast (OVC) layer is the ceiling. For example, if the METAR sky condition element is **SCT030 BKN060 OVC090**, the ceiling is 6,000 ft.

For a total surface-based obscuration, no ceiling is plotted and the METAR must be consulted.

If the sky cover is clear, few, or scattered, no ceiling is plotted.

The ceiling is plotted to the lower right of the station circle. Ceilings are reported as hundreds of feet AGL. If no ceiling is present, the code **999** will be plotted.

3.7.1.2.10 Present Weather (WX).

Present weather symbols are entered to the left of the station. Note that the older Surface Aviation Observation (SAO) code is used instead of surface analysis chart symbols or the modern METAR code.

Table 3-10. AAWU Surface Observation Precipitation Symbols

Symbol	Meaning
T	Thunderstorm
R	Rain
RW	Rain Shower
L	Drizzle
ZR	Freezing Rain
ZL	Freezing Drizzle
A	Hail
IP	Ice Pellets
IPW	Ice Pellet Showers
S	Snow
SW	Snow Showers
SP	Snow Pellets
SG	Snow Grains
IC	Ice Crystals

Table 3-11. AAWU Surface Observation Obstruction to Visibility Symbols

Symbol	Meaning
BD	Blowing Dust
BN	Blowing Sand
BS	Blowing Snow
BY	Blowing Spray
D	Dust
F	Fog
GF	Ground Fog
H	Haze
IF	Ice Fog
K	Smoke

Table 3-12. AAWU Surface Observation Precipitation Intensity Symbols

Symbol	Meaning
-	Light
(No symbol)	Moderate
+	Heavy

3.7.1.3**Use.**

AAWU Surface Observations provide an overview of weather flying categories and other adverse weather conditions for the valid time shown on the graphic display. This product often does not completely represent the en route conditions because of terrain variations and the possibility of weather occurring between reporting stations. This product should be used in addition to the latest METAR/SPECIIs, PIREPs, and radar and satellite imagery for a complete look at the latest flying conditions.

3.7.2 METARs on Aviationweather.gov.

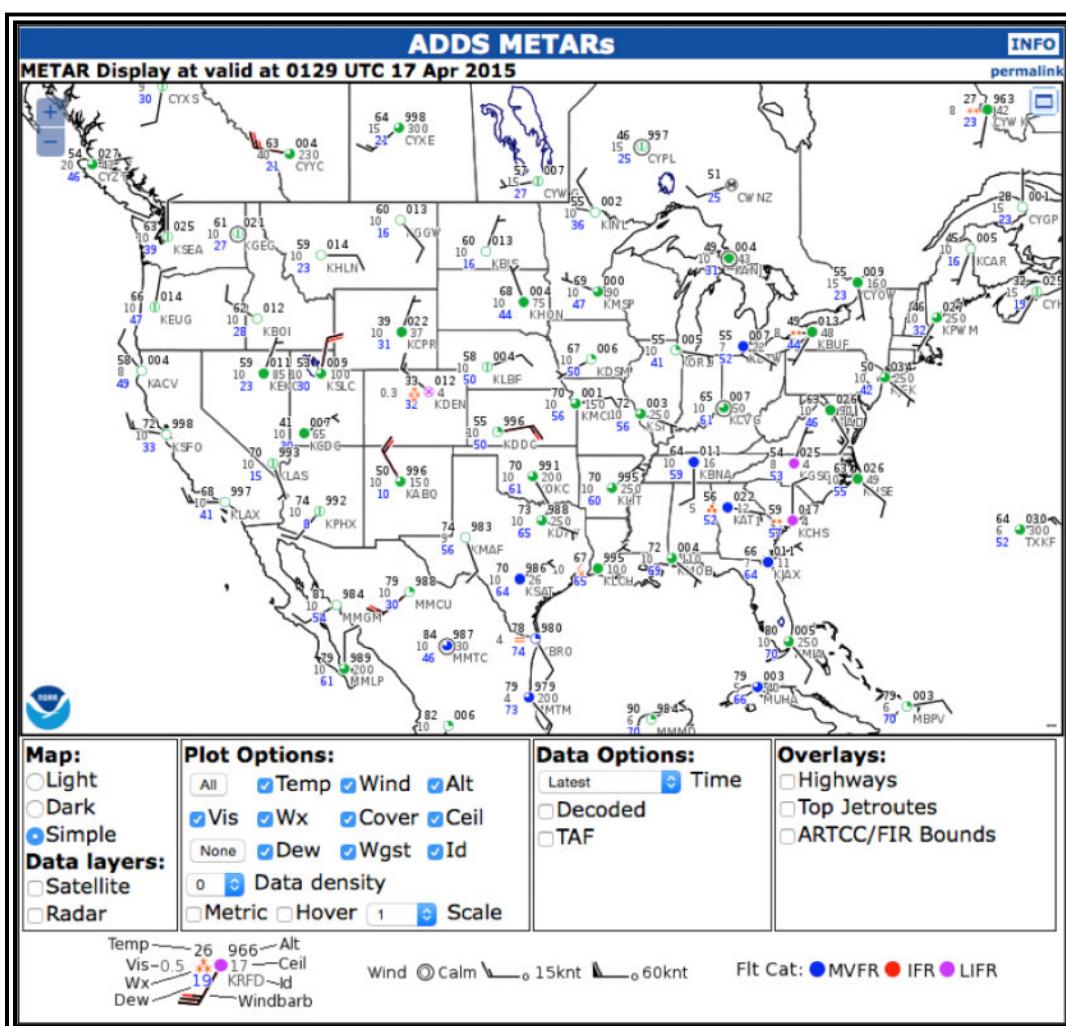
3.7.2.1 Issuance.

Surface observations (METAR and SPECI) are provided on <http://www.aviationweather.gov> in several formats. The formats range from traditional text (referred to as the raw format) to different types of map displays. The two types of map displays are interactive (see Figure 3-41, Surface Observations—Aviationweather.gov METAR Interactive Display Example) and static (see Figure 3-44).

3.7.2.1.1 Interactive Display.

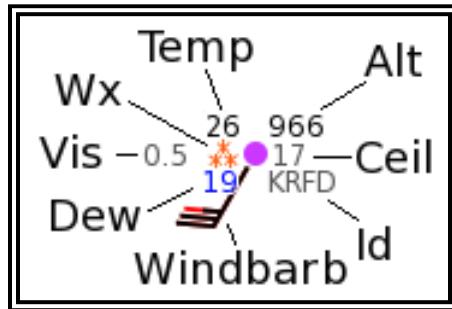
The interactive display includes zoom and pan. Increasing the zoom allows more METARs to be displayed.

Figure 3-41. Surface Observations—Aviationweather.gov METAR Interactive Display Example



“Plot Options” allows users to choose the weather elements displayed (e.g., view only ceilings and visibilities). The following parameters can be displayed using a station plot model (see Figure 3-42, Interactive Display Station Plot Example):

Figure 3-42. Interactive Display Station Plot Example



- **Temp:** Temperature in Fahrenheit. Celsius is also available, if metric is selected.
- **Alt:** Atmospheric pressure reduced to MSL.
 - Where expressed in inches of mercury (Hg) or altimeter setting, the value is expressed in hundredths of an inch where the leading 2 or 3 is omitted (e.g., 982 would be 29.82 in, 025 would be 30.25 in). When trying to determine whether to add a 2 or 3, use the number that will give you a value closest to 30.00 in.
 - Where expressed in millibars, the value is expressed in tenths of a millibar with the leading 9 or 10 omitted (e.g., 998 would be 999.8 mb, 164 would be 1,016.4 mb). When trying to determine whether to add a 9 or 10, use the number that will give you a value closest to 1,000 mb.
- **Ceil:** Cloud ceiling in hundreds of feet (BKN, OVC, and OVX only).
- **Id:** The four-letter ICAO identifier for the airport.
- **Windbarb:** The stick points in the direction the winds are coming from. Wind speed is in knots. Red represents wind gusts.
- **Dew:** Dewpoint in Fahrenheit. Celsius is also available, if metric is selected.
- **Vis:** Visibility in miles. Kilometers (km), if metric is selected. Visibility value on the chart may not represent actual value reported in the METAR or SPECI, and may be fractionally lower than shown. (e.g., 2½ in the METAR is shown as 3 on the surface plot) (see Table [3-12](#), Rounding of Actual METAR Visibility Values for Depiction on Aviationweather.gov/AWC METAR Display).
- **Wx:** Weather symbol representing current weather.

- **Sky:** Cloud cover symbol (see Figure [3-43](#), Station Plot Sky Symbols) is plotted in the center. The amount the circle is filled represents the amount of cloud cover. The color of the circle represents one of the following weather categories (see Table [3-14](#), Station Plot Weather Categories):
 - Green: VFR,
 - Blue: MVFR,
 - Red: IFR, or
 - Purple: Low instrument flight rules (LIFR).

A click on the station circle displays the raw METAR in a separate text window. When the Hover option is selected, the raw METAR text window appears by merely placing the cursor over the station circle. If the Decoded option is set, the METAR appears in plain language instead of METAR code. If the TAF option is set, the latest Terminal Aerodrome Forecast (TAF) will be appended to the information in the text window.

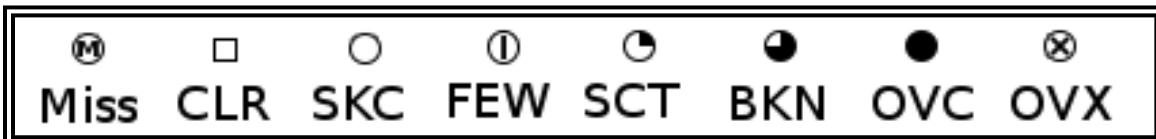
Table 3-13. Rounding of Actual METAR Visibility Values for Depiction on Aviationweather.gov/AWC METAR Display

Visibility Reported in METAR	Visibility, as depicted on surface plot
0, 1/16, 1/8, 3/16, 1/4, 3/8	0.3
1/2	0.5
3/4	0.8
1½, 1¾,	2
2½, 3	3

Table 3-14. Station Plot Weather Categories

Category*	Color	Ceiling		Visibility
LIFR (Low IFR)	Magenta	Below 500 feet AGL	and/or	Less than 1 mile
IFR	Red	500 to below 1,000 feet AGL	and/or	1 mile to less than 3 miles
MVFR (Marginal VFR)	Blue	1,000 to 3,000 feet AGL	and/or	3 to 5 miles
VFR	Green	Greater than 3,000 feet AGL	and	Greater than 5 miles

*These categories are not flight rules and should not be confused with the flight rules provided in Part 91, including those for Basic VFR Weather Minimums. Rather, these categories were created for weather charts as a means to visually enhance the products.

Figure 3-43. Station Plot Sky Symbols

Automated stations report “CLR” when clouds may exist above 12,000 ft, so a square is used to represent this uncertainty, whereas an unfilled circle is used for “SKC”, when a human reports the sky is completely clear overhead. The abbreviation “OVX” is unofficial, but AWC uses it to indicate the sky is obscured, which is the case when a METAR reports vertical visibility and no cloud information. “Miss” means the sky condition is missing.

3.7.2.1.2 Static Display.

Static display products are provided on the AWC’s website for 19 select regions plus the CONUS. Each product is updated every 5 minutes using the latest METAR or SPECI information. The Web page automatically refresh every 15 minutes.

The static display has fewer features than the interactive display. Primarily, the static display does not provide ceiling height. Also, the static display does not have the functionality to display separately the raw METAR or TAF, or change units to metric.

Figure 3-44. Surface Observations—Aviationweather.gov METAR Static Display Example

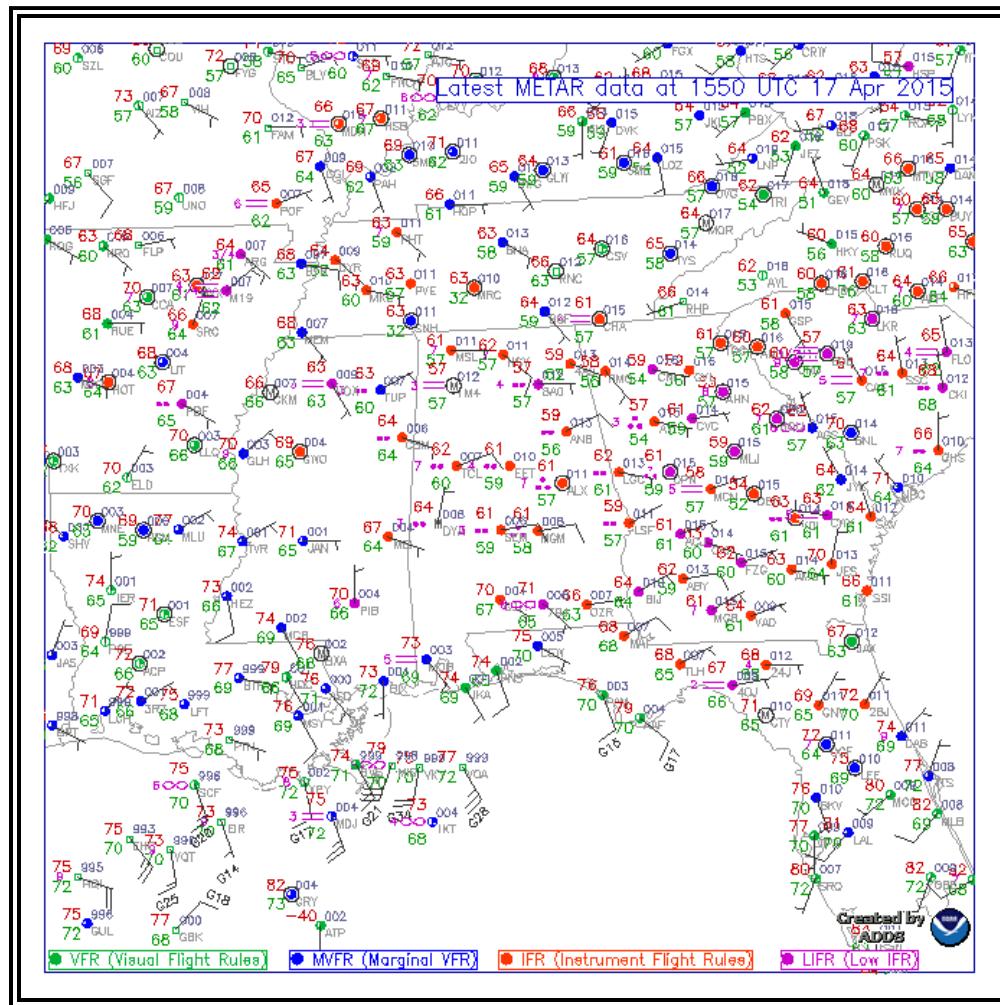
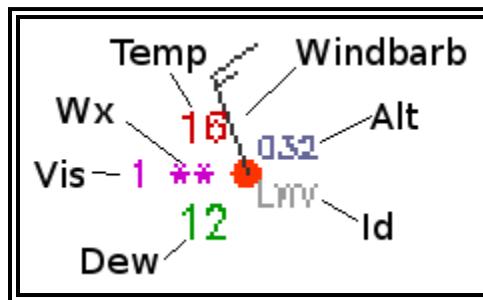


Figure 3-45. Static Display Station Plot Example



Station plot descriptions are:

- **Temp:** Temperature in Fahrenheit (F).
- **Windbarb:** The windbarb. The stick points in the direction the winds are coming from.

- **Alt:** Last three digits of the altimeter setting in inches of mercury. For example, 032 represents 30.32 in Hg.
- **Id:** The last three letters of the ICAO identifier for the airport.
- **Dew:** The dewpoint temperature in Fahrenheit.
- **Vis:** The visibility in statute miles.
- **Wx:** Weather symbol representing current weather.
- **Sky:** The cloud cover symbol is plotted in the center. The amount the circle is filled represents the amount of cloud cover. The color of the circle represents one of the following weather categories:
 - Green: VFR,
 - Blue: MVFR,
 - Red: IFR, or
 - Purple: LIFR.

3.7.2.2 Use.

Graphical depictions of surface observations, both interactive and static display, provide an overview of weather flying categories and other adverse weather conditions for the valid time shown on the graphic display.

3.8 Aviation Weather Cameras.

3.8.1 FAA Aviation Weather Cameras.

The FAA's Aviation Weather Camera network (see Figure 3-46, Map of FAA's Aviation Weather Camera Network in Alaska) consists of more than 220 camera facilities in Alaska. Each site has up to four cameras. The direction of each camera (see Figure 3-47, Sectional Chart Depicting Shungnak (SHG), Alaska Camera Orientations) is provided with reference to a Sectional Chart. A clear day image (see Figure 3-48, "Clear Day" Image from Aviation Weather Camera Image at Shungnak (SHG), Alaska) is provided for reference and comparison with the latest image (see Figure 3-49, Aviation Weather Camera Image at Shungnak (SHG), Alaska).

3.8.2 Issuance.

Camera images are available on the FAA's Aviation Weather Camera website. Images are generally updated every 10 minutes. The time of the last update is indicated on each image. Actual site conditions may differ from displayed images due to a variety of reasons (e.g., rapidly changing weather conditions, image update frequency, optical distortion).

Figure 3-46. Map of FAA's Aviation Weather Camera Network in Alaska

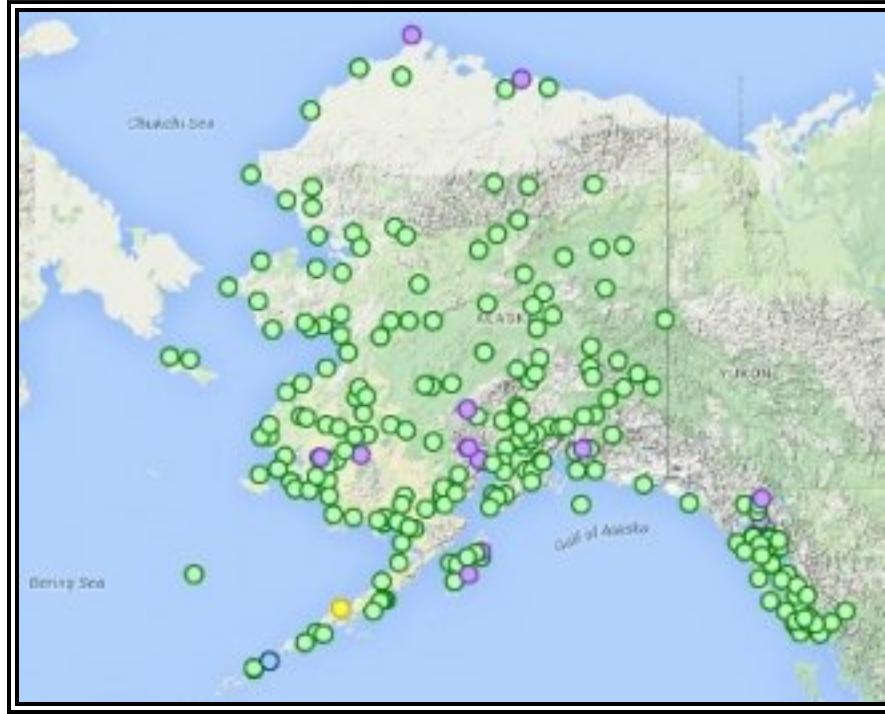


Figure 3-47. Sectional Chart Depicting Shungnak (SHG), Alaska Camera Orientations

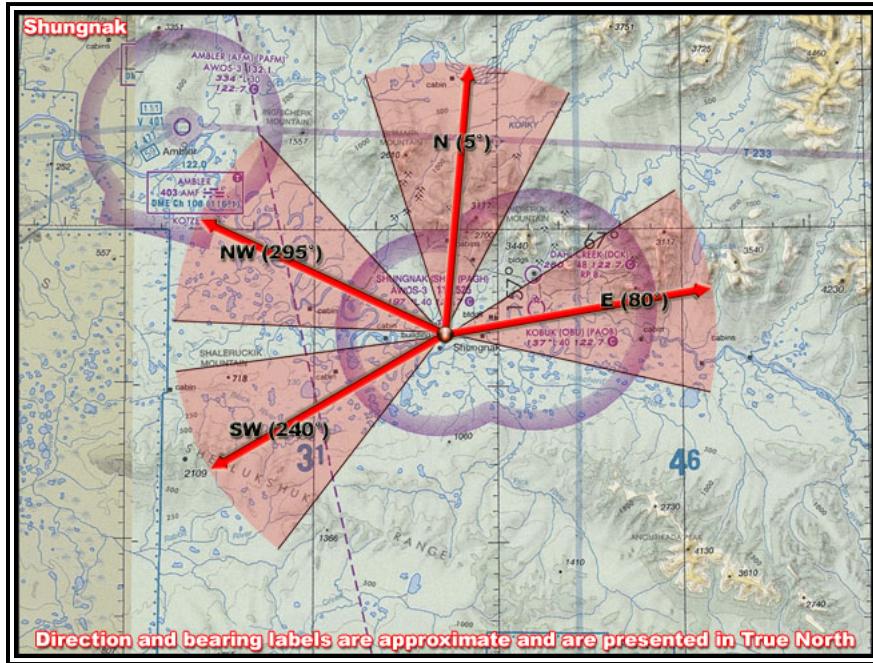


Figure 3-48. “Clear Day” Image from Aviation Weather Camera Image at Shungnak (SHG), Alaska

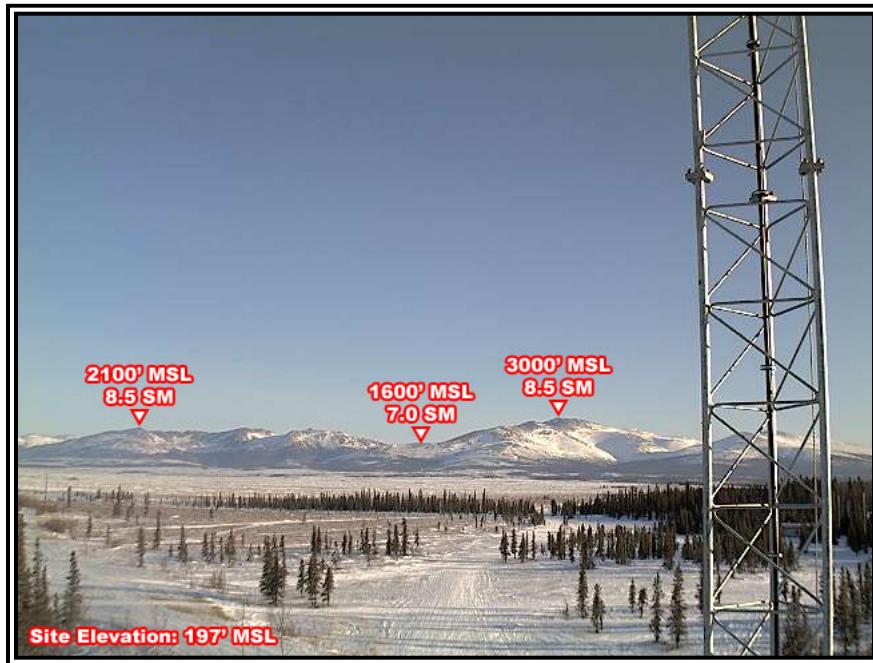


Figure 3-49. Aviation Weather Camera Image at Shungnak (SHG), Alaska



3.8.3 Use

The images should only be used for flight planning and to improve situational awareness (SA). They are not to be used to comply with regulatory requirements (e.g., to determine weather minimums for IFR flight).

CHAPTER 4. ANALYSIS

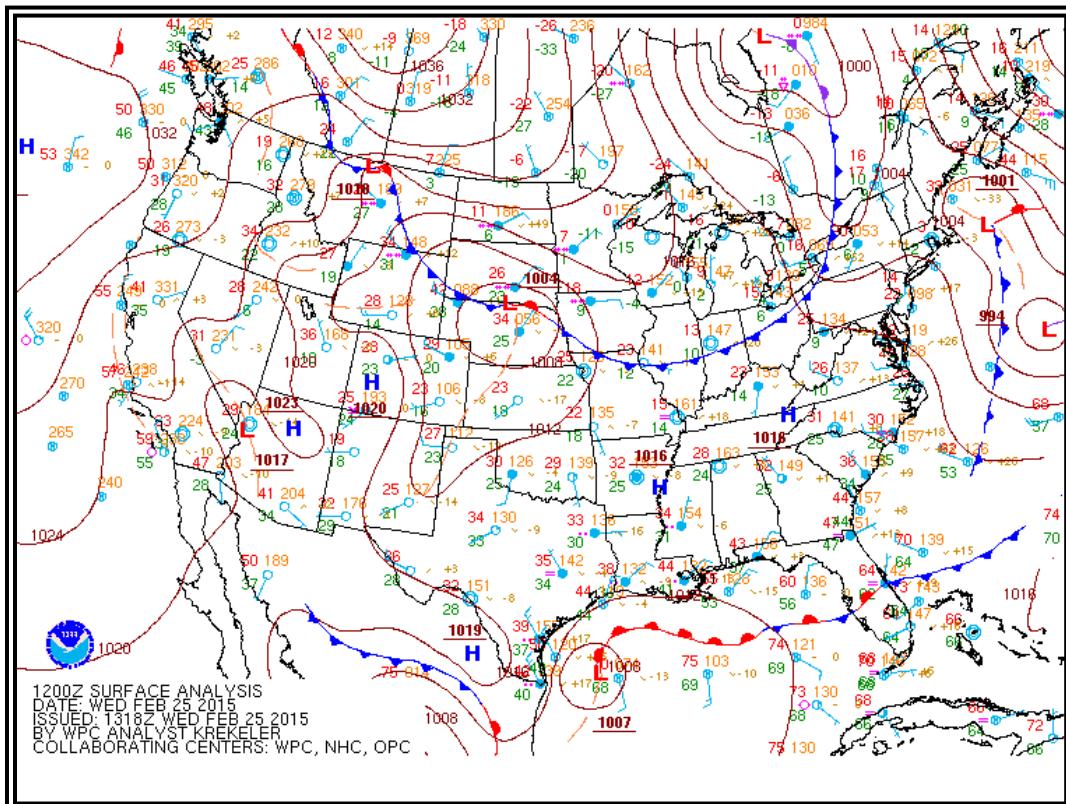
The second of three distinct types of weather (meteorological) information are analyses. Analyses of weather information are an enhanced depiction and/or interpretation of observed weather data. Prior to the 1990s, most analysis charts were hand drawn by forecasters. Today's analyses are automated, and depending on the weather information provider (i.e., NWS, commercial weather services, and flight planning services), the appearance and content of these analyses will vary.

Chapter 4 will only focus on those analyses produced by the NWS and made available on various websites, including the Aviation Weather Center (AWC), the Weather Prediction Center (WPC), the Ocean Prediction Center (OPC), and the Alaska Aviation Weather Unit (AAWU).

4.1 Surface Analysis Charts.

Surface analysis charts are analyzed charts of surface weather observations. The chart depicts the distribution of several items, including sea-level pressure; the positions of highs, lows, ridges, and troughs; the location and type of fronts; and the various boundaries such as drylines. Pressure is referred to in mean sea level (MSL) on the surface analysis chart while all other elements are presented as they occur at the surface point of observation.

Figure 4-1. NWS Surface Analysis Chart Example

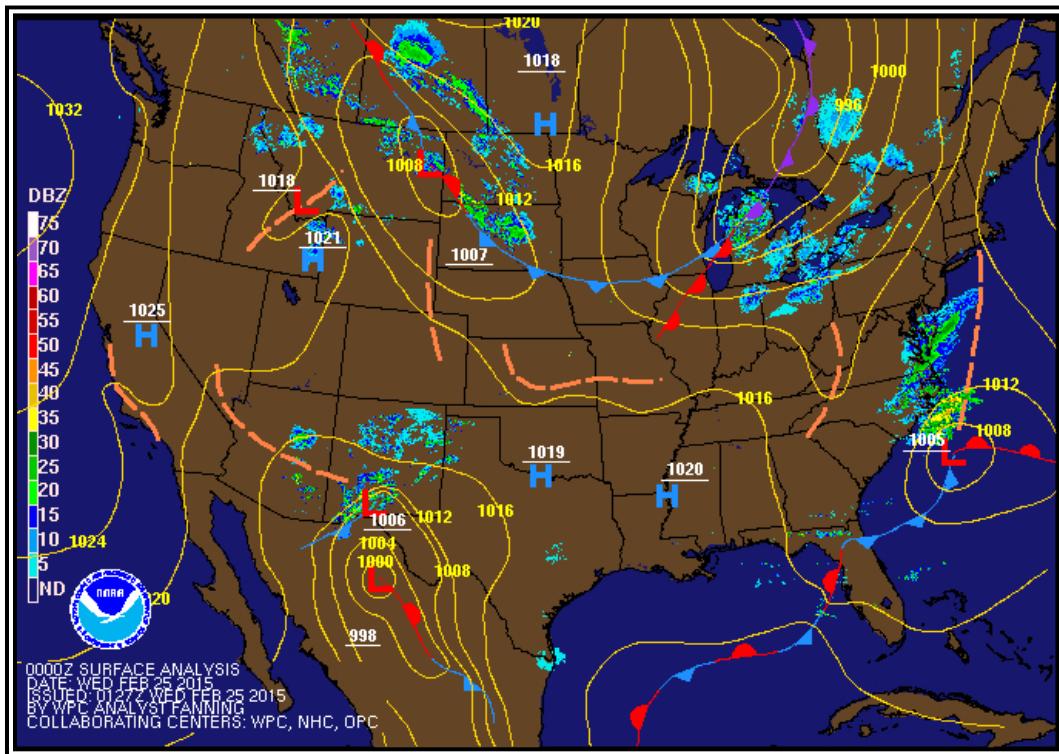


4.1.1 WPC Surface Analysis Charts

The WPC in College Park, MD, produces a variety of surface analysis charts for North America that are available on their website. Figure 4-1, NWS Surface Analysis Chart Example, is one example of several surface analysis products available on their website. WPC's surface analysis is also available at <http://www.aviationweather.gov>.

Some of WPC's surface analysis charts are combined with radar or satellite imagery (Figure 4-2, NWS Surface Analysis and Radar Composite Example) as well as have different background features (e.g., terrain).

Figure 4-2. NWS Surface Analysis and Radar Composite Example

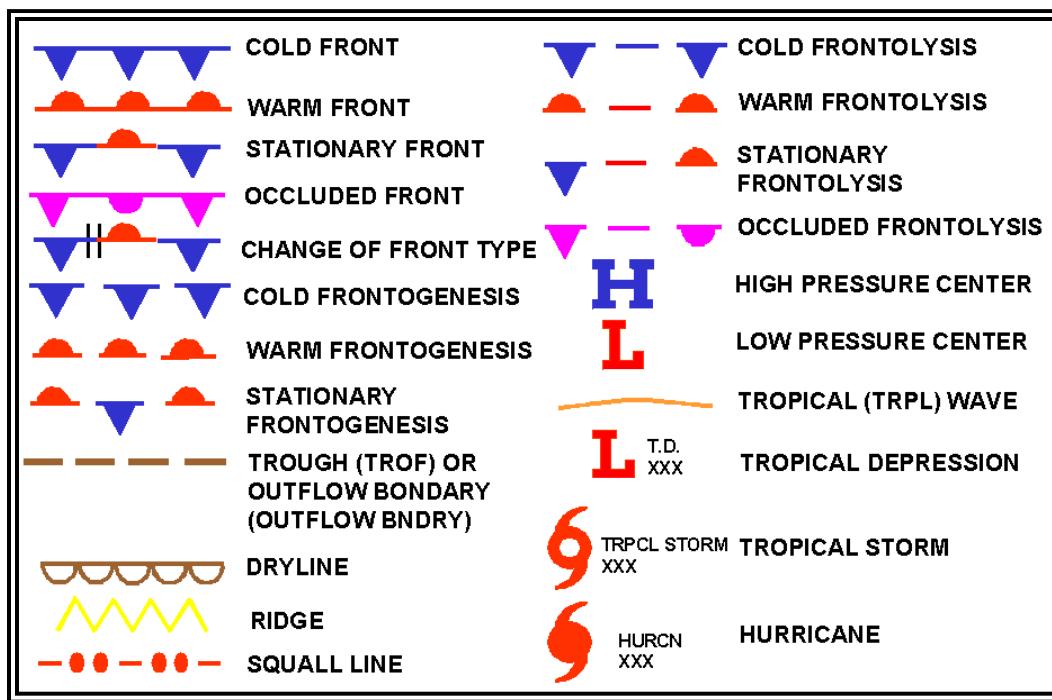


4.1.1.1 **Issuance.**

The WPC issues surface analysis charts for North America eight times daily, valid at 00, 03, 06, 09, 12, 15, 18, and 21 Coordinated Universal Time (UTC).

4.1.1.2 **Analysis Symbols.**

Figure 4-3, NWS Surface Analysis Chart Symbols, shows analysis symbols used on NWS surface analysis charts.

Figure 4-3. NWS Surface Analysis Chart Symbols

4.1.1.3 Station Plot Models.

Land, ship, buoy, and Coastal-Marine Automated Network (C-MAN) stations are plotted on the chart to aid in analyzing and interpreting the surface weather features. These plotted observations are referred to as station models. Some stations may not be plotted due to space limitations. However, all reporting stations are used in the analysis.

Figure 4-4, NWS Surface Analysis Chart Station Plot Model, and Figure 4-5, NWS Surface Analysis Chart Ship/Buoy Plot Model, contain the most commonly used station plot models used in surface analysis charts.

Figure 4-4. NWS Surface Analysis Chart Station Plot Model

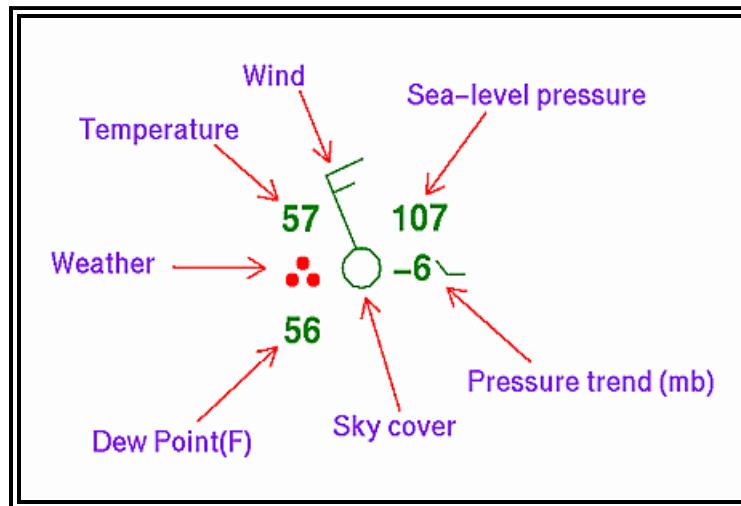
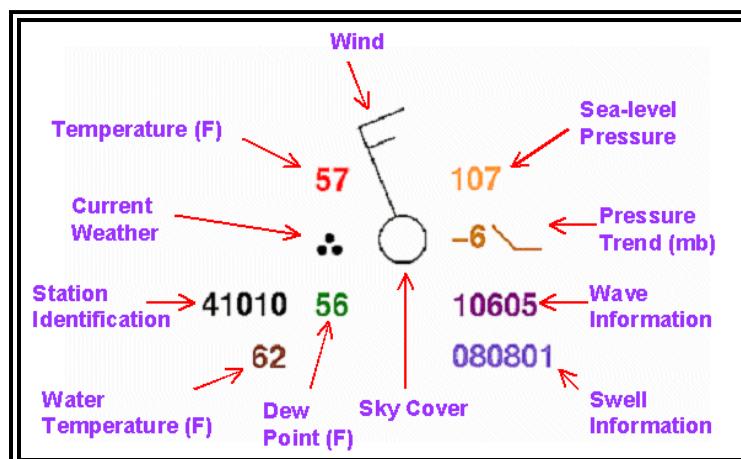
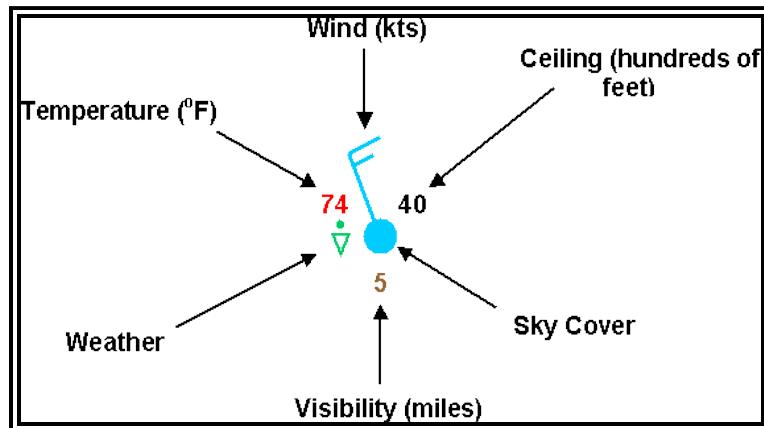


Figure 4-5. NWS Surface Analysis Chart Ship/Buoy Plot Model



WPC also produces surface analysis charts specifically for the aviation community. Figure 4-6, NWS Surface Analysis Chart for Aviation Interests Station Plot Model, contains the station plot model for these charts.

Figure 4-6. NWS Surface Analysis Chart for Aviation Interests Station Plot Model



4.1.1.3.1 Station Identifier

The format of the station identifier depends on the observing platform.

- Ship: Typically four or five characters. If five characters, then the fifth will usually be a digit.
- Buoy: Whether drifting or stationary, a buoy will have a five-digit identifier. The first digit will always be a 4.
- C-MAN: Usually located close to coastal areas. Their identifier will appear like a five-character ship identifier; however, the fourth character will identify off which state the platform is located.
- Land: Land stations will always be three characters, making them easily distinguishable from ship, buoy, and C-MAN observations.

4.1.1.3.2 Temperature

The air temperature is plotted in whole degrees Fahrenheit.

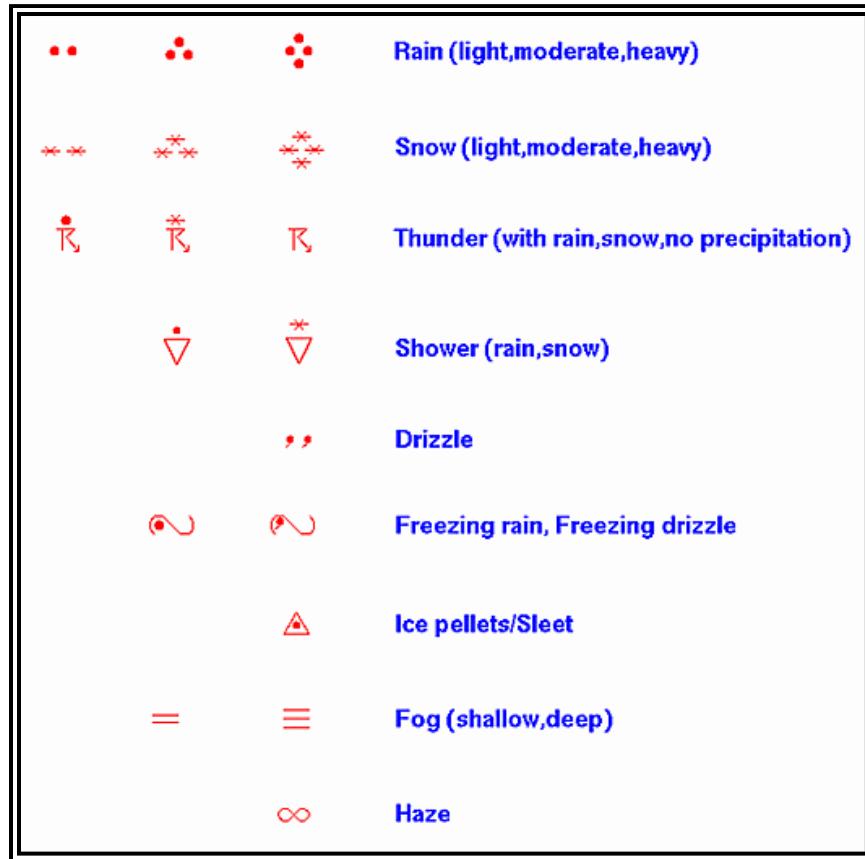
4.1.1.3.3 Dewpoint

The dewpoint temperature is plotted in whole degrees Fahrenheit.

4.1.1.3.4 Weather

A weather symbol is plotted if, at the time of observation, precipitation is either occurring or a condition exists causing reduced visibility.

Figure [4-7](#), NWS Surface Analysis Chart Common Weather Symbols, contains a list of the most common weather symbols.

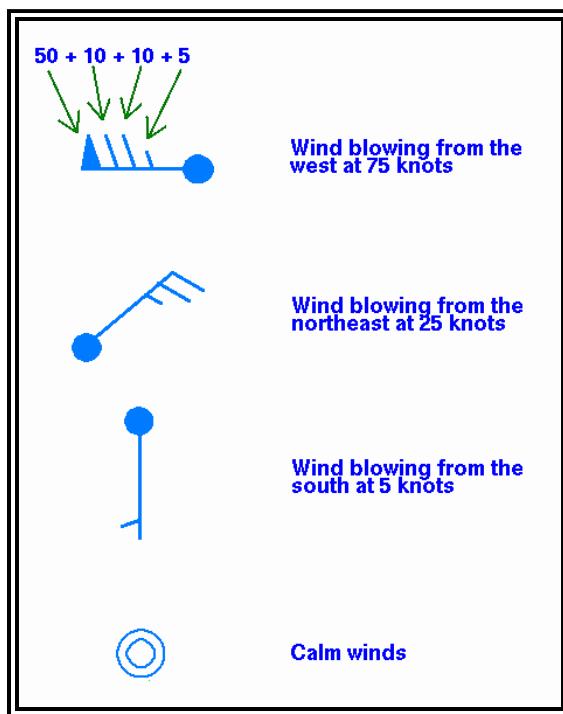
Figure 4-7. NWS Surface Analysis Chart Common Weather Symbols**4.1.1.3.5 Wind.**

Wind is plotted in increments of 5 knots (kts). The wind direction is referenced to true north and is depicted by a stem (line) pointed in the direction from which the wind is blowing. Wind speed is determined by adding the values of the flags (50 kts), barbs (10 kts) and half-barbs (5 kts) found on the stem.

If the wind is calm at the time of observation, only a single circle over the station is depicted.

Figure [4-8](#), NWS Surface Analysis Chart Wind Plotting Model, includes some sample wind symbols.

Figure 4-8. NWS Surface Analysis Chart Wind Plotting Model



4.1.1.3.6 Ceiling.

Ceiling is plotted in hundreds of feet above ground level (AGL).

4.1.1.3.7 Visibility.

Surface visibility is plotted in whole statute miles (sm).

4.1.1.3.8 Pressure.

Sea-level pressure is plotted in tenths of millibars (mb), with the first two digits (generally 10 or 9) omitted. For reference, 1013 mb is equivalent to 29.92 inches (in) of mercury. Below are some sample conversions between plotted and complete sea-level pressure values.

410	1041.0 mb
-----	-----------

103	1010.3 mb
-----	-----------

987	998.7 mb
-----	----------

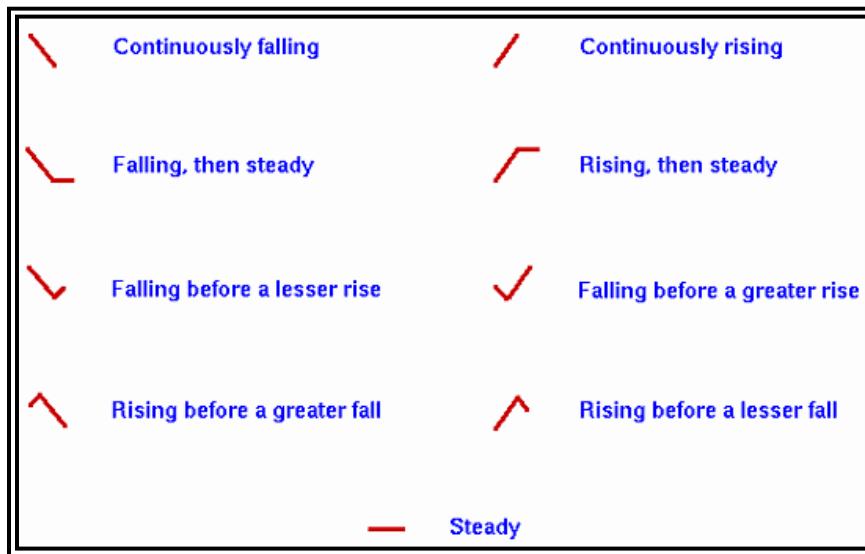
872	987.2 mb
-----	----------

4.1.1.3.9 Pressure Trend.

The pressure trend has two components, a number and a symbol, to indicate how the sea-level pressure has changed during the past 3 hours. The number provides the 3-hour change in tenths of millibars, while the symbol provides a graphic illustration of how this change occurred.

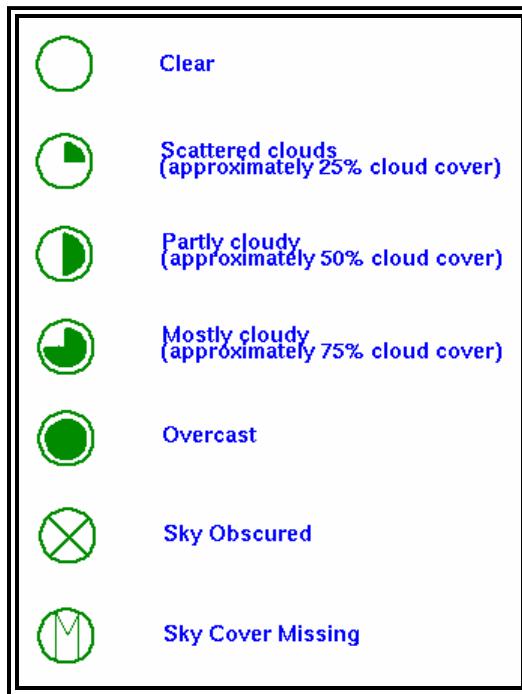
Figure 4-9, NWS Surface Analysis Chart Pressure Trends, contains the meanings of the pressure trend symbols.

Figure 4-9. NWS Surface Analysis Chart Pressure Trends



4.1.1.3.10 Sky Cover.

The approximate amount of sky cover can be determined by the circle at the center of the station plot. The amount that the circle is filled reflects the amount of sky covered by clouds. Figure 4-10, NWS Surface Analysis Chart Sky Cover Symbols, contains the common cloud cover depictions.

Figure 4-10. NWS Surface Analysis Chart Sky Cover Symbols**4.1.1.3.11 Water Temperature**

Water temperature is plotted in whole degrees Fahrenheit.

4.1.1.3.12 Swell Information

Swell direction, period, and height are represented in the surface observations by a six-digit code. The first two digits represent the swell direction, the middle digits describe the swell period (in seconds), and the last two digits are the swell's height (in half meters).

090703:

09: The swell direction is from 90 degrees (i.e., it is coming from due east)

07: The period of the swell is 7 seconds

03: The height of the swell is 3 half meters (m)

271006:

27: The swell direction is from 270 degrees (due west)

10: The period is 10 seconds

06: The height of the swell is 6 half meters

4.1.1.3.13 Wave Information

Period and height of waves are represented by a five-digit code. The first digit

is always 1. The second and third digits describe the wave period (in seconds), and the final two digits give the wave height (in half meters).

10603:

1: A group identifier. The first digit will always be **1**

06: The wave period is 6 seconds

03: The wave height is 3 half meters

10515:

1: A group identifier

05: The wave period is 5 seconds

15: The wave height is 15 half meters

In some charts by the OPC, only the wave height (in feet) is plotted.

4.1.1.4 **Analyses.**

Isobars, pressure systems, and fronts are the most common analyses depicted on surface analysis charts.

4.1.1.4.1 Isobars.

An isobar is a line of equal or constant pressure commonly used in the analysis of pressure patterns.

On a surface analysis chart, isobars are solid lines usually spaced at intervals of 4 mb. Each isobar is labeled. For example, **1032** signifies 1,032.0 mb and **992** signifies 992.0 mb.

4.1.1.4.2 Pressure Systems.

On a surface analysis chart, a High (**H**) is a maximum of atmospheric pressure, while a Low (**L**) is a minimum of atmospheric pressure. Central pressure is the atmospheric pressure located at the center of a High or Low. In general, the central pressure is the highest pressure in the center of a High and the lowest pressure at the center of a Low. The central pressure is denoted near each pressure center.

A trough or an elongated area of low atmospheric pressure is denoted by dashed lines and identified with the word **TROF**. A ridge or an elongated area of high atmospheric pressure is denoted by saw-toothed symbols. Ridges are rarely denoted on charts produced by the WPC.

Tropical storms, hurricanes, and typhoons are low-pressure systems with their names and central pressures denoted.

4.1.1.4.3 Fronts

NWS surface analysis charts positions and types of fronts are shown by symbols in Figure [4-3](#). The symbols on the front indicate the type of front and point in the direction toward which the front is moving. Two short lines across a front indicate a change in front type.

4.1.2 Unified Surface Analysis Chart

The NWS Unified Surface Analysis Chart is a surface analysis product produced collectively and collaboratively by NWS's WPC, the OPC, the National Hurricane Center (NHC), and Weather Forecast Office (WFO) Honolulu. The chart contains an analysis of isobars, pressure systems, and fronts.

This chart is available on the OPC website as well as the AWC. Users can zoom in by clicking an area on the map (see Figure 4-11, Unified Surface Analysis Chart Example) to enlarge (see Figure [4-12](#), Unified Surface Analysis Chart Example) and show station plot models (see paragraph [4.1.1.3](#)).

4.1.2.1 **Issuance.**

The Unified Surface Analysis Chart is issued four times daily for valid times 00, 06, 12, and 18 UTC.

Figure 4-11. Unified Surface Analysis Chart Example

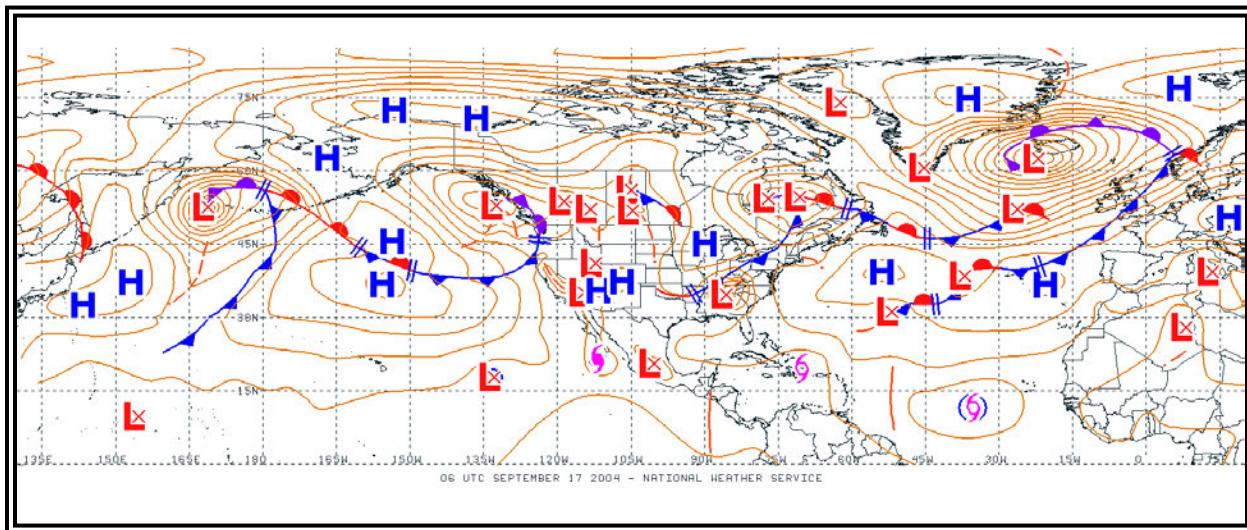
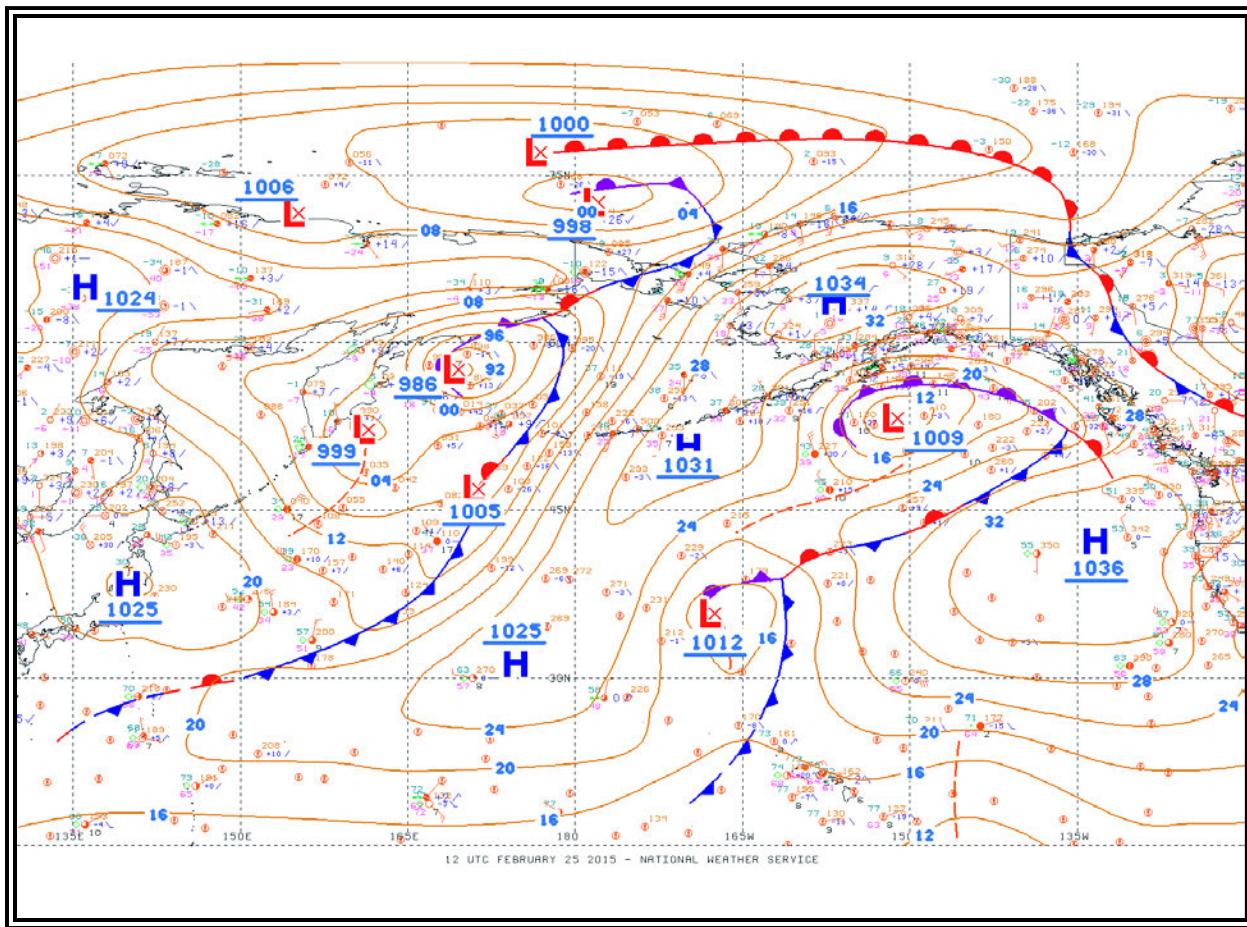


Figure 4-12. Unified Surface Analysis Chart Example



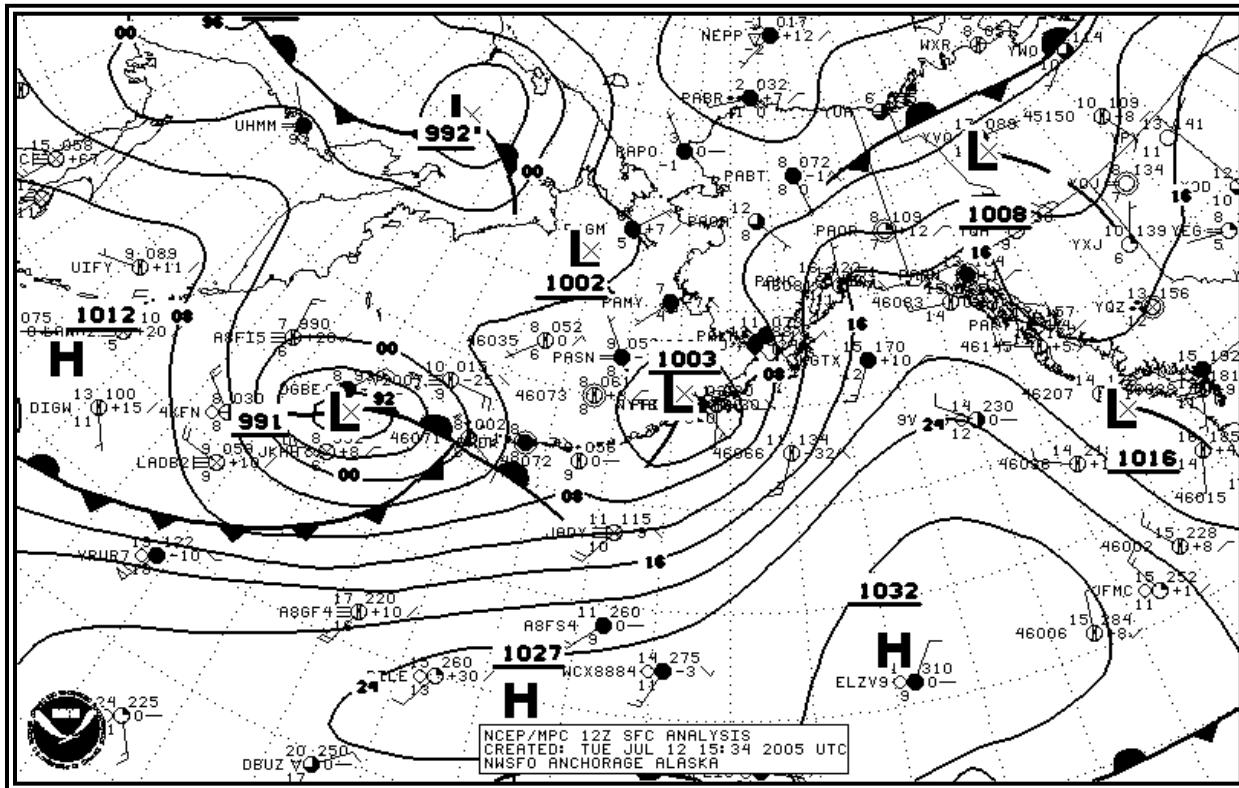
4.1.2.2 Analysis Symbols.

Unified Surface Analysis Charts use the symbols shown in Figure [4-3](#).

4.1.3 AAWU Surface Chart.

The NWS's Unified Surface Analysis chart covers the Alaskan area. The AAWU also provides a fixed area image of the Unified Surface Analysis Chart centered over Alaska (see Figure [4-13](#), Unified Surface Analysis Chart Example With Fixed Area Coverage Over Alaska). This chart is available from AAWU's website.

Figure 4-13. Unified Surface Analysis Chart Example With Fixed Area Coverage Over Alaska



4.2 Ceiling and Visibility.

4.2.1 Ceiling and Visibility Analysis (CVA).

The CVA product provides a real-time analysis of current observed and estimated ceiling and visibility conditions across the continental United States (CONUS). The product is primarily intended to help the general aviation pilot (particularly the Visual Flight Rules (VFR)-only pilot) avoid instrument flight rules (IFR) conditions. However, CVA's overview of ceiling and visibility conditions can be useful to others involved in flight planning or weather briefing.

4.2.1.1 Issuance.

CVA is issued every 5 minutes and is available through <http://www.aviationweather.gov>.

4.2.1.2 Content.

CVA presents information via full-CONUS graphic and 18 regional graphics. Each graphic is rendered on a horizontal grid of 5 km resolution and shows viewer-selectable representations of ceiling height (AGL), surface visibility in statute miles (sm) and flight category designation.

Each regional display includes an overlay of station plots showing the current ceiling and visibility observations reported at selected Aviation Routine

Weather Report (METAR) stations. To avoid overcrowding, the overlay shows only a subset of the total number of stations available at the CONUS scale view. Additional stations are displayed when zooming in.

4.2.1.3

CVA Ceiling Analysis.

The CVA Ceiling Analysis uses observed and estimated ceiling heights as follows:

- At display points corresponding to METAR locations, CVA uses the ceiling values observed by the nearest METAR.
- At display points between METAR locations (where there are no direct observations), CVA uses estimated ceiling values derived by adjusting the ceiling observation from the nearest METAR to take into account intervening changes in terrain height. When corresponding **Geostationary Operational Environmental Satellite** (GOES) observations yield an unambiguous indication that no cloud is present, adjusted ceiling observations are reset to indicate clear conditions.
- At display points where observed or estimated ceiling height is less than 200 feet (ft) AGL, CVA reports “Possible Terrain Obstruction.”

The CVA Ceiling Analysis graphic is rendered as follows:

- Ceiling less than 1,000 ft AGL: pale yellow.
- Ceiling less than 200 ft. AGL and Possible Terrain Obstruction: orange.

Figure 4-14, CONUS Display of CVA Ceiling Analysis, shows a CONUS-scale CVA Ceiling Analysis. Figure 4-15, Regional Display of CVA Ceiling Analysis, shows a regional-scale Ceiling Analysis.

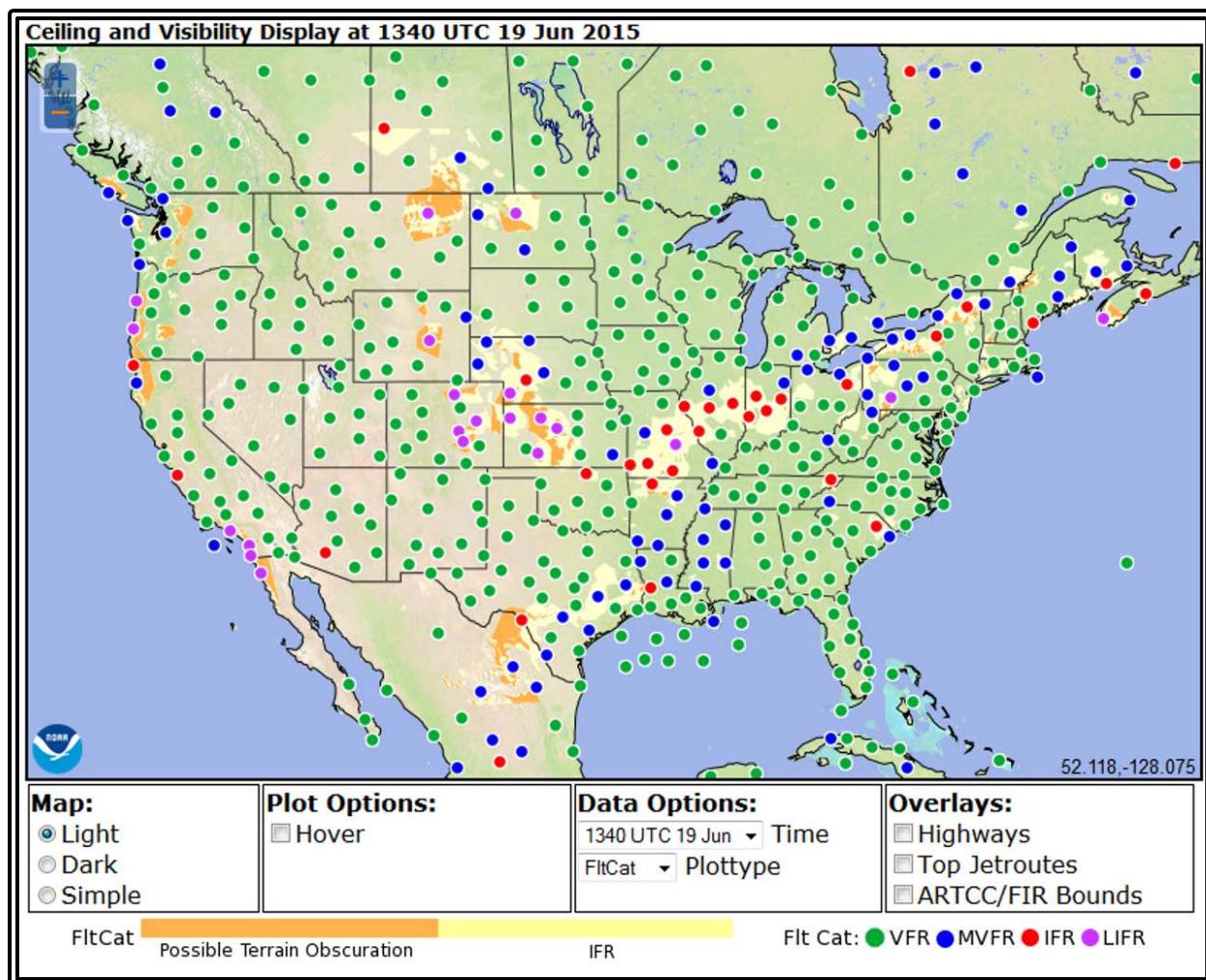
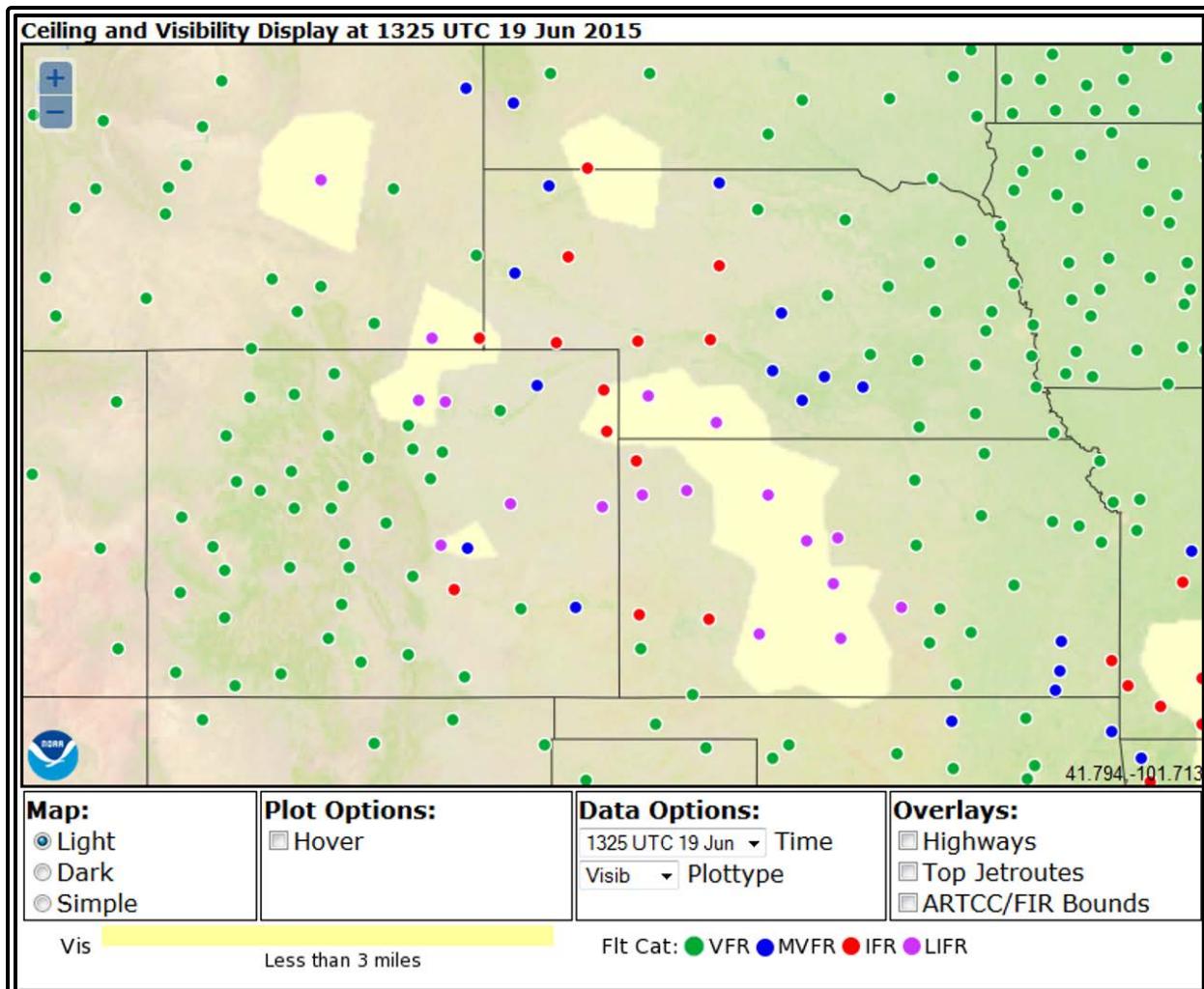
Figure 4-14. CONUS Display of CVA Ceiling Analysis

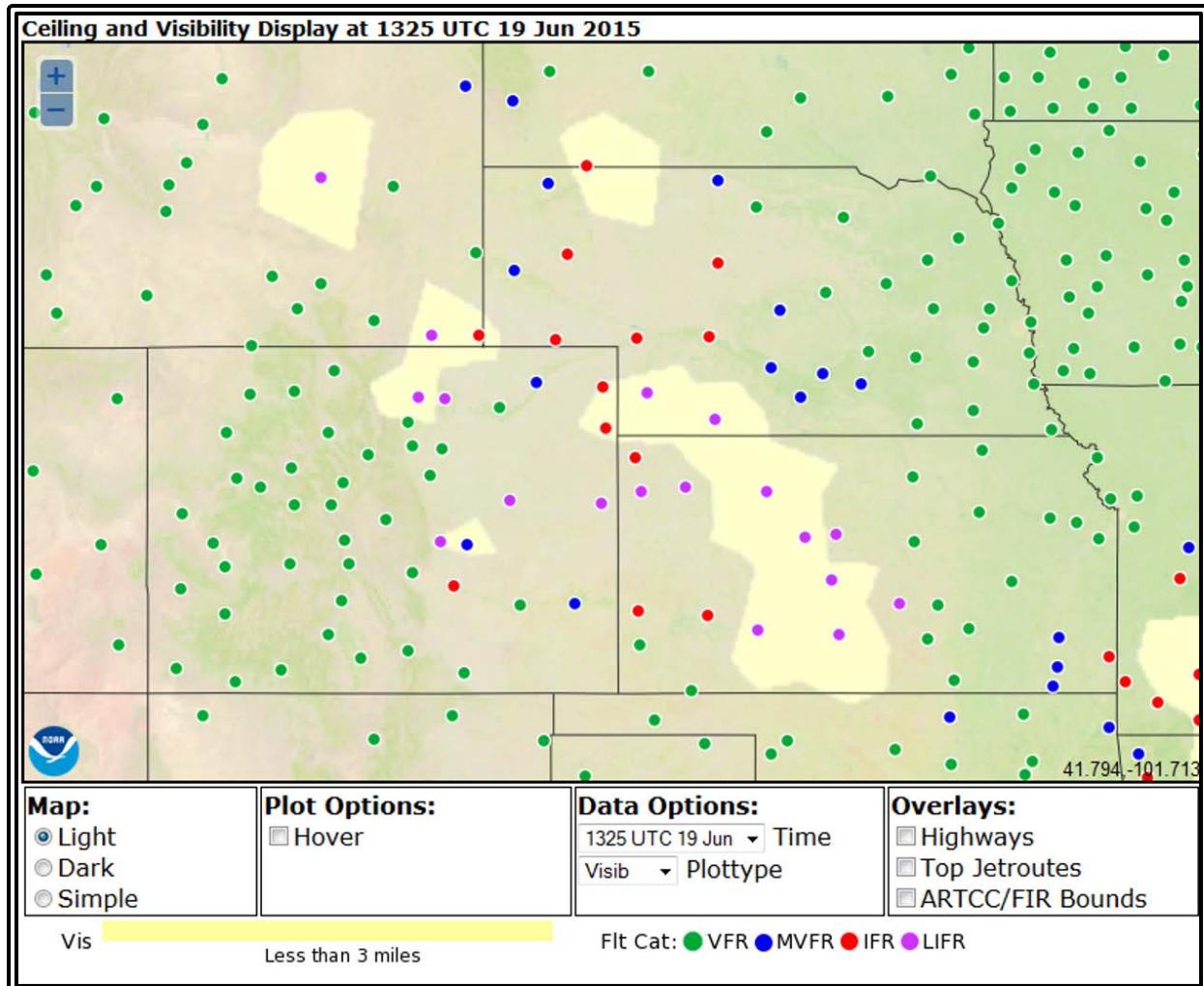
Figure 4-15. Regional Display of CVA Ceiling Analysis



4.2.1.4 CVA Visibility Analysis.

The CVA Visibility Analysis (shown as a regional view in Figure 4-16, Regional Display of CVA Visibility Analysis) reports the observed visibility at the nearest METAR. The graphic is rendered as follows:

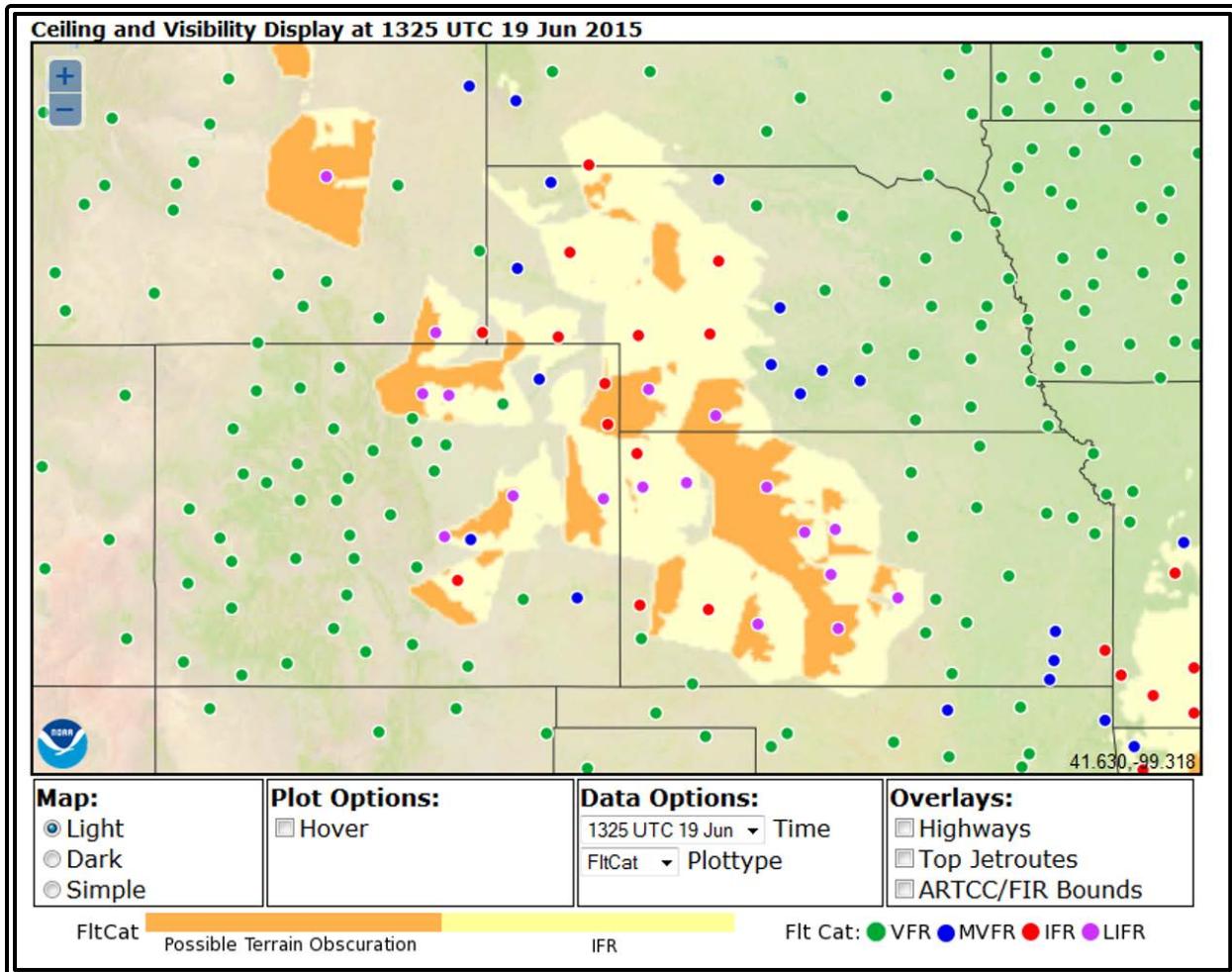
- Surface visibility less than 3 sm: pale yellow.

Figure 4-16. Regional Display of CVA Visibility Analysis

4.2.1.5 CVA Flight Category Analysis.

The CVA Flight Category Analysis (shown as a regional view in Figure 4-17, Regional Display of CVA Flight Category Analysis) uses observed and estimated ceiling and visibility values to report the flight category at each display point. The graphic is rendered as follows:

- IFR—pale yellow: Ceiling less than 1,000 ft AGL and/or visibility less than 3 sm.
- LIFR—orange: Ceiling less than 200 ft AGL and Possible Terrain Obstruction.

Figure 4-17. Regional Display of CVA Flight Category Analysis

4.2.1.6 Strengths and Limitations.

4.2.1.6.1 CVA Strengths.

- The CVA's area-wide graphics highlight observed and estimated IFR, VFR, and possible ground obscuration conditions, enabling a user's quick recognition of ceiling and visibility hazards, as represented by existing observational tools.
- The CVA is issued every 5 minutes using the most current METAR and GOES observations available. These rapid updates enhance recognition of trends when conditions are changing. The CVA incorporates "special" METAR observations as they are issued.

4.2.1.6.2 CVA Limitations.

- The CVA is an analysis of estimated real-time conditions only. It is not a forecast and cannot be used in place of a forecast.
- The CVA must only be used with products such as METARS, Terminal Aerodrome Forecasts (TAF), and Airmen's Meteorological Information (AIRMET).
- The CVA's representation of ceiling and visibility conditions in regions between METARS (where direct observations are unavailable) can be significantly in error. As distance from the nearest METAR increases, the uncertainty in represented conditions increases.
- Impacted ceiling and visibility conditions can be highly localized and smaller in scale than the 5 km grid used to convey CVA information. Thus, small-scale variations in ceiling and visibility conditions may not be represented by CVA, even in regions close to observing stations.

4.2.1.7

Use.

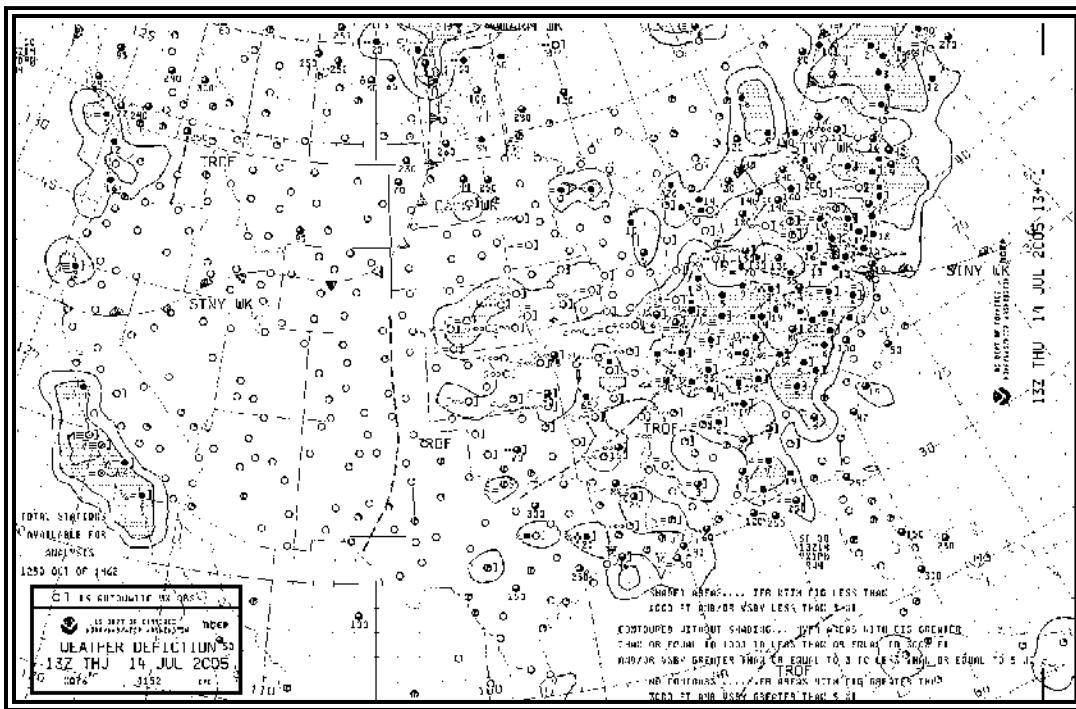
General aviation pilots, weather briefers, and others involved in flight planning can use CVA as a companion to METARS, TAFs, and AIRMETs to help them recognize and avoid IFR conditions. Along with the foregoing weather information sources, the CVA can aid IFR avoidance and escape for the en route pilot who inadvertently encounters IFR conditions.

Pilots and flight planners must exercise judgment when using CVA information, as it is based in recent weather information and calculated estimations. Degrading conditions are more likely as the distance and time increase from the station's reported weather.

The CVA is one of the data fields included in the part of the helicopter emergency medical services (HEMS) tool (see paragraph [6.1](#)).

4.2.2 Weather Depiction Chart.

The Weather Depiction Chart (see Figure [4-18](#), Weather Depiction Chart—Example) is being phased out by the NWS, in favor of newer ceiling and visibility products, like the CVA product.

Figure 4-18. Weather Depiction Chart—Example

4.3 Upper-Air Analyses.

4.3.1 Issuance.

The NWS National Centers for Environmental Prediction (NCEP) Central Operations (NCO) produces and provides upper-air analyses and forecast products. Their website, Model Analyses and Guidance (see Figure 4-19, NWS NCEP Central Operations Model Analyses and Guidance Website), contains a user's guide that provides descriptions, details, and examples of the various products. A select subset of these products is available on <http://www.aviationweather.gov>.

Figure 4-19. NWS NCEP Central Operations Model Analyses and Guidance Website

Check here for the Latest News

Select Model Guidance, Observations and Analyses, or Tropical Guidance

MODEL GUIDANCE OBSERVATIONS AND ANALYSES TROPICAL GUIDANCE

Upcoming Changes | User's Guide | Frequently Asked Questions | Product Description Document

MAG v3.0.0

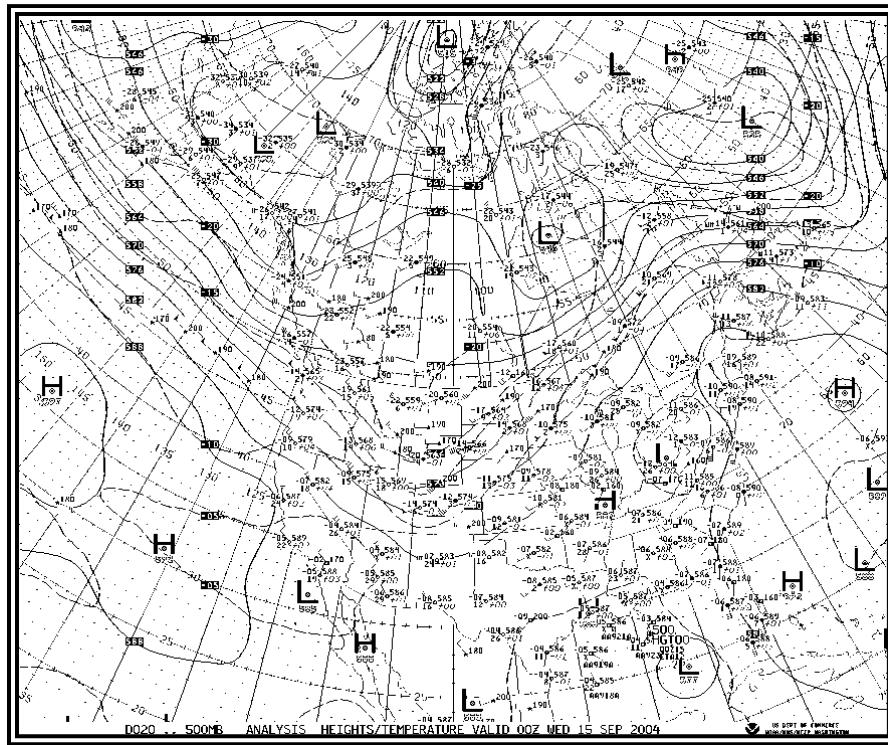
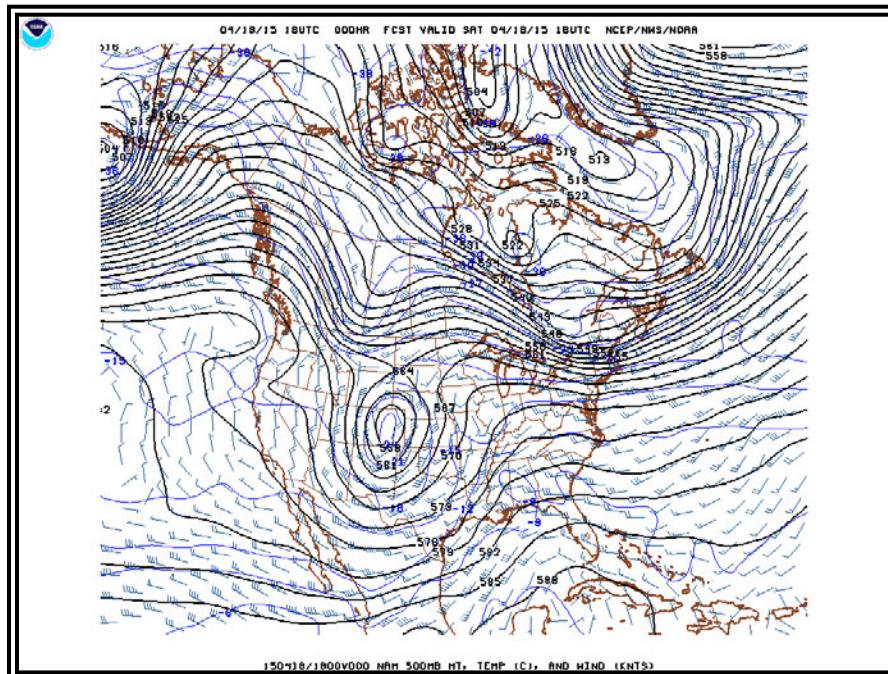
NOAA/National Weather Service
National Centers for Environmental Prediction
5830 University Research Court
College Park, MD 20740
NCEP Internet Services Team
Page last modified: May 20 2013 17:08 PM UTC.

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A user's guide, located within Website Information (upper right corner), provides descriptions, details, and examples of the various products.

4.3.1.1 Constant Pressure Analyses.

Constant Pressure Charts (see Figure 4-20, 500 MB Analysis Chart—Example) are being phased out by the NWS in favor of other products (see Figure 4-21, 500 MB Height, Temperature, and Wind, 00-hour Forecast (i.e., Model's Analyses from the NWS's North American Model [NAM] Example)) available on NCO's Model Analyses and Guidance website. See paragraph 5.17.1 for additional information.

Figure 4-20. 500 MB Analysis Chart—Example**Figure 4-21. 500 MB Height, Temperature, and Wind, 00-hour Forecast (i.e., Model’s Analyses from the NWS’s North American Model (NAM) Example)**

Specific details regarding the content of the product is provided in the Product Description tab on the NCO’s Model Analyses and Guidance Web page.

4.3.1.2 Use.

See paragraph [5.17.1.2](#).

4.3.2 Radiosonde Observation Analysis.

A common means of analyzing radiosonde observations (see paragraph [3.6.1](#)) is the skew-T diagram (see Figure [4-22](#), Skew-T Diagram—Example). Skew-T diagrams are primarily intended for, and used by, meteorologists as part of their analyses of the atmosphere. For example, the skew-T diagram can be used to:

- Determine the freezing level (or levels);
- Determine the stability of the atmosphere;
- Determine the potential for severe weather;
- Determine the height and depth of inversions;
- Infer cloud bases, tops, and cloud layers; and
- Determine soaring conditions.

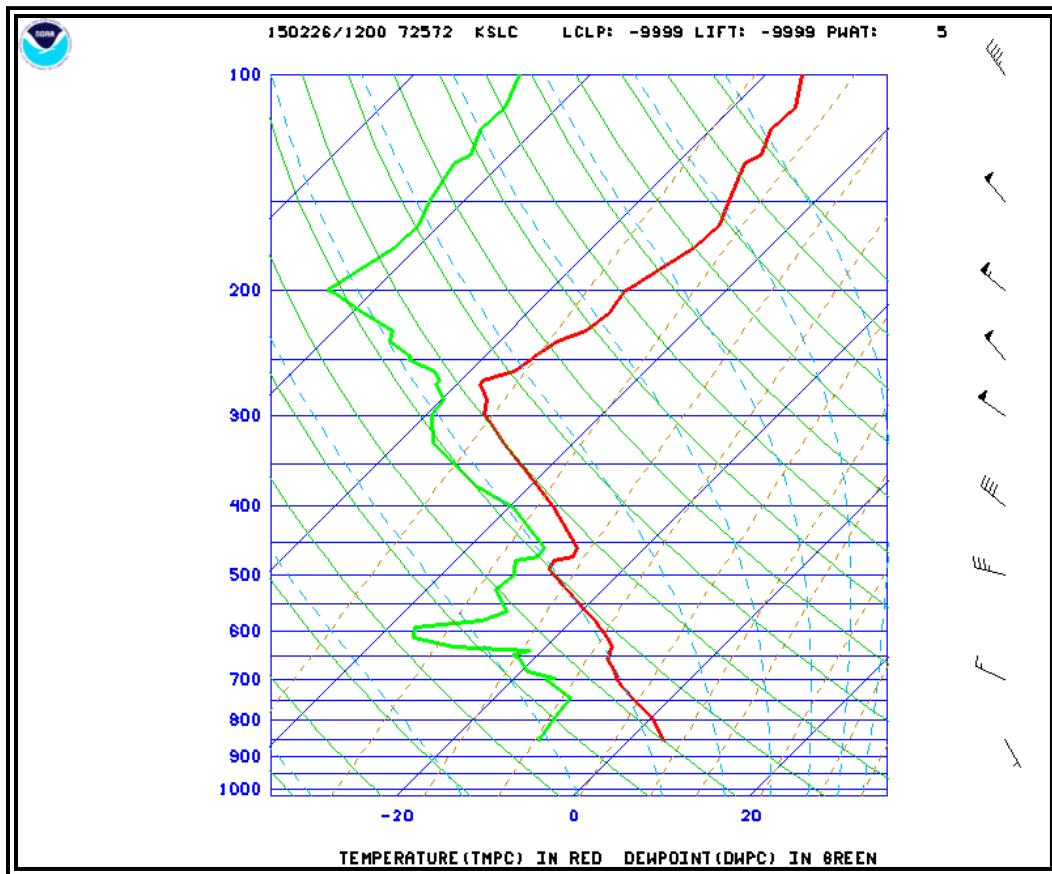
4.3.2.1 Issuance.

Skew-T diagrams are available from the NWS NCO. Their website, Model Analyses and Guidance (see Figure [4-19](#)), contains a user's guide that provides descriptions, details, and examples of the various products, including the skew-T.

4.3.2.2 Format.

The skew-T diagram provided on the NWS NCO Model Analyses and Guidance website uses the following format (other weather providers and websites may have different formats, especially colors):

- Horizontal axis is temperature in degrees Celsius, skewed to the right, labeled (minus) -20, 0, and 20 (Celsius).
- Vertical axis is pressure levels in millibars, labeled 1,000 (near sea level) to 100 (approximately 53,000 ft MSL).
- Bold solid red line represents the temperature profile over the station taken from the radiosonde observation (weather balloon).
- Bold solid green line represents the dewpoint profile.
- Wind aloft is shown on the far right side.

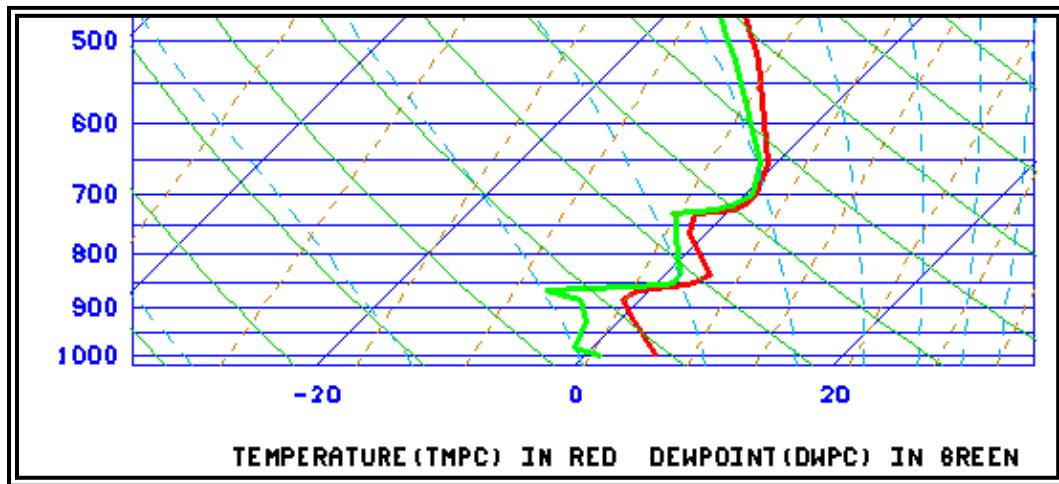
Figure 4-22. Skew-T Diagram—Example

4.3.2.3 Example.

Two examples are provided: a multiple freezing level example (see Figure 4-23, Skew-T Diagram—Multiple Freezing Level Example) and a cloud top example (see Figure 4-24, Skew-T Diagram—Cloud Top Example).

4.3.2.3.1 Multiple Freezing Level Example.

Figure 4-23. Skew-T Diagram—Multiple Freezing Level Example

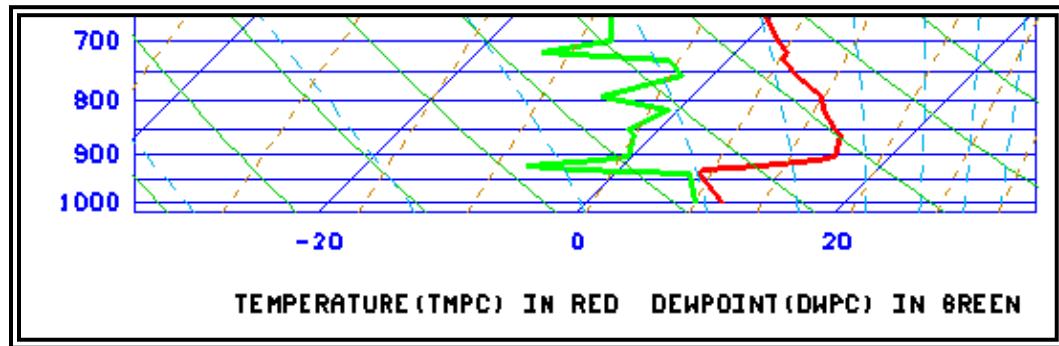


Horizontal axis is temperature in degrees Celsius, skewed to the right, labeled -20, 0, and 20 (Celsius). Vertical axis is pressure levels in millibars, labeled 1000 (near sea level) to 500 (18,000 ft). Bold solid red line represents the temperature profile over the station taken from the radiosonde observation (weather balloon). Bold solid green line represents the dewpoint profile. Note how the temperature profile (bold red line) crosses the 0 degree temperature line (also known as an isotherm) 5 times (near 900 MB, 860 MB, 775 MB, 725 MB, and 675 MB).

4.3.2.3.2 Cloud Top Example.

Figure 4-24 is the radiosonde observation from Vandenberg Air Force Base (VAFB), California, for 1200 UTC for a typical coastal stratus cloud.

Figure 4-24. Skew-T Diagram—Cloud Top Example



At about 950 MB, the temperature profile (bold red line) and dewpoint profile (bold green line) almost touch each other. This is the profile of a cloud top. The temperature and dewpoint quickly diverge, representing a change from the cool, moist air (and associated stratus cloud) to the dry and warmer air (cloud free) above.

4.3.2.4 Use.

Skew-T diagrams are primarily intended for, and used by, meteorologists as part of their analyses of the atmosphere and formulation of various forecasts.

CHAPTER 5. FORECASTS

The third distinct type of weather (meteorological) information is forecasts. Chapter 5 will discuss many forecast products, including in-flight advisories, produced by the NWS that are either specific to aviation or are public products of interest to aviation users.

5.1 Significant Meteorological Information (SIGMET).

A SIGMET is a concise description of the occurrence or expected occurrence of specified en route weather phenomena that may affect the safety of aircraft operations. SIGMETs are issued in text format and intended for dissemination to all pilots in flight to enhance safety. SIGMETs are issued as soon as practical to give notice to operators and aircrews of potentially hazardous en route conditions.

- All SIGMETs are available on <http://www.aviationweather.gov>.
- SIGMETs for Alaska are also available on the Alaska Aviation Weather Unit (AAWU) website.
- SIGMETs for Hawaii are also available on the NWS Weather Forecast Office (WFO) Honolulu website.

Although the areas where the SIGMETs apply may be shown graphically, a graphical depiction of the SIGMET area is *not* the entire SIGMET. Additional information regarding the SIGMET may be contained in the text version.

5.1.1 SIGMET Issuance.

SIGMETs are issued from Meteorological Watch Offices (MWO). The United States has three MWOs: the Aviation Weather Center (AWC), the AAWU, and the WFO Honolulu. Their Areas of Responsibility (AOR) are as follows:

The AWC:

- Twenty domestic Air Route Traffic Control Center (ARTCC) Flight Information Regions (FIRs) covering the continental United States (CONUS) and adjacent coastal waters. CONUS SIGMETs except for Convective SIGMETs are grouped into six areas (see Figure 5-1, AWC SIGMET Areas of Responsibility—Continental U.S.).
- The New York, Houston, Miami, and San Juan Oceanic FIRs (see Figure 5-2, AWC SIGMET Areas of Responsibility—Atlantic Basin).
- The Oakland Oceanic FIR north of 30 north latitude and the portion east of 140 west longitude, which is between the equator and 30 north latitude (see Figure 5-3, SIGMET Areas of Responsibility—Pacific Basin).

The AAWU is responsible for the Anchorage Continental FIR and Anchorage Oceanic FIR (see Figure 5-3).

WFO Honolulu is responsible for the Oakland Oceanic FIR south of 30 north latitude and between 140 west and 130 east longitude (see Figure 5-3).

Figure 5-1. AWC SIGMET Areas of Responsibility—Continental U.S.

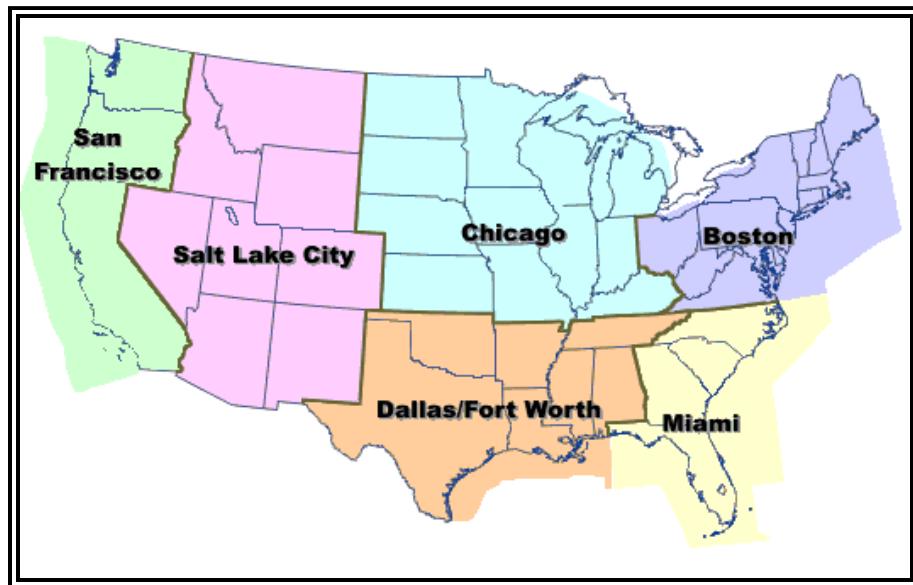


Figure 5-2. AWC SIGMET Areas of Responsibility—Atlantic Basin

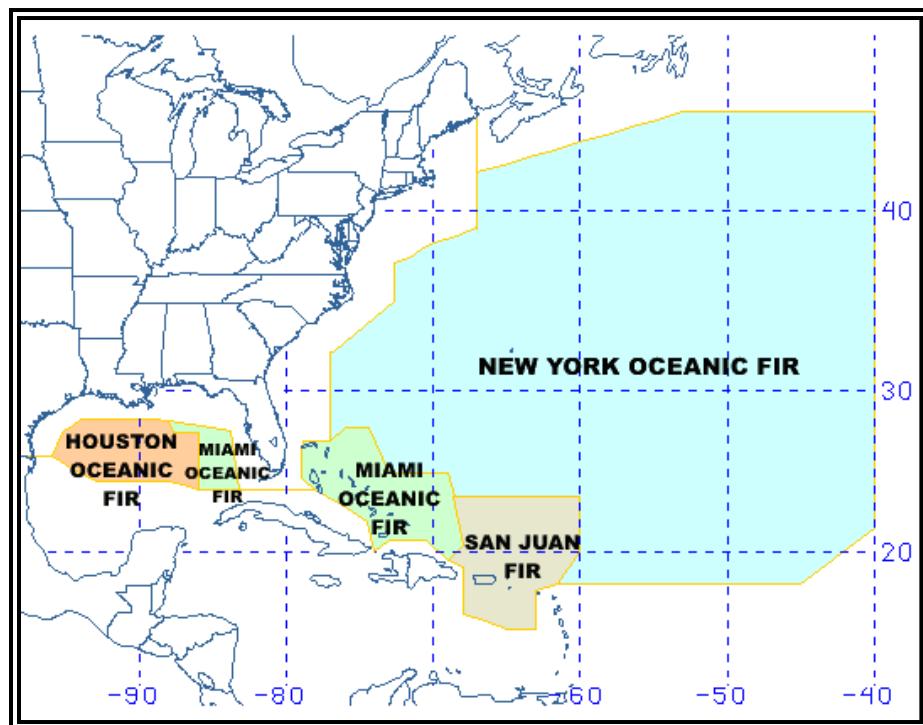
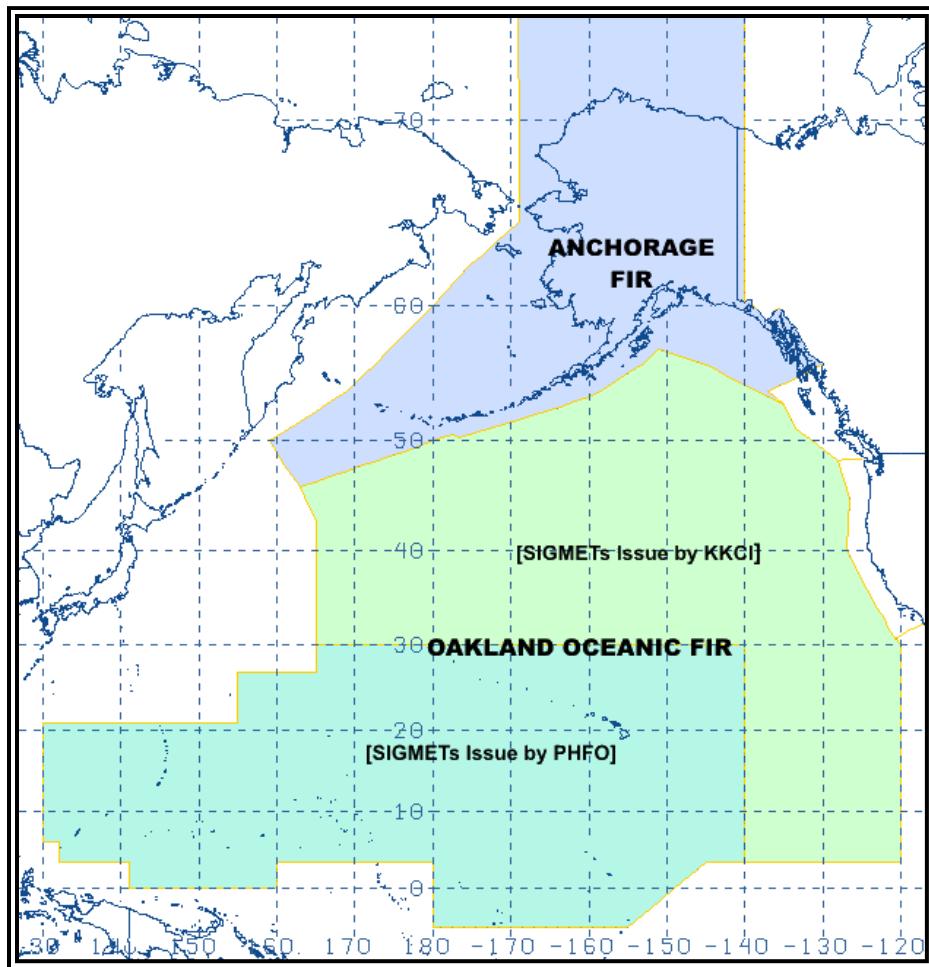


Figure 5-3. SIGMET Areas of Responsibility—Pacific Basin



Note that KKCI refers to the AWC that is in Kansas City, MO.

5.1.1.1 SIGMET Identification.

U.S. SIGMETs (other than Convective SIGMETs) are assigned a series identifier:

- AWC for CONUS:
 - **NOVEMBER, OSCAR, PAPA, QUEBEC, ROMEO, UNIFORM, VICTOR, WHISKEY, XRAY and YANKEE.** Note that **SIERRA** and **TANGO** are excluded.
- AWC for Oakland Oceanic FIR:
 - **ALFA, BRAVO, CHARLIE, DELTA, ECHO, FOXTROT, GOLF and HOTEL.**
- Honolulu MWO for Oakland Oceanic FIR:
 - **NOVEMBER, OSCAR, PAPA, QUEBEC, ROMEO, SIERRA, TANGO, UNIFORM, VICTOR, WHISKEY, XRAY, YANKEE and ZULU.**

- AAWU for Anchorage FIR:
 - **INDIA, JULIET, KILO, LIMA and MIKE.**

A number is assigned sequentially with each issuance until the phenomenon ends. At 0000 Coordinated Universal Time (UTC) each day, all continuing SIGMETs are renumbered to 1 regardless of a continuation of the phenomena (e.g., YANKEE 1, YANKEE 2, YANKEE 3).

5.1.2 SIGMET Standardization.

SIGMETs follow these standards:

- All heights or altitudes are referenced to above Mean Sea Level (MSL), unless otherwise noted, and annotated using the height in hundreds of feet, consisting of three digits (e.g., 040). For heights at or above 18,000 feet (ft), the level is preceded by flight levels (FL) (e.g., FL180).
- References to latitude and longitude are in whole degrees and minutes following the model: Nddmm or Sddmm, Wdddmm, or Edddmm with a space between latitude and longitude and a hyphen between successive points. Example: N3106 W07118—N3011 W7209.
- Messages are prepared in abbreviated plain language using contractions from FAA Order [JO 7340.2](#), Contractions, for domestic products and International Civil Aviation Organization (ICAO) document [8400](#) for international products issued for Oceanic FIRs. A limited number of non-abbreviated words, geographical names, and numerical values of a self-explanatory nature may also be used.

5.1.3 SIGMET (Non-Convective)—CONUS.

5.1.3.1 SIGMET (Non-Convective) Issuance Criteria—CONUS.

A SIGMET may be issued in the CONUS when any of the following conditions are affecting or, in the judgment of the forecaster, are expected to affect an area of at least 3,000 square miles (m^2) or an area judged to have a significant impact on the safety of aircraft operations:

- Severe or greater turbulence (**SEV TURB**).
- Severe icing (**SEV ICE**).
- Widespread duststorm (**WDSPR DS**).
- Widespread sandstorm (**WDSPR SS**).
- Volcanic ash (**VA**).

5.1.3.2 SIGMET (Non-Convective) Issuance Time and Valid Period—CONUS.

A SIGMET is an unscheduled product issued any time conditions reaching SIGMET criteria are occurring or expected to occur within a 4-hour period. A SIGMET can have a valid period up to, but not exceeding, 4 hours. SIGMETs

for continuing phenomena will be reissued at least every 4 hours as long as SIGMET conditions continue to occur in the AOR.

5.1.3.3 SIGMET (Non-Convective) Format and Example—CONUS.

The content and order of elements in the SIGMET are as follows:

- Series name and number.
- Valid beginning and ending time (UTC).
- List of states affected by the phenomena.
- Location of phenomena delineated by high-altitude Very High Frequency Omni-Directional Range (VOR) coordinates covering the affected area during the SIGMET valid time.
- Phenomena description (e.g., **SEV ICE**).
- Vertical extent (base and top), if appropriate.
- Movement, if appropriate.
- Intensity change (**INTSF**—intensifying, **WKN**—weakening, **NC**—no change).
- Indication that the weather condition will continue during the 4 hours beyond the valid time of the SIGMET.

Figure 5-4. SIGMET for the Continental U.S.—Example

```
SFOR UWS 100130
SIGMET ROMEO 1 VALID UNTIL 100530
OR WA
FROM SEA TO PDT TO EUG TO SEA
SEV TURB BTN FL280 AND FL350. CONDS CONTG BYD 0530Z.
```

Table 5-1. Decoding a SIGMET (Non-Convective) for the Continental U.S.

Line	Content	Description
1	SFO	SIGMET area identifier
	R	SIGMET series
	WS	Product identifier
	100130	Issuance date/time UTC
2	SIGMET	Product type
	ROMEO	SIGMET series name
	1	Series issuance number
	VALID UNTIL 100530	Ending valid date/time UTC
3	OR WA	Phenomenon location (states)
4	FROM SEA TO PDT TO EUG TO SEA	Phenomenon location (high-altitude VOR coordinates)
5	SEV TURB BTN FL280 AND FL350. CONDS CONTG BYD 1000Z	Phenomenon description

The SIGMET in Figure [5-4](#), SIGMET for the Continental U.S.—Example, is decoded as the following:

(Line 1) SIGMET ROMEO series issued for the San Francisco Area at 0130 UTC on the 10th day of the month.

(Line 2) This is the first issuance of the SIGMET ROMEO series and is valid until the 10th day of the month at 0530 UTC.

(Line 3) The affected states within the SFO area are Oregon and Washington.

(Line 4) From Seattle, WA; to Pendleton, OR; to Eugene, OR; to Seattle, WA.

(Line 5) Severe turbulence between Flight Level 280 and Flight Level 350. Conditions continuing beyond 0530Z.

5.1.3.4 SIGMET (Non-Convective) Cancellations—CONUS.

A CONUS Non-Convective SIGMET is canceled when the phenomena is no longer occurring or no longer expected to occur or has moved out of the AOR.

5.1.3.5 SIGMET (Non-Convective) Amendments—CONUS.

Amendments to CONUS Non-Convective SIGMETs are *not* issued. Instead, a new SIGMET is issued using the next series number.

5.1.3.6 SIGMET (Non-Convective) Corrections—CONUS.

Corrections to CONUS Non-Convective SIGMETs are issued as necessary. The corrected SIGMET is identified by a “COR” located at the end of the first line after the issuance UTC date/time.

5.1.4 Convective SIGMET.

Convective SIGMETs are issued for the CONUS instead of SIGMETs for thunderstorms. Any Convective SIGMET implies severe or greater turbulence, severe icing, and low-level windshear.

Although the areas where the Convective SIGMETs apply may be shown graphically, a graphical depiction of the Convective SIGMET area is *not* the entire Convective SIGMET. Information regarding the Convective SIGMET identified by graphic depiction should be referred to for further information.

5.1.4.1 Convective SIGMET—Routine Issuance Criteria.

A Convective SIGMET will be issued when any of the following conditions are occurring or, in the judgment of the forecaster, are expected to occur:

- A line of thunderstorms at least 60 miles (mi) long with thunderstorms affecting at least 40 percent of its length.
- An area of active thunderstorms affecting at least 3,000 mi² covering at least 40 percent of the area concerned and exhibiting a very strong radar reflectivity intensity or a significant satellite or lightning signature.
- Embedded or severe thunderstorm(s) expected to occur for more than 30 minutes during the valid period regardless of the size of the area.

5.1.4.2 Convective SIGMET—Special Issuance Criteria.

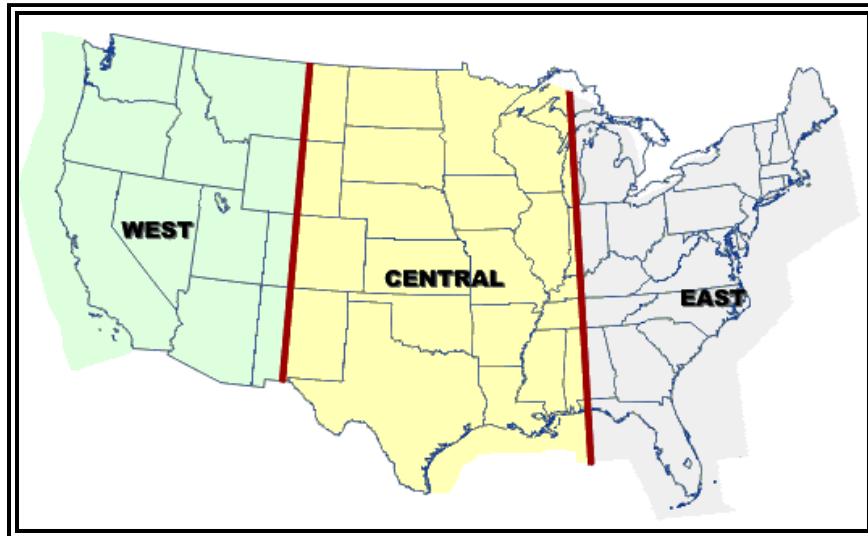
A special Convective SIGMET may be issued when any of the following criteria are occurring or, in the judgment of the forecaster, are expected to occur for more than 30 minutes of the valid period.

- Tornado, hail greater than or equal to $\frac{3}{4}$ inch (in) (at the surface), or wind gusts greater than or equal to 50 knots (kts) (at the surface) are reported.
- Indications of rapidly changing conditions if, in the forecaster’s judgment, they are not sufficiently described in existing Convective SIGMETs.
- Special issuance is not required for a valid Convective SIGMET.

5.1.4.3 Convective SIGMET Issuance Time and Valid Period.

Convective SIGMET bulletins for the eastern, central, and western regions of the CONUS (see Figure 5-5, AWC Convective SIGMET Areas of Responsibility) are issued on a scheduled basis, hourly at 55 minutes past the hour. Each bulletin contains all valid Convective SIGMETs within the region. Convective SIGMETs are valid for 2 hours or until superseded by the next hourly issuance. A Convective SIGMET bulletin must be transmitted each hour for each region. When conditions do not meet or are not expected to meet Convective SIGMET criteria within a region at the scheduled time of issuance, a “**CONVECTIVE SIGMET...NONE**” message is transmitted.

Figure 5-5. AWC Convective SIGMET Areas of Responsibility



5.1.4.4 Convective SIGMET Format and Example.

Each Convective SIGMET bulletin includes one or more individually numbered Convective SIGMETs for the region. The content and order of each bulletin is as follows:

- Convective SIGMET series number and region letter (**E**, **W** or **C**).
- Valid ending time (**UTC**).
- List of states affected by the phenomena.
- Location of phenomena delineated by high-altitude VOR coordinates covering the affected area during the SIGMET valid time.
- Phenomena description (e.g., **AREA SEV EMBD TS**).
- Movement (e.g., **MOV FROM 26030KT**).
- Cloud top (e.g., **TOPS ABV FL450**).
- Remarks (e.g., **TORNADOES...HAIL TO 2.5 IN...WIND GUSTS TO 70KT POSS**).

Note 1: Tropical cyclone information will be added to remarks section of the CONUS Convective SIGMETs when appropriate.

Note 2: See Appendix [A](#), Definition of Common Terms Used in En Route Forecasts and Advisories, for definitions of common terms used in Convective SIGMETs.

Figure 5-6. Convective SIGMET Decoding—Example

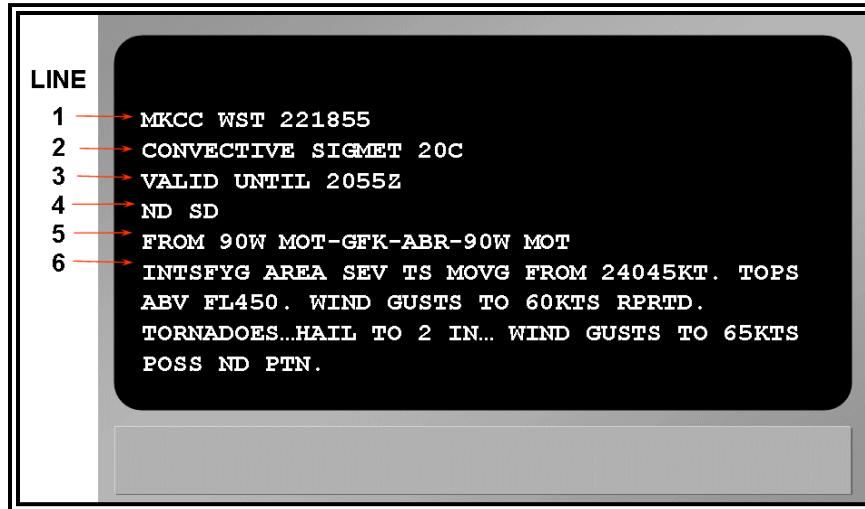


Table 5-2. Decoding a Convective SIGMET

Line	Content	Description
1	MKC	Issuing Office (AWC)
	C	Region (East, Central or West)
	WST	Product Identifier
	221855	Issuance date/time (DDHHMM)
2	CONVECTIVE SIGMET	Product type
	20	Issuance number
	C	Region (East, Central or West)
3	VALID UNTIL 2055Z	Valid ending time (UTC)
4	ND SD	States/areas affected
5	FROM 90W MOT-GFK-ABR-90W MOT	Phenomenon location (high altitude VOR coordinates)
6	INTSFYG AREA SEV TS MOVG FROM 24045KT. TOPS ABV FL450. WIND GUSTS TO 60KTS RPTD. TORNADOES...HAIL TO 2 IN... WIND GUSTS TO 65KTS POSS ND PTN	Phenomenon description, movement, cloud top, remarks

The Convective SIGMET in Figure [5-6](#), Convective SIGMET Decoding—Example, is decoded as the following:

(Line 1) Convective SIGMET issued for the central portion of the United States on the 22nd at 1855Z.

(Line 2) This is the 20th Convective SIGMET issued on the 22nd for the central United States as indicated by “20C.”

(Line 3) Valid until 2055Z.

(Line 4) The affected states are North and South Dakota.

(Line 5) From 90 nautical miles west of Minot, ND; to Grand Forks, ND; to Aberdeen, SD; to 90 nautical miles west of Minot, ND.

(Line 6) An intensifying area of severe thunderstorms moving from 240 degrees at 45 knots (to the northeast). Thunderstorm tops above Flight Level 450. Wind gusts to 60 knots reported. Tornadoes, hail to 2 inches in diameter and wind gusts to 65 knots possible in the North Dakota portion.

5.1.4.5 Convective SIGMET Outlook.

Each Convective SIGMET bulletin includes a 2- to 6-hour outlook at the end of the bulletin. The content and order of each bulletin is as follows:

- Beginning and ending valid times.
- Location of expected Convective SIGMET issuances delineated by high-altitude VOR coordinates for the outlook valid time.

5.1.4.6 Convective SIGMET Cancellations.

Convective SIGMETs are not canceled but are superseded by the next Convective SIGMET in the series.

5.1.4.7 Convective SIGMET Amendments.

Amended Convective SIGMETs are *not* issued. Instead, a new Convective SIGMET is issued for that region.

5.1.4.8 Convective SIGMET Corrections.

Corrections to Convective SIGMETs are issued as necessary. The corrected Convective SIGMET is identified by a “COR” located at the end of the first line after the issuance UTC date/time.

5.1.5 SIGMET—Outside the CONUS.

5.1.5.1 SIGMET Issuance Criteria—Outside the CONUS.

U.S. SIGMETs outside the CONUS are issued when any of the following is occurring or expected to occur affecting an area greater than 3,000 mi² or, in

the judgment of the forecaster, an area having the potential to have a significant effect on the safety of aircraft operations.

- Thunderstorm—of type below*
 - Obscured (**OBSC TS**)
 - Embedded (**EMBD TS**)
 - Widespread (**WDSPR TS**)
 - Squall line (**SQL TS**)
 - Isolated severe (**ISOL SEV TS**)
- Severe turbulence (**SEV TURB**)
- Severe icing (**SEV ICE**)
 - With freezing rain (**SEV ICE (FZRA)**)
- Widespread duststorm (**WDSPR DS**)
- Widespread sandstorm (**WDSPR SS**)
- Volcanic ash (**VA**)
- Tropical cyclone (**TC**)
- Radioactive cloud (**RDOACT CLD**)

Note: Obscured, embedded, or squall line thunderstorms do not have to reach 3,000 mi² criteria.

*Tornado (**TDO**), funnel cloud (**FC**), waterspout (**WTSPT**) and heavy hail (**HVY GR**) may be used as a further description of the thunderstorm, as necessary.

5.1.5.2 SIGMET Issuance Time and Valid Period—Outside the CONUS.
A SIGMET is an unscheduled product issued any time conditions reaching SIGMET criteria are occurring or expected to occur within a 4-hour period. A SIGMET outside the CONUS can have a valid period up to, but not exceeding, 4 hours, except for volcanic ash (VA) and tropical cyclone (TC), which can be valid up to 6 hours. SIGMETs for continuing phenomena will be reissued at least every 4 (or 6) hours as long as SIGMET conditions continue to occur in the area for responsibility.

5.1.5.3 SIGMET Format and Example—Outside the CONUS.
SIGMETs outside the CONUS contain the following information, related to the specific phenomena and in the order indicated:

- Phenomenon and its description (e.g., **SEV TURB**).
- An indication whether the information is observed, using OBS and/or FCST. The time of observation will be given in UTC.

- Location of the phenomenon referring, where possible the latitude and longitude, and FLs (altitude) covering the affected area during the SIGMET valid time. SIGMETs for volcanic ash cloud and tropical cyclones contain the positions of the ash cloud, tropical cyclone center, and radius of convection at the start of the validity time of the SIGMET.
- Movement toward or expected movement using sixteen points of the compass, with speed in knots, or stationary, if appropriate.
- Thunderstorm maximum height as **FL**.
- Changes in intensity, using, as appropriate, the abbreviations intensifying (INTSF), weakening (WKN), or no change (NC).
- Forecast position of volcanic ash cloud or the center of the tropical cyclone at the end of the validity period of the SIGMET message.

Figure 5-7. SIGMET Outside the Continental U.S. Decoding Example

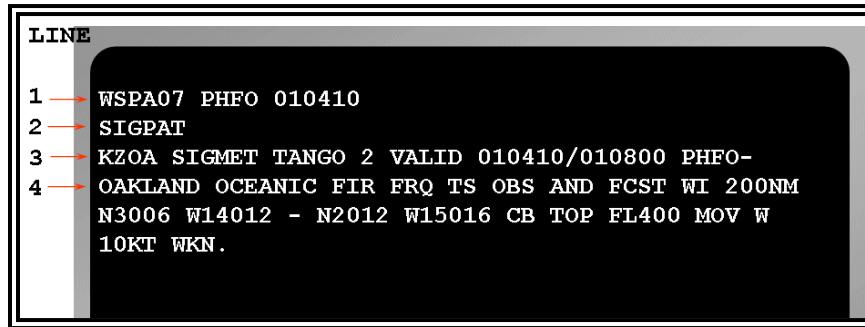


Table 5-3. Decoding a SIGMET Outside of the Continental U.S.

Line	Content	Description
1	WSPA07	ICAO communication header
	PHFO	Issuance MWO
	010410	Issuance UTC date/time
2	SIGPAT	NWS AWIPS communication header
3	KZOA	Area Control Center
	SIGMET	Product type
	TANGO	SIGMET series
	2	Issuance number
	VALID 010410/010800	Valid period UTC date/time
	PHFO	Issuance office
4	OAKLAND OCEANIC FIR	Flight Information Region (FIR)
	FRQ TS OBS AND FCST WI 200NM N3006 W14012 - N2012 W15016 CB TOP FL400 MOV W 10KT WKN.	Phenomenon description

The SIGMET in Figure [5-7](#), SIGMET Outside the Continental U.S. Decoding Example, is decoded as the following:

(Line 1) The WMO product header is WSPA07. Issued by the PHFO on the 1st day of the month at 0410 UTC.

(Line 2) The NWS AWIPS communication header is SIGPAT.

(Line 3) For the Oakland (KZOA) Area Control Center. This is the 2nd issuance of SIGMET Tango series, valid from the 1st day of the month at 0410 UTC until the 1st day of the month at 0800 UTC, issued by the Honolulu Meteorological Watch Office.

(Line 4) Concerning the Oakland Oceanic Flight Information Region (FIR), frequent thunderstorms observed and forecast within 200 nautical miles of 30 degrees and 6 minutes north; 140 degrees and 12 minutes west; to 20 degrees and 12 minutes north, 150 degrees and 16 minutes west, cumulonimbus tops to flight level 400 moving west at 10 knots, weakening.

5.1.5.4

SIGMETs for Volcanic Ash—Outside the CONUS.

A SIGMET for volcanic ash cloud is issued for volcanic eruptions. A volcanic eruption is any volcanic activity, including the emission of volcanic ash, regardless of the eruption's magnitude. Initial volcanic ash SIGMETs may be issued based on credible pilot reports in the absence of a volcanic ash advisory

(VAA), but are updated once a VAA is issued. Volcanic ash SIGMETs will continue to be issued until the ash cloud is no longer occurring or expected to occur over the AOR.

SIGMETs for volcanic ash cloud are valid up to 6 hours and provide an observed or forecast location of the ash cloud at the beginning of the SIGMET. A 6-hour forecast position for the ash cloud, valid at the end of the validity period of the SIGMET message, is also included. SIGMETs are reissued at least every 6 hours while the volcanic ash cloud hazard exists or is expected to exist.

5.1.5.5

SIGMETs for Tropical Cyclone—Outside the CONUS.

SIGMETs for a tropical cyclone may be issued for non-frontal synoptic-scale cyclones meeting the following criteria:

- Originates over tropical or sub-tropical waters with organized convection and definite cyclonic surface wind circulation.
- Wind speeds reach 35 kts independent of the wind averaging time used by the Tropical Cyclone Advisory Center (TCAC).

SIGMETs for tropical cyclones will be valid up to 6 hours. SIGMETs for tropical cyclones will include two positions. The first position included will be the TCAC advisory position. The second position will be the forecast position valid at the end of the SIGMET period.

In addition to the two storm positions, SIGMETs will include associated convection when applicable. SIGMETs will be reissued at least every 6 hours while the tropical cyclone wind remains or are expected to remain above 34 kts.

5.1.5.6

SIGMET Cancellation—Outside the CONUS.

SIGMETs are canceled when the phenomena is no longer occurring or expected to occur in the AOR.

5.1.5.7

SIGMET Amendments—Outside the CONUS.

SIGMET amendments will *not* be issued. Instead, the next SIGMET in the series is issued to accomplish the update. The valid time of the new SIGMET is reset to reflect the new 4-hour valid period (6-hour for VA and TC SIGMETs).

5.1.5.8

SIGMET Corrections—Outside the CONUS.

Corrections to SIGMETs are issued as necessary. This is done by issuing a new SIGMET in the series, which advances the SIGMET number and cancels the previous SIGMET.

5.1.5.9 SIGMET for Volcanic Ash Example—Outside the CONUS.

WVNT06 KKCI 082030
TJZS SIGMET FOXTROT 2 VALID 082030/090230 KKCI-
SAN JUAN FIR VA FROM SOUFRIERE HILLS LOC 1642N06210W

VA CLD OBS AT 2030Z WI N1730 W06400 - N1700 W06300 -
N1650 W06300 - N1710 W06400 - N1730 W06400. SFC/060.
MOV W 15KT. FCST 0230Z VA CLD APRX N1730 W06500 -
N1700 W06300 - N1650 W06300 - N1710 W06500 - N1730
W06500.

The ICAO communication header for this product is WVNT06. It is a SIGMET issued by the Aviation Weather Center (KKCI) in Kansas City, Missouri, on the 8th day of the month at 2030 UTC. This is the second (2) issuance of SIGMET series Foxtrot valid from the 8th day of the month at 2030 UTC until the 9th day of the month at 0230 UTC. Within the San Juan Oceanic FIR, volcanic ash from Soufriere Hills volcano located at 16 degrees/42 minutes north, 62 degrees/10 minutes west. Volcanic ash cloud observed at 2030 UTC within an area bounded by 17 degrees/30 minutes north, 64 degrees/00 minutes west to 17 degrees/00 minutes north, 63 degrees/00 minutes west to 16 degrees/50 minutes north, 63 degrees/00 minutes west to 17 degrees/ 10 minutes north, 64 degrees/00 minutes west to 17 degrees/30 minutes north, 64 degrees/00 minutes west. From the surface to 6,000 feet MSL. Moving to the west at 15 knots. Forecast at 0230 UTC, volcanic ash cloud located approximately at 17 degrees/30 minutes north, 65 degrees/00 minutes west to 17 degrees/00 minutes north, 63 degrees/00 minutes west to 16 degrees/50 minutes north, 63 degrees/00 minutes west to 17 degrees/10minutes north, 65 degrees/00 minutes west to 17 degrees/30 minutes north, 65 degrees/ 00 minutes west.

5.1.5.10 SIGMET for Tropical Cyclone Example—Outside the CONUS.

WSNT03 KKCI 081451
SIGA0C
KZNY SIGMET CHARLIE 11 VALID 081500/082100 KKCI-

NEW YORK OCEANIC FIR TC KYLE OBS N3106 W07118 AT
1500Z CB TOP FL500 WI 120NM OF CENTER MOV WSW 5 KT
NC FCST 2100Z TC CENTER N3142 W07012

The ICAO communication header for this product is WSNT03. It is a SIGMET issued by the Aviation Weather Center (KKCI) in Kansas City, Missouri, on the 8th day of the month at 1451 UTC. The National Weather Service AWIPS communication header for this product is SIGPAT. This is the eleventh (11) issuance of SIGMET series Charlie valid from the 8th day of the month at 1500 UTC until the 8th day of the month at 2100 UTC. Within the New York Oceanic FIR, Tropical Cyclone Kyle observed at 31 degrees/6 minutes north, 71 degrees/18 minutes west at 1500 UTC, cumulonimbus tops to flight level 500 (approximately 50,000 feet MSL), within 120 nautical miles of the center, moving from west-southwest at 5 knots, no change in intensity is forecast, at 2100 UTC the tropical cyclone center will be at 31 degrees/42 minutes north, 70 degrees/12 minutes west.

5.2 Airmen's Meteorological Information (AIRMET).

An AIRMET is a concise description of the occurrence or expected occurrence of specified en route weather phenomena that may affect the safety of aircraft operations, but at intensities lower than those that require the issuance of a SIGMET. AIRMETs are intended for dissemination to all pilots in flight to enhance safety and are of particular concern to operators and pilots of aircraft sensitive to the phenomena described and to pilots without instrument ratings. AIRMETs give notice to operators and aircrews of potentially hazardous en route conditions.

Although the areas where the AIRMETs apply may be shown graphically, a graphical depiction of the AIRMET area is *not* the entire AIRMET. Additional information regarding the AIRMET may be contained in the text version.

- AIRMETs are available for the CONUS on <http://www.aviationweather.gov>.
- AIRMETs are available for Alaska on the AAWU website.
- AIRMETs are available for Hawaii on the NWS WFO Honolulu website.

5.2.1 AIRMET Issuance

AIRMETs are issued from the three MWOs located at the AWC, AAWU, and WFO Honolulu. Their AORs are:

- AWC: The CONUS and adjacent coastal waters (see Figure 5-8, AWC AIRMET Areas of Responsibility—Continental U.S.).
- AAWU: Alaska and adjacent coastal waters (see Figure 5-9, AAWU Flight Advisory and Area Forecast (FA) Zones—Alaska).
- WFO Honolulu: Hawaii and adjacent waters (see Figure 5-10, WFO Honolulu AIRMET Areas of Responsibility—Hawaii).

Figure 5-8. AWC AIRMET Areas of Responsibility—Continental U.S.



Figure 5-9. AAWU Flight Advisory and Area Forecast (FA) Zones—Alaska

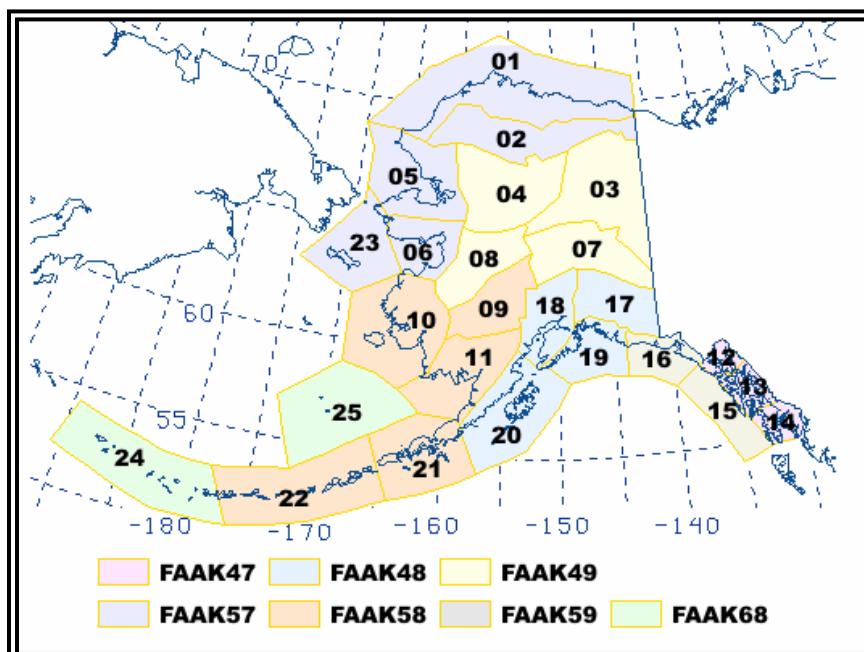
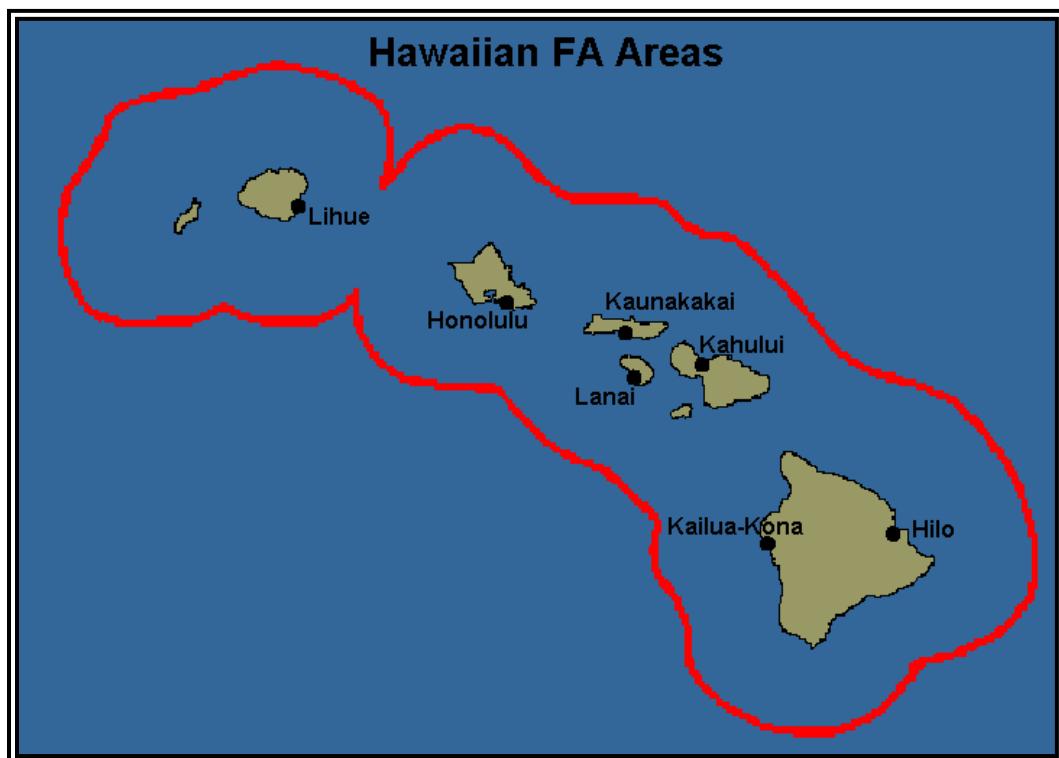


Table 5-4. AAWU Flight Advisory and Area Forecast (FA) Zones—Alaska

1	Arctic Coast Coastal	14	Southern Southeast Alaska
2	North Slopes of the Brooks Range	15	Coastal Southeast Alaska
3	Upper Yukon Valley	16	Eastern Gulf Coast
4	Koyukuk and Upper Kobuk Valley	17	Copper River Basin
5	Northern Seward Peninsula-Lower Kobuk Valley	18	Cook Inlet-Susitna Valley
6	Southern Seward Peninsula-Eastern Norton Sound	19	Central Gulf Coast
7	Tanana Valley	20	Kodiak Island
8	Lower Yukon Valley	21	Alaska Peninsula-Port Heiden to Unimak Pass
9	Kuskowim Valley	22	Unimak Pass to Adak
10	Yukon-Kuskowim Delta	23	St. Lawrence Island-Bering Sea Coast
11	Bristol Bay	24	Adak to Attu
12	Lynn Canal and Glacier Bay	25	Pribilof Islands and Southeast Bering Sea
13	Central Southeast Alaska		

Figure 5-10. WFO Honolulu AIRMET Areas of Responsibility—Hawaii

5.2.2 AIRMET Issuance Criteria

An AIRMET may be issued when any of the following weather phenomena are occurring or are expected to occur over an area of at least 3,000 mi²:

- Ceiling less than 1,000 ft and/or visibility less than 3 statute miles (sm) (**IFR**).
 - Weather phenomena restricting the visibility including, but not limited to, precipitation (**PCPN**), smoke (**FU**), haze (**HZ**), mist (**BR**), fog (**FG**), and blowing snow (**BS**).
- Widespread mountain obscuration (**MTN OBSCN**).
 - Weather phenomena causing the obscuration are included, but not limited to, clouds (**CLDS**), precipitation (**PCPN**), smoke (**FU**), haze (**HZ**), mist (**BR**), and fog (**FG**).
- Moderate turbulence (**MOD TURB**).
 - Top and bottom of **MOD TURB** layer are specified.
- Sustained surface wind greater than 30 kts (**STG SFC WND**).
- Moderate icing (**MOD ICE**).
 - Top and bottom of **MOD ICE** are specified.
 - The range of freezing level altitudes is given when the bottom altitude of **MOD ICE** is the freezing level (**FRZLVL**).
 - Areas with multiple freezing levels are specified.
 - Range of freezing levels over the area is specified.
 - Lowest freezing levels above ground level (AGL) at intervals of 4,000 ft MSL (or SFC as appropriate) are specified.
- Non-Convective low-level windshear potential below 2,000 ft AGL (**LLWS POTENTIAL**).

5.2.3 AIRMET Standardization

All AIRMETs follow these standards:

- All heights or altitudes are referenced to above MSL, unless otherwise noted, and annotated using the height in hundreds of feet, consisting of three digits (e.g., 040). For heights at or above 18,000 ft, the level is preceded by FL to represent flight levels (e.g., FL180).
- Messages are prepared in abbreviated plain language using contractions from Order 7340.2. A limited number of non-abbreviated words, geographical names, and numerical values of a self-explanatory nature may also be used.
- Weather and obstructions to visibility are described using the weather abbreviations for surface weather observations (Aviation Routine Weather Report (METAR)/Special Weather Report (SPECI)). See the [Federal Meteorological](#)

[Handbook No. 1 \(FMH-1\)](#), Surface Weather Observations and Reports, or paragraph [3.1](#) of this document.

Note: See Appendix [A](#) for definitions of common terms used in AIRMETs.

5.2.4 AIRMET Bulletins, Issuance Times, and Valid Period.

AIRMETs are issued as bulletins containing one or more AIRMET messages following the schedule listed in Table 5-5, AIRMET Issuance Schedule. AIRMETs are issued 4 times a day except for those in Alaska, which are issued three times a day. Unscheduled AIRMETs are issued when conditions are occurring or expected to occur but were not forecast.

Table 5-5. AIRMET Issuance Schedule

	1st Scheduled Issuance (UTC)	2nd Scheduled Issuance (UTC)	3rd Scheduled Issuance (UTC)	4th Scheduled Issuance (UTC)
CONUS	0245	0845	1445	2045
Alaska	0415 (DT)/ 0515 (ST)	1215 (DT)/ 1315 (ST)	2015 (DT)/ 2115 (ST)	None
Hawaii	0400	1000	1600	2200

Note: DT—During Alaska Daylight Time, ST—During Alaska Standard Time

AIRMETs are valid for 6 hours except for those in Alaska, which are valid for 8 hours. The valid period of an AIRMET message cannot exceed the valid time of the AIRMET bulletin. However, note that each AIRMET contains remarks concerning the continuance of the phenomenon during the 6 hours following the AIRMET ending time. Also, AIRMET bulletins can contain a separate outlook when conditions meeting AIRMET criteria are expected to occur during the 6-hour (8-hour for Alaska) period after the valid time of the AIRMET bulletin.

5.2.5 AIRMET Format and Example.

An AIRMET message includes the following information as appropriate and in the order indicated:

- Reference to appropriate active SIGMETs affecting the area at the time of AIRMET issuance (e.g., SEE SIGMET BRAVO SERIES).
- Beginning time of the AIRMET phenomenon if different from the AIRMET beginning valid time.
- AIRMET name (SIERRA, TANGO, or ZULU), update number, weather phenomenon, and ending valid time. (Note: The AIRMET number is reset to 1 after 0000 UTC each day.)

- AIRMET Sierra describes IFR (instrument flight rules) conditions and/or extensive mountain obscurations. Hawaii AIRMETs for mountain obscuration may be issued for an area less than 3,000 mi².
- AIRMET Tango describes moderate turbulence, sustained surface winds of 30 kts or greater, and Non-Convective low-level windshear.
- AIRMET Zulu describes moderate icing and provides freezing-level heights.
- List of affected states (CONUS only).
- Location of phenomenon using VORs.
- Description of phenomenon for the AIRMET issuance.
- Vertical extent (bases and tops), as appropriate.
- Ending time of phenomenon if different from the AIRMET ending time.
- Remarks concerning the continuance of the phenomenon during the 6 hours following the AIRMET ending time.
- CONUS and Hawaii AIRMETs: A separate AIRMET outlook is included in the AIRMET bulletin when conditions meeting AIRMET criteria are expected to occur during the 6-hour period after the valid time of the AIRMET bulletin.
- Alaska AIRMETs: Outlook information is included in the appropriate area forecast (FA) zone when conditions are expected to occur during the 8-hour period after the valid time of the AIRMET bulletin.

Figure 5-11. AIRMET Bulletin Decoding—Example

LINE	
1	BOSS WA 211945
2	AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 220200
3	.
3	AIRMET IFR..ME NH VT MA CT RI NY NJ AND CSTL WTRS
4	FROM CAR TO YSJ TO 150E ACK TO EWR TO YOW TO CAR
5	CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONT BYD 02Z THRU 08Z.
3	.
3	AIRMET MTN OBSCN..ME NH VT MA NY PA
4	FROM CAR TO MLT TO CON TO AVP TO SYR TO CAR
5	MTNS OBSCD BY CLDS/PCPN/BR. CONDS CONT BYD 02Z THRU 08Z.

Table 5-6. Decoding an AIRMET Bulletin

Line	Content	Description
1	BOS	AIRMET area identifier
	S	AIRMET series
	WA	Product type
	211945	Issuance UTC date/time
2	AIRMET	Product type
	SIERRA	AIRMET series
	UPDT 3	Update number
	FOR IFR AND MTN OBSCN	Product description
	VALID UNTIL 220200	Ending UTC date/time
3A	AIRMET IFR..ME NH VT MA CT RI NY NJ AND CSTL WTRS	Product type/series... Phenomenon location (states)
3B	AIRMET MTN OBSCN..ME NH VT MA NY PA	
4A	FROM CAR TO YSJ TO 150E ACK TO EWR TO YOW TO CAR	Phenomenon location (VOR locations)
4B	FROM CAR TO MLT TO CON TO SLT TO SYR TO CAR	
5A	CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONT BYD 02Z THRU 08Z.	Phenomenon description
5B	MTNS OBSCD BY CLDS/PCPN/BR. CONDS CONT BYD 02Z THRU 08Z.	

The AIRMET bulletin in Figure 5-11, AIRMET Bulletin Decoding—Example, is decoded as follows:

(Line 1) AIRMET SIERRA issued for the Boston area at 1945Z on the 21st day of the month. “SIERRA” contains information on instrument flight rules (IFR) and/or mountain obscurations.

(Line 2) This is the third updated issuance of this Boston AIRMET series as indicated by “SIERRA UPDT 3” and is valid until 0200Z on the 22nd.

(Line 3A) The affected states within the BOS area are: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey and coastal waters.

(Line 3B) The affected states within the BOS area are: Maine, New Hampshire, Vermont, Massachusetts, New York and Pennsylvania.

(Line 4A) Within an area bounded by: Caribou, ME; to Saint Johns, New Brunswick; to 150 nautical miles east of Nantucket, MA; to Newark, NJ; to Ottawa, Ontario; to Caribou, ME.

(Line 4B) Within an area bounded by: Caribou, ME to Millinocket, ME to Concord, NH to Slate Run, PA to Syracuse, NY to Caribou, ME.

(Line 5A) Ceiling below 1,000 feet/visibility below 3 statute miles, precipitation/mist. Conditions continuing beyond 0200Z through 0800Z.

(Line 5B) Mountains Obscured by clouds, precipitation and mist. Conditions continuing beyond 0200Z through 0800Z.

5.2.5.1 AIRMET Updates and Amendments.

If an AIRMET is amended, **AMD** is added after the date/time group on the FAA product line. The update number will be incremented, **UPDT** is added to end of the line containing the list of affected states (CONUS only). The issuance time of the AIRMET bulletin is updated to reflect the time of the amendment. The ending valid time remains unchanged.

5.2.5.2 AIRMET Corrections.

AIRMETs containing errors are corrected by adding **COR** after the date/time group on the FAA product line. The issuance time of the AIRMET bulletin is updated to reflect the time of the correction. The ending valid time remains unchanged.

5.3 Graphical Airman's Meteorological Advisory (G-AIRMET).

The Graphical AIRMET (G-AIRMET) product is a decision-making tool based on weather "snapshots" displayed at short time intervals. The G-AIRMET identifies hazardous weather in space and time more precisely than text products, enabling pilots to maintain high safety margins while flying more efficient routes.

The NWS's goal is to maximize aviation safety and air space efficiency by providing the most accurate and timely weather information possible to enhance both pre-flight and in-flight decision making. For decades, NWS has issued text-based AIRMETs that have provided broad-scale descriptions of hazardous weather. Often referred to as a time "smear," the text-based AIRMET requires meteorologists to describe hazardous weather over large geographical areas for 6-hour periods. G-AIRMET provides more precise and informative weather hazard depictions than the text-only AIRMET.

Aviation weather users have found that pictures are worth a thousand contractions. G-AIRMETs provide a better path from the aviation meteorologist to the weather user, by providing precise, interactive, and easy-to-understand graphical displays. Meteorologists can put their energy into creating and updating G-AIRMET weather graphics. The traditional text AIRMET coincides with G-AIRMET information because texts AIRMETs are formatted from G-AIRMET information.

G-AIRMETs are available for the CONUS and adjacent coastal waters only and can be viewed on <http://www.aviationweather.gov>.

5.3.1 G-AIRMET Issuance

G-AIRMETs are issued by the AWC every 6 hours and are updated/amended as necessary, coinciding with the text AIRMET products.

Table 5-7. G-AIRMET Issuance Schedule

	1 st Scheduled Issuance (UTC)	2 nd Scheduled Issuance (UTC)	3 rd Scheduled Issuance (UTC)	4 th Scheduled Issuance (UTC)
CONUS	0300	0900	1500	2100

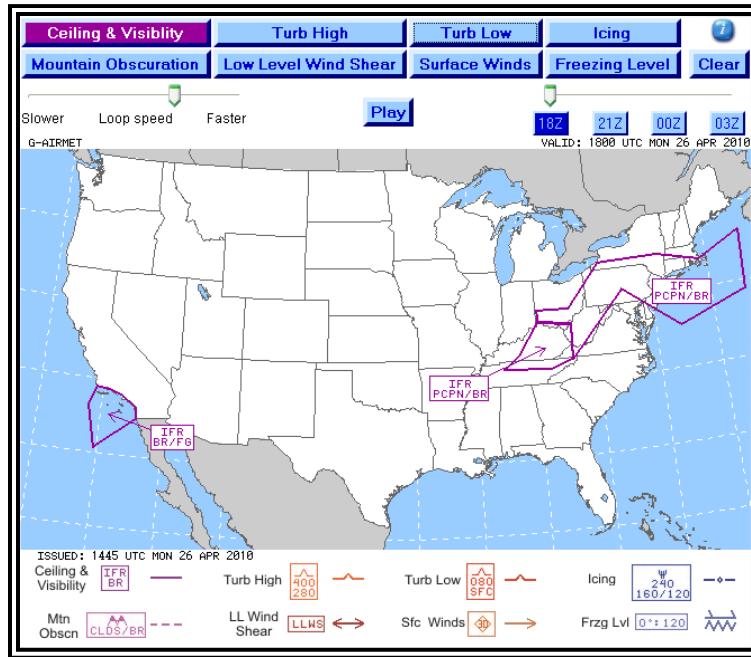
5.3.2 G-AIRMET Content

G-AIRMET snapshots are graphical forecasts of en route weather hazards valid at discrete times no more than 3 hours apart for a period of up to 12 hours into the future (00, 03, 06, 09, and 12 hours). 00 hour represents the initial conditions, and the subsequent 3-hourly graphics depict the area affected by the particular hazard at that valid time.

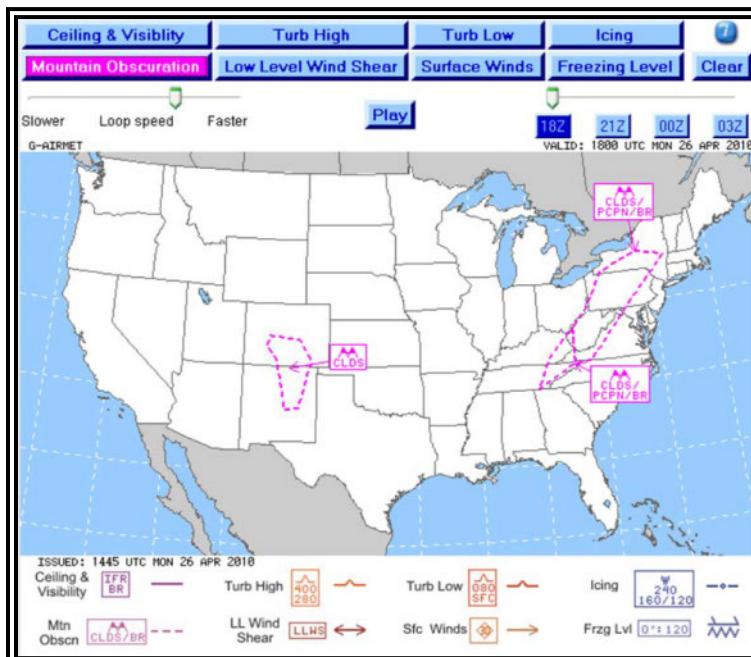
The AWC's website provides several options to display the G-AIRMET. There is an interactive display as well as snapshots that may be viewed as static (single), combined, and looped images using the tools provided on the Web page. The following are examples of G-AIRMET snapshot static images.

G-AIRMET depicts the following en route aviation weather hazards:

- IFR Ceiling and Visibility (see Figure [5-12](#), G-AIRMET—Ceiling and Visibility (IFR) Snapshot Example).
 - Areas of cloud ceilings with bases less than 1000 ft AGL and/or areas of surface visibilities below 3 sm, including the weather causing the visibility restriction. The cause of the visibility restriction includes only **PCPN**, **FU**, **HZ**, **BR**, **FG**, and **BLSN**.

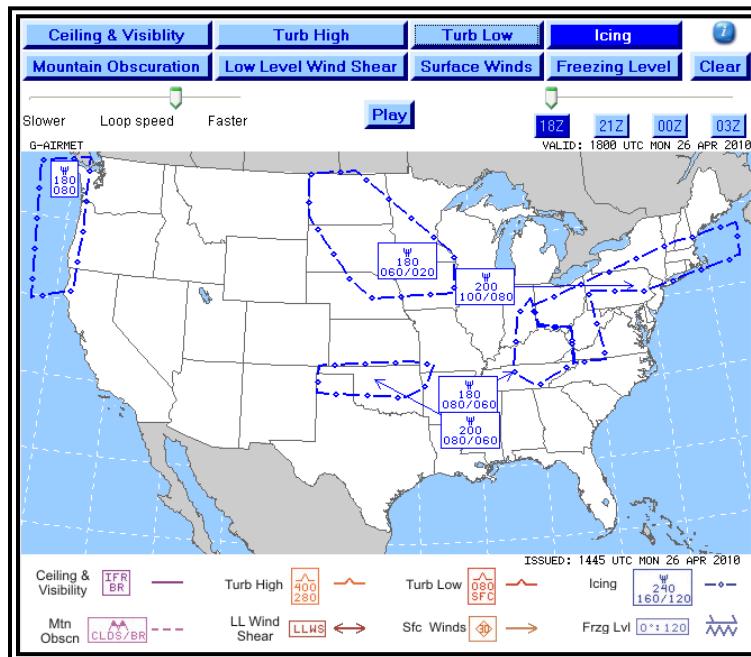
Figure 5-12. G-AIRMET—Ceiling and Visibility (IFR) Snapshot Example

- Mountain Obscuration (see Figure 5-13, G-AIRMET—Mountain Obscuration Snapshot Example).
 - Areas of widespread mountain obscuration where Visual Meteorological Conditions (VMC) cannot be maintained, including the weather causing the obscuration. The weather causing the obscuration includes only **CLDS**, **PCPN**, **FU**, **HZ**, **BR**, and **FG**.

Figure 5-13. G-AIRMET—Mountain Obscuration Snapshot Example

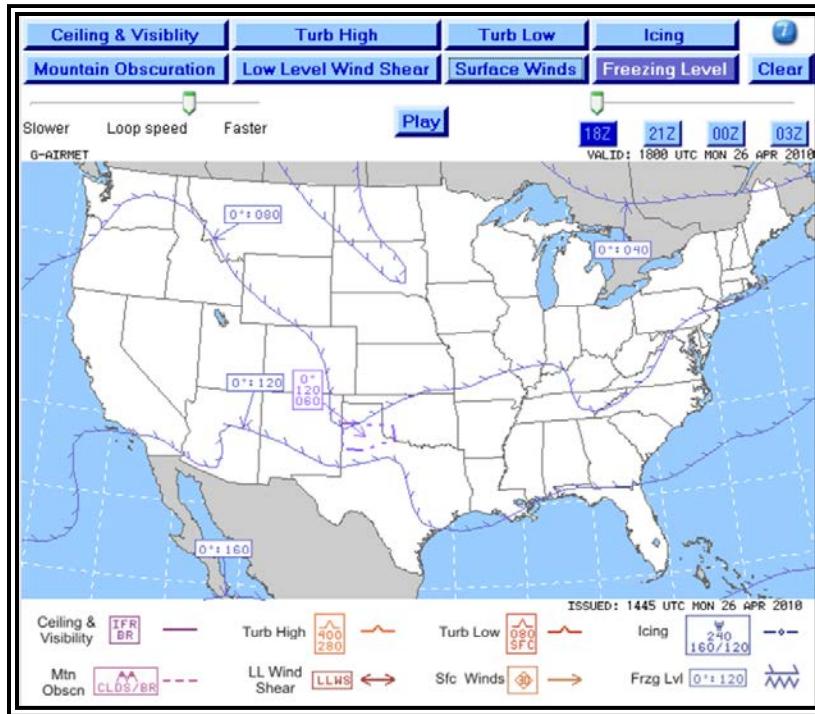
- Icing (see Figure 5-14, G-AIRMET—Icing Snapshot Example).
 - Areas of moderate airframe icing, other than convectively induced, including the vertical extent (base and top). Altitude variations in the base of icing layers may be denoted (e.g., “080 / 060” indicates the altitude varies between 6,000 and 8,000 ft MSL).

Figure 5-14. G-AIRMET—Icing Snapshot Example

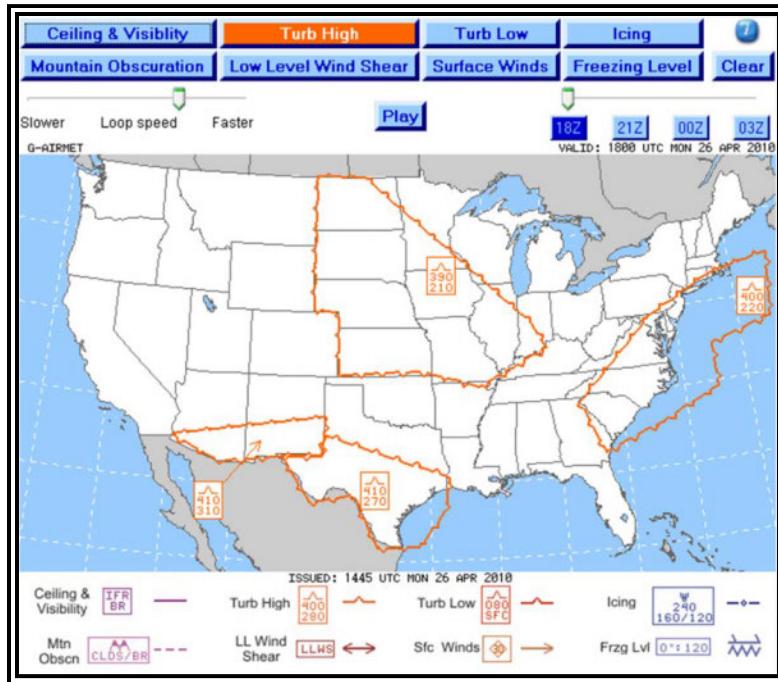
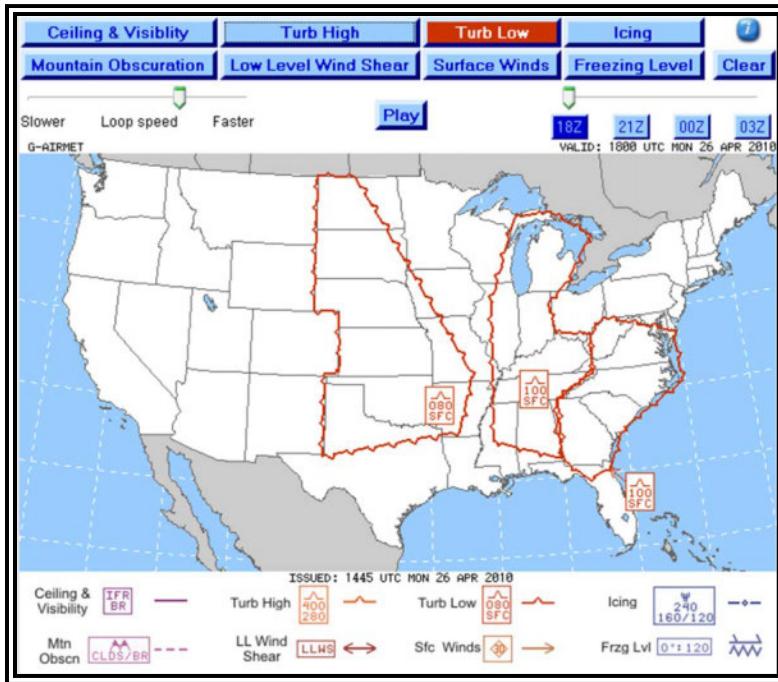


- Freezing Level (see Figure 5-15, G-AIRMET—Freezing Level Snapshot Example).
 - Freezing level is defined as the lowest freezing level above the ground or at the SFC as appropriate. Freezing levels above the ground are delineated at 4,000 ft intervals MSL. Areas with multiple freezing levels above the ground are delineated including the vertical extent (base and top).

Figure 5-15. G-AIRMET—Freezing Level Snapshot Example

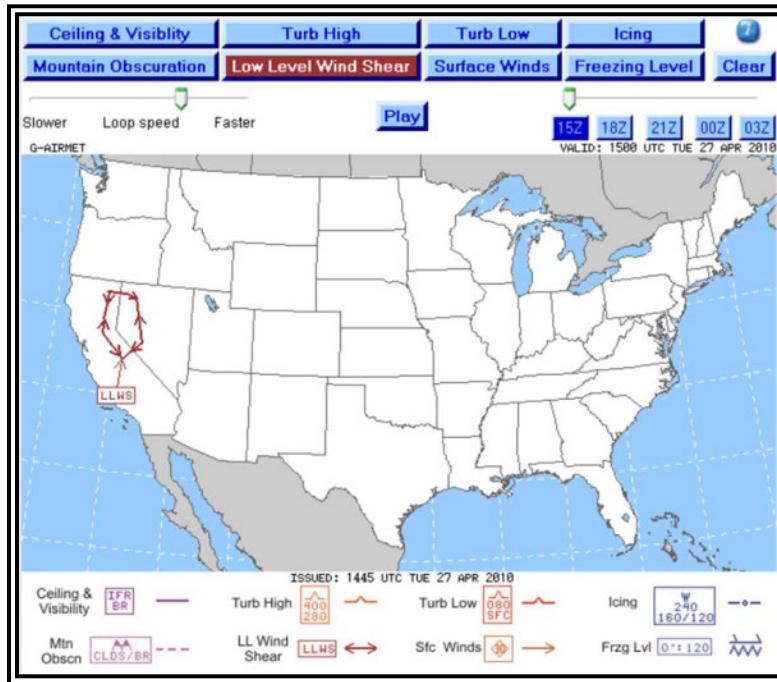


- Turbulence (see Figure [5-16](#), G-AIRMET—Turbulence-High Snapshot Example, and Figure [5-17](#), G-AIRMET—Turbulence-Low Snapshot Example).
 - Areas of moderate turbulence, other than convectively induced, including the vertical extent (base and top).

Figure 5-16. G-AIRMET—Turbulence-High Snapshot Example**Figure 5-17. G-AIRMET—Turbulence-Low Snapshot Example**

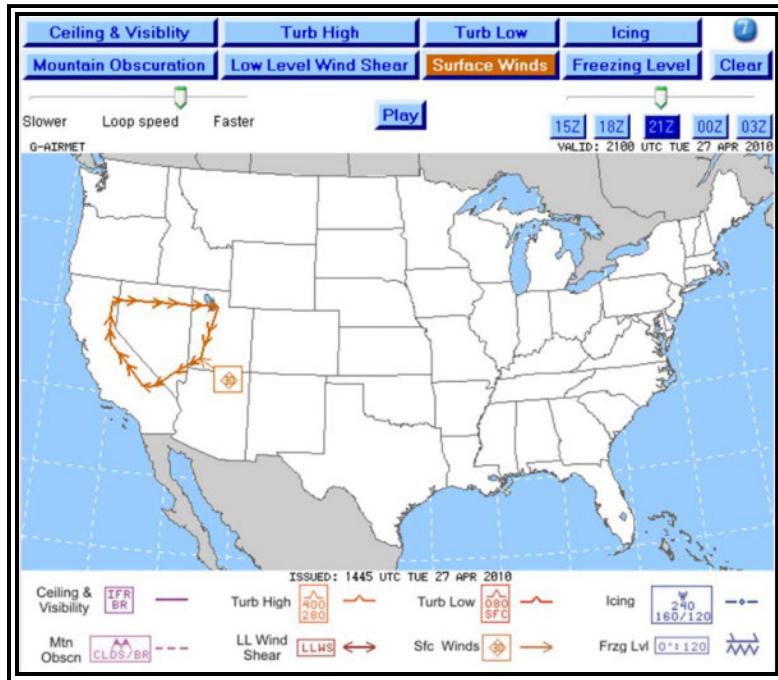
- Low-Level Wind Shear (LLWS) (see Figure 5-18, G-AIRMET—Low-Level Wind Shear (LLWS) Snapshot Example).
 - LLWS is defined as windshear below 2,000 ft AGL, other than convectively induced, exceeding 10 kts per 100 ft (vector difference between two points in space).

Figure 5-18. G-AIRMET—Low-Level Wind Shear (LLWS) Snapshot Example



- Strong Surface Winds (see Figure 5-19, G-AIRMET—Strong Surface Winds Snapshot Example).
 - Areas of sustained surface winds greater than 30 kts. The direction and speed of winds are not depicted; only the area where sustained surface winds greater than 30 kts are occurring or forecast to occur.

Figure 5-19. G-AIRMET—Strong Surface Winds Snapshot Example



5.3.3 Use.

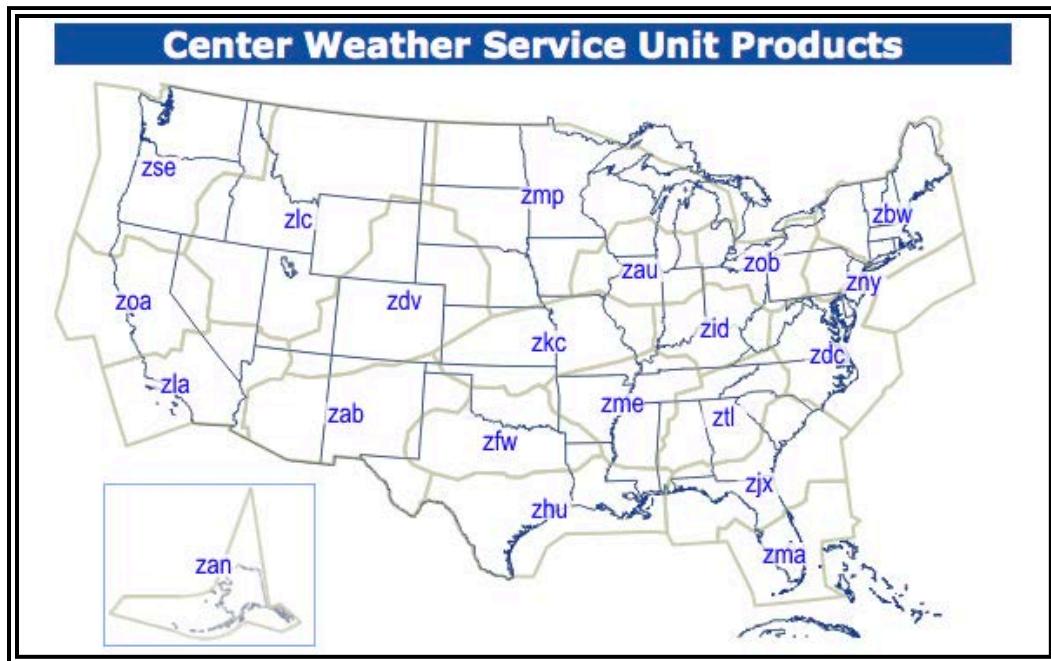
When using the G-AIRMET, users must keep in mind that if a 00-hour forecast shows no significant weather and a 03-hour forecast shows hazardous weather, they must assume a change is occurring during the period between the two forecasts. It should be taken into consideration that the hazardous weather starts immediately after the 00-hour forecast unless there is a defined initiation or ending time for the hazardous weather. The same would apply after the 03-hour forecast. The user should assume the hazardous weather condition is occurring between the snapshots unless informed otherwise.

5.4 Center Weather Advisory (CWA).

A CWA is an aviation weather warning for conditions meeting or approaching national in-flight advisory (AIRMET, SIGMET, or Convective SIGMET) criteria. The CWA is primarily used for aircrews to anticipate and avoid adverse weather conditions in the en route and terminal environments. CWAs are available on <http://www.aviationweather.gov>.

5.4.1 CWA Issuance.

CWAs are issued by the NWS Center Weather Service Units (CWSU). CWSU AORs are depicted on Figure 5-20, Center Weather Service Unit (CWSU) Areas of Responsibility.

Figure 5-20. Center Weather Service Unit (CWSU) Areas of Responsibility

CWAs are valid for up to 2 hours and may include forecasts of conditions expected to begin within 2 hours of issuance. If conditions are expected to persist after the advisory's valid period, a statement to that effect is included in the last line of the text. Additional CWAs will subsequently be issued as appropriate. Notice of significant changes in the phenomenon described in a CWA is provided by a new CWA issuance for that phenomenon. If the forecaster deems it necessary, CWAs may be issued hourly for Convective activity.

5.4.2 CWA Criteria.

CWAs may be issued for the following situations:

- There is no existing AWC or AAWU advisory in effect.
- Any of the following conditions occur:
 - Conditions meeting Convective SIGMET criteria.
 - Icing—moderate or greater.
 - Turbulence—moderate or greater.
 - Heavy and extreme precipitation.
 - Freezing precipitation.
 - Conditions at or approaching low IFR (LIFR).
 - Surface wind gust at or above 30 kts.
 - LLWS (Surface—2,000 ft).
 - Volcanic ash, duststorms, or sandstorms.

- When a hazard has grown significantly outside of the boundary defined by the AWC or AAWU advisory.
- To upgrade a thunderstorm advisory to include severe thunderstorms.
- To upgrade an AIRMET to include isolated severe turbulence or icing. If greater than isolated severe turbulence or icing is occurring, then a new (non-supplementary) CWA should be issued.
- To define a line of thunderstorms within a larger area covered by the AWC or AAWU advisory.
- To better define hazards expected at a major terminal already within an AWC or AAWU advisory.
- Anything that in the judgment of the CWSU forecaster will add value to an existing advisory.
- In the forecaster's judgment the conditions listed above, or any others, may adversely impact the safe flow of air traffic.

5.4.3 CWA Format and Example.

Figure 5-21. Center Weather Advisory (CWA) Decoding Example

LINE	
1	ZDV2 CWA 032140
2	ZDV CWA 202 VALID UNTIL 032340
3	FROM FMN TO 10N FMN TO 20NE FMN TO 10E FMN TO FMN
4	ISOLD SEV TS NR FMN MOVG NEWD 10KTS. TOP FL410. WND GSTS TO 55KTS. HAIL TO 1 INCH RPRTD AT FMN. SEV TS CONTG BYD 2340Z.

Table 5-8. Decoding a Center Weather Advisory (CWA)

Line	Content	Description
1	ZDV	ARTCC Identification
	2	Phenomenon Number (single digit, 1-6)
	CWA	Product Type (UCWA/CWA)
	032140	Beginning and/or issuance UTC date/time
2	ZDV	ARTCC Identification
	CWA	Product Type
	2	Phenomenon Number (single digit, 1-6)
	02	Issuance Number (issued sequentially for each Phenomenon Number)
	VALID TIL 032340Z	Ending valid UTC date/time
3	FROM FMN TO 10N FMN TO 20NE FMN TO 10E FMN TO FMN	Phenomenon Location
4	ISOLD SEV TS NR FMN MOVG NEWD 10KTS. TOP FL410. WND GSTS TO 55KTS. HAIL TO 1 INCH RPTD AT FMN. SEV TS CONTG BYD 2340Z	Phenomenon Description

The CWA in Figure 5-21, Center Weather Advisory (CWA) Decoding Example, is decoded as follows:

(Line 1) Center Weather Advisory issued for the Denver ARTCC (ZDV) CWSU. The “2” after ZDV in the first line denotes this is the second meteorological event of the local calendar day. This CWA was issued/begins on the 3rd day of the month at 2140 UTC.

(Line 2) The Denver ARTCC (ZDV) is identified again. The “202” in the second line denotes the phenomena number again (2) and the issuance number (02) for this phenomenon. This CWA is the valid until the 3rd day of the at 2340 UTC.

(Line 3) From Farmington, New Mexico to 10 nautical miles north of Farmington, New Mexico to 20 nautical miles northeast of Farmington, NM to 10 nautical mile east of Farmington, New Mexico to Farmington, New Mexico.

(Line 4) Isolated severe thunderstorms near Farmington moving northeastward at 10 knots. Tops to Flight Level 410. Wind gusts to 55 knots. Hail to one inch reported at Farmington. Severe thunderstorms continuing beyond 2340 UTC.

5.5 Meteorological Impact Statement (MIS).

The MIS is a nontechnical plain language product intended primarily for FAA traffic managers and those involved in planning aircraft routing. MISs are issued by NWS Center Weather Service Units (CWSU).

MISs are available at <http://www.aviationweather.gov>, as well as CWSU websites.

5.5.1 Valid Period.

The MIS valid times are determined according to local policy. The MIS is limited to not exceed a 48-hour valid period.

5.5.2 Content.

The MIS is a brief nontechnical discussion of meteorological events causing or expecting to cause the disruption of the safe flow of air traffic. This is followed by specifics such as what is causing the disruption, area, altitudes, and movement.

The MIS may refer to an online graphic, especially for complex situations, using a specific Web address and provide a brief description of the weather that is included in the text MIS. MIS products are numbered sequentially beginning at midnight local time each day. The MIS is disseminated and stored as a “replaceable product.” If the expiration time of the MIS is after the closing time of the CWSU, then a “No updates available after ddhhmmZ” message should be included at the end of the MIS text, where dd = date, hh = hour, mm = minutes.

5.5.3 Format.

The MIS format consists of a communication header line, the words “FOR ATC PLANNING PURPOSES ONLY,” and the text.

- Header Line: zzz MIS ii Valid ddttt-ddttt
 Zzz is the ARTCC identification (i.e. ZJX),
 MIS is the product type,
 ii is the 2-digit sequential issuance number, and
 ddttt is the valid beginning and ending date/time UTC.
- The line immediately below the header line reads “FOR ATC PLANNING PURPOSES ONLY.”
- The maximum length of the MIS is four lines. The MIS is nontechnical in nature to convey expected weather and impacts in the clearest and simplest manner possible to the user. References to a graphical product on the local CWSU website or <http://www.aviationweather.gov> may be included.

Example:

```
ZAB MIS 02 VALID 281300-290300
...FOR ATC PLANNING PURPOSES ONLY...
AN UPPER-LVL DISTURBANCE OVER COLORADO COMBINED WITH A STRONG JET STREAM MOVING
ACROSS THE SWRN U.S. IS FCST TO PRODUCE AREAS OF TURBULENCE ACROSS PORTIONS OF
ZAB. THE TURBULENCE IS FCST TO SUBSIDE AFT 00Z AS THE DISTURBANCE AND JETSTREAM
MOVE FURTHER EAST.
```

MIS issued by the Albuquerque, New Mexico, CWSU. The second MIS issuance of the day, valid from the 28th day of the month at 1300 UTC until the 29th at 0300 UTC. For air traffic control (ATC) planning purposes only. (Brief discussion of the meteorological events to affect the ARTCC.)

5.6 Additional Products for Convection.

In addition to the SIGMETs, Convective SIGMETs, and CWAs already discussed, the NWS offers more products informing the aviation community about the potential for Convective weather.

5.6.1 Convective Outlooks (AC).

The NWS Storm Prediction Center (SPC) issues narrative and graphical Convective Outlooks to provide the CONUS NWS WFOs, the public, the media, and emergency managers with the potential for severe (tornado, wind gusts 50 kts or greater, or hail 1 in in diameter or greater) and non-severe (general) convection and specific severe weather threats during the following 8 days. The Convective Outlook defines areas of marginal risk (**MRGL**), slight risk (**SLGT**), enhanced risk (**ENH**), moderate risk (**MDT**), or high risk (**HIGH**) of severe weather based on a percentage probability, which varies for time periods from 1 day to 3 days, and then two probabilistic thresholds for days 4 through 8. The day 1, day 2, and day 3 Convective Outlooks also depict areas of general thunderstorms (**TSTMS**). The outlooks in graphical (see Figure 5-22, Day 1 Categorical Convective Outlook Graphic Example) and text formats are available on the SPC website.

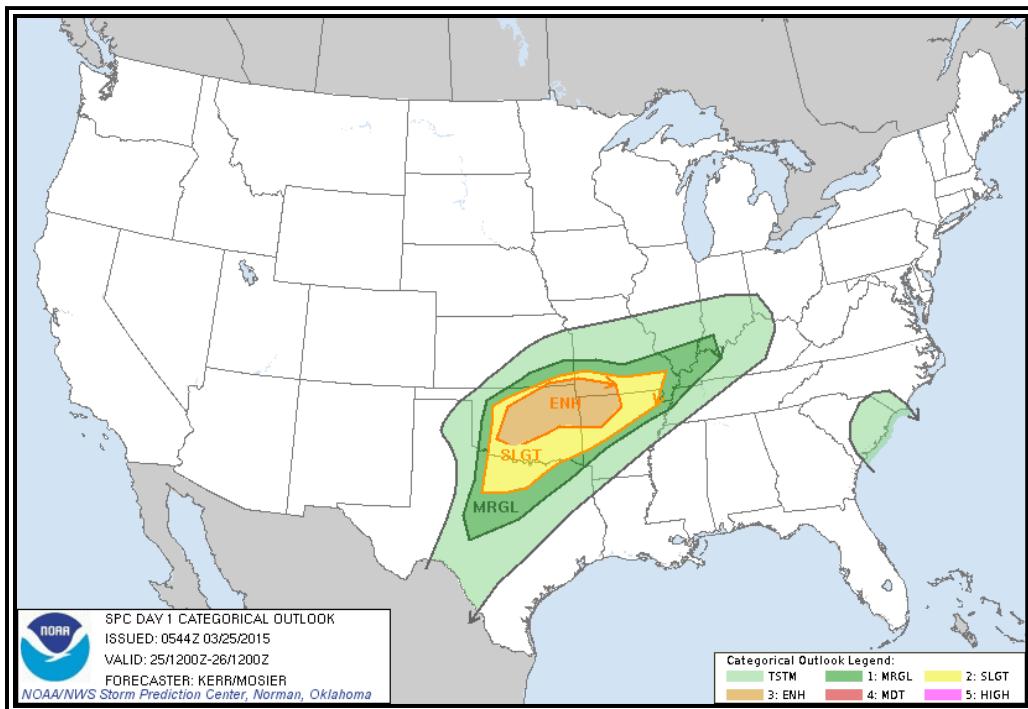
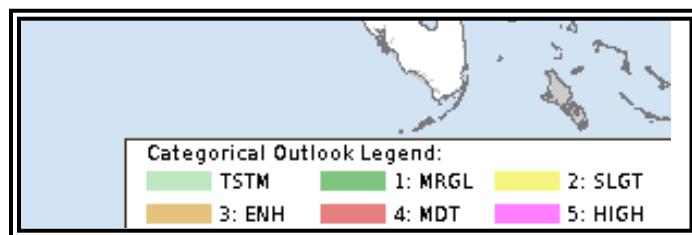
5.6.1.1 **Issuance.**

Convective Outlooks are scheduled products issued at the following times:

Table 5-9. Convective Outlook Issuance Schedule

Convective Outlook	Issuance Time (UTC)	Valid Period (UTC)
Day 1	0600	1200 – 1200
	1300	1300 – 1200
	1630	1630 – 1200
	2000	2000 – 1200
	0100	0100 – 1200
Day 2	0600 (Daylight Saving Time) 0700 (Standard Time)	Day 2/1200 – 1200
	1730	Day 2/1200 – 1200
Day 3	0730 (Daylight Saving Time) 0830 (Standard Time)	Day 3/1200 – 1200
Day 4-8	0900 (Daylight Saving Time) 1000 (Standard Time)	Day 4/1200 – Day 8/1200 (1 day intervals provided in graphic format on SPC Web page)

SPC corrects outlooks for format and grammatical errors and amends outlooks when the current forecast does not or will not reflect the ongoing or future Convective development.

Figure 5-22. Day 1 Categorical Convective Outlook Graphic Example**Figure 5-23. Categorical Outlook Legend for Days 1-3 Convective Outlook Graphic Example**

Format and Example of the Categorical Convective Outlook Narrative.

DAY 1 CONVECTIVE OUTLOOK
NWS STORM PREDICTION CENTER NORMAN OK
1244 AM CDT WED MAR 25 2015

VALID 251200Z - 261200Z

...THERE IS AN ENH RISK OF SVR TSTMS LATE THIS AFTERNOON AND EVENING ACROSS PARTS OF NORTH CENTRAL AND NORTHEAST OKLAHOMA...ADJACENT SOUTHEAST KANSAS...SOUTHWEST MISSOURI AND NORTHWEST ARKANSAS...

...THERE IS A SLGT RISK OF SVR TSTMS SURROUNDING THE ENH RISK...ACROSS PARTS OF THE SOUTH CENTRAL PLAINS INTO THE OZARK PLATEAU...

...THERE IS A MRGL RISK OF SVR TSTMS ACROSS SURROUNDING AREAS OF THE CENTRAL AND SOUTHERN PLAINS EAST NORTHEASTWARD INTO PARTS OF THE LOWER OHIO VALLEY...

...SUMMARY...

SEVERE THUNDERSTORMS...MAINLY CAPABLE OF PRODUCING LARGE HAIL AND LOCALLY DAMAGING WIND GUSTS...ARE EXPECTED ACROSS PARTS OF THE SOUTH CENTRAL PLAINS INTO THE OZARK PLATEAU LATE THIS AFTERNOON AND EVENING.

...SYNOPSIS...

SIGNIFICANT AMPLIFICATION IS ONGOING WITHIN A BRANCH OF MID-LATITUDE WESTERLIES ACROSS THE EASTERN PACIFIC INTO WESTERN NORTH AMERICA. AS LARGE-SCALE MID/UPPER RIDGING CONTINUES TO BUILD NEAR THE PACIFIC COAST DURING THIS PERIOD...MODELS INDICATE THAT LARGE-SCALE TROUGHING WILL BEGIN TO EVOLVE DOWNSTREAM...EAST OF THE ROCKIES...THROUGH THE VICINITY OF THE APPALACHIANS.

WITHIN THIS LATTER REGIME...ONE NOTABLE SHORT WAVE IMPULSE IS FORECAST TO PIVOT RAPIDLY NORTHEASTWARD...FROM THE OHIO VALLEY THROUGH THE ST. LAWRENCE VALLEY BY LATE TONIGHT. AN ASSOCIATED SURFACE LOW MAY CONSOLIDATE WITH ANOTHER LOW OVER THE GREAT LAKES REGION...BEFORE CONTINUING INTO QUEBEC LATE IN THE PERIOD...WITH A TRAILING COLD FRONT ADVANCING SOUTHEASTWARD ACROSS THE CENTRAL UNITED STATES.

INITIALLY STALLED OVER PARTS OF THE LOWER OHIO VALLEY/OZARK PLATEAU AND CENTRAL PLAINS...MODELS SUGGEST THAT THE SOUTHWESTERN FLANK OF THIS FRONT WILL BEGIN A MORE RAPID SOUTHWARD SURGE...IN RESPONSE TO ANOTHER SIGNIFICANT SHORT WAVE IMPULSE DIGGING SOUTHEAST OF THE CENTRAL ROCKIES THROUGH MUCH OF THE SOUTH CENTRAL PLAINS BY 12Z THURSDAY. THIS MAY BE ACCCOMPANIED BY WIDESPREAD CONVECTIVE DEVELOPMENT...AND THE RISK FOR SEVERE STORMS.

...SOUTH CENTRAL PLAINS/OZARK PLATEAU INTO LOWER OHIO VALLEY... SOME BOUNDARY LAYER MOISTENING CONTINUES ALONG AND SOUTH OF THE FRONT...BUT A SUBSTANTIVE RETURN FLOW OF MOISTURE OFF THE GULF OF MEXICO STILL APPEARS UNLIKELY DURING THIS PERIOD. MODEL SURFACE DEW

POINT FORECASTS FOR THIS AFTERNOON MAY STILL BE AT LEAST A BIT TOO HIGH. HOWEVER...NORTHEASTWARD ADVECTION OF WARM ELEVATED MIXED LAYER AIR IS EXPECTED TO AGAIN CONTRIBUTE TO VERY STEEP MID-LEVEL LAPSE RATES BY THIS AFTERNOON. THIS PROBABLY WILL SUPPORT SIZABLE CAPE /PERHAPS AT OR ABOVE 2000 J PER KG/ WITHIN AT LEAST A NARROW

CORRIDOR ALONG THE FRONTRAL ZONE. IN THE PRESENCE OF STRONG SHEAR BENEATH 40-50 KT WESTERLY 500 MB FLOW...CONDITIONS SHOULD BECOME CONDUCIVE TO THE DEVELOPMENT OF SEVERE STORMS FOR AT LEAST A PERIOD LATE THIS AFTERNOON INTO EARLY EVENING.

MODELS SUGGEST THAT FORCING FOR ASCENT ASSOCIATED WITH LOW-LEVEL WARM ADVECTION MAY SUPPORT A RAPID INCREASE IN SEVERE STORM DEVELOPMENT BY 20-22Z NEAR THE CENTRAL AND EASTERN KANSAS/OKLAHOMA BORDER AREA. THIS MAY INITIALLY INCLUDE DISCRETE STORMS...BEFORE

GROWING UPSCALE...WHICH SHOULD TEND TO TRACK EASTWARD ALONG THE FRONT INTO THE OZARK PLATEAU. ADDITIONAL SEVERE STORMS MAY FORM SHORTLY THEREAFTER ACROSS PARTS OF WEST CENTRAL OKLAHOMA. IT APPEARS THAT THIS LATTER ACTIVITY WILL OCCUR JUST AHEAD OF THE SOUTHWARD SURGING COLD FRONT...AND STRONGER STORMS PROBABLY WILL BE CAPABLE OF PRODUCING LARGE HAIL AND LOCALLY STRONG WIND GUSTS.

AS LARGE-SCALE FORCING SUPPORTS INCREASINGLY WIDESPREAD THUNDERSTORM ACTIVITY THROUGH MUCH OF THE INSTABILITY AXIS...WHILE THE SURFACE COLD FRONT BEGINS TO SURGE SOUTHWARD AND TENDS TO UNDERCUT

CONVECTION...IT REMAINS UNCLEAR AT THE PRESENT TIME HOW LONG THE SEVERE WEATHER POTENTIAL WILL CONTINUE INTO THE EVENING HOURS.

..KERR/MOSIER.. 03/25/2015

5.6.2 Watch Notification Messages

The SPC issues Aviation Watch Notification Messages (SAW) to provide an area threat alert for the aviation meteorology community to forecast organized severe thunderstorms that may produce tornadoes, large hail, and/or Convective damaging winds as indicated in Public Watch Notification Messages within the CONUS.

SPC issues three types of Watch Notification Messages: SAW, Public Severe Thunderstorm Watch Notification Message, and Public Tornado Watch Notification Message. They are available on the SPC website.

The SAW was formerly known as the Alert Severe Weather Watch Bulletin (AWW). The NWS no longer uses that title or acronym for this product. The NWS uses the acronym SAW for the Aviation Watch Notification Message, but retains AWW in the product header for processing by weather data systems. The NWS uses the acronym AWW for their Aviation Weather Warning product, which is a completely different product from the SAW.

The Severe Thunderstorm and Tornado Watch Notification Messages were formerly known as the Severe Weather Watch Bulletins (WW). The NWS no longer uses that title or acronym for this product but retains WW in the product header for processing by weather data systems.

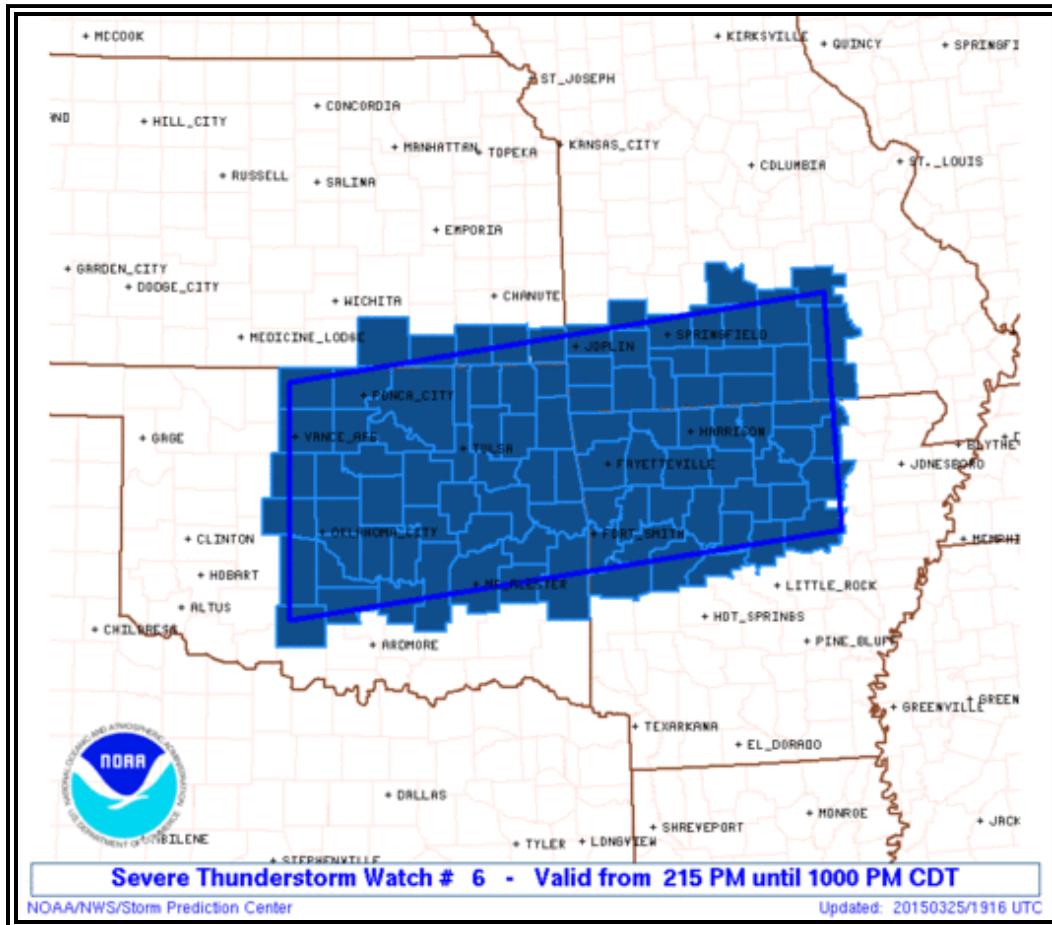
It is important to note the difference between a Severe Thunderstorm (or Tornado) **Watch** and a Severe Thunderstorm (or Tornado) **Warning**. A watch means severe weather is possible during the watch valid time, while a warning means that severe weather has been observed or is expected within the hour. Only the SPC issues Severe Thunderstorm and Tornado Watches, while only NWS WFOs issue Severe Thunderstorm and Tornado Warnings.

5.6.2.1 Aviation Watch Notification Message (SAW)

The SPC issues SAW to provide an area threat alert for the aviation meteorology community to forecast organized severe thunderstorms that may produce tornadoes, large hail, and/or Convective damaging winds as indicated in Public Watch Notification Messages.

The SAW product is **an approximation** of the area in a watch. For the official area covered by a watch, see the corresponding Public Watch product. To illustrate, Figure [5-24](#), Aviation Watch (polygon) Compared to Public Watch (shaded) Example, is an example of the Aviation Watch (polygon) compared to the Public Watch (shaded). Also, the SAW is easier to communicate verbally over the radio and telephone than reciting the entire Public Watch product.

Figure 5-24. Aviation Watch (polygon) Compared to Public Watch (shaded) Example



5.6.2.1.1 Issuance.

The SPC will issue the SAW after the proposed Convective watch area has been collaborated with the affected NWS WFOs defining the **approximate** areal outline of the watch.

Watch Notification Messages are nonscheduled, event-driven products valid from the time of issuance to expiration or cancellation time. Valid times are in UTC. SPC will correct watches for formatting and grammatical errors.

When tornadoes or severe thunderstorms have developed, the local NWS WFO will issue the warnings for the storms.

5.6.2.1.2 Format and Example of an Aviation Watch Notification Message (SAW).

SPC forecasters may define the area as a rectangle or parallelogram (X mi either side of the line from point A to point B) or (X miles north and south or east and west of the line from point A to point B). Distances of the axis coordinates should be in sm. The aviation coordinates referencing VOR locations and state distances will be in nautical miles (NM). Valid times will be in UTC. The watch half width will be in sm. The SAW will contain hail

size in inches or 1/2 in (forecaster discretion for tornado watches associated with hurricanes) surface and aloft, surface Convective wind gusts in knots, maximum cloud tops and the Mean Storm Motion Vector, and replacement information, if necessary.

The SAW will refer users to the accompanying public product, known as the Watch Outline Update (WOU) message, which provides the names of all counties or parishes in the watch area. Note the letter "n" refers to the issuance number, e.g., 2 means the second issuance of the WOU message.

WWUS30 KWNS 271559
SAW2
SPC AWW 271559
WW 568 TORNADO AR LA MS 271605Z - 280000Z
AXIS..65 STATUTE MILES EAST AND WEST OF LINE..
45ESE HEZ/NATCHEZ MS/ - 50N TUP/TUPELO MS/
..AVIATION COORDS.. 55NM E/W /18WNW MCB - 60E MEM/
HAIL SURFACE AND ALOFT..3 INCHES. WIND GUSTS..70 KNOTS. MAX TOPS TO
550. MEAN STORM MOTION VECTOR 26030.

LAT...LON 31369169 34998991 34998762 31368948

THIS IS AN APPROXIMATION TO THE WATCH AREA. FOR A
COMPLETE DEPICTION OF THE WATCH SEE WOUS64 KWNS
FOR WOU2.

Table 5-10. Decoding an Aviation Weather Watch Notification Message

Line(s)	Content	Description
1	WWUS30 KWNS 271559	Communication header with issuance date/time
2	SAW2	NWS product type (SAW) and issuance number (2)
3	SPC AWW 271559	Issuing office Product Type Issuance date/time
4	WW 568 TORNADO AR LA MS 271605Z - 280000Z	Watch number Watch Type States affected Valid date/time period
5	AXIS..65 STATUTE MILES EAST AND WEST OF A LINE...	Watch axis
6	45ESE HEZ/NATCHEZ MS/ - 50N TUP/TUPELO MS/	Anchor points
7	...AVIATION COORDS..55NM E/W /18WNW MCB - 60E MEM/	Aviation coordinates
8-9	HAIL SURFACE AND ALOFT...3 INCHES. WIND GUSTS..70 KNOTS. MAX TOPS TO 550. MEAN STORM MOTION VECTOR 26030.	Type, intensity, max tops and mean storm motion using standard contractions.
10	(blank line)	
11	LAT...LON 31369169 34998991 4998762 31368948	Latitude and longitude coordinates
12	(blank line)	
13-15	THIS IS AN APPROXIMATION TO THE WATCH AREA. FOR A COMPLETE DEPICTION OF THE WATCH SEE WOUS64 KWNS FOR WOU2.	Notice that this is an approximation of the watch area and for users to refer to the referenced product for the actual area

5.6.2.2 Public Severe Thunderstorm Watch Notification Message.

The SPC issues a Public Severe Thunderstorm Watch Notification Message when forecasting six or more hail events of 1 in (quarter sized) diameter or greater or damaging winds of 50 kts (58 mph) or greater. The forecast event minimum threshold is at least 2 hours over an area of at least 8,000 mi².

Below these thresholds, the SPC, in collaboration with affected NWS offices, may issue a watch for smaller areas and for shorter periods of time when conditions warrant, and for Convective watches along coastlines, near the Canadian border, and near the Mexican border.

A Public Severe Thunderstorm Watch Notification Message contains three bulleted blocks of information:

- The geographic area of the watch,
- The valid time of the watch, and
- A description of the primary threats anticipated within the watch.

A plain text watch summary is included beneath the bulleted information followed by a more detailed description of the area and axis of the watch.

The SPC includes the term “adjacent coastal waters” when the watch affects coastal waters adjacent to the Pacific/Atlantic coast, the Gulf of Mexico, or the Great Lakes. Adjacent coastal waters refers to a WFO’s near-shore responsibility (out to 20 NM for oceans), except for Convective watches, which include portions of the Great Lakes.

The SPC issues a watch cancellation message when *no* counties, parishes, independent cities and/or marine zones remaining are in the watch area prior to the expiration time. The text of the message will specify the number and area of the canceled watch.

5.6.2.2.1 Format of Public Severe Thunderstorm Watch Notification Message.

```
WWUS20 KWNS ddhhmm (communication header)

URGENT - IMMEDIATE BROADCAST REQUESTED
SEVERE THUNDERSTORM WATCH NUMBER nnnn
NWS STORM PREDICTION CENTER NORMAN OK
time am/pm time zone day mon dd yyyy

THE STORM PREDICTION CENTER HAS ISSUED A

* SEVERE THUNDERSTORM WATCH FOR PORTIONS OF PORTION(S) OF STATE(S) AND
ADJACENT COASTAL WATERS (IF REQUIRED)

* EFFECTIVE (TIME PERIOD) UNTIL hhmm am/pm time zone.

...THIS IS A PARTICULARLY DANGEROUS SITUATION (IF NECESSARY)...

* PRIMARY THREATS INCLUDE...
HAIL TO X.X INCHES IN DIAMETER POSSIBLE
THUNDERSTORM WIND GUSTS TO XX MPH POSSIBLE
DANGEROUS LIGHTNING POSSIBLE

SUMMARY...PLAIN TEXT DESCRIPTION OF WHY THE WATCH IS NEEDED.

NARRATIVE DESCRIPTION OF WATCH AREA USING A LINE AND ANCHOR
POINTS. DISTANCES TO EITHER SIDE OF THE LINE WILL BE IN STATUTE
MILES. THIS SECTION INDICATES THE WATCH AREA IS AN APPROXIMATION
AND "FOR A COMPLETE DEPICTION OF THE WATCH SEE THE ASSOCIATED WATCH
OUTLINE UPDATE (WOUS64 KWNS WOUu)."

PRECAUTIONARY/PREPAREDNESS ACTIONS...
```

CALL TO ACTION STATEMENTS

OTHER WATCH INFORMATION...OTHER WATCHES IN EFFECT AND IF THIS WATCH REPLACES A PREVIOUS WATCH.

&&

AVIATION...BRIEF DESCRIPTION OF SEVERE WEATHER THREAT TO AVIATORS. HAIL SIZE WILL BE GIVEN IN INCHES AND WIND GUSTS IN KNOTS. MAXIMUM STORM TOPS AND A MEAN STORM VECTOR WILL ALSO BE GIVEN.

\$\$

..FORECASTER NAME.. MM/DD/YY

To see a dynamic representation of this, please go to the following website:
<http://www.spc.noaa.gov/products/watch/ww0018.html>.

5.6.2.2.2 Example of a Public Severe Thunderstorm Watch Notification Message.

WWUS20 KWNS 161711 (*communication header*)
SEL2
SPC WW 161710

URGENT - IMMEDIATE BROADCAST REQUESTED
SEVERE THUNDERSTORM WATCH NUMBER 647
NWS STORM PREDICTION CENTER NORMAN OK
1210 PM CDT FRI JUL 16 2011

THE NWS STORM PREDICTION CENTER HAS ISSUED A

* SEVERE THUNDERSTORM WATCH FOR PORTIONS OF EASTERN IOWA
NORTHERN ILLINOIS
NORTHWEST INDIANA
LAKE MICHIGAN

* EFFECTIVE THIS FRIDAY AFTERNOON FROM 1210 PM UNTIL 500 PM CDT.

* PRIMARY THREATS INCLUDE...
HAIL TO 2 INCHES IN DIAMETER POSSIBLE...
THUNDERSTORM WIND GUSTS TO 70 MPH POSSIBLY DANGEROUS LIGHTNING
POSSIBLE

THE SEVERE THUNDERSTORM WATCH AREA IS APPROXIMATELY ALONG AND 75 STATUTE MILES EITHER SIDE OF A LINE FROM 40 MILES SOUTHEAST OF SOUTH BEND INDIANA TO 35 MILES SOUTHWEST OF CEDAR RAPIDS IOWA. FOR A COMPLETE DEPICTION OF THE WATCH SEE THE ASSOCIATED WATCH OUTLINE UPDATE (WOUS64 KWNS WOU2).

PRECAUTIONARY/PREPAREDNESS ACTIONS...

REMEMBER...A SEVERE THUNDERSTORM WATCH MEANS CONDITIONS ARE

FAVORABLE FOR SEVERE THUNDERSTORMS IN AND CLOSE TO THE WATCH AREA. PERSONS IN THESE AREAS SHOULD BE ON THE LOOKOUT FOR THREATENING WEATHER CONDITIONS AND LISTEN FOR LATER STATEMENTS AND POSSIBLE WARNINGS. SEVERE THUNDERSTORMS CAN AND OCCASIONALLY DO PRODUCE TORNADOES.

OTHER WATCH INFORMATION...CONTINUE...WW 646...

DISCUSSION...THUNDERSTORMS WILL CONTINUE TO INCREASE ACROSS WATCH AREA WHERE AIR MASS HAS BECOME STRONGLY UNSTABLE AND UNCAPPED. VEERING SHEAR PROFILE SUPPORT STORMS EVOLVING INTO SHORT LINE SEGMENTS ENHANCING WIND DAMAGE POTENTIAL

AVIATION...A FEW SEVERE THUNDERSTORMS WITH HAIL SURFACE AND ALOFT TO 2 INCHES. EXTREME TURBULENCE AND SURFACE WIND GUSTS TO 60 KNOTS. A FEW CUMULONIMBI WITH MAXIMUM TOPS TO 500. MEAN STORM MOTION VECTOR 33025.

...NAME

5.6.2.3 Public Tornado Watch Notification Message.

The SPC issues a Public Tornado Watch Notification Message when forecasting two or more tornadoes or any tornado that could produce EF2 or greater damage. The forecast event minimum thresholds are at least 2 hours over an area at least 8,000 mi². Below these thresholds, the SPC, in collaboration with affected NWS offices, may issue for smaller areas and for shorter periods of time when conditions warrant, and for Convective watches along coastlines, near the Canadian border, and near the Mexican border.

A Public Tornado Watch Notification Message contains the area description and axis, watch expiration time, the term “damaging tornadoes,” a description of the largest hail size and strongest thunderstorm wind gusts expected, the definition of the watch, a call-to-action statement, a list of other valid watches, a brief discussion of meteorological reasoning, and technical information for the aviation community.

The SPC may enhance a Public Tornado Watch Notification Message by using the words “THIS IS A PARTICULARLY DANGEROUS SITUATION” when there is a likelihood of multiple strong (damage of EF2 or EF3) or violent (damage of EF4 or EF5) tornadoes.

The SPC includes the term “adjacent coastal waters” when the watch affects coastal waters adjacent to the Pacific/Atlantic coast or the Gulf of Mexico. Adjacent coastal waters refers to a WFO’s near-shore responsibility (out to 20 NM for oceans), which include portions of the Great Lakes.

The SPC issues a watch cancellation message whenever it cancels a watch prior to the expiration time. The text of the message will specify the number and area of the canceled watch.

5.6.2.3.1 Format of a Public Tornado Watch Notification Message.

The format for a Public Tornado Watch Notification Message is the same as the Public Severe Thunderstorm Watch Notification Message.

5.6.2.3.2 Example of a Public Tornado Watch Notification Message.

A Public Tornado Watch Notification Message contains three bulleted blocks of information:

- The geographic area of the watch,
- The valid time of the watch, and
- A description of the primary threats anticipated within the watch.

A plain text summary is included beneath the bulleted information.

(Note this is a fictitious example)

WWUS20 KWNS 050550 (communication header)
SEL2
SPC WW 051750

URGENT - IMMEDIATE BROADCAST REQUESTED
TORNADO WATCH NUMBER 243
NWS STORM PREDICTION CENTER NORMAN OK
1250 AM CDT MON MAY 5 2011

THE NWS STORM PREDICTION CENTER HAS ISSUED A

* TORNADO WATCH FOR PORTIONS OF
WESTERN AND CENTRAL ARKANSAS
SOUTHERN MISSOURI
FAR EASTERN OKLAHOMA

* EFFECTIVE THIS MONDAY MORNING FROM 1250 AM UNTIL 600 AM CDT.

...THIS IS A PARTICULARLY DANGEROUS SITUATION...

* PRIMARY THREATS INCLUDE
NUMEROUS INTENSE TORNADOES LIKELY
NUMEROUS SIGNIFICANT DAMAGING WIND GUSTS TO 80 MPH LIKELY
NUMEROUS VERY LARGE HAIL TO 4 INCHES IN DIAMETER LIKELY

THE TORNADO WATCH AREA IS APPROXIMATELY ALONG AND 100 STATUTE MILES EAST AND WEST OF A LINE FROM 15 MILES WEST NORTHWEST OF FORT LEONARD WOOD MISSOURI TO 45 MILES SOUTHWEST OF HOT SPRINGS ARKANSAS. FOR A COMPLETE DEPICTION OF THE WATCH SEE THE ASSOCIATED WATCH OUTLINE UPDATE (WOUS64 KWNS WOU2).

REMEMBER...A TORNADO WATCH MEANS CONDITIONS ARE FAVORABLE FOR TORNADOES AND SEVERE THUNDERSTORMS IN AND CLOSE TO THE WATCH AREA. PERSONS IN THESE AREAS SHOULD BE ON THE LOOKOUT FOR THREATENING WEATHER CONDITIONS AND LISTEN FOR LATER STATEMENTS AND POSSIBLE WARNINGS.

OTHER WATCH INFORMATION...THIS TORNADO WATCH REPLACES TORNADO WATCH NUMBER 237. WATCH NUMBER 237 WILL NOT BE IN EFFECT AFTER 1250 AM CDT. CONTINUE...WW 239...WW 240...WW 241...WW 242...

DISCUSSION...SRN MO SQUALL LINE EXPECTED TO CONTINUE EWD...WHERE LONG/HOOKED HODOGRAPHS SUGGEST THREAT FOR EMBEDDED SUPERCELLS/POSSIBLE TORNADOES. FARTHER S...MORE WIDELY SCATTERED SUPERCELLS WITH A THREAT FOR TORNADOES WILL PERSIST IN VERY STRONGLY DEEP SHEARED/LCL ENVIRONMENT IN AR.

AVIATION...TORNADOES AND A FEW SEVERE THUNDERSTORMS WITH HAIL SURFACE AND ALOFT TO 4 INCHES. EXTREME TURBULENCE AND SURFACE WIND GUSTS TO 70 KNOTS. A FEW CUMULONIMBI WITH MAXIMUM TOPS TO 500. MEAN STORM MOTION VECTOR 26045.

..NAME

To see a dynamic representation of this, please go to the following website:
<http://www.spc.noaa.gov/products/watch/ww0020.html>.

5.6.3 Traffic Flow Management (TFM) Convective Forecast (TCF)

The TCF is a high-confidence graphical representation of forecasted convection meeting specific criteria of coverage, intensity, and echo top height. The TCF graphics are produced every 2 hours and are valid at 4, 6, and 8 hours after issuance time. Areas of convection in the TCF include any area of Convective cells containing (at a minimum):

1. Composite radar reflectivity of at least 40 decibels (dBZ);
2. Echo tops at or above FL250;
3. Coverage (1 and 2) of at least 25 percent of the polygon area; and
4. Forecaster confidence of at least 50 percent (high) that criteria (1, 2, and 3) will be met.

Lines of convection in the TCF include any lines of Convective cells having (at a minimum):

1. Composite radar reflectivity of at least 40 dBZ having a length of at least 100 NM;
2. Linear coverage of 40 percent or greater;
3. Echo tops at or above FL250; and
4. Forecaster confidence of at least 50 percent (high) that criteria (1, 2, and 3) will be met.

All four of the threshold criteria listed above for both areas and lines of convection are required for inclusion in the TCF. This is defined as the minimum TCF criteria.

The TCF domain is the FIR covering the CONUS and adjacent coastal waters. It also includes the Canadian airspace south of a line from Thunder Bay, Ontario to Quebec City, Quebec.

From March 1st through October 31st, the TCF is collaboratively produced by meteorologists at the AWC in Kansas City, MO, and embedded at the FAA Air Traffic Control System Command Center (ATCSCC) in Warrenton, VA; at the CWSU

embedded at the FAA's ARTCC; at various airlines; and by other authorized participants. Automated routines will continue to make the TCF available from November 1st through February 28th.

The TCF is issued 24 hours a day, 7 days a week at 30 minutes prior to the indicated issuance time. The issuance time supports the FAA's Strategic Planning (SP) Webinar, which occurs 15 minutes following odd hours Eastern Time (ET). The Canadian portion of the forecast is available from April 1st through September 30th. However, Nav Canada may request the issuance of each forecast as early as March 1st and as late as October 31st. All available Canadian forecasts are incorporated into the TCF. During times the forecasts are not available for Canadian airspace, the TCF graphics will be annotated with "No Canadian TCF."

The TCF is intended to be used as an SP tool for air traffic flow management. It aids in the reduction of air traffic delays, reroutes, and cancellations due to significant convection. It is not intended to be used for tactical air traffic flow decisions, in the airport terminal environment, or for pilot weather briefing purposes. The graphical representation is subject to annual revision.

Figure 5-25. TFM Convective Forecast (TCF)—Example

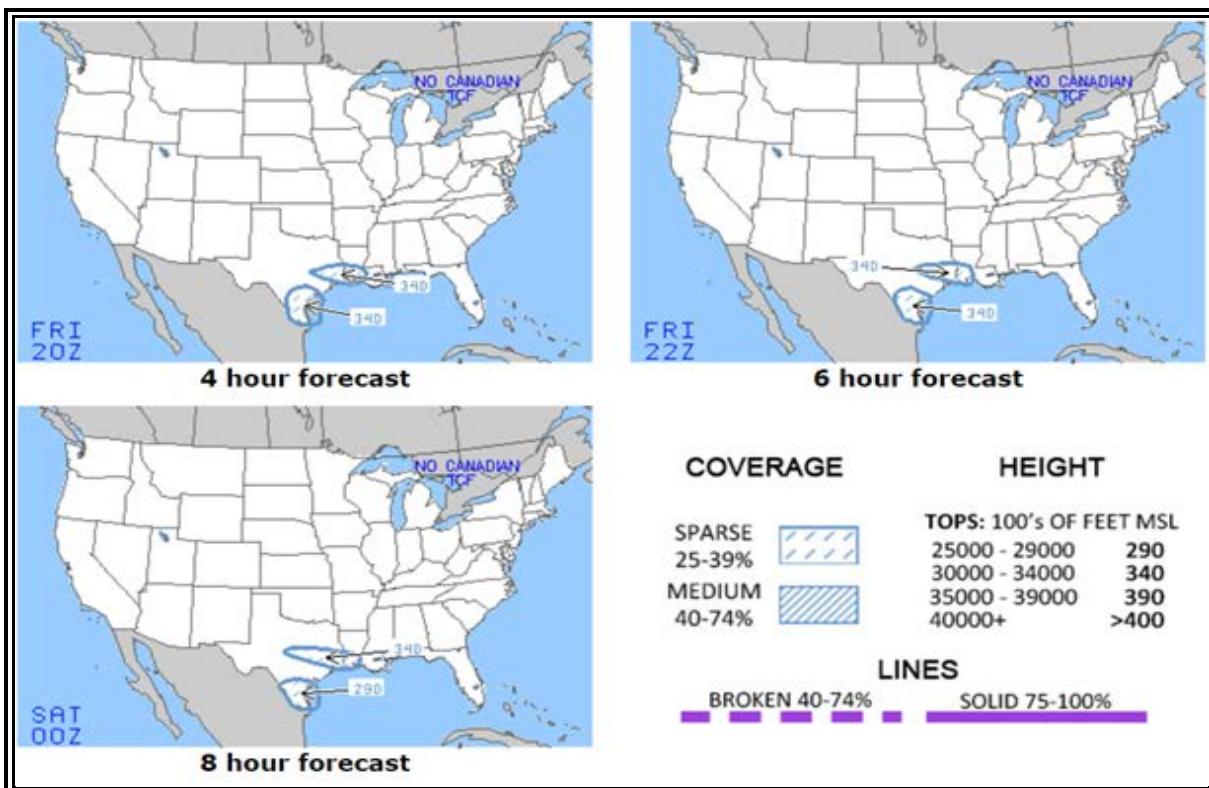
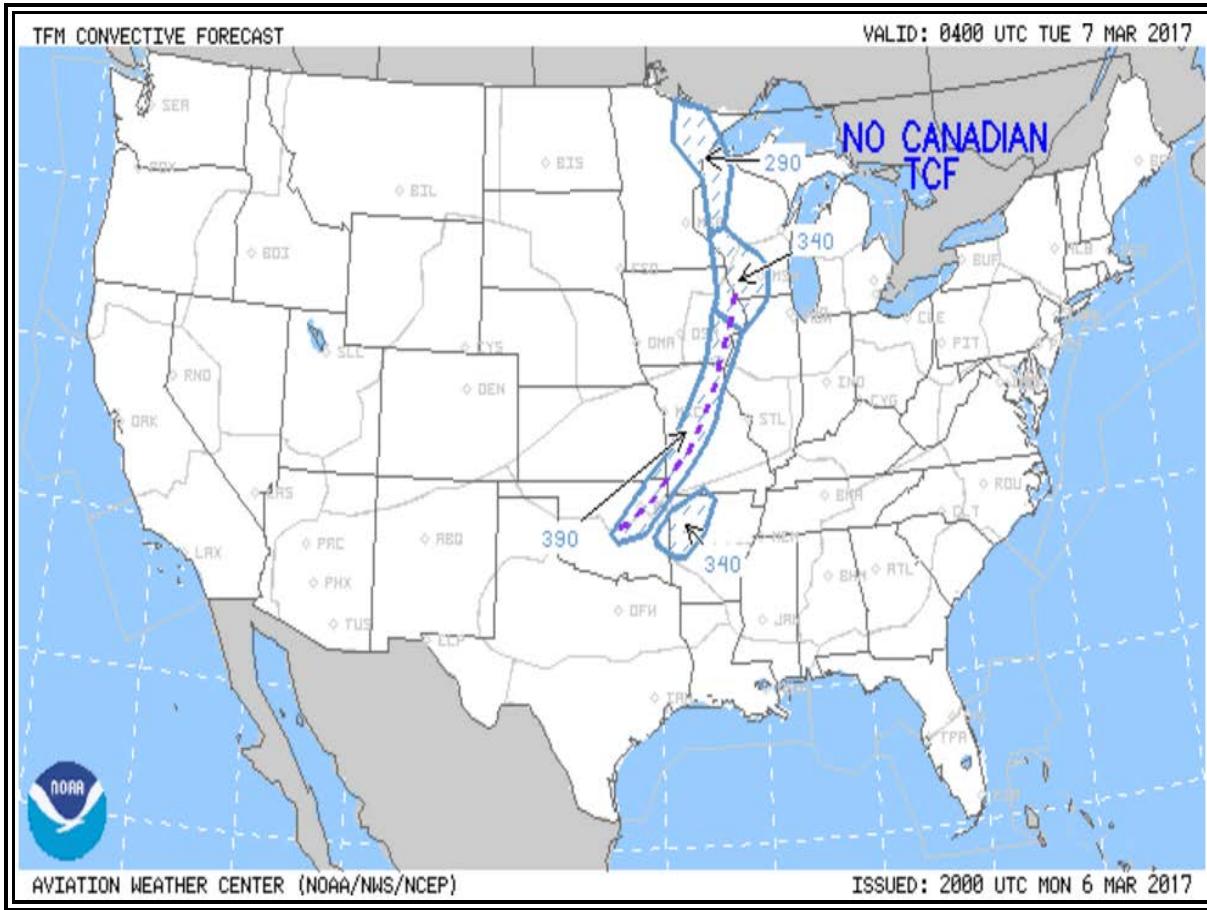


Figure 5-26. TFM Convective Forecast (TCF)—Example



5.6.3.1 **Issuance.**

The TCF is issued by the AWC.

The TCF is issued every 2 hours. The TCF product issuance time is approximately the bottom of the hour preceding the FAA ATCSCC's SP telecom (i.e., the 1600 UTC issuance would be available at ~1530 UTC for the 1615 UTC SP telecom). The product can be found on <http://www.aviationweather.gov>.

5.6.3.2 **Content.**

Data graphically displayed on the TCF consist of coverage of convection within a defined polygon, maximum tops, and confidence of Convective occurrence meeting the TCF minimum criteria.

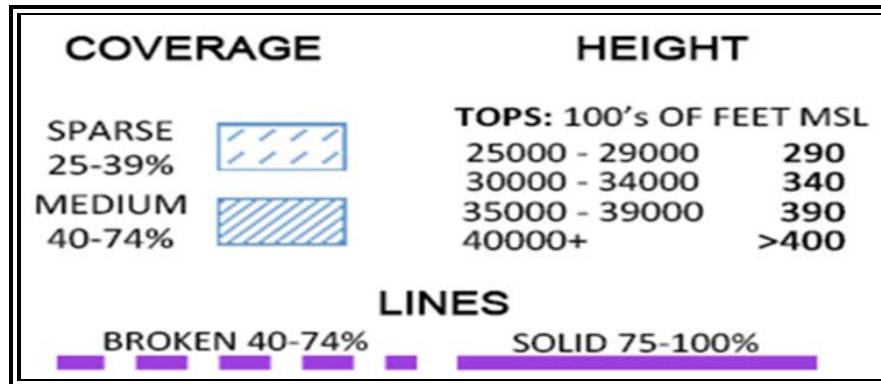
Additional information on the TCF product is available on the TCF website form under the INFO tab, on <http://www.aviationweather.gov>.

5.6.3.3 Coverage.

The Convective coverage within the forecast polygon is represented by the amount of fill within the polygon (see Figure 5-27, TCF Product Legend). The polygon is then assigned as a sparse or medium coverage.

- Medium coverage, defined by medium fill, indicates 40 to 100 percent of the polygon is forecast to contain convection.
- Sparse coverage, represented by sparse fill, means 25 to 39 percent of the polygon is forecast to contain convection.

Figure 5-27. TCF Product Legend



5.6.3.3.1 Confidence.

The TCF is a high confidence (50 to 100 percent) graphical representation of forecasted convection that denotes the forecasters' confidence that the represented convection will meet the minimum criteria. Confidence is not to be associated with probability of occurrence.

5.6.3.3.2 TOPS.

The word "TOPS" is used to depict the forecast maximum echo tops, in thousands of feet MSL, specified by four selected layers listed in Figure 5-27. The heights of the forecast echo tops must cover at least 25 percent of the polygon. The exact location of the highest echo top within the polygon cannot be determined.

5.6.3.4 Use.

The TCF is an SP tool for air traffic flow management in the 2- to 8-hour forecast period.

The TCF does not include a forecast for all convection. If the convection does not meet the threshold criteria, it is not included in the TCF. The TCF is *not* intended to be used as a tactical short-term decision product.

The product is not intended to be used as a pilot weather briefing product; however, TCF is available to pilots and aircraft dispatchers as an additional product for SP.

5.6.4 Extended Convective Forecast Product (ECFP).

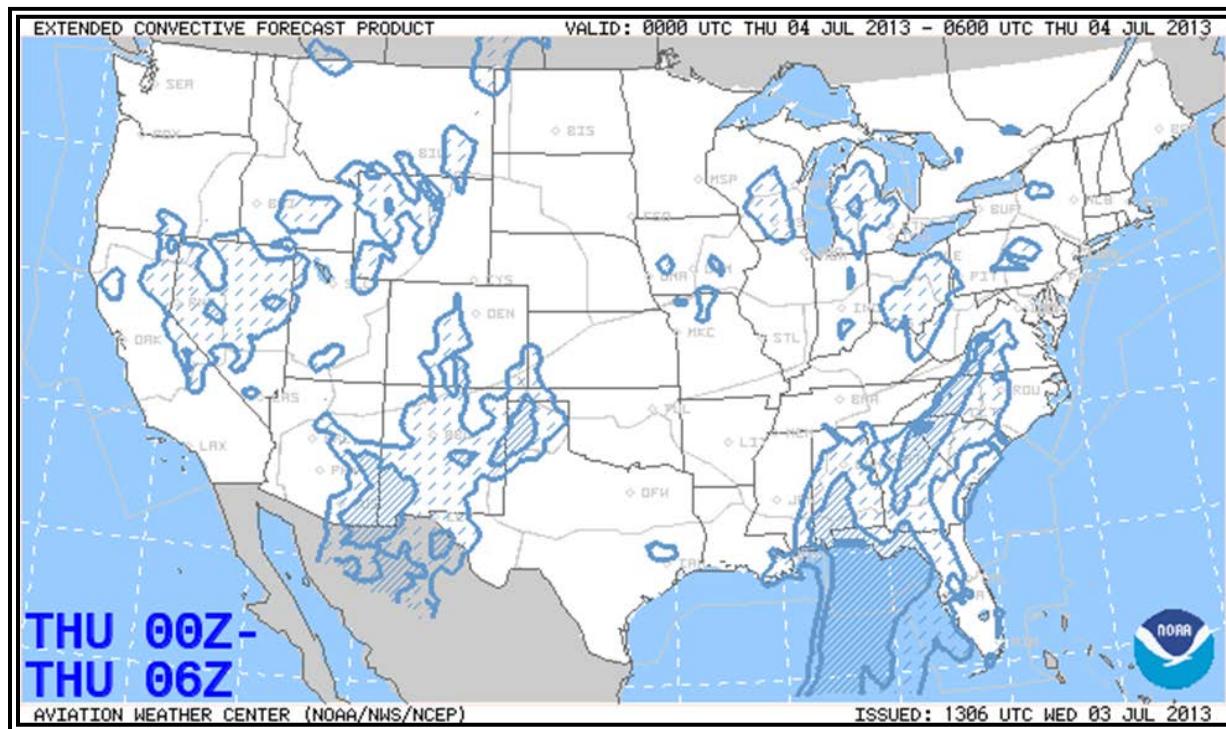
The ECFP planning tool (see Figure 5-28, ECFP Example) is a graphical representation of the forecast probability of thunderstorms and is also intended to support the long-range planning for Convective constraints in the National Airspace System (NAS). The product identifies graphically where thunderstorms are expected through the next 72 hours over the CONUS. Although the ECFP uses TCF-style graphics to facilitate ease of interpretation, the ECFP *does not forecast TCF criteria*.

The development of the ECFP planning tool was a response to FAA and industry needs in planning for weather hazards, specifically convection, 1 to 3 days in advance. To meet these planning needs, the ECFP provides traffic planners and collaborators a quick look at where the probability of convection is greatest. By utilizing TCF-style graphics, users familiar with TCF can easily determine where traffic constraints are most likely to occur over the next 3 days.

5.6.4.1 **Issuance.**

The ECFP is an automated forecast product issued by the AWC. It is issued four times a day at approximately 0100, 0700, 1300, and 1900 UTC.

Figure 5-28. ECFP Example



5.6.4.2 **Content.**

This automated graphical forecast is created from the Short Range Ensemble Forecast (SREF) Calibrated Thunderstorm guidance. Probability of thunderstorm contours are depicted at 40, 60, and 80 percent probabilities, using TCF-like shading. Hashed areas represent 40 to 59 percent probability,

solid lined areas represent 60 to 79 percent probability, and solid, blue-filled areas represent greater than 80 percent probability.

5.6.4.3 Use.

The ECFP is intended for FAA traffic managers at ARTCC, FAA ATCSCC, airline and aviation industry dispatch and flight planners, as well as commercial weather information providers supporting airlines and the FAA.

5.6.5 National Convective Weather Forecast (NCWF).

The NCWF is a near real-time, high-resolution display of current and 1-hour extrapolated forecasts of selected hazardous Convective conditions for the CONUS. The NCWF may be used in conjunction with the report and forecast information contained within Convective SIGMETs. The NCWF is available for use by General Aviation (GA), aircraft dispatchers, and Traffic Management Units (TMU).

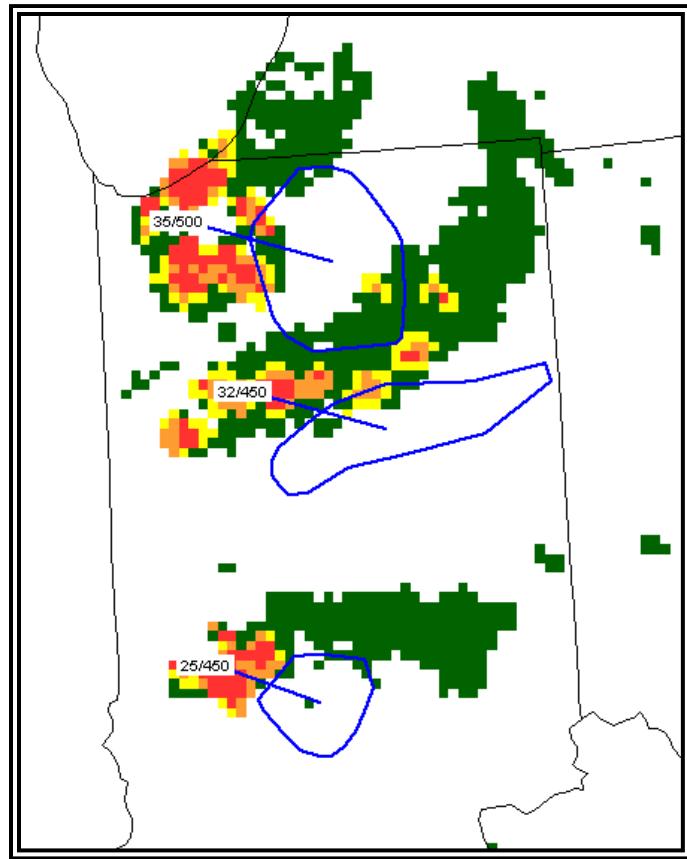
5.6.5.1 Issuance.

The NCWF is issued by the AWC and is updated every 5 minutes. The product is available at the Convection Web page on <http://www.aviationweather.gov>.

5.6.5.2 Content.

The NCWF displays current Convective hazard fields (detection), 1-hour extrapolated forecast polygons (see Figure 5-29, NCWF Example), forecast speed and directions, and echo tops. Past performance polygons can also be selected for display.

Figure 5-29. NCWF Example



5.6.5.2.1 NCWF Hazard Scale

The Convective hazard scale uses six hazard levels (see Figure [5-30](#), NCWF Hazard Scale) to characterize hazardous convection conditions.

The six hazard levels are determined by two factors:

- Intensities and maximum tops of WSR-88D reflectivity data; and
- Frequencies of cloud-to-ground lightning.

Higher hazard levels are associated with higher radar reflectivity intensities and higher frequencies of lightning strikes.

The six hazard levels are reduced to four-color codes for display on the NCWF.

Figure 5-30. NCWF Hazard Scale

NCWF Hazard Scale		
Level	Color	Effect
6	RED	Thunderstorms may contain any or all of the following: severe turbulence, severe icing, hail, frequent lightning, tornadoes, and low-level wind shear.
5	RED	
4	Orange	
3	Yellow	The risk of hazardous weather generally increases with levels on the NCWF hazard scale
2	Green	
1	Green	

5.6.5.2.2 One-Hour Extrapolated Forecast Polygons.

One-hour extrapolated forecast polygons are high-resolution polygons outlining areas expected to be filled by selected Convective hazard fields in 1 hour. Extrapolated forecasts depict new locations for the Convective hazard fields based on their past movements. Extrapolation forecasts do *not* forecast the development of new Convective hazard conditions or the dissipation of existing conditions. Forecasts are provided *only* for Convective hazard scale Levels 3 or higher. The forecast polygons do not depict specific forecast hazard levels. In Figure 5-29, the light blue polygon denotes the location of the 1-hour forecast Convective hazard field.

5.6.5.2.3 Forecast Speed and Direction.

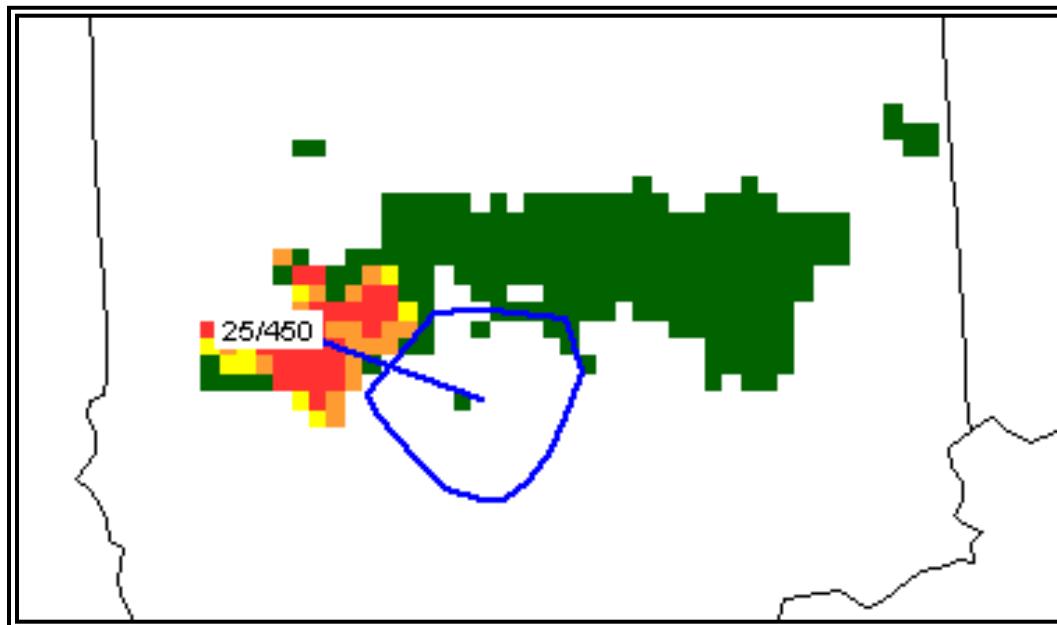
Forecast speed and direction are assigned to current Convective hazard fields having a 1-hour extrapolated forecast. A line (or arrow on the AWC JavaScript product) is used to depict the direction of movement. The speed in knots is depicted by the first group of two numbers located near the current Convective hazard field. The second group of three numbers identifies echo tops.

Forecast speed and direction is only updated every 10 minutes. The larger update time interval (compared to five-minute updates for the NCWF) smooths erratic forecast velocities. In Figure 5-29, the forecast direction (depicted by an arrow) is pointing to the southeast, and the speed is 25 kts.

5.6.5.2.4 Echo Tops.

Echo tops are assigned to current Convective hazard fields having a 1-hour extrapolated forecast. Echo tops are depicted by a group of three numbers located near the current Convective hazard field and are plotted in hundreds of feet MSL. In Figure 5-31, NCWF One-Hour Extrapolated Forecast Polygon, Forecast Movement Velocity and Echo Tops—Example, the echo tops are 45,000 ft MSL.

Figure 5-31. NCWF One-Hour Extrapolated Forecast Polygon, Forecast Movement Velocity and Echo Tops—Example



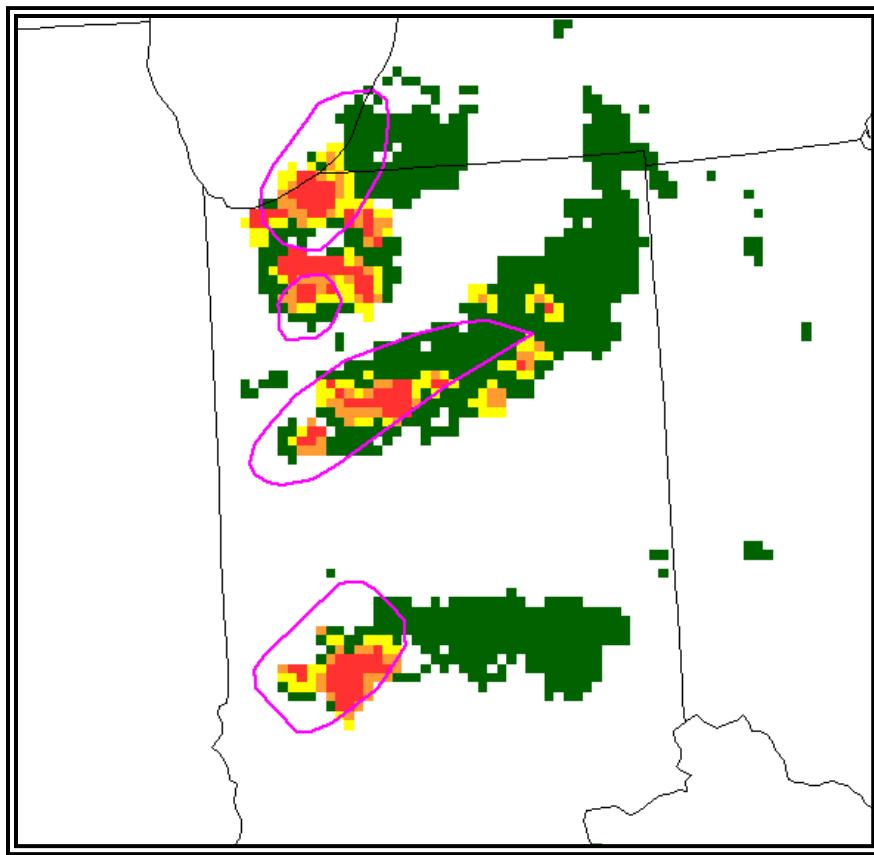
5.6.5.2.5 Past Performance Polygons.

Past performance polygons are magenta polygons displaying the past hour's extrapolated forecast polygons *with* the current Convective hazard fields. A perfect forecast would have the polygons filled with Convective hazard scale Levels 3 or higher data. Levels 1 and 2 would be outside the polygons. The display of past performance polygons allows the user to review the accuracy of the past hour's forecast.

Figure [5-32](#), NCWF Past Performance Polygons—Example, depicts current Convective hazard fields and past performance polygons (magenta) valid at 1500Z. The past performance polygons are the 1-hour extrapolated forecasts made at 1400Z. Although the polygons do not perfectly match the current Level 3 and higher hazard fields, the forecasts are still fairly accurate.

Newly developed Convective hazard Levels 3 and higher do not have past performance polygons. Extrapolated forecasts do not forecast developing hazardous Convective.

Figure 5-32. NCWF Past Performance Polygons—Example



5.6.5.3 Strengths and Limitations.

5.6.5.3.1 Strengths.

Strengths of the NCWF include:

- Convective hazard fields that agree very well with radar and lightning data;
- Updates every five minutes;
- High-resolution forecasts of Convective hazards; and
- Well-forecasted long-lived Convective precipitation.

5.6.5.3.2 Limitations.

Limitations of the NCWF include:

- Initiation, growth, and decay of Convective precipitation are not forecast;
- Short-lived or embedded convection may not be accurately displayed or forecast;
- Low-topped convection that contains little or no lightning may not be depicted;

- Erroneous motion vectors are occasionally assigned to storms; and
- Convective hazard field scales are not identified within the forecast polygons.

5.6.5.4 Uses of the NCWF.

The purpose of the NCWF is to produce a Convective hazard field diagnostic and forecast product based on radar data, echo top mosaics, and lightning data. The target audience includes the FAA and other government agencies, pilots, aircraft dispatchers, aviation meteorologists, and other interested aviation users in the general public.

5.7 Products for Tropical Cyclones.

The NWS issues SIGMETs, Convective SIGMETs, and CWA to inform the aviation community about the potential or existence of tropical cyclones. These above-listed products are the primary source of information. The NWS also issues other products pertaining to tropical cyclones. Tropical cyclones have a sustained wind speed of 34 kts or greater and are called tropical storm, hurricane, typhoon, and cyclone, depending on their intensity or region of the world.

5.7.1 Tropical Cyclone Advisory (TCA).

The TCA is intended to provide tropical cyclone forecast guidance, through 24 hours, for international aviation safety and routing purposes. TCAs are issued by the World Meteorological Organization's (WMO) TCACs for all ongoing tropical cyclone activity in their respective AORs. There are seven TCACs worldwide, with two in the United States, the NWS' National Hurricane Center (NHC) in Miami, Florida, and the NWS's Central Pacific Hurricane Center (CPHC) in Honolulu, Hawaii.

The NHC is responsible for all ongoing tropical cyclone activity in the Atlantic and eastern Pacific, north of the equator, while the CPHC is responsible for the central Pacific, north of the equator. TCAs are available on their respective websites.

5.7.1.1 Issuance.

The NHC and CPHC issue TCAs at 0300, 0900, 1500, and 2100 UTC and are valid from the time of issuance until the next scheduled issuance or update. The forecast position information in the TCA is interpolated from the official forecast data, which is valid at 0000, 0600, 1200, and 1800 UTC.

5.7.1.2 Content.

TCAs list the current tropical cyclone position, motion, and intensity, and 6-, 12-, 18-, and 24-hour forecast positions and intensities. It is an alphanumeric text product produced by hurricane forecasters and consists of information extracted from the official forecasts.

This forecast is produced from subjective evaluation of current meteorological and oceanographic data as well as output from Numerical Weather Prediction (NWP) models, and is coordinated with affected NWS offices, the NWS National Centers, and the Department of Defense (DOD).

5.7.1.3 Format.

The format of the Aviation Tropical Cyclone Advisory is as follows:

```
FKaa2i cccc ddhhmm (ICAO communication header)
(TROPICAL CYCLONE TYPE) (NAME) ICAO ADVISORY NUMBER ##
(ISSUING OFFICE CITY STATE) BBCCYYYY
time UTC day of week mon dd yyyy

TEXT
$$
```

5.7.1.4 Aviation Tropical Cyclone Advisory (TCA) Example.

```
FKNT25 KNHC 210900
TCANT5

TROPICAL STORM ICAO ADVISORY NUMBER 27
NWS TPC/NATIONAL HURRICANE CENTER MIAMI FL AL092007
0900 UTC SUN OCT 21 2007

TC ADVISORY

DTG: 20071021/0900Z
TCAC: KNHC
TC: ERNESTO
NR: 027
PSN: N3000 W08012
MOV: N 13KT
C: 0998HPA
MAX WIND: 045KT
FCST PSN + 06 HR: 211200 N3106 W07951
FCST MAX WIND + 06 HR: 045KT
FCST PSN + 12 HR: 211800 N3206 W07930
FCST MAX WIND + 12 HR: 050KT
FCST PSN + 18 HR: 220000 N3321 W07903
FCST MAX WIND + 18 HR: 045KT
```

FCST PSN + 24 HR: 220600 N3436 W07836
FCST MAX WIND + 24 HR: 040KT
RMK THE FORECAST POSITION INFORMATION IN
THIS PRODUCT IS INTERPOLATED FROM
OFFICIAL FORECAST DATA VALID AT 0000...
0600...1200...AND 1800Z.
NXT MSG: 20071021/1500Z
\$\$

5.7.1.5 Additional Tropical Cyclone Information Products.

The NHC, CPHC, and select WFOs issue many public tropical storm and hurricane/typhoon information products. Many are in Web-based graphic format. For more information on these public forecasts, see the websites of NHC, CPHC, WFO Guam, and WFOs along the Gulf Coast and the East Coast.

5.8 Volcanic Ash Forecasts.

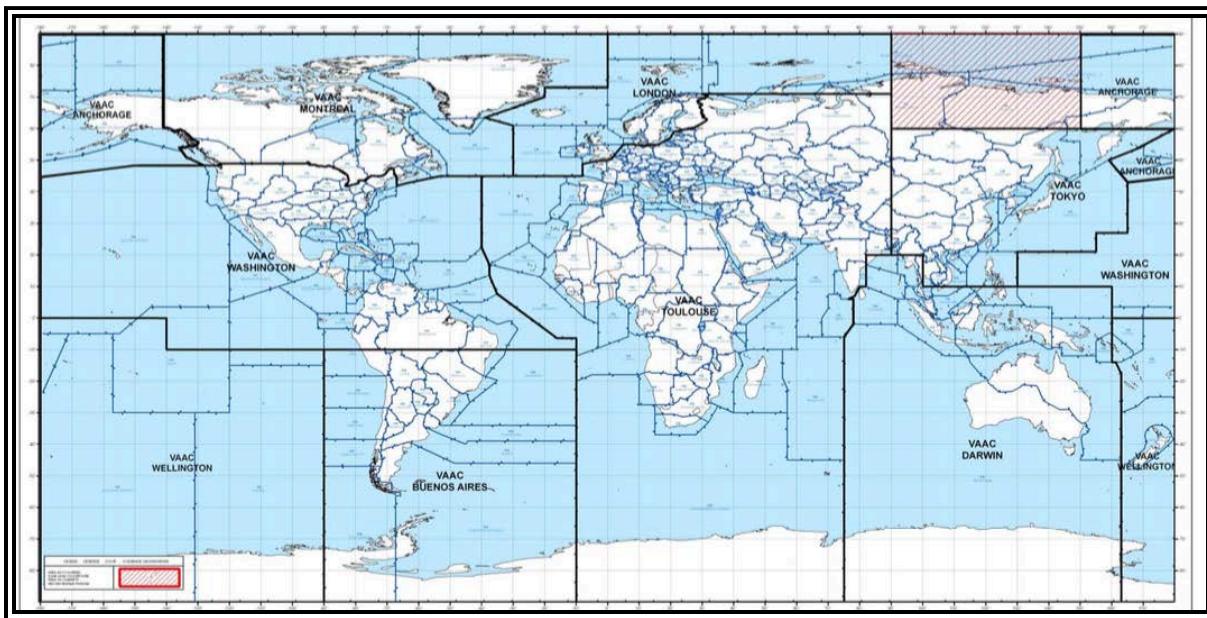
In addition to SIGMETs, the NWS issues forecasts to notify the aviation community of volcanic ash clouds.

5.8.1 Volcanic Ash Advisory Center (VAAC).

A VAAC is a meteorological office designated by an ICAO regional air navigation agreement to provide advisory volcanic ash information to MWOs, World Area Forecast Centers (WAFC), area control centers, flight information centers, and international operational meteorological (OPMET) data banks regarding the lateral and vertical extent and forecast movement of volcanic ash in the atmosphere following a volcanic eruption. There are nine VAACs worldwide (see Figure 5-33, Volcanic Ash Advisory Centers (VAACs)). The duties of a VAAC include:

- Monitoring relevant geostationary and polar-orbiting satellite data to detect the existence and extent of volcanic ash in the atmosphere in the area concerned;
- Activating the volcanic ash numerical trajectory/dispersion model in order to forecast the movement of any ash cloud that has been detected or reported; and
- Issuing advisory information regarding the extent and forecast movement of the volcanic ash cloud.

Figure 5-33. Volcanic Ash Advisory Centers (VAACs)



AORs for VAACs include Anchorage, Montreal, Washington, Wellington (New Zealand), Buenos Aires (Argentina), London, Toulouse (France), Tokyo, and Darwin.

The United States has two VAACs with responsibilities defined in ICAO Annex 3, Meteorological Service for International Air Navigation. The Washington VAAC is jointly managed by the National Environmental Satellite, Data, and Information Service (NESDIS) Satellite Analysis Branch (SAB) and the NWS National Centers for Environmental Prediction (NCEP) Central Operations (NCO). The Anchorage VAAC is managed by the NWS's AAWU. The AORs for each VAAC are:

- Washington VAAC.
 - FIRs in CONUS and adjacent coastal waters.
 - The Oakland Oceanic FIR over the Pacific Ocean.
 - The New York FIR over the western Atlantic Ocean.
 - FIRs over and adjacent to the Caribbean and Central and South America north of 10 degrees south latitude.
- Anchorage VAAC.
 - The Anchorage FIR.
 - Russian FIRs north of 60 degrees north latitude and east of 150 degrees east longitude.

5.8.2 Volcanic Ash Advisory (VAA).

The VAA is advisory information on volcanic ash cloud issued in abbreviated plain language, using approved ICAO abbreviations and numerical values of self-explanatory nature.

A graphical (e.g., chart) version of the VAA is also produced and is sometimes referred to as VAG. The VAG contains the same information as in the VAA but in a four-panel chart format.

5.8.2.1 VAA Issuance.

Each VAAC issues VAAs to provide guidance to MWOs for SIGMETs involving volcanic ash.

VAAs are issued as necessary, but at least every 6 hours until such time as the volcanic ash cloud is no longer identifiable from satellite data, no further reports of volcanic ash are received from the area, and no further eruptions of the volcano are reported.

VAAs in both text and graphical format are available from the websites of the VAAC.

5.8.2.2 VAA Format.

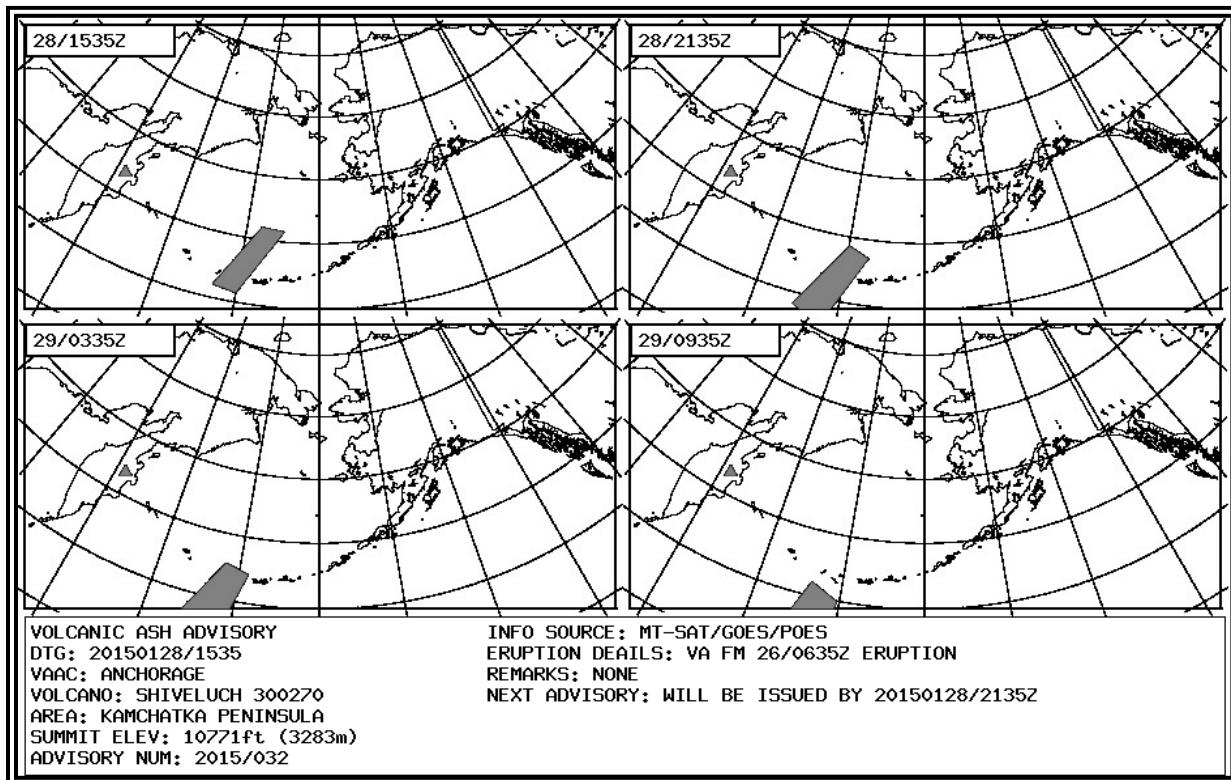
The VAA format conforms to the “Template for advisory message for volcanic ash” included in ICAO Annex 3.

5.8.2.3 VAA Example.

FVAK21 PAWU 190615
VOLCANIC ASH ADVISORY
ISSUED: 20030419/0615Z
VAAC: ANCHORAGE
VOLCANO: CHIKURACHKI, 900-36
LOCATION: N5019 E15527
AREA: KAMCHATKA NORTHERN KURIL ISLANDS
SUMMIT ELEVATION: 7674 FT (2339 M)
ADVISORY NUMBER: 2003-02
INFORMATION SOURCE: SATELLITE
AVIATION COLOR CODE: NOT GIVEN
ERUPTION DETAILS: NEW ERUPTION OCCURRED APPROX 190500 UTC.
HEIGHT IS ESTIMATED AT FL300. ESTIMATE IS
BASED ON OBSERVED AND MODEL WINDS. MOVEMENT
APPEARS TO BE E AT 75 KTS.
OBS ASH DATA/TIME: 19/0500Z
OBS ASH CLOUD: VA EXTENDS FM NEAR VOLCANO EWD TO N50 E160.
FCST ASH CLOUD +6HR: 30NM EITHER SIDE OF
LN FM NIPPI N49 E159 - N50 E175.
FCST ASH CLOUD +12HR: 30NM EITHER SIDE OF LN FM N50 E168 - N50 E180.
FCST ASH CLOUD +18HR: 30NM EITHER SIDE OF LN FM N51 E175 - N50 E185.
NEXT ADVISORY: 20030419/1500Z
REMARKS: UPDATES AS SOON AS INFO BECOMES AVAILABLE.

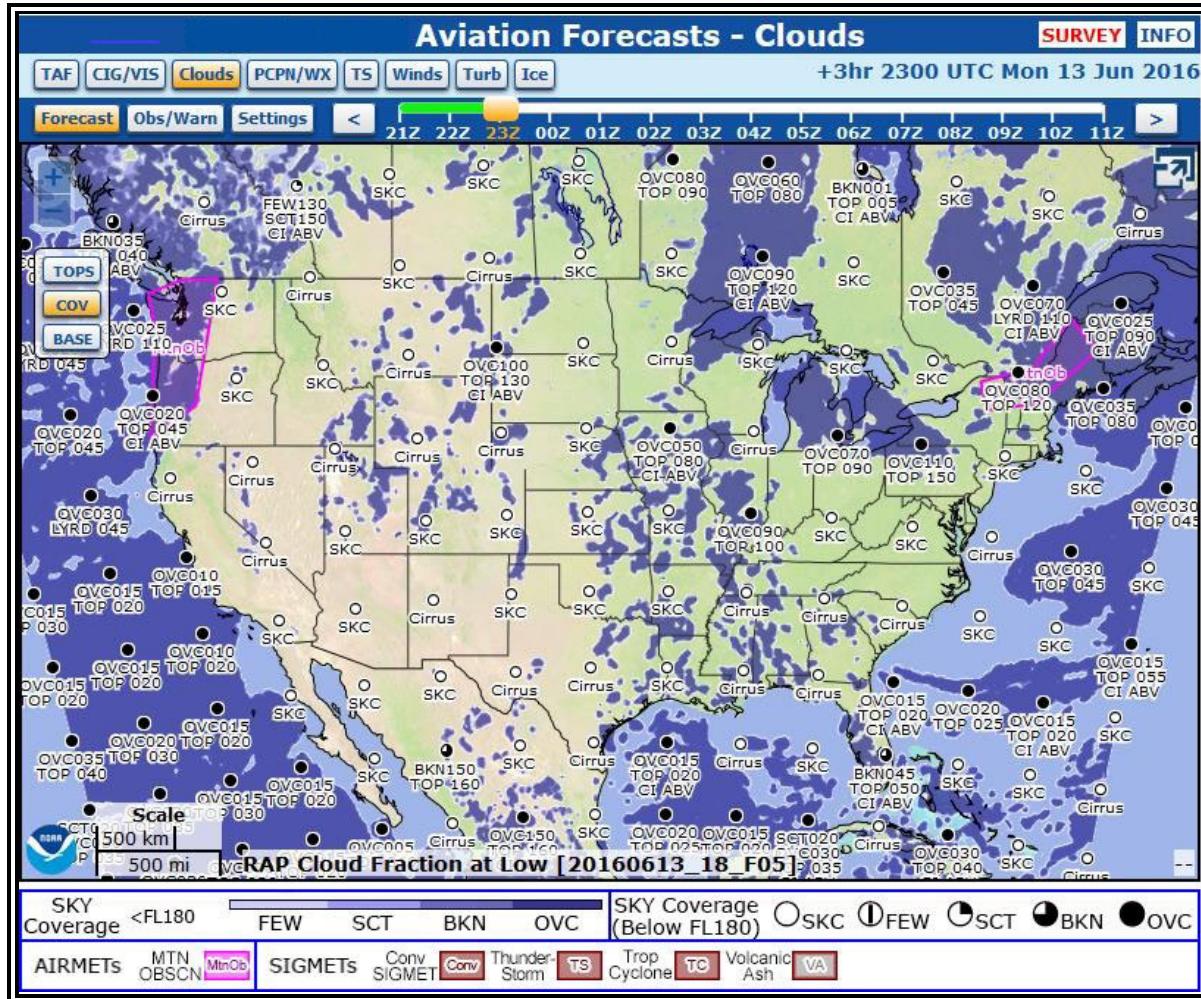
5.8.2.4 VAA Graphic Example.

Figure 5-34. Volcanic Ash Advisory in Graphical Format



5.9 Graphical Forecast for Aviation (GFA).

The GFAs are a set of Web-based displays which are expected to provide the necessary aviation weather information to give users a complete picture of the weather that may impact flights in the CONUS. These displays are updated continuously and provide forecasts, observational data, and warnings of weather phenomena that can be viewed from 14 hours in the past to 15 hours in the future. This product covers the surface up to FL420 (or 42,000 ft MSL). Wind, icing, and turbulence forecasts are available in 3,000-ft increments from the surface up to 18,000 ft MSL, and in 6,000-ft increments from 18,000 ft MSL to FL420. Turbulence forecasts are also broken into low (below 18,000 ft MSL) and high (above 18,000 ft MSL) graphics. A maximum icing graphic and maximum wind velocity graphic (regardless of altitude) are also available. The graphic below is an example of an aviation forecast for clouds.

Figure 5-35. Aviation Forecast for Clouds—Example

5.9.1 Time Selection and Slider.

Available weather product tabs are configured based on the time selection. Users may choose between Forecast and Observations/Warnings (Obs/Warn). The specific hour may then be chosen by the time slider.

Figure 5-36. Time Selection and Slider

5.9.1.1 Forecast Weather Products Tabs.

Weather products with forecast information are available by selecting one of the tabs at the top of the display above the time selector. The selected product will be highlighted. The default is TAF.

Figure 5-37. Forecast Weather Products Tabs

5.9.1.2 Forecast Weather Product Elements Tabs.

The following table shows which weather elements are displayed on each forecast product tab.

Table 5-11. Weather Elements on Forecast Product Tabs

Product	Gridded Product	Weather Data Overlay	SIGMET	NWS Warnings	AIRMET	Vertical Levels
TAF	-	-	All	All	-	-
CIG/VIS	LAMP Flight Category, Ceiling, or Visibility	NDFD Precipitation/Weather Type and Intensity Symbol	C-SIG TC TS BD BS VA	WS BZ	Sierra (IFR)	-
Clouds	RAP Model Cloud Coverage, Tops, or Bases	RAP Model Cloud Base, Layers, and Tops	C-SIG TC TS VA	-	Mountain Obscuration	-
PCPN/WX	NDFD Precipitation/Weather Type and Likelihood	NDFD Precipitation/Weather Type and Intensity	C-SIG TC TS BD BS VA	TO TS WS BZ IS LS ST	-	-
TS	NDFD Thunderstorm Coverage	NDFD Thunderstorm Type and Intensity	C-SIG TC TS	TO TS	-	-
Winds	RAP/NDFD Wind Speed	RAP/NDFD Wind and Gust Barb	C-SIG TC TS	WS BZ IS ST GA HW	LLWS, Strong Surface Winds	SFC, MAX, every 3,000 ft from FL030 to FL300; every 6,000 ft from FL300 to FL480
Turb	Graphical Turbulence Guidance (GTG)	-	C-SIG TC TS TB	-	Turbulence	LO, HI, every 3,000 ft from FL030 to FL300; every 6,000 ft from FL300 to FL480
Ice	FIP @ "SFC" NDFD Winter Precipitation/Weather Type and Likelihood	@ "SFC" NDFD Winter Precipitation/Weather Type and Intensity	C-SIG TC TS IC	@ "SFC" WS BZ IS LS	Icing	SFC, MAX, every 3,000 ft from FL030 to FL300; every 6,000 ft from FL300 to FL480

5.9.1.3 Observations/Warnings (Obs/Warn).

The Observation/Warning option provides an option to display weather data for the current time and the previous fourteen hours (rounded to the nearest hour). Users may advance through time using the arrow buttons or by clicking on the desired hour.

Figure 5-38. Observations/Warnings Tab



5.9.1.4 Observations/Warnings Weather Product Tabs.

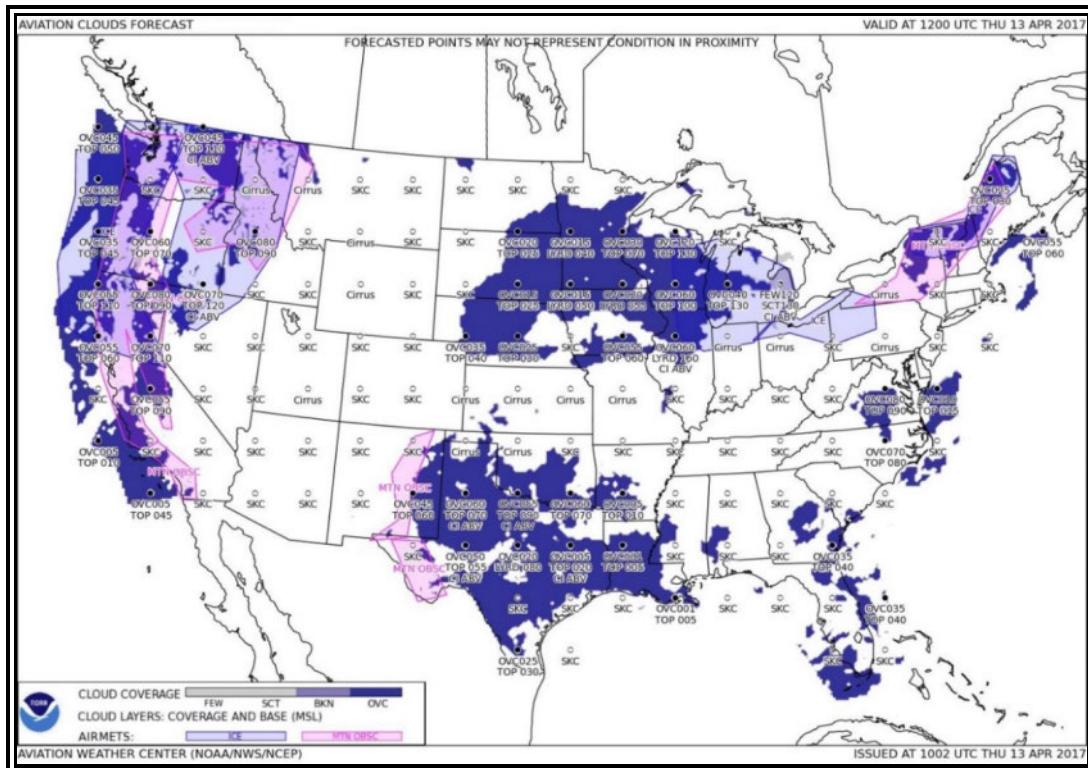
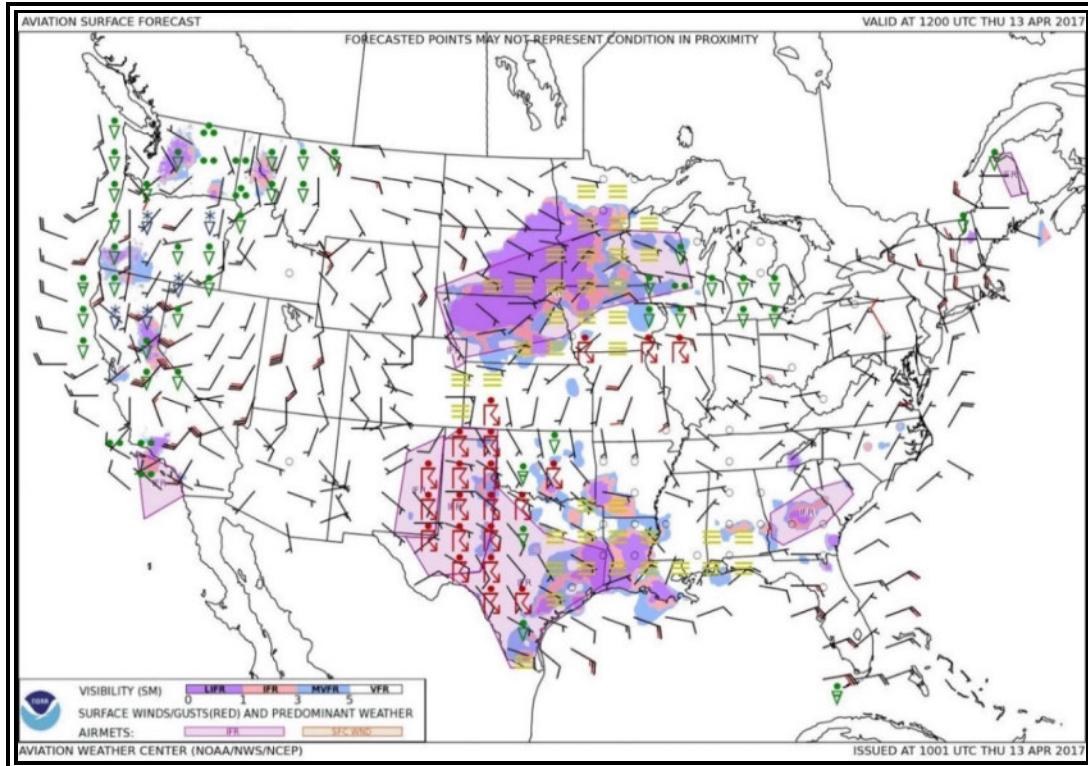
The following table shows what is displayed on each Observations/Warnings weather product tab. Each product in this menu is overlaid on an infrared (IR) satellite image with a radar loop of the five most recent images up to the selected hour.

Table 5-12. Products Displayed on Observations/Warnings Weather Products Tab

Product	Weather Data Overlay	SIGMET	NWS Warnings	Vertical Levels
METAR	METAR Station Plot	All	All	-
PCPN/WX	METAR Precipitation Weather Symbol	C-SIG TC TS BD BS VA	TO TS WS BZ IS LS ST	-
CIG/VIS	FLT CAT: Non-VFR Color-Coded METAR Flight Category Symbol CIG: Number (ft/100) VIS: Number (SM)	C-SIG TC TS BD BS VA	WS BZ	-
PIREP	PIREP symbols	All	-	ALL, every 3,000 ft from FL030 to FL300; every 6,000 ft from FL300 to FL480
RAD/SAT	-	All	All	-

5.9.2 GFA Static Images.

Some users with limited Internet connectivity may access static images via the AWC at <http://www.aviationweather.gov/gfa/plot>. There are two static graphical images available titled, “Aviation Cloud Forecast” and “Aviation Surface Forecast.” The Aviation Cloud Forecast provides cloud coverage, bases, layers, and tops with AIRMET Sierra for mountain obscuration and AIRMET Zulu for icing overlaid. The Aviation Surface Forecast provides visibility, weather phenomena, and winds (including wind gusts) with AIRMET Sierra for IFR conditions and AIRMET Tango for sustained surface winds of 30 kts or more overlaid. These images are presented on 10 separate maps providing forecast views for the entire CONUS on one, and 9 regional views which provide more detail for the user. They are updated every 3 hours and provide forecast snapshots for 3, 6, 9, 12, 15, and 18 hours in the future.

Figure 5-39. GFA Static Cloud Forecast**Figure 5-40. GFA Surface Forecast**

5.9.3 Strengths and Limitations (GFA).

5.9.3.1 Strengths.

- One-stop shop for multiple data fields.
- Focused on low-altitude flights common to GA community.
- Simplified display for non-meteorologist users.
- Available 24 hours a day, 7 days a week.
- Updated continuously.
- Resolution of 2.2 km.
- Available 6 hours in the past up to 15 hours in the future.

5.9.3.2 Limitations.

Caution should be applied as users configure the GFA for use. Users can turn on and turn off certain functions, i.e., AIRMET's and SIGMET's overlays for a given geographical area. This can lead to hidden areas of hazardous weather for a given flight path.

5.9.4 Recommended Action for Users.

- 5.9.4.1** For more information on how to use this product, all users are encouraged to visit the GFA interactive web tool at <https://www.aviationweather.gov/gfa>.
- 5.9.4.2** A short video explaining how to navigate the GFA can be found at <https://www.youtube.com/watch?v=kLe6Eu3fwS0>.
- 5.9.4.3** Users may provide feedback for the Aviation Surface Forecast and the Aviation Cloud Forecast graphics at <http://new.aviationweather.gov/areafest>.

5.10 Localized Aviation Model Output Statistics (MOS) Program (LAMP).

The LAMP weather product is a statistical model program that provides specific point forecast guidance on sensible weather elements (perceivable elements such as temperature, wind, sky cover, etc.). LAMP weather product forecasts are provided in both graphical and coded text format, and are currently generated for more than 1,500 locations. The LAMP weather product is entirely automated and may not be as accurate as a forecast generated with human involvement. However, information from the LAMP weather product can be used in combination with Terminal Aerodrome Forecasts (TAF), and other weather reporting and forecasting products and tools, to provide additional information and enhance situational awareness regarding a particular location.

5.10.1 Strengths and Limitations (LAMP).

5.10.1.1 Strengths.

- Updated hourly, incorporating the latest surface conditions to produce hourly forecasts of weather elements reaching up to 25 hours in the future.
- Users can access fresh forecast information for the next 24 hours.
- Provides both categorical and probabilistic forecast guidance on various elements, allowing users to extract the type of information they want.
- Categorical ceiling/visibility forecast information is presented, along with forecasts dependent on the occurrence of precipitation. This data attempts to account for some of the temporary fluctuations that occur in flight.

5.10.1.2 Limitations.

May not be as accurate as a forecast generated with human involvement.

5.10.2 Recommended Action for Users.

- A list of LAMP airports can be found at <http://www.nws.noaa.gov/mdl/gfslamp/gfslamp.shtml>.

Note: Once you have selected the above link, look at the left-side menu under “Text Forecasts” and select “By Station” to get a list of the LAMP stations by state.

- A detailed description of the LAMP can be accessed at http://www.nws.noaa.gov/mdl/gfslamp/docs/LAMP_description.shtml.
- The NOAA/NWS LAMP home page can be accessed at <http://www.nws.noaa.gov/mdl/lamp/index.shtml>.

5.11 Area Forecasts (FA).

An FA is an abbreviated plain language forecast concerning the occurrence or expected occurrence of specified en route weather phenomena. The FA (in conjunction with AIRMETs, SIGMETs, Convective SIGMETs, CWAs, etc.) is used to determine forecast en route weather over a specified geographic region. FAs cover an 18- to 24-hour period, depending on the region, and issued three to four times daily, depending on the region, and are updated as needed. The exact phenomenon contained in FAs also varies by region.

FAs are not intended for use as a substitute for a TAF for those air carrier operations that require weather forecasts at specific airports (i.e., origin, destination, and any alternate). In these operations, a TAF or equivalent forecast that is generated for the specific airport in question, is required to meet the 14 CFR regulatory requirements that specify certain weather conditions and minima at the origin, destination, and alternate airports.

5.11.1 FA—Gulf of Mexico, Caribbean, Hawaii, and Alaska.

5.11.1.1 FA Issuance.

The following offices issue FAs for the following areas:

- The AWC:
 - Gulf of Mexico: The northern Gulf of Mexico, including the Houston Oceanic FIR, the Gulf of Mexico portion of the Miami Oceanic FIR, and the coastal waters west of 85W longitude (see Figure [5-41](#), AWC Area Forecast (FA) Region and WMO Header—Gulf of Mexico).
 - Caribbean Sea: Portions of the Gulf of Mexico (south of the Houston Oceanic FIR to approximately 22N latitude), the Caribbean Sea, and adjacent portions of the North Atlantic (see Figure [5-42](#), AWC Area Forecast (FA) Region and WMO Header—Caribbean).
 - Hawaii: The main Hawaiian Islands and adjacent coastal waters extending out 40 NM from the coastlines (see Figure [5-43](#), WFO Honolulu Area Forecast (FA) Region and WMO Header—Hawaii).
- The AAWU:
 - Alaska: Seven FAs containing a total of 25 zones (see Table [5-11](#), Weather Elements on Forecast Product Tabs), covering separate geographical areas of Alaska and the adjacent coastal waters, including the Pribilof Islands and Southeast Bering Sea (see Figure [5-44](#), AAWU Flight Advisory and Area Forecast (FA) Zones—Alaska).

Figure 5-41. AWC Area Forecast (FA) Region and WMO Header—Gulf of Mexico



Figure 5-42. AWC Area Forecast (FA) Region and WMO Header—Caribbean

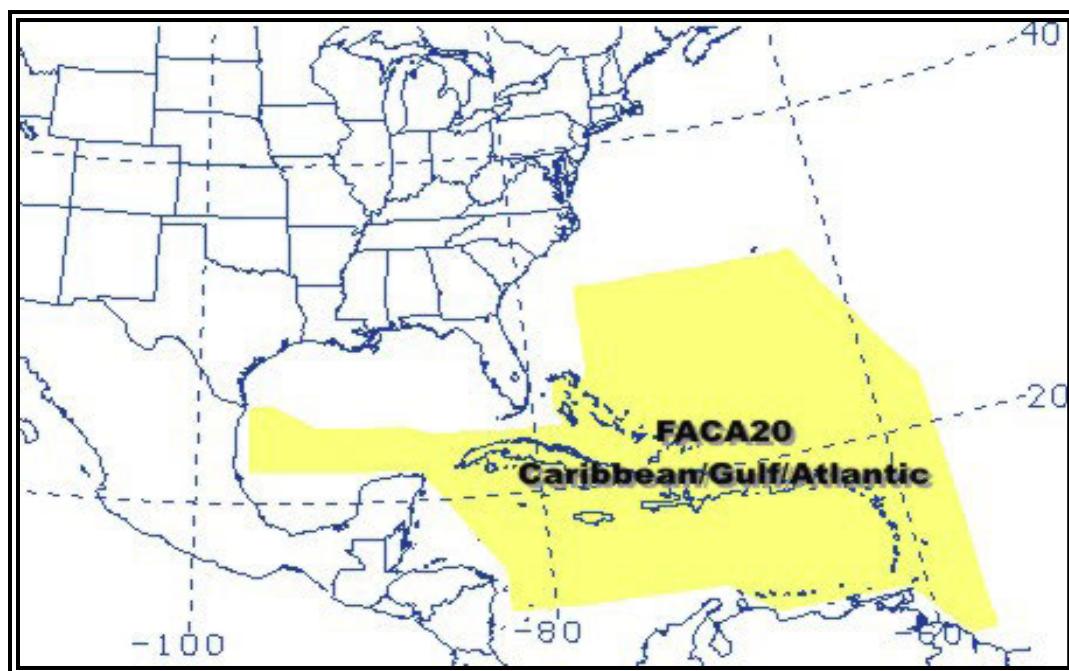


Figure 5-43. WFO Honolulu Area Forecast (FA) Region and WMO Header—Hawaii

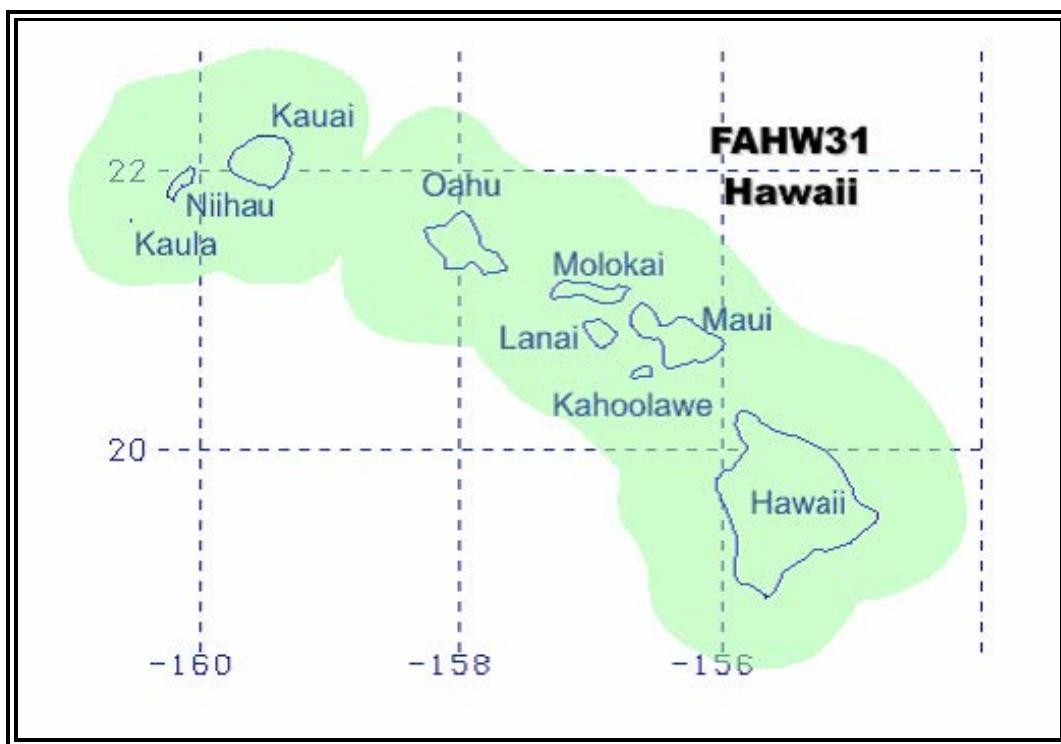


Figure 5-44. AAWU Flight Advisory and Area Forecast Zones—Alaska

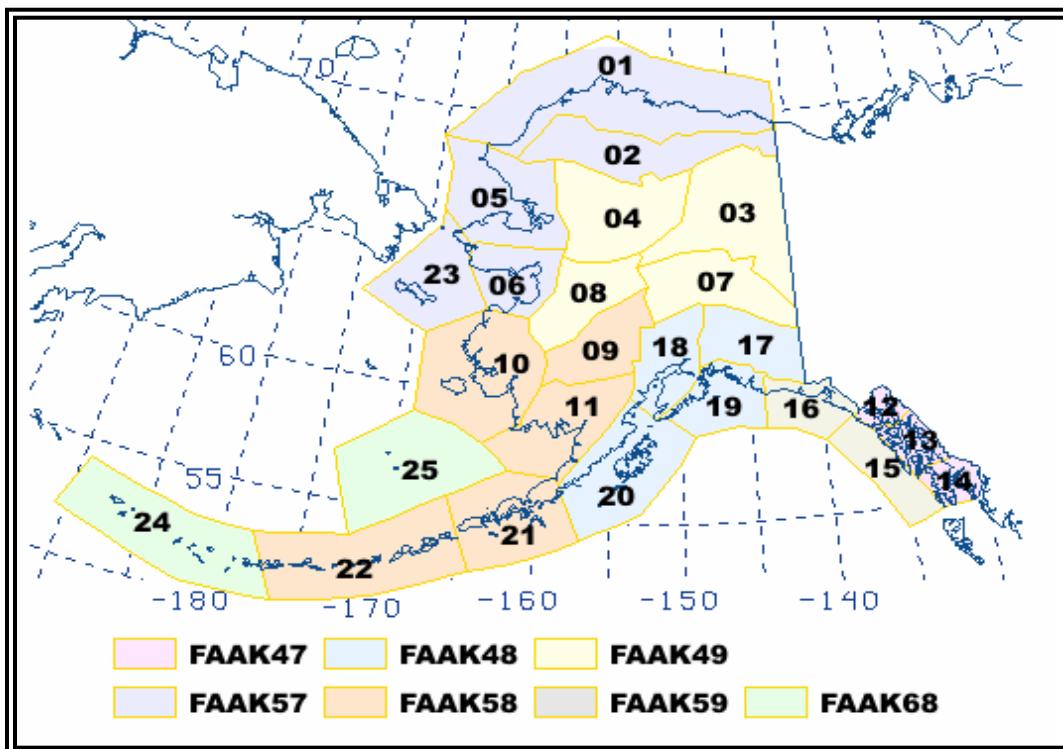


Table 5-13. AAWU Area Forecast (FA) Zones—Alaska

1	Arctic Coast Coastal	14	Southern Southeast Alaska
2	North Slopes of the Brooks Range	15	Coastal Southeast Alaska
3	Upper Yukon Valley	16	Eastern Gulf Coast
4	Koyukuk and Upper Kobuk Valley	17	Copper River Basin
5	Northern Seward Peninsula-Lower Kobuk Valley	18	Cook Inlet-Susitna Valley
6	Southern Seward Peninsula-Eastern Norton Sound	19	Central Gulf Coast
7	Tanana Valley	20	Kodiak Island
8	Lower Yukon Valley	21	Alaska Peninsula-Port Heiden to Unimak Pass
9	Kuskowim Valley	22	Unimak Pass to Adak
10	Yukon-Kuskowim Delta	23	St. Lawrence Island-Bering Sea Coast
11	Bristol Bay	24	Adak to Attu
12	Lynn Canal and Glacier Bay	25	Pribilof Islands and Southeast Bering Sea
13	Central Southeast Alaska		

5.11.1.2 FA Standardization.

All FAs follow these standards:

- All heights or altitudes are referenced to **MSL**, unless otherwise noted (i.e., prefaced by **AGL** or **CIG**), and annotated using the height in hundreds of feet, consisting of three digits (e.g., 040). For heights at or above 18,000 ft, the level is preceded by **FL** to represent FLs (e.g., FL180). Tops are always referenced to MSL.
- References to latitude and longitude are in whole degrees and minutes following the model: Nnn[nn] or Snn[nn], Wnnn[nn], or Ennn[nn] with a space between latitude and longitude and a hyphen between successive points. Example: N3106 W07118 – N3011 W7209.
- Messages are prepared in abbreviated plain language using contractions from Order 7340.2 for domestic products and ICAO Document 8400 for products issued for Oceanic FIRs. A limited number of non-abbreviated words, geographical names, and numerical values of a self-explanatory nature may also be used.
- Weather and obstructions to visibility are described using the weather abbreviations for surface weather observations (**METAR/SPECI**).

5.11.1.3 FA Issuance Schedule.

FAs are scheduled products issued at the following times (see Table [5-14](#), Area Forecast (FA) Issuance Schedule).

Table 5-14. Area Forecast (FA) Issuance Schedule

	Gulf of Mexico (UTC)	Caribbean (UTC)	Hawaii (UTC)	Alaska (UTC)
1st Issuance	0130	0330	0340	0415 (DT) 0515 (ST)
2nd Issuance	1030	0930	0940	1215 (DT) 1315 (ST)
3rd Issuance	1830	1530	1540	2015 (DT) 2115 (ST)
4th Issuance	None	2130	2140	None

Note: DT—During Alaska Daylight Time, ST—During Alaska Standard Time, UTC—Coordinated Universal Time.

5.11.1.4 FA Amendments.

Amendments are issued whenever the weather significantly improves or deteriorates based upon the judgment of the forecaster. **AMD** is included after the date/time group on the FAA product line. The date/time group on the WMO and FAA lines is updated to indicate the time of the correction. The ending valid time remains unchanged.

5.11.1.5 FA Corrections.

FAs containing errors will be corrected. **COR** is included after the date/time group on the FAA product line. The date/time group on the WMO and FAA lines is updated to indicate the time of the correction. The ending valid time remains unchanged.

5.11.1.6 FA—Gulf of Mexico (FAGX).

FAs issued for the Gulf of Mexico (FAGX) cover the airspace between the surface and 45,000 ft MSL and include the following elements with each geographical section having an entry, even if it is negative:

- Synopsis: A brief discussion of the significant synoptic weather affecting the FAGX area during the entire 24-hour valid period.
- Significant Clouds and Weather: A description of the significant clouds and weather for the first 12 hours of the forecast period, including the following elements:
 - Cloud amount (**SCT**, **BKN** or **OVC**) for clouds with bases below FL180.
 - Cloud bases and tops associated with the above bullet.
 - Precipitation and thunderstorms.
 - Visibility below 7 sm and obstruction(s) to visibility.
 - Sustained surface winds greater than or equal to 20 kts.
 - 12- to 24-hour categorical outlook (**LIFR**, **IFR**, **MVFR** or **VFR**).

- Icing and Freezing Level: Moderate or severe icing and freezing level.
- Turbulence: Moderate or greater turbulence.

5.11.1.6.1 FA—Gulf of Mexico (FAGX) Example.

```

FAGX20 KKCI 091812 (ICAO product header)
OFAGX (NWS AWIPS Communication header)
SYNOPSIS VALID TIL 101900Z
FCST...091900Z-100700Z
OTLK...100700Z-101900Z
INTERNATIONAL OPERATIONS BRANCH
AVIATION WEATHER CENTER KANSAS CITY MISSOURI
.
CSTL WATERS FROM COASTLINE OUT TO HOUSTON OCEANIC FIR AND GLFMEX
MIAMI OCEANIC FIR AND W OF 85W. HOUSTON OCEANIC FIR AND GLFMEX MIAMI
OCEANIC FIR.
.
TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS. HGTS MSL.
.
01 SYNOPSIS...HIGH PRES OVR NRN GLFMEX.
.
02 SIGNIFICANT CLD/WX...
.
CSTL WATERS...
SCT020. OTLK...VFR.
.
HOUSTON OCEANIC FIR...
SCT020. OTLK...VFR.
.
GLFMEX MIAMI OCEANIC FIR...
SCT020. OTLK...VFR.
.
03 ICE AND FRZLVL...
CSTL WATERS...SEE AIRMETS ZULU WAUS44 KKCI AND WAUS42 KKCI.
HOUSTON OCEANIC FIR... NO SGFNT ICE EXP OUTSIDE CNVTW ACT.
GLFMEX MIAMI OCEANIC FIR...NO SGFNT ICE EXP OUTSIDE CNVTW ACT.
FRZLVL...140 THRUT.
.
04 TURB...
CSTL WATERS...SEE AIRMETS TANGO WAUS44 KKCI AND WAUS42 KKCI.
HOUSTON OCEANIC FIR... NO SGFNT TURB EXP OUTSIDE CNVTW ACT.
GLFMEX MIAMI OCEANIC FIR...NO SGFNT TURB EXP OUTSIDE CNVTW ACT.

```

5.11.1.7 FA—Caribbean (FACA).

FAs issued for the Caribbean (FACA) cover the airspace between the surface and 24,000 ft MSL and include the following elements. Each geographical section will have an entry even if it is negative.

- Synopsis: A brief discussion of the significant synoptic weather affecting the FACA area during the 24-hour valid period.
- Significant Clouds and Weather: A description of the significant clouds and weather for the first 12 hours of the forecast period, including the following elements.

- Cloud amount (**SCT**, **BKN**, or **OVC**) for cloud bases below FL180.
- Cloud bases and tops associated with the above bullet.
- Precipitation and thunderstorms.
- Visibility below 7 sm and obstruction(s) to visibility.
- Sustained surface winds greater than or equal to 20 kts.
- 12- to 24-hour categorical outlook (**IFR**, **MVFR** or **VFR**).
- Icing and Freezing Level: Moderate or greater icing and freezing level.
- Turbulence: Moderate or greater turbulence.

5.11.1.7.1 FA—Caribbean (FACA) Example.

```

FACA20 KKCI 121530 (ICAO product header)
OFAMKC (NWS AWIPS Communication header)
INTERNATIONAL OPERATIONS BRANCH
AVIATION WEATHER CENTER KANSAS CITY MISSOURI
VALID 121600-130400
OUTLOOK...130400-131600
.
ATLANTIC S OF 32N W OF 57W...CARIBBEAN...GULF OF MEXICO BTN 22N AND
24N.
.
TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS. SFC TO 400 MB.
.
SYNOPSIS...WK CDFNT EXTDS FM NR 28N60W TO 23N63W TO THE MONA
PASSAGE. CDFNT WL MOV EWD AND WKN TODAY. EXP NARROW BAND OF
CLDS WITH ISOL SHRA INVOF CDFNT.
.
SIGNIFICANT CLD/WX...
ERN MONTERREY FIR...NRN MERIDA FIR
SCT025 SCT060. OTLK...VFR.
.
ATLC SWRN NEW YORK FIR...SAN JUAN FIR
NW OF CDFNT...SCT025 SCT060. LYR OCNL BKN. TOP 120. ISOL SHRA.
OTLK...VFR.
VCNTY CDFNT...SCT025 BKN060. OCNL BKN025. TOP 120. WDLY SCT
SHRA. ISOL TSRA TIL 20Z. OTLK...VFR SHRA.
SE OF CDFNT...SCT025 SCT060. ISOL SHRA. OTLK...VFR.
.
ATLC MIAMI FIR
SCT025 SCT060. LYR OCNL BKN. TOP 120. ISOL SHRA. OTLK...VFR.
.
WRN PIARCO FIR...NRN MAIQUETIA FIR...CURACAO FIR
BTN 61W-63W...SCT025 BKN060. OCNL BKN025. TOP 120. WDLY SCT
SHRA. OTLK...VFR SHRA.
RMNDR...SCT025 SCT060. ISOL SHRA. OTLK...VFR.
.
SANTO DOMINGO FIR...PORT-AU-PRINCE FIR
SCT025 SCT060. LYR OCNL BKN. TOP 120. ISOL SHRA. OTLK...VFR.
.
NRN BARRANQUILLA FIR...NRN PANAMA FIR
SCT025 SCT060. ISOL SHRA. SFC WND NE 20-25KT. OTLK...VFR.
.
KINGSTON FIR...NERN CNTRL AMERICAN FIR...HABANA FIR
SCT025 SCT060. ISOL SHRA. OTLK...VFR.

```

ICE AND FRZLVL...
NO SGFNT ICE EXP OUTSIDE CNVTV ACT.
FRZLVL... 145-170.
TURB...
NO SGFNT TURB EXP OUTSIDE CNVTV ACT.

5.11.1.8 FA—Hawaii.

FAs issued for Hawaii cover the airspace between the surface and 45,000 ft MSL and include the following elements:

- Synopsis: A brief discussion of the significant synoptic weather affecting the FA area during the 18-hour valid period.
- Significant Clouds and Weather: A description of the significant clouds and weather for the first 12 hours of the forecast period, including the following elements:
 - Cloud amount (**SCT**, **BKN**, or **OVC**) with bases and tops.
 - Visibilities of 6 sm or less with obstruction(s) to visibility.
 - Precipitation and thunderstorms.
 - Sustained surface winds of 20 kts or greater.
 - 12- to 18-hour categorical outlook (**IFR**, **MVFR**, or **VFR**), including expected precipitation and/or obstructions to visibility.

5.11.1.8.1 FA—Hawaii Example.

FAHW31 PHFO 080940 (*ICAO product header*)
FA0HI (NWS AWIPS *Communication header*)
.
HNLC FA 080940 (*Area forecast region, product type, issuance date/time*)
SYNOPSIS AND VFR CLD/WX
SYNOPSIS VALID UNTIL 090400
CLD/WX VALID UNTIL 082200...OUTLOOK VALID 082200-090400
.
SEE AIRMET SIERRA FOR IFR CLD AND MT OBSC.
TS IMPLY SEV OR GREATER TURB SEV ICE LOW LEVEL WS AND IFR COND.
NON MSL HGT DENOTED BY AGL OR CIG.
.
SYNOPSIS...SFC HIGH FAR N PHNL NEARLY STNR.
.
BIG ISLAND ABOVE 060.
SKC. 20Z SCT090. OUTLOOK...VFR.
.
BIG ISLAND LOWER SLOPES...COAST AND ADJ WATERS FROM UPOLU POINT TO
CAPE KUMUKAHI TO APUA POINT.
SCT030 BKN050 TOPS 080 ISOL BKN030 VIS 3-5SM -SHRA BR. 21Z SCT030
SCT-BKN050 TOPS 080 ISOL BKN030 5SM -SHRA. OUTLOOK...VFR.
.
BIG ISLAND LOWER SLOPES...COAST AND ADJ WATERS FROM APUA POINT TO SOUTH
CAPE TO UPOLU POINT. SKC. 21Z SCT-BKN060 TOPS 080. 23Z SCT030 SCT-
BKN060 TOPS 080 ISOL BKN030 -SHRA. OUTLOOK...VFR.
.

BIG ISLAND LOWER SLOPES...COAST AND ADJ WATERS FROM SOUTH CAPE TO PHKO TO UPOLU POINT.
SCT050 ISOL BKN050 TOPS 080. 18Z FEW050. 23Z SCT-BKN050 TOPS 080. OUTLOOK...VFR.
N AND E FACING SLOPES...COAST AND ADJ WATERS OF THE REMAINING ISLANDS.
SCT020 BKN045 TOPS 070 TEMPO BKN020 VIS 3-5SM -SHRA...FM OAHU EASTWARD ISOL CIG BLW 010 AND VIS BLW 3SM SHRA BR WITH TOPS 120. 22Z SCT025
SCT-BKN050 TOPS 070 ISOL BKN025 3-5SM -SHRA. OUTLOOK...VFR.
REST OF AREA.
SCT035 SCT-BKN050 TOPS 070 ISOL BKN030 -SHRA. 20Z SCT050 ISOL SCT030 BKN045 TOPS 070 -SHRA. OUTLOOK...VFR

5.11.1.9 FA—Alaska.

FAs issued for Alaska cover the airspace between the surface and 45,000 ft MSL and include the following elements:

- Synopsis: A brief description of the significant synoptic weather affecting the FA area during the first 18 hours of the forecast period.
- Significant Clouds and Weather: A description of the significant clouds and weather for each geographical zone during the first 12 hours of the forecast period, including the following elements:
 - AIRMET information for **IFR** ceiling and visibility, mountain obscuration, and strong surface winds.
 - Cloud amount (**SCT**, **BKN**, or **OVC**) with bases and tops.
 - Visibility below 7 sm and obstruction(s) to visibility.
 - Precipitation and thunderstorms.
 - Surface wind greater than 20 kts.
 - Mountain pass conditions using categorical terms (for selected zones only).
 - 12- to 18-hour categorical outlook (**VFR**, **MVFR** and **IFR**).
- Icing and Freezing Level: A description of expected icing conditions including the following elements:
 - AIRMET information for icing and freezing precipitation.
 - Icing not meeting SIGMET or AIRMET criteria during the 6- to 12-hour period.
 - Freezing level.
 - If no significant icing is forecast, **NIL SIG** will be entered, followed by the freezing level.
- Turbulence: A description of expected turbulence conditions, including the following elements:

- AIRMET information for turbulence or LLWS.
- Turbulence not meeting SIGMET or AIRMET criteria during the 6- to 12-hour period.
- If no significant turbulence is forecast, **NIL SIG** will be entered.

5.11.1.9.1 FA—Alaska Example.

FAAK47 PAWU 222010 (*ICAO product header*)

FA7H (*NWS AWIPS Communication header*)

JNUH FA 222015 (*Area forecast region, product type, issuance date/time*)

EASTERN GULF COAST AND SE AK...

AIRMETS VALID UNTIL 230415

CB IMPLY POSSIBLE SEV OR GREATER TURB SEV ICE LLWS AND IFR CONDS.

NON MSL HEIGHTS NOTED BY AGL OR CIG.

SYNOPSIS VALID UNTIL 231400

989 MB LOW 275 NM SE KODIAK IS WILL MOV SE WARD TO ABOUT 350 NM S
PASI BY 14Z WHILE FILLING TO 998 MB. ASSOCD OCFNT ARCLNG E AND SE FM
LOW WILL MOV ONSHR SE AK AND DSIPR BY END OF PD.

LYNN CANAL AND GLACIER BAY JB...VALID UNTIL 230800

...CLOUDS/WX...

FEW025 SCT050 BKN100 TOP 120.

OTLK VALID 230800-231400...VFR.

PASSES...WHITE...CHILKOOT...VFR.

...TURB...

NIL SIG.

...ICE AND FZLVL...

NIL SIG. FZLVL 020.

CNTRL SE AK JC...VALID UNTIL 230800

...CLOUDS/WX...

FEW025 SCT050 BKN100 TOP 120.

AFT 03Z ISOL BKN050 -SHRA.

OTLK VALID 230800-231400...VFR.

...TURB...

AFT 05Z SW PAFE ISOL MOD TURB BLW 040.

...ICE AND FZLVL...

NIL SIG. FZLVL 025.

```
SRN SE AK JD...VALID UNTIL 230800
...CLOUDS/WX...
FEW025 SCT050 BKN100 TOP 120.
AFT 00Z OCNL BKN050 -RA. ISOL BKN025 -RA.
AFT 03Z SFC WND SE 25G35KT.
OTLK VALID 230800-231400...VFR.
...TURB...
AFT 02Z CLARENCE STRAIT SW ISOL MOD TURB BLW 040.
...ICE AND FZLVL...
AFT 02Z OUTER CST PAHY S ISOL MOD ICEIC 040-100. FZLVL 025.
```

5.12 Alaskan Graphical Area Forecasts (FA).

NWS's AAWU produces a series of graphical forecasts to complement the text-based FA for Alaska (see paragraph [5.11.1](#)). These forecasts are available from the AAWU's Web page under Graphical FA.

- Flying Weather.
- Surface Forecast.
- Icing Forecast.
- Turbulence Forecast.
- Convective Outlook.

Additional products may be available. Some of these may be labeled experimental and, thus, the contents and format are subject to change.

5.12.1 Issuance.

The AAWU issues the Alaskan Graphical FAs. The flying weather, icing, and turbulence forecasts are issued three times a day, approximately at 0530, 1330, and 2130 UTC during Alaska Standard Time (AKST), and 0430, 1230, and 2030 UTC during Alaska Daylight Time (AKDT). Surface Forecasts are issued four times a day, approximately at 0315, 0915, 1530, and 2130 UTC during AKST, and 0215, 0815, 1430, and 2030 UTC during AKDT. The Convective Outlook is a seasonal product and only issued from May 1st through September 30th at 1230 UTC with updates at 0430 UTC.

All forecasts are amended as needed.

5.12.2 Content.

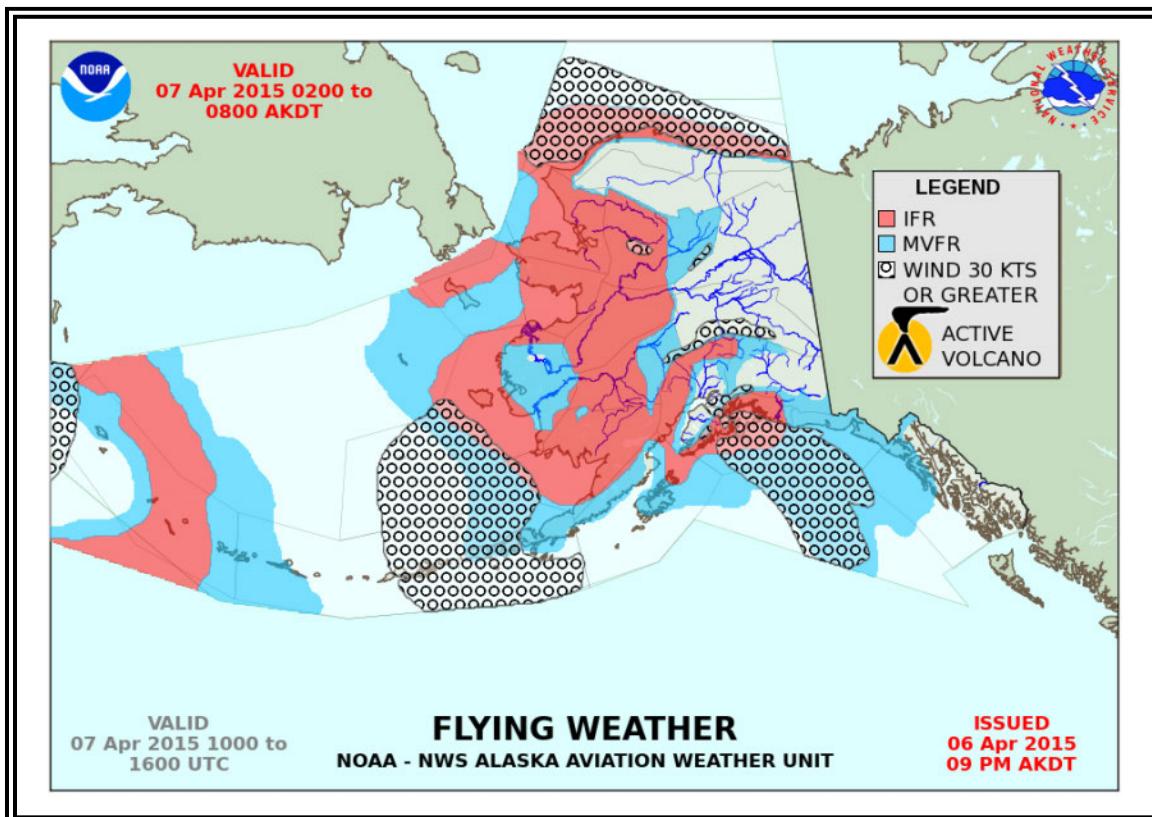
5.12.2.1 Flying Weather.

The Flying Weather graphic (see Figure 5-45, Alaskan Graphical Area Forecast (FA)—Flying Weather Example) illustrates areas of prevailing Marginal VFR (**MVFR**) or **IFR** conditions, strong winds (30 kts sustained or greater), and any active volcano in Alaska. This product consists of two 6-hour forecasts valid for a total of 12 hours. Each forecast specifies where such conditions can be expected within the 6-hour valid time.

Areas of occasional or continuous **MVFR/IFR** are represented by shaded regions (red for **IFR**, blue for **MVFR**), whereas areas of predominately VFR weather are not shaded. **MVFR/IFR** conditions are possible outside these shaded regions, but only isolated in coverage. Strong surface winds are shown in a circle hatch overlay. Active volcanoes are denoted by a volcano symbol at the location of the volcano.

Note: This forecast is also referred to as **IFR/MVFR** graphic on their website.

Figure 5-45. Alaskan Graphical Area Forecast (FA)—Flying Weather Example

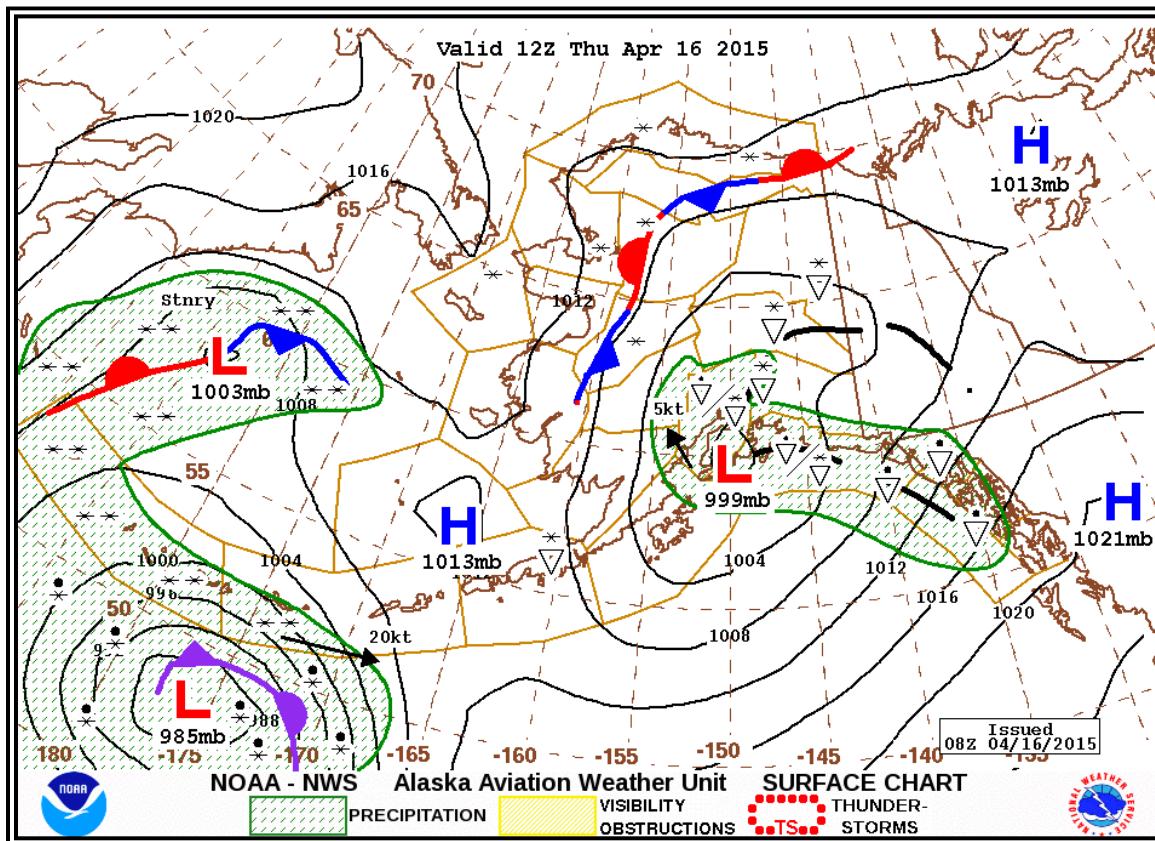


5.12.2.2 Surface Forecast.

The Surface Forecast graphic (see Figure 5-46, Alaskan Graphical Area Forecast (FA)—Surface Chart Example) illustrates prominent surface features, including sea-level pressure, areas of high and low pressure, fronts and troughs, and precipitation. Each forecast shows the surface weather that can be expected within 1 hour of the designated time.

Areas of high pressure are depicted along with the maximum sea-level pressure. Areas of low pressure are depicted with the minimum sea-level pressure. The mean 12-hour motion of low pressure systems are also shown. Areas of occasional or continuous precipitation and/or fog are represented by shaded regions (green for precipitation, yellow for fog), whereas isolated or scattered precipitation is not shaded. This product is issued every 6 hours with forecasts valid for 00Z, 06Z, 12Z, and 18Z.

Figure 5-46. Alaskan Graphical Area Forecast (FA)—Surface Chart Example

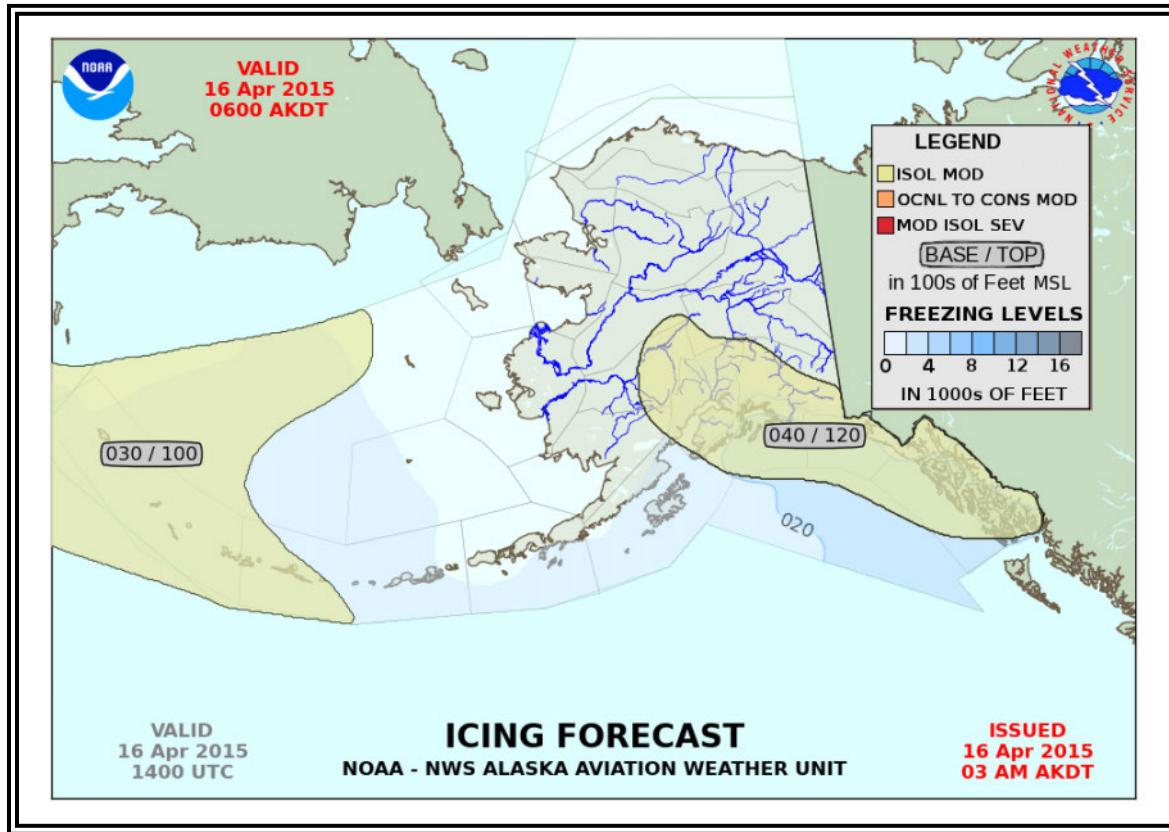


5.12.2.3 Icing Forecast.

The Icing Forecast graphic (see Figure 5-47, Alaskan Graphical Area Forecast (FA)—Icing Forecast Example) provides information about freezing levels and the potential for significant icing at specified valid times.

Freezing level heights are blue-filled contours (every 2,000 ft). Areas of isolated (**ISOL**) moderate (**MOD**) icing are shaded yellow, occasional (**OCNL**) or continuous (**CONS**) moderate icing are shaded orange, and red is used for moderate with isolated severe (**SEV**) icing (refer to SIGMETs for occasional or greater severe icing). These forecasts are issued every 8 hours and amended as needed.

Figure 5-47. Alaskan Graphical Area Forecast (FA)—Icing Forecast Example



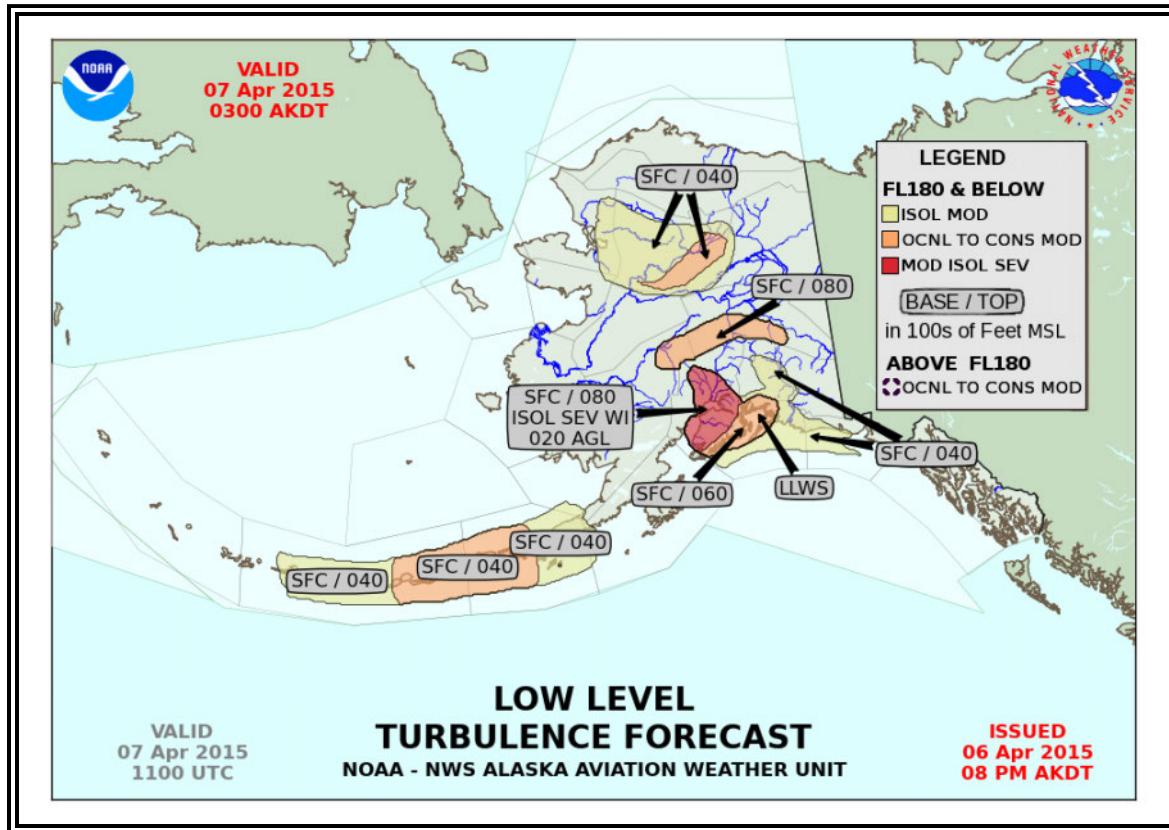
5.12.2.4 Turbulence Forecast.

The Turbulence Forecast graphic (see Figure 5-48, Alaskan Graphical Area Forecast (FA)—Turbulence Forecast Example) depicts areas of significant turbulence at specified valid times.

Areas of isolated (**ISOL**) moderate (**MOD**) turbulence are shaded yellow, occasional (**OCNL**) or continuous (**CONS**) moderate turbulence are shaded orange, and red is used for moderate with isolated severe (**SEV**) turbulence (refer to SIGMETs for occasional or greater severe turbulence).

Separate graphics are provided for low-level (defined for this product as FL180 and below) and high-level (defined for this product as above FL180) turbulence.

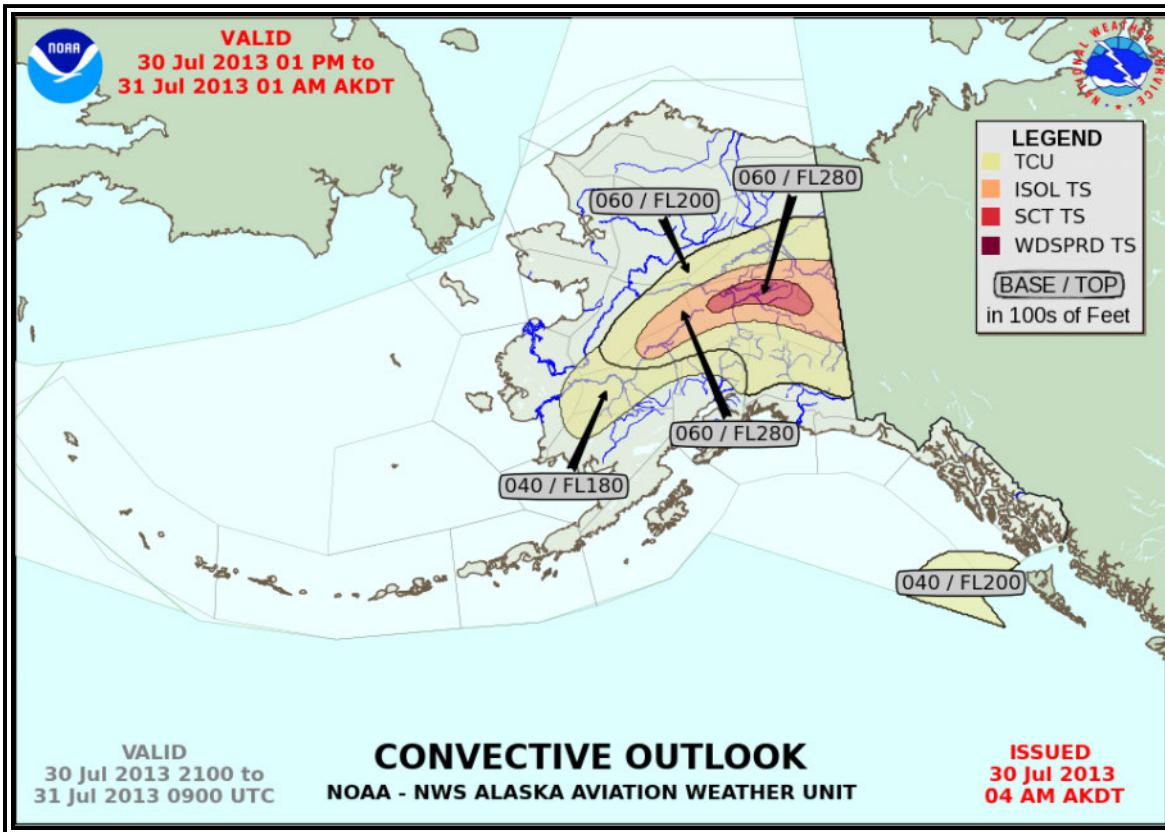
Figure 5-48. Alaskan Graphical Area Forecast (FA)—Turbulence Forecast Example



5.12.2.5 Convective Outlook.

The Convective Outlook graphic (see Figure 5-49, Alaskan Graphical Area Forecast (FA)—Convective Outlook) is a seasonal product that provides information about Convective activity at specific valid times. Each forecast indicates where conditions are favorable for the development of towering cumulus and thunderstorms.

Locations of towering cumulus are depicted in yellow. Locations of isolated (ISOL), scattered (SCT), and widespread (WDSPRD) thunderstorms (TS) are depicted in orange, red, and dark red, respectively. Cloud bases and tops are also depicted.

Figure 5-49. Alaskan Graphical Area Forecast (FA)—Convective Outlook**5.12.3 Use.**

The Alaska Graphical FAs are a series of forecasts intended to complement, not replace, the text-based FA for Alaska.

5.13 Terminal Aerodrome Forecast (TAF).

A TAF is a concise statement of the expected meteorological conditions significant to aviation for a specified time period within 5 sm of the center of the airport's runway complex (terminal). The TAFs use the same weather codes found in METAR weather reports (see paragraph 3.1) and can be viewed on <http://www.aviationweather.gov>.

5.13.1 Responsibility.

TAFs are issued by NWS WFOs.

5.13.2 Generic Format of the Forecast Text of an NWS-Prepared TAF.

Table 5-15. Generic Format of NWS TAFs

<p>TAF or TAF AMD or TAF COR</p> <p><i>Type of report</i></p>			
CCCC	YYGGggZ	Y₁Y₁G₁G₁/Y₂Y₂G₂G₂	dddffGf_mf_mKT
<i>Location identifier</i>	<i>Date/time of forecast origin group</i>	<i>Valid period</i>	<i>Wind group</i>
VVVV	w'w' or NSW	N_sN_sN_sh_sh_sh_s or VVh_sh_sh_s or SKC	WSh_wh_wh_w/dddftKT
<i>Visibility group</i>	<i>Significant weather group</i>	<i>Cloud and vertical obscuration groups</i>	<i>Non-Convective Low-Level Wind Shear (LLWS) group</i>
<p>TTGGgg</p> <p><i>Forecast change indicator groups</i></p>			
FMY₁Y₁GGgg	TEMPO Y₁Y₁GG/Y_eY_eG_eG_e	PROB30 Y₁Y₁GG/Y_eY_eG_eG_e	
<i>From group</i>	<i>Temporary group</i>	<i>Probability group</i>	

5.13.2.1 Type of Report (TAF or TAF AMD or TAF COR).

The report-type header always appears as the first element in the TAF and is produced in three forms: a routine forecast, **TAF**, an amended forecast, **TAF AMD**, or a corrected forecast, **TAF COR**.

TAFs are amended whenever they become, in the forecaster's judgment, unrepresentative of existing or expected conditions, particularly regarding those elements and events significant to aircraft and airports. An amended forecast is identified by **TAF AMD** (in place of **TAF**) on the first line of the forecast text.

5.13.2.2 Location Identifier (CCCC).

After the line containing either **TAF**, **TAF AMD**, or **TAF COR**, each TAF begins with its four-letter ICAO location identifier.

Examples:

KDFW	Dallas-Fort Worth
PANC	Anchorage, Alaska
PHNL	Honolulu, Hawaii

5.13.2.3 Date/Time of Forecast Origin Group (YYGGggZ).

The date/time of forecast origin group (**YYGGggZ**) follows the terminal's location identifier. It contains the day of the month in two 2 digits (**YY**) and the time in four digits (**GGgg** in hours and minutes) in which the forecast is completed and ready for transmission, with a **Z** appended to denote UTC. This time is entered by the forecaster. A routine forecast, TAF, is issued 20 to 40 minutes before the beginning of its valid period.

Examples:

061737Z

The TAF was issued on the 6th day of the month at 1737 UTC.

121123Z

The TAF was issued on the 12th day of the month at 1123 UTC.

5.13.2.4 Valid Period (Y1Y1G1G1/Y2Y2G2G2).

The TAF valid period (**Y₁Y₁G₁G₁/Y₂Y₂G₂G₂**) follows the date/time of forecast origin group. Scheduled 24- and 30-hour TAFs are issued four times per day, at 0000, 0600, 1200, and 1800Z. The first two digits (**Y₁Y₁**) are the day of the month for the start of the TAF. The next two digits (**G₁G₁**) are the starting hour (UTC). **Y₂Y₂** is the day of the month for the end of the TAF, and the last two digits (**G₂G₂**) are the ending hour (UTC) of the valid period. A forecast period that begins at midnight UTC is annotated as **00**. If the end time of a valid period is at midnight UTC, it is annotated as **24**. For example,

a 00Z TAF issued on the 9th of the month and valid for 24 hours would have a valid period of **0900/0924**.

Whenever an amended TAF (**TAF AMD**) is issued, it supersedes and cancels the previous TAF. That is, users should not wait until the start of the valid period indicated within the TAF AMD to begin using it.

Examples:

1512/1612

The TAF is valid from the 15th day of the month at 1200 UTC until the 16th day of the month at 1200 UTC.

2306/2412

This is a 30-hour TAF valid from the 23rd day of the month at 0600 UTC until the 24th day of the month at 1200 UTC.

0121/0218

This is an amended TAF valid from the 1st day of the month at 2100 UTC until the 2nd day of the month at 1800 UTC.

0600/0624

This TAF is valid from the 6th day of the month at 0000 UTC until the 6th day of the month at 2400 UTC (or 7th day of the month at 0000 UTC).

5.13.2.5 Wind Group (dddffGfmfmKT).

The initial time period and any subsequent **FM** groups begin with a mean surface wind forecast (**dddffGfmfmKT**) for that period. Wind forecasts are expressed as the mean three-digit direction (**ddd**—relative to true north) from which the wind is blowing, rounded to the nearest 10 degrees, and the mean wind speed in knots (**ff**) for the time period. If wind gusts are forecast (gusts are defined as rapid fluctuations in wind speeds with a variation of 10 kts or more between peaks and lulls), they are indicated immediately after the mean wind speed by the letter **G**, followed by the peak gust speed expected. **KT** is appended to the end of the wind forecast group. Any wind speed of 100 kts or more will be encoded in three digits. Calm winds are encoded as **00000KT**.

The prevailing wind direction is forecast for any speed greater than or equal to 7 kts. When the prevailing surface wind direction is variable (variations in wind direction of 30 degrees or more), the forecast wind direction is encoded as **VRBffKT**. Two conditions where this can occur are very light winds and Convective activity. Variable wind direction for very light winds must have a wind speed of 1 to 6 kts inclusive. For Convective activity, the wind group may be encoded as **VRBffGfmfmKT**, where **Gfmfm** is the maximum expected wind gusts. **VRB** is not used in the Non-Convective LLWS group.

Squalls are forecast in the wind group as gusts (**G**) but must be identified in the significant weather group with the code **SQ**.

Examples:

23010KT

Wind from 230 degrees “true” (southwest) at 10 knots.

28020G35KT

Wind from 280 degrees “true” (west) at 20 knots gusting to 35 knots.

VRB05KT

Wind variable at 5 knots. This example depicts a forecast for light winds that are expected to variable in direction.

VRB15G30KT

Wind variable at 15 knots gusting to 30 knots. This example depicts winds that are forecast to be variable with Convective activity.

00000KT

Wind calm

090105KT

Wind from 90 degrees at 105 knots

5.13.2.6 **Visibility Group (VVVV).**

The initial time period and any subsequent FM groups include a visibility forecast (**VVVV**) in statute miles appended by the contraction sm.

When the prevailing visibility is forecast to be less than or equal to 6 sm, one or more significant weather groups are included in the TAF. However, drifting dust (**DRDU**), drifting sand (**DRSA**), drifting snow (**DRSN**), shallow fog (**MIFG**), partial fog (**PRFG**), and patchy fog (**BCFG**) may be forecast with prevailing visibility greater than or equal to 7 sm.

When a whole number and a fraction are used to forecast visibility, a space is included between them (e.g., **1 1/2SM**). Visibility greater than 6 sm is encoded as **P6SM**.

If the visibility is not expected to be the same in different directions, prevailing visibility is used.

When volcanic ash (**VA**) is forecast in the significant weather group, visibility is included in the forecast, even if it is unrestricted (**P6SM**). For example, an expected reduction of visibility to 10 sm by volcanic ash is encoded in the forecast as **P6SM VA**.

Although *not* used by the NWS in U.S. domestic TAFs, the contraction “CAVOK” (Ceiling and Visibility OK) may replace the visibility, weather, and sky condition groups if all of the following conditions are forecast: Visibility of 10 kilometers (km) (6 sm) or more, no clouds below

1500 meters (m) (5,000 ft) or below the highest minimum sector altitude (whichever is greater), no cumulonimbus, and no significant weather phenomena.

Examples:

P6SM
Visibility unrestricted

1 1/2SM
Visibility 1 and ½ sm

4SM
Visibility 4 sm

5.13.2.7 Significant Weather Group (w'w' or NSW).

The significant weather group (w'w' or NSW) consists of the appropriate qualifier(s) and weather phenomenon contraction(s) or NSW (no significant weather).

If the initial forecast period and subsequent FM groups are not forecast to have explicit significant weather, the significant weather group is omitted. NSW is *not* used in the initial forecast time period or FM groups.

One or more significant weather group(s) is (are) required when the visibility is forecast to be 6 sm or less. The exceptions are: volcanic ash (VA), low drifting dust (DRDU), low drifting sand (DRSA), low drifting snow (DRSN), shallow fog (MIFG), partial fog (PRFG), and patchy fog (BCFG).

Obstructions to vision are only forecast when the prevailing visibility is less than 7 sm or, in the opinion of the forecaster, is considered operationally significant.

Volcanic ash (VA) is always forecast when expected. When VA is included in the significant weather group, visibility is included in the forecast as well, even if the visibility is unrestricted (P6SM).

NSW is used in place of significant weather only in a TEMPO group to indicate when significant weather (including in the vicinity (VC)) included in a previous subdivided group is expected to end.

Multiple precipitation elements are encoded in a single group (e.g., -TSRASN). If more than one type of precipitation is forecast, up to three appropriate precipitation contractions can be combined in a single group (with no spaces) with the predominant type of precipitation being first. In this single group, the intensity refers to the total precipitation and can be used with either one or no intensity qualifier, as appropriate. In TAFs, the intensity qualifiers (light, moderate, and heavy) refer to the intensity of the precipitation and not to the intensity of any thunderstorms associated with the precipitation.

Intensity is coded with precipitation types, except ice crystals and hail, including those associated with thunderstorms and those of a showery nature (**SH**). No intensity is ascribed to blowing dust (**BLDU**), blowing sand (**BLSA**), or blowing snow (**BLSN**). Only moderate or heavy intensity is ascribed to sandstorm (**SS**) and duststorm (**DS**).

5.13.2.7.1 Exception for Encoding Multiple Precipitation Types.

When more than one type of precipitation is forecast in a time period, any precipitation type associated with a descriptor (e.g., **FZRA**) is encoded first in the precipitation group, regardless of the predominance or intensity of the other precipitation types. Descriptors are not encoded with the second or third precipitation type in the group. The intensity is associated with the first precipitation type of a multiple precipitation type group. For example, a forecast of moderate snow and light freezing rain is coded as **-FZRASN**, although the intensity of the snow is greater than the freezing rain.

Examples:

Combinations of one precipitation and one non-precipitation weather phenomena:

-DZ FG

Light drizzle and fog (obstruction that reduces visibility to less than 5/8 sm)

RA BR

Moderate rain and mist

-SHRA FG

Light rain showers and fog

+SN FG

Heavy snow and fog

Combinations of more than one type of precipitation:

-RASN FG HZ

Light rain and snow (light rain predominant), fog and haze

TSSNRA

Thunderstorm with moderate snow and rain (moderate snow predominant)

FZRASNPL

Moderate freezing rain, snow and ice pellets (freezing rain mentioned first due to the descriptor, followed by other precipitation types in order of predominance)

SHSNPL

Moderate snow showers and ice pellets

5.13.2.7.2 Thunderstorm Descriptor

The TS descriptor is treated differently than other descriptors in the following cases:

- When non-precipitating thunderstorms are forecast, **TS** may be encoded as the sole significant weather phenomenon; and
- When forecasting thunderstorms with freezing precipitation (**FZRA** or **FZDZ**), the **TS** descriptor is included first, followed by the intensity and weather phenomena.

Example:

TS -FZRA

When a thunderstorm is included in the significant weather group (even using vicinity—**VCTS**), the cloud group (**NsNsNshshs**) includes a forecast cloud type of CB. See the following example for encoding **VCTS**.

Example:

-FZRA VCTS BKN010CB

5.13.2.7.3 Fog Forecast

A visibility threshold must be met before a forecast for fog (FG) is included in the TAF. When forecasting a fog-restricted visibility from 5/8 sm to 6 sm, the phenomena is coded as **BR** (mist). When a fog-restricted visibility is forecast to result in a visibility of less than 5/8 sm, the code **FG** is used. The forecaster never encodes weather obstruction as mist (**BR**) when the forecast visibility is greater than 6 sm (P6SM).

The following fog-related terms are used as described below:

Table 5-16. TAF Fog Terms

TERM	DESCRIPTION
Freezing Fog (FZFG)	Any fog (visibility less than 5/8 SM) consisting predominantly of water droplets at temperatures less than or equal to 32 °F / 0 °C, whether or not rime ice is expected to be deposited. FZBR is not a valid significant weather combination and will not be used in TAFs.
Shallow Fog (MIFG)	The visibility at 6 feet above ground level is greater than or equal to 5/8 sm and the apparent visibility in the fog layer is less than 5/8 sm.
Patchy Fog (BCFG)	Fog patches covering part of the airport. The apparent visibility in the fog patch or bank is less than 5/8 sm, with the foggy patches extending to at least 6 feet above ground level.
Partial Fog (PRFG)	A substantial part of the airport is expected to be covered by fog while the remainder is expected to be clear of fog (e.g., a fog bank). Note: MIFG , PRFG and BCFG may be forecast with prevailing visibility of P6SM.

Examples:

1 / 2SM FG

Fog is reducing visibilities to less than 5/8 sm, therefore FG is used to encode the fog.

3SM BR

Fog is reducing visibilities to between 5/8 and 6 sm, therefore BR is used to encode the fog.

5.13.2.8 **Vicinity (VC).**

In the United States, vicinity (**VC**) is defined as a donut-shaped area between 5 and 10 sm from the center of the airport's runway complex. The FAA requires TAFs to include certain meteorological phenomena, which may directly affect flight operations to and from the airport. Therefore, NWS TAFs may include a prevailing condition forecast of fog, showers, and thunderstorms in the airport's vicinity. A prevailing condition is defined as a greater than or equal to 50 percent probability of occurrence for more than half of the subdivided forecast time period. **VC** is not included in **TEMPO** or **PROB** groups.

The significant weather phenomena in Table [5-17](#), TAF Use of Vicinity (VC), are valid for use in prevailing portions of NWS TAFs in combination with **VC**:

Table 5-17. TAF Use of Vicinity (VC)

PHENOMENON	CODED
Fog*	VCFG
Shower(s)**	VCSH
Thunderstorm	VCTS

*Always coded as VCFG regardless of visibility in the obstruction, and without qualification as to intensity or type (frozen or liquid)

**The VC group, if used, should be the last entry in any significant weather group (w'w')

5.13.2.9 Cloud and Vertical Obscuration Groups (NsNsNshshshs or VVhshshs or SKC).

The initial time period and any subsequent **FM** groups include a cloud or obscuration group (**NsNsNshshshs** or **VVhshshs** or **SKC**), used as appropriate to indicate the cumulative amount (**NsNsNs**) of all cloud layers in ascending order and height (**hshshs**), to indicate vertical visibility (**VVhshshs**) into a surface-based obstructing medium, or to indicate a clear sky (**SKC**). All cloud layers and obscurations are considered opaque.

5.13.2.9.1 Cloud Group (NsNsNshshshs).

The cloud group (**NsNsNshshshs**) is used to forecast cloud amount in Table 5-18, TAF Sky Cover.

Table 5-18. TAF Sky Cover

SKY COVER CONTRACTION	SKY COVERAGE
SKC	0 oktas
FEW	0 to 2 oktas
SCT	3 to 4 oktas
BKN	5 to 7 oktas
OVC	8 oktas

When 0 oktas of sky coverage is forecast, the cloud group is replaced by **SKC**. The contraction **CLR**, which is used in the METAR code, is not used in TAFs. TAFs for sites with ASOS/AWOS contain the cloud amount and/or obscurations, which the forecaster expects, not what is expected to be reported by an ASOS/AWOS.

Heights of clouds (**hshshs**) are forecast in hundreds of feet AGL.

The lowest level at which the cumulative cloud cover equals 5/8 or more of the celestial dome is understood to be the forecast ceiling. For example, **VV008**, **BKN008**, or **OVC008** all indicate an 800 ft ceiling.

5.13.2.9.2 Vertical Obscuration Group (VVhshshs).

The vertical obscuration group (**VVhshshs**) is used to forecast, in hundreds of feet AGL, the vertical visibility (**VV**) into a surface-based total obscuration. **VVhshshs** is this ceiling at the height indicated in the forecast. TAFs do not include forecasts of partial obscurations (i.e., **FEW000**, **SCT000**, or **BKN000**).

Example:

1SM BR VV008
Ceiling is 800 ft due to vertical visibility into fog

5.13.2.9.3 Cloud Type (CB).

The only cloud type included in the TAF is **CB**. **CB** follows cloud or obscuration height (**hshshs**) without a space whenever thunderstorms are included in significant weather group (**w'w'**), even if thunderstorms are only forecast in the vicinity (**VCTS**). **CB** can be included in the cloud group (**NsNsNshshshs**) or the vertical obscuration group (**VVhshshs**) without mentioning thunderstorm in the significant weather group (**w'w'**). Therefore, situations may occur where nearly identical **NsNsNshshshs** or **VVhshshs** appear in consecutive time periods, with the only change being the addition or elimination of **CB** in the forecast cloud type.

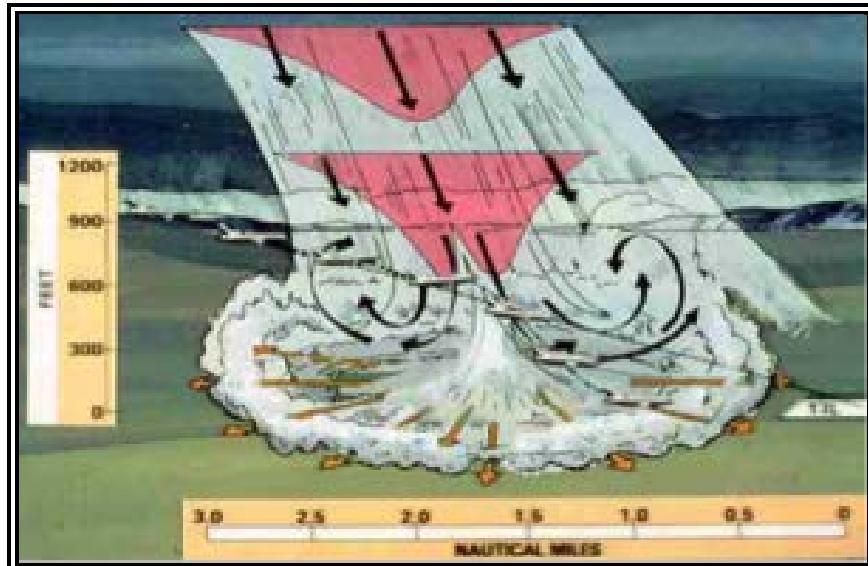
Examples:

1/2SM TSRA OVC010CB
Thunderstorms are forecast at the airport

5.13.2.10 Low-Level Wind Shear Alert System (LLWAS).

The LLWAS system was originally developed by the FAA in the 1970s to detect large-scale wind shifts (sea breeze fronts, gust fronts, and cold and warm fronts). It was developed by the FAA in response to an accident at JFK Airport in New York. The aircraft (Eastern 66) landed during a wind shift caused by interacting sea breeze and thunderstorm outflows.

Figure 5-50. Microburst Effect on Landing Aircraft



Artist rendition of a microburst and its effect on a landing aircraft (Image Credit: National Center for Atmospheric Research (NCAR)).

This Phase-1 LLWAS was very simple. It compared a center field wind to five other sensors around the airport. When there was a 15-knot vector difference, it would flash the wind data to the air traffic controller and the controller would read the raw winds (e.g., 120/35 (120 degrees at 35 kts), 110/20, 350/15, etc.) from each sensor to the pilot landing or about to take off and the pilot had to do the vector addition in his head to determine the headwind/tailwind components.

This simple system worked for large-scale weather features, but it also had a serious false alarm problem and the sensors were too far apart to capture small, but intense windshear events important to aircraft. Also, the center field wind could be variable and this would trigger windshear alarms at all the outer sensors since all the other sensor winds were compared to center field. Research conducted at the NCAR in the 1980s indicated that microburst windshear was very dangerous to aircraft below 1,000 ft. Several major accidents during the 1980s also implicated windshear as a factor.

5.13.2.10.1 LLWAS History.

In 1983, the FAA asked NCAR to develop a version of LLWAS that could detect microbursts. Between 1983 and 1988, NCAR developed and tested a new LLWAS system, called enhanced LLWAS, or LLWAS-Network Expansion, that detected microbursts, determined the strength in terms of headwind/tailwind gains or losses (in knots), and located the event (on the runway, at 1, 2, or 3 NM on departure or arrival). The system was designed to provide alerts specific to each runway operation. It was designed to have a probability of detection of 90 percent or greater and a false alarm rate of 10 percent or less.

This system was later improved and is now called the Phase-3 LLWAS. A typical Phase-3 LLWAS will have enough sensors to be spaced 2 km apart (~1 NM apart) and cover out to 2 NM from the end of each major runway. The largest LLWAS is at Denver International Airport, which has 32 wind sensors. Most Phase-3 systems have between 12 and 16 wind sensors. A siting evaluation is done for each airport to determine the network geometry since it depends on terrain, number of runways, obstructions, etc.

The Phase-3 LLWAS alert information is described below.

If a pilot is landing on runway 08, and there is a microburst on his path, the controller would have a display that reads: 08A MBA 30K-3MF 350/25. This is read to a pilot arriving on runway 08 (08A) by a final controller as “microburst alert (MBA), expect a thirty knot loss (30K-) at three miles final (3MF), threshold wind three-five-zero at 25 (knots).”

If there was a windshear with a wind speed gain at 1 mile departure (headwind gain), for a pilot departing runway 25 left, the final controller’s LLWAS display would show: 25LD WSA 15k+ 1MD. This would be read as “windshear alert, expect a fifteen knot gain at one mile departure.” There are Phase-3 LLWAS systems at 9 U.S. airports and Phase-2 LLWAS at more than 100 airports. Taiwan, Korea, Singapore, Saudi Arabia, and Kuwait are now implementing Phase-3 LLWAS systems. Note, the FAA also has Terminal Doppler Weather Radars (TDWR) for windshear detection at 45 airports and has Airport Surveillance Radar-9 (ASR-9)-based windshear detection systems at another 37 airports. The FAA originally had 110 Phase-1 LLWAS systems, which were upgraded to Phase-2 systems.

A Phase-2 LLWAS has the same number of sensors (5 to 6) as a Phase-1 system (described above), but the windshear algorithm was upgraded to significantly decrease the number of false alarms. As mentioned above, a Phase-1 or Phase-2 LLWAS was not designed to detect microbursts per se, but if the flow is large and strong, it may send an alert.

When NCAR developed the Phase-3 LLWAS, it gave the specifications to the FAA. The University Corporation for Atmospheric Research (UCAR) Foundation owned the intellectual property for the windshear algorithm during the lifetime of the patent. A license agreement was required for companies to implement LLWAS technology until early 2013 when the patent exclusion expired. A license from UCAR Foundation is no longer required to utilize the LLWAS algorithm. The UCAR Foundation does, however, provide technical materials such as test datasets, test airport configuration files, test alert outputs, etc. to aid companies in the implementation and testing of the Phase-3 LLWAS algorithm.

5.13.2.10.2 Frequently Asked Questions (FAQ).

1. Q. What is LLWAS?
A. A typical Phase-3 LLWAS system includes a network of anemometers (wind sensors) atop tall poles located around the airport (i.e., remote stations) out to no more than 3 NM from the end of the runways, a master station that processes system data and communicates with the remote stations, an archiving system, operator console, alphanumeric alarm displays, and in some instances, graphical displays.
2. Q. How does it work?
A. The wind data at each remote station is processed every 10 seconds to determine if there is divergence or convergence within the network, or station-to-station wind differences between stations aligned with the runways. The divergence/convergence information is processed and if the intensity of the event is large enough, the system will calculate the strength of the along-runway wind losses or gains and generate windshear or microburst alerts (depending on strength), and identify the location of the event.
3. Q. What is a microburst?
A. A microburst is an intense windshear. By definition: Microburst n: A small, very intense downdraft that descends to the ground resulting in a strong wind divergence. The size of the event is typically less than 4 km across. Microbursts are capable of producing winds of more than 100 mph, causing significant damage. The life span of a microburst is around 5 to 15 minutes.
4. Q. What causes microbursts?
A. Microbursts are strong windshears (greater than 30-knot wind speed losses over distances of 1 to 4 km) that are primarily generated by evaporative cooling and rain loading. When precipitation (rain or snow) descends below the cloud base or is mixed with dry air, it begins to evaporate and this evaporation process cools the air. The cool air descends and accelerates as it approaches the ground. When the cool air approaches the ground, it spreads out in all directions and this divergence of the wind is the signature of the microburst. In humid climates, microbursts can also generate from heavy precipitation. The weight and drag associated with the falling precipitation can result in a downdraft that will descend to the ground and spread out.
5. Q. Why is it a problem for airplanes?
A. Windshear is a rapid change of wind speed or direction over a short distance. In general, windshear becomes a hazard for aircraft if the wind changes more than 20 kts over a distance of 1 to 4 km (0.5 to 2.5 NM). On either takeoff or landing, aircraft are near stall speeds. When going through a windshear, the headwind decreases

resulting in a loss of lift. If the aircraft is near stall, then a little loss of lift can make all the difference to whether the aircraft can continue the flight.

6. Q. How and what kind of decisions do airports or airlines make using LLWAS?
 - A. LLWAS provides information on windshear type, location, and intensity. Windshear alerts are issued via radio to arriving and departing aircraft by final air traffic controllers. In the United States, most airlines require that pilots not continue their arrival or departure if there is a microburst alert valid for their operation. Although most aviation authorities do not close the runways when microbursts are occurring, the air traffic controllers will work with the pilots to reroute aircraft away from the event to a runway that is not impacted by the windshear.
7. Q. How and what kind of decisions do airports make using LLWAS?
 - A. LLWAS provides information on windshear type, location, and intensity. The pilots get the alert from the controller and the pilot is supposed to determine if they feel comfortable continuing the operation. In the United States, airlines require that pilots do not continue if there is a microburst alert.
8. Q. Where have LLWAS systems been implemented?
 - A. Phase-3 LLWAS systems have been implemented throughout the United States and at numerous international airports including, but not limited to, Taiwan, Korea, Saudi Arabia, Hong Kong, Kuwait, Italy, Singapore, and Spain. Additional LLWAS procurements are in progress.
9. Q. What are some of the windshear problems associated with airports?
 - A. Any airport that has thunderstorms will be exposed to Convective windshear. Any airport near mountains will experience terrain-induced windshear from time to time. Any airport near a coast will experience windshear due to sea breezes. In the drier climates, even a light shower (or virga) can produce severe windshears, so in some places, the convection does not have to be as strong as a thunderstorm (e.g., Denver, Phoenix, Reno, Albuquerque, etc.).

Discussion Credit: NCAR.

For more information readers can go to:

<https://www.ral.ucar.edu/projects/low-level-wind-shear-alert-system-llwas>.

5.13.2.11 Non-Convective Low-Level Wind Shear (LLWS) Group (WShwshwshws/dddffKT).

Windshear (**WS**) is defined as a rapid change in horizontal wind speed and/or direction, with distance and/or a change in vertical wind speed and/or direction with height. A sufficient difference in wind speed, wind direction, or both can severely impact airplanes, especially within 2,000 ft AGL because of limited vertical airspace for recovery.

Forecasts of LLWS in the TAF refer only to Non-Convective LLWS from the surface up to and including 2,000 ft AGL. LLWS is always assumed to be present in Convective activity. LLWS is included in TAFs on an “as-needed” basis to focus the aircrew’s attention on LLWS problems that currently exist or are expected. Non-Convective LLWS may be associated with the following: frontal passage, inversion, low-level jet, lee side mountain effect, sea breeze front, Santa Ana winds, etc.

When LLWS conditions are expected, the Non-Convective LLWS code **WS** is included in the TAF as the last group (after cloud forecast). Once in the TAF, the **WS** group remains the prevailing condition until the next **FM** change group or the end of the TAF valid period if there are no subsequent **FM** groups. Forecasts of Non-Convective LLWS are not included in **TEMPO** or **PROB** groups.

The format of the Non-Convective LLWS group is:

WShwshwshws / dddffKT

WS	Indicator for Non-Convective LLWS
Hwshwshws	Height of the top of the WS layer in hundreds of feet AGL
Ddd	True direction in 10-degree increments at the indicated height -- VRB is not used for direction in the Non-Convective LLWS forecast
Ff	Speed in knots of the forecast wind at the indicated height
KT	Unit indicator for wind

Example:

TAF...13012KT...WS020 / 27055KT

Windshear from the surface to 2,000 ft. Surface winds from 130 (southeast) at 12 kts changes to 270 (west) at 55 knots at 2,000 ft.

In this example, the indicator **WS** is followed by a three-digit number that is the top of the windshear layer. LLWS is forecast to be present from the surface to this level. After the solidus (/), the five-digit wind group is the wind direction and speed at the top of the windshear layer. It is not a value for the amount of shear.

A Non-Convective LLWS forecast is included in the initial time period or a **FM** group in a TAF whenever:

- One or more Pilot Weather Reports (PIREP) are received of Non-Convective LLWS within 2,000 ft of the surface, at or in the vicinity of the TAF airport, causing an indicated air speed loss or gain of 20 kts or more, and the forecaster determines the report(s) reflect a valid Non-Convective LLWS event rather than mechanical turbulence; or
- When Non-Convective vertical **WS** of 10 kts or more per 100 ft in a layer more than 200 ft thick are expected or reliably reported within 2,000 ft of the surface at, or in the vicinity of, the airport.

5.13.2.12 Forecast Change Indicator Groups.

Forecast change indicator groups are contractions that are used to subdivide the forecast period (24 hours for scheduled TAFs; less for amended or delayed forecasts) according to significant changes in the weather.

The forecast change indicators **FM**, **TEMPO**, and **PROB** are used when a change in any or all of the elements forecast is expected.

5.13.2.12.1 From (FM) Group (FMYYGGgg).

The change group **FMYYGGgg** (voiced as “from”) is used to indicate when prevailing conditions are expected to change significantly over a period of less than 1 hour. In these instances, the forecast is subdivided into time periods using the contraction **FM**, followed, without a space, by six digits, the first two of which indicate the day of the month and the final four, which indicate the time (in hours and minutes Z) the change is expected to occur. While the use of a four-digit time in whole hours (e.g. 2100Z) is acceptable, if a forecaster can predict changes and/or events with higher resolution, then more precise timing of the change to the minute will be indicated. All forecast elements following **FMYYGGgg** relate to the period of time from the indicated date and time (**YYGGgg**) to the end of the valid period of the terminal forecast, or to the next **FM** if the terminal forecast valid period is divided into additional periods.

The **FM** group will be followed by a complete description of the weather (i.e., self-contained), and all forecast conditions given before the **FM** group are superseded by those following the group. All elements of the TAF (surface wind, visibility, significant weather, clouds, obscurations, and when expected, Non-Convective LLWS) will be included in each **FM** group, regardless if they are forecast to change or not. For example, if forecast cloud and visibility changes warrant a new **FM** group but the wind does not, the new **FM** group will include a wind forecast, even if it is the same as the most recently forecast wind.

The only exception to this involves the significant weather group. If no significant weather is expected in the **FM** time period group, then significant

weather group is omitted. A TAF may include one or more **FM** groups, depending on the prevailing weather conditions expected. In the interest of clarity, each **FM** group starts on a new line of forecast text, indented five spaces.

Examples:

```
TAF
KDSM 022336Z 0300/0324 20015KT P6SM BKN015
FM030230 29020G35KT 1SM +SHRA OVC005
    TEMPO 0303/0304 30030G45KT 3/4SM -SHSN
    FM030500 31010G20KT P6SM SCT025...
```

A change in the prevailing weather is expected on the **3rd** day of the month at **0230** UTC and the **3rd** day of the month at **0500** UTC.

```
TAF
KAPN 312330Z 0100/0124 13008KT P6SM SCT030
FM010320 31010KT 3SM -SHSN BKN015
FM010500 31010KT 1/4SM +SHSN VV007...
```

Note the wind in the **FM010500** group is the same as the previous **FM** group, but is repeated since all elements are required to be included in a **FM** group.

5.13.2.12.2 TEMPO (YYGG/Y_eY_eGeGe) Group.

The change-indicator group **TEMPO YYGG/Y_eY_eGeGe** is used to indicate temporary fluctuations to forecast meteorological conditions that are expected to:

- Have a high percentage (greater than 50 percent) probability of occurrence;
- Last for one hour or less in each instance; and
- In the aggregate, cover less than half of the period **YYGG** to **Y_eY_eGeGe**.

The first two digits (**YY**) are the day of the month for the start of the **TEMPO**. The next two digits (**GG**) are the starting hour (UTC). After the solidus (/), the next two digits (**Y_eY_e**) are the ending day of the month, while the last two digits (**GeGe**) are the ending hour (UTC) of the **TEMPO** period.

Each **TEMPO** group is placed on a new line in the TAF. The **TEMPO** identifier is followed by a description of all the elements in which a temporary change is forecast. A previously forecast element that has not changed during the **TEMPO** period is understood to remain the same and will not be included in the **TEMPO** group. Only those weather elements forecast to temporarily change are required to be included in the **TEMPO** group.

TEMPO groups will not include forecasts of either significant weather in the vicinity (**VC**) or Non-Convective LLWS.

Examples:

```
TAF
KDDC 221130Z 2212/2312 29010G25KT P6SM SCT025
TEMPO 2215/2217 30025G35KT 1 1/2SM SHRA BKN010...
```

In the example, all forecast elements in the TEMPO group are expected to be different than the prevailing conditions. The TEMPO group is valid on the 17 from 1500 UTC to 1700 UTC.

```
TAF
KSEA 091125Z 0912/1012 19008KT P6SM SCT010 BKN020
OVC090
TEMPO 0912/0915 -RA SCT010 BKN015 OVC040...
```

In this example the visibility is *not* forecast in the TEMPO group. Therefore, the visibility is expected to remain the same (P6SM) as forecast in the prevailing conditions group. Also, note that in the TEMPO 0912/0915 group, all three cloud layers are included, although the lowest layer is not forecast to change from the initial time period.

5.13.2.12.3 PROB30 (YYGG/Y_eY_eG_eG_e) Group.

The probability group, **PROB30 YYGG/Y_eY_eG_eG_e**, is only used by NWS forecasters to forecast a low probability occurrence (30 percent chance) of a thunderstorm or precipitation event and its associated weather and obscuration elements (wind, visibility, and/or sky condition) at an airport.

The **PROB30** group is the forecaster's assessment of probability of occurrence of the weather event that follows it. The first two digits (**YY**) are the day of the month for the start of the PROB30. The next two digits (**GG**) are the starting hour (UTC). After the solidus (/), the next two digits (**Y_eY_e**) are the ending day of the month, while the last two digits (**G_eG_e**) are the ending hour (UTC) of the PROB30 period. PROB30 is the only PROB group used in NWS TAFs. Note that U.S. military and international TAFs may use the PROB40 (40 percent chance) group as well.

The **PROB30** group is located within the same line of the prevailing condition group, continuing on the line below if necessary.

NWS TAFs do not use the **PROB30** group in the first 9 hours of the TAF's valid period, including amendments. Also, only one **PROB30** group may be used in the initial forecast period and in any subsequent **FM** groups. Note that U.S. military and international TAFs do not have these restrictions.

PROB30 groups do not include forecasts of significant weather in the vicinity (VC) or Non-Convective LLWS.

Example:

FM012100 18015KT P6SM SCT050 PROB30 0123/0201 2SM
TSRA OVC020CB

In this example, the PROB30 group is valid on the 1st day of the month at 2300 UTC to the 2nd day of the month at 0100 UTC.

5.13.2.12.4 TAF Examples.

TAF
KPIR 111140Z 1112/1212 13012KT P6SM BKN100 WS020/35035KT
TEMPO 1112/1114 5SM BR
FM111500 16015G25KT P6SM SCT040 BKN250
FM120000 14012KT P6SM BKN080 OVC150 PROB30 1200/1204 3SM TSRA
BKN030CB
FM120400 14008KT P6SM SCT040 OVC080 TEMPO 1204/1208 3SM TSRA
OVC030CB

TAF	Terminal Aerodrome Forecast
KPIR	Pierre, South Dakota
111140	Prepared on the 11 th at 1140 UTC
1112/1212	Valid from the 11 th at 1200 UTC until the 12 th at 1200 UTC
13012KT	Wind 130 at 12 kts
P6SM	Visibility greater than 6 sm
BKN100	Ceiling 10,000 broken
WS020/35035KT	Windshear at 2,000 ft, wind from 350 at 35 kts
TEMPO 1112/1114	Temporary conditions between the 11 th day of the month at 1200 UTC and the 11 th day of the month at 1400 UTC
5SM	Visibility 5 statute miles
BR	Mist
FM111500	From the 11 th day of the month at 1500 UTC
16015G25KT	Wind 160 at 15 kts gusting to 25 kts
P6SM	Visibility greater than 6 sm
SCT040 BKN250	4,000 scattered, ceiling 25,000 broken
FM120000	From the 12 th day of the month at 0000Z
14012KT	Wind 140 at 12 kts
P6SM	Visibility greater than 6 sm
BKN080 OVC150	Ceiling 8,000 broken, 15,000 overcast
PROB30 1200/1204	30 percent probability between the 12 th day of the month at 0000 UTC and the 12 th day of the month at 0400 UTC
3SM	Visibility 3 sm
TSRA	Thunderstorm with moderate rain showers

BKN030CB	Ceiling 3,000 broken with cumulonimbus
FM120400	From the 12 th day of the month at 0400 UTC
14008KT	Wind 140 at 8 kts
P6SM	Visibility greater than 6 sm
SCT040 OVC080	4,000 scattered, ceiling 8,000 overcast
TEMPO 1204/1208	Temporary conditions between the 12 th day of the month at 0400 UTC and the 12 th day of the month at 0800 UTC
3SM	Visibility 3 sm
TSRA	Thunderstorms with moderate rain showers
OVC030CB	Ceiling 3,000 overcast with cumulonimbus

TAF AMD
 KEYW 131555Z 1316/1412 VRB03KT P6SM VCTS SCT025CB BKN250
 TEMPO 1316/1318 2SM TSRA BKN020CB
 FM131800 VRB03KT P6SM SCT025 BKN250 TEMPO 1320/1324 1SM TSRA
 OVC010CB
 FM140000 VRB03KT P6SM VCTS SCT020CB BKN120 TEMPO 1408/1412
 BKN020CB

TAF AMD	Amended Terminal Aerodrome Forecast
KEYW	Key West, Florida
131555Z	Prepared on the 13 th at 1555 UTC
1316/1412	Valid from the 13 th at 1600 UTC until the 14 th at 1200 UTC
VRB03KT	Wind variable at 3 kts
P6SM	Visibility greater than 6 sm
VCTS	Thunderstorms in the vicinity
SCT025CB BKN250	2,500 scattered with cumulonimbus, ceiling 25,000 broken
TEMPO 1316/1318	Temporary conditions between the 13 th day of the month at 1600 UTC and the 13 th day of the month at 1800 UTC
2SM	Visibility 2 sm
TSRA	Thunderstorms with moderate rain showers
BKN020CB	Ceiling 2,000 broken with cumulonimbus
FM131800	From the 13 th day of the month at 1800 UTC
VRB03KT	Wind variable at 3 knots
P6SM	Visibility greater than 6 sm
SCT025 BKN250	2,500 scattered, ceiling 25,000 broken
TEMPO 1320/1324	Temporary conditions between the 13 th day of the month at 2000 UTC and the 14 th day of the month at 0000 UTC
1SM	Visibility 1 sm
TSRA	Thunderstorms with moderate rain showers
OVC010CB	Ceiling 1,000 overcast with cumulonimbus
FM140000	From the 14 th day of the month at 0000 UTC
VRB03KT	Variable wind at 3 knots
P6SM	Visibility greater than 6 sm
VCTS	Thunderstorms in the vicinity

SCT020CB BKN120 TEMPO 1408/1412	2,000 scattered with cumulonimbus, ceiling 12,000 broken Temporary conditions between the 14 th day of the month at 0800 UTC and the 14 th day of the month at 1200 UTC
BKN020CB	Ceiling 2,000 broken with cumulonimbus

5.13.3 Issuance

Scheduled TAFs prepared by NWS offices are issued four times a day, every 6 hours, according to the following schedule:

Table 5-19. TAF Issuance Schedule

SCHEDULED ISSUANCE	VALID PERIOD	ISSUANCE WINDOW
0000 UTC	0000 to 2400 or 0600 UTC	2320 to 2340 UTC
0600 UTC	0600 to 0600 or 1200 UTC	0520 to 0540 UTC
1200 UTC	1200 to 1200 or 1800 UTC	1120 to 1140 UTC
1800 UTC	1800 to 1800 or 2400 UTC	1720 to 1740 UTC

5.13.3.1 **Minimum Observational Requirements for Routine TAF Issuance and Continuation.**

The NWS forecaster must have certain information for the preparation and scheduled issuance of each individual TAF. Although integral to the TAF writing process, a complete surface (METAR/SPECI) observation is not required. Forecasters use the “total observation concept” to write TAFs with data including nearby surface observations, radar, satellite, radiosonde, model data, aircraft, and other sources.

If information sources, such as surface observations, are missing, unreliable, or not complete, forecasters will append **AMD NOT SKED** to the end of a TAF. The use of **AMD NOT SKED** indicates the forecaster has enough data, using the total observation concept, to issue a forecast but will not provide updates. This allows airport operations to continue using a valid TAF.

In rare situations where observations have been missing for extended periods of time (i.e., more than one TAF cycle of 6 hours), and the total observation concept cannot provide sufficient information, the TAF may be suspended by the use of **NIL TAF**.

5.13.3.2 **Sites With Scheduled Part-Time Observations.**

For TAFs with less than 24-hour observational coverage, the TAF will be valid to the end of the routine scheduled forecast period even if observations cease prior to that time. The time observations are scheduled to end and/or

resume will be indicated by expanding the **AMD NOT SKED** statement. Expanded statements will include the observation ending time (**AFT Y₁Y₁HHmm**, e.g., AFT 120200), the scheduled observation resumption time (**TIL Y₁Y₁HHmm**, e.g., TIL 171200Z) or the period of observation unavailability (**Y₁Y₁HH/Y_eY_{ehh}**, e.g., 2502-2512). TIL will be used only when the beginning of the scheduled TAF valid period coincides with the time of the last observation or when observations are scheduled to resume prior to the next scheduled issuance time. When used, these remarks will immediately follow the last forecast group. If a routine TAF issuance is scheduled to be made after observations have ceased, but before they resume, the remark **AMD NOT SKED** will immediately follow the valid period group of the scheduled issuance. After sufficient data using the total observation concept has been received, the **AMD NOT SKED** remark will be removed.

Examples of Scheduled Part-Time Observations TAFs.

```
TAF AMD
KRWF 150202Z 1502/1524 {TAF text}
AMD NOT SKED 1505Z-1518Z=
```

No amendments will be available between the 15th day of the month at 0500 UTC and the 15th day of the month at 1800 UTC due to lack of a complete observational set between those times.

```
TAF AMD
KPSP 190230Z 1903/1924 {TAF text}
AMD NOT SKED=
```

Amendments are not scheduled.

5.13.3.3

Automated Observing Sites Requiring Part-Time Augmentation.

TAFs for automated stations without present weather and obstruction to vision information and have no augmentation or only part-time augmentation, are prepared using the procedures for part-time manual observation sites detailed in the previous paragraph, with one exception. This exception is the remark used when the automated system is unattended. Specifically, the time an augmented automated system is scheduled to go into unattended operation and/or the time augmentation resumes is included in a remark unique to automated observing sites: **AMD LTD TO CLD VIS AND WIND (AFT YYHHmm, or TIL YYhhmm, or YYHH-YYhh)**, where **YY** is the date, **HHmm** is the time, in hours and minutes, of last augmented observation and **hhmm** is the time, in hours and minutes, the second complete observation is expected to be received. This remark, which does not preclude amendments for other forecast elements, is appended to the last scheduled TAF issued prior to the last augmented observation. It will also be appended to all subsequent amendments until augmentation resumes.

The **AMD LTD TO** (elements specified) remark is a flag for users and differs from the **AMD NOT SKED AFT Z** remark for part-time manual observation sites. **AMD LTD TO** (elements specified) means users should expect amendments only for those elements and the times specified.

Example:

```
TAF AMD
KCOE 150202Z 1502/1524 text
AMD LTD TO CLD VIS AND WIND 1505-1518=
The amended forecast indicates that amendments will only be issued for wind,
visibility, and clouds, between the 15th day of the month at 0500Z and the
15th day of the month at 1800Z.
```

An amendment includes forecasts for all appropriate TAF elements, even those not reported when the automated site is not augmented. If unreported elements are judged crucial to the TAF and cannot be adequately determined (e.g., fog versus moderate snow), the TAF will be suspended (i.e., an amended TAF stating “**AMD NOT SKED**”).

AWOS systems with part-time augmentation, which the forecaster suspects are providing unreliable information when not augmented, will be reported for maintenance and treated the same as part-time manual observation sites. In such cases, the **AMD NOT SKED AFT YY/aaZ** remark will be used.

5.13.3.4 Non-Augmented Automated Observing Sites.

The TAF issued for automated observing stations with no augmentation may be suspended in the event the forecaster is notified of, or strongly suspects, an outage or unrepresentative data. Forecasters may also suspend TAF amendments when an element the forecaster judges to be critical is missing from the observation and cannot be obtained using the total observation concept. The term **AMD NOT SKED** will be appended, on a separate line and indented five spaces, to the end of an amendment to the existing TAF when appropriate.

5.14 Route Forecasts (ROFOR).

5.14.1 Issuance.

ROFORs are only issued by the NWS WFO in Honolulu, HI, twice per day for two routes: San Francisco, CA (KSFO), to Honolulu, HI (PHNL), and Santa Barbara, CA (KSBA), and PHNL. ROFORs are available on the NWS WFO Honolulu website.

5.14.2 ROFOR Amendments.

ROFORs are not required to be amended.

5.14.3 ROFOR Corrections.

ROFOR corrections are issued as soon as possible when erroneous data has been transmitted.

5.14.4 ROFOR Content

ROFORs contain some or all of the following forecast parameters, which are valid for the specified times:

- Winds and temperatures aloft at flight levels (FL) 050, 100, 180 and 240 (true direction in tens of degrees, speed in knots, air temperature in whole degrees Celsius with **P** for a value above 0 and **M** for a value below zero).
- Significant en route weather.
- Zone weather, in abbreviated code, for numbered zones (zone map available on NWS WFO Honolulu website).
 - Cloud amount in oktas, cloud types, cloud bases. and tops (MSL or FL).
 - Coverage and type of precipitation and weather along with visibility when below 7 sm.
- Overall wind factor component at FLs 050, 100, 180 and 240.
- Weather Synopsis.

Note: See Appendices [A](#) and [B](#) for definitions of common terms used in ROFORs.

5.14.5 Example

5.14.5.1 Santa Barbara and San Francisco to Honolulu Route ROFOR Example.

```

FRPN31 PHFO 301857
RFRKSF
WINDS/TEMPERATURES AND WEATHER BY ZONE FOR
ROUTE SFO/HNL VIA 31.3N/140W VALID AT 311200Z
FLIGHT LEVELS
ZONE FL050      FL100      FL180      FL240      ZONE WEATHER
25   3315 P16    3208 P11    3109 M07    3216 M19    6-8 STSC 010/030
26   3316 P13    3211 P09    3117 M06    3023 M18    4-6 STSC 015/045
27   3013 P12    3212 P09    3020 M06    3024 M18    6-8 MERGING LYR TO 200
                                         ISOL VIS 3-5SM RA
                                         ISOL TCU TOPS FL220
28   3008 P14    3008 P08    2815 M06    2918 M18    DO
29   9905 P14    9905 P08    2609 M06    2612 M18    4-6 CUSC 020/050
30   0506 P14    9905 P08    9905 M06    2406 M18    DO
31   0818 P15    0613 P09    0307 M06    9905 M18    4-6 CUSC 020/080
                                         ISOL -SHRA
32   0822 P15    0719 P09    0711 M05    9905 M17    DO
OVERALL COMPONENTS
P4          P2          M4          M10

```

```

ROUTE SBA/HNL VIA 29.5N/140W VALID AT 311200Z
FLIGHT LEVELS
ZONE FL050      FL100      FL180      FL240      ZONE WEATHER
25   3509 P17    3108 P11    3011 M07    3015 M19    6-8 STSC 010/030
26   3416 P14    3312 P09    3218 M05    3123 M18    4-6 STSC 015/045
27   0111 P13    3510 P10    3017 M05    3021 M18    2-4 CUSC 020/045
28   0307 P14    3606 P09    2713 M05    2717 M18    DO
29   0406 P14    9905 P08    2507 M05    2610 M18    4-6 CUSC 020/050
30   0815 P15    0610 P09    9905 M05    9905 M17    DO

```

31	0821 P15	0616 P09	0408 M05	9905 M18	4-6 CUSC 020/080
32	0822 P15	0719 P09	0812 M06	9905 M18	ISOL -SHRA
OVERALL COMPONENTS					
	P10	P5	M4	M7	DO
SYNOPSIS...1024MB HIGH CENTERED NEAR N3000 W15600.					

In the above example, for the route KSFO to PHNL, valid for 1200 UTC on the 31st of the month, for zone 25 the winds at FL050 (FLs, i.e., altimeter setting 29.92, are used when flying over the oceans) is at forecast are 330 degree (true) and 15 kts, temperature plus 16 Celsius. The Zone Weather for zone 25 is 6 to 8 oktas (i.e. BKN to OVC) cloud cover, stratus and stratocumulus cloud types, with bases 1,000 MSL and tops 3,000 MSL. The overall wind factor component at FL 050 is plus 4 kts. For zone 28, the “DO” stands for ditto and means that the zone weather is the same as the zone above, in this case zone 27.

5.15 Wind and Temperature Aloft.

There are many wind and temperature forecasts and products produced by the NWS. Each NWP model outputs wind and temperature at multiple levels. The primary output of these forecasts is a gridded binary code format (e.g., GRIB2) intended for use in flight planning software.

This paragraph discusses one of the wind and temperature aloft forecast products, Wind and Temperature Aloft Forecasts (FB). Other paragraphs within this AC provide additional wind and temperature aloft forecasts, i.e., constant pressure level forecasts (see paragraph [5.17.1](#)), and the global winds and temperature forecasts provided under the World Area Forecast System (WAWS) (see paragraph [5.19.1](#)).

5.15.1 Wind and Temperature Aloft Forecast (FB).

Wind and Temperature Aloft Forecasts (FB) are computer-prepared forecasts of wind direction, wind speed, and temperature at specified times, altitudes, and locations. FBs are available on <http://www.aviationweather.gov> in both text and graphic format.

5.15.1.1 Issuance.

The NWS NCEP produces scheduled FB Wind and Temperature Aloft Forecasts four times daily for specified locations in the CONUS, the Hawaiian Islands, Alaska and coastal waters, and the western Pacific Ocean. Specified locations are documented on <http://www.aviationweather.gov> under ADDS Wind Temp Data Web page.

Amendments are not issued to the forecasts. Wind forecasts are not issued for altitudes within 1,500 ft of a location’s elevation. Temperature forecasts are not issued for altitudes within 2,500 ft of a location’s elevation.

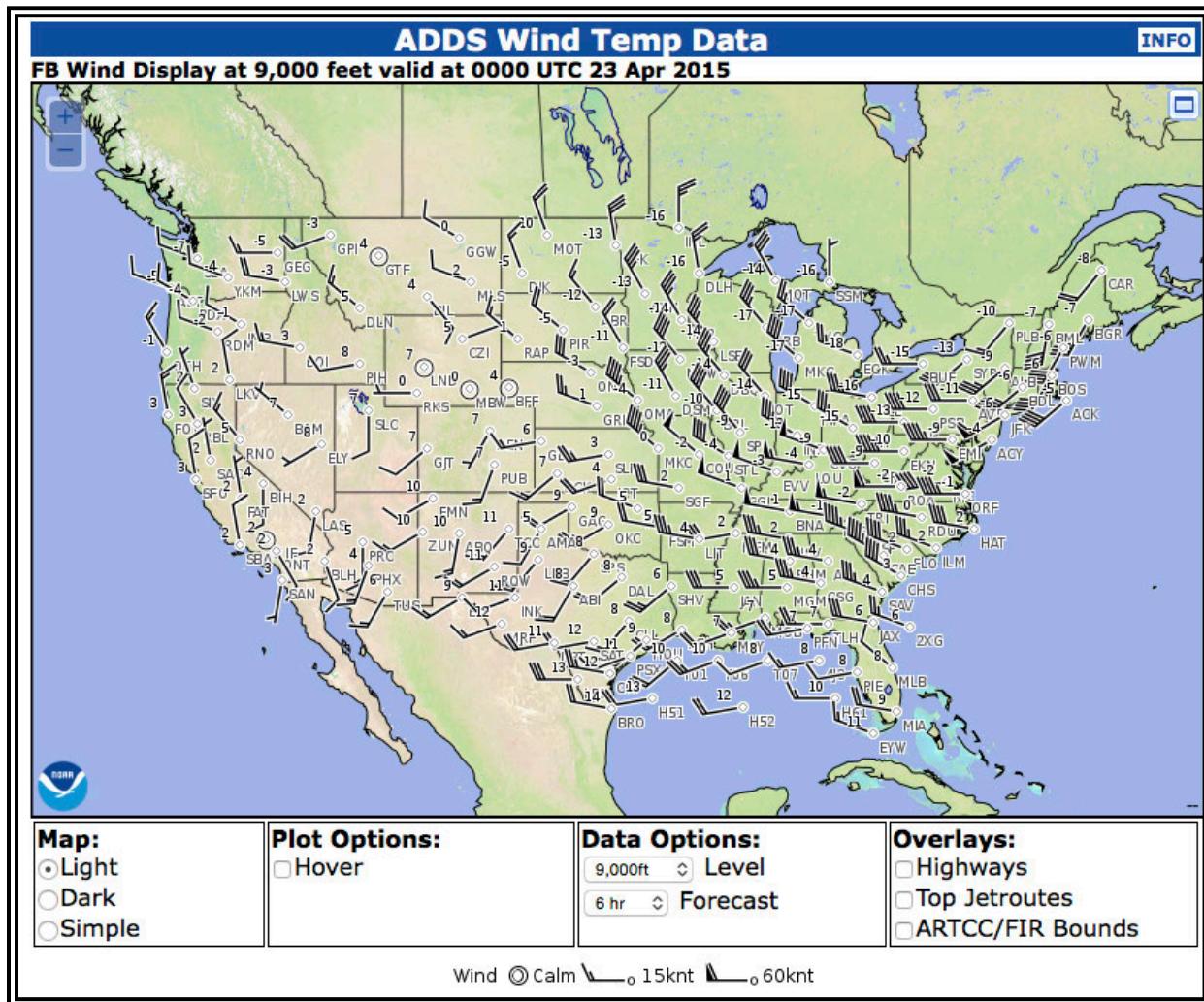
5.15.1.2 Format.

The AWC’s website provides a graphical depiction of the FB wind and temperature forecasts as well as a text version.

5.15.1.2.1 Graphical Display.

The AWC's website provides an interactive display (see Figure 5-51, FB Wind and Temperature Aloft Interactive Display Example) of the FB wind and temperature forecasts.

Figure 5-51. FB Wind and Temperature Aloft Interactive Display Example



The interactive graphic depicts wind speed (knots) and direction (referenced to true north) using standard windbarb display. Temperature (Celsius) is placed to the upper left of the station circle.

A click on the station displays the wind and temperature forecast and station three-letter identification in a separate text window. When the "Hover" option is selected, the wind and temperature text window appears by merely placing the cursor over the station.

Selected altitudes (3,000, 6,000, 9,000, 12,000, 18,000, 24,000, 30,000, 34,000, 39,000, 45,000, and 53,000 ft) and forecast valid times (6-, 12- and 24-hour) can be changed using the pulldown menus under “Data Options.”

5.15.1.2.2 Text Format

Forecasts are provided for select altitudes and locations. Some locations have additional altitudes.

The text format for the FB wind and temperature forecasts uses the symbolic form **DDff+TT** in which **DD** is the wind direction, **ff** the wind speed, and **TT** the temperature.

Wind direction is indicated in tens of degrees (two digits) with reference to true north and wind speed is given in knots (two digits). Light and variable wind or wind speeds of less than 5 kts are expressed by **9900**. Forecast wind speeds of 100 through 199 kts are indicated by subtracting 100 from the speed and adding 50 to the coded direction. For example, a forecast of 250 degrees, 145 kts, is encoded as **7545**. Forecast wind speeds of 200 kts or greater are indicated as a forecast speed of 199 kts. For example, **7799** is decoded as 270 degrees at 199 kts or greater.

Temperature is indicated in degrees Celsius (two digits) and is preceded by the appropriate algebraic sign for the levels from 6,000 through 24,000 ft. Above 24,000 ft, the sign is omitted since temperatures are always negative at those altitudes.

The product header includes the date and time observations were collected, the forecast valid date and time, and the time period during which the forecast is to be used.

5.15.1.2.3 Examples

1312+05

The wind direction is from 130 degree (i.e., southeast), the wind speed is 12 kts, and the temperature is 5 °Celsius.

9900+10

Wind light and variable, temperature +10 °Celsius.

7735-07

The wind direction is from 270 degrees (i.e., west), the wind speed is 135 kts, and the temperature is minus 7 °Celsius.

5.15.1.2.4 Coding Example.

Sample winds aloft text message:

```
DATA BASED ON 010000Z
VALID 010600Z FOR USE 0500-0900Z. TEMPS NEG ABV 24000
FT 3000 6000 9000 12000 18000 24000 30000 34000 39000
MKC 9900 1709+06 2018+00 2130-06 2242-18 2361-30 247242
258848 550252
```

Sample message decoded:

```
DATA BASED ON 010000Z
Forecast data is based on computer forecasts generated the 1st day of
the month at 0000 UTC.
```

```
VALID 010600Z FOR USE 0500-0900Z. TEMPS NEG ABV
24000
The valid time of the forecast is the 1st day of the month at 0600 UTC. The
forecast winds and temperature are to be used between 0500 and 0900 UTC.
Temperatures are negative above 24,000 ft.
```

```
FT 3000 6000 9000 12000 18000 24000 30000 34000
39000
```

FT indicates the altitude of the forecast.

```
MKC 9900 1709+06 2018+00 2130-06 2242-18 2361-30
247242 258848 550252
```

MKC indicates the location of the forecast. The rest of the data is the winds and temperature aloft forecast for the respective altitudes.

Table [5-20](#), Wind and Temperature Aloft Forecast Decoding Examples, shows data for MKC (Kansas City, MO).

Table 5-20. Wind and Temperature Aloft Forecast Decoding Examples

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000 MKC 9900 1709+06 2018+00 2130-06 2242-18 2361-30 247242 258848 550252			
Altitude (feet)	Coded	Wind	Temperature (°C)
3,000 FT	9900	Light and variable	Not forecast
6,000 FT	1709+06	170 degrees at 9 knots	+06 degrees Celsius
9,000 FT	2018+00	200 degrees at 18 knots	Zero degrees Celsius
12,000 FT	2130-06	210 degrees at 30 knots	-06 degrees Celsius
18,000 FT	2242-18	220 degrees at 42 knots	-18 degrees Celsius
24,000 FT	2361-30	230 degrees at 61 knots	-30 degrees Celsius
30,000 FT	247242	240 degrees at 72 knots	-42 degrees Celsius
34,000 FT	258848	250 degrees at 88 knots	-48 degrees Celsius
39,000 FT	750252	250 degrees at 102 knots	-52 degrees Celsius

5.15.1.3 Use.

Table 5-21, Wind and Temperature Aloft Forecast (FB) Periods, provides the time periods for use of FB Wind and Temperature forecasts.

Table 5-21. Wind and Temperature Aloft Forecast (FB) Periods

Model Run	Product Available	6 hour Forecast		12 hour Forecast		24 hour Forecast	
		Valid	For Use	Valid	For Use	Valid	For Use
0000Z	~0200Z	0600Z	0200-0900Z	1200Z	0900-1800Z	0000Z	1800-0600Z
0600Z	~0800Z	1200Z	0800-1500Z	1800Z	1500-0000Z	0600Z	0000-1200Z
1200Z	~1400Z	1800Z	1400-2100Z	0000Z	2100-0600Z	1200Z	0600-1800Z
1800Z	~2000Z	0000Z	2000-0300Z	0600Z	0300-1200Z	1800Z	1200-0000Z

5.16 Freezing-Level Graphics.

The freezing level is the lowest altitude in the atmosphere over a given location at which the air temperature reaches 0 °C. This altitude is also known as the height of the 0 °C constant-temperature surface. A freezing-level graphic (see Figure 5-52, Aviationweather.gov Freezing Level Graphic—Example) shows the height of the 0 °C constant-temperature surface.

The concept of freezing level becomes slightly more complicated when more than one altitude is determined to be at a temperature of 0 °C. These “multiple freezing layers” occur when a temperature inversion at altitudes above the defined freezing level are present. For example, if the first freezing level is at 3000 ft MSL and the second is at 7000 ft MSL, a temperature inversion is between these two altitudes. This would indicate temperatures rising above freezing above 3000 ft MSL and then back below freezing at 7000 ft MSL.

The AWC provides freezing-level graphics available on their website.

The freezing-level graphics provide an initial analysis and forecasts at specified times into the future. The forecasts are based on output from a NWS NCEP NWP.

5.16.1 Issuance.

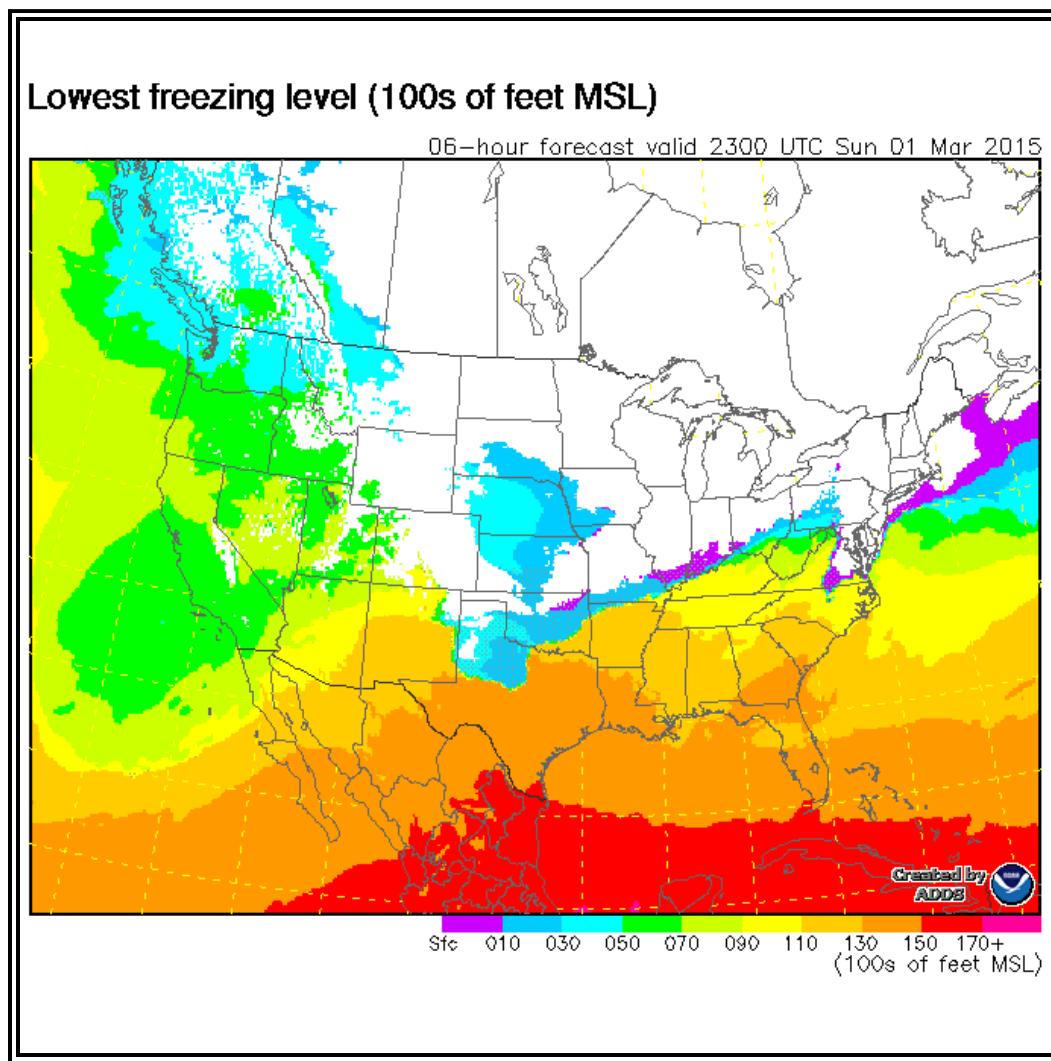
The initial analysis and forecast graphics are updated hourly.

5.16.2 Format.

The colors represent the height in hundreds of feet above MSL of the lowest freezing level. Regions with white indicate the surface and the entire depth of the atmosphere are below freezing. Hatched or spotted regions (if present) represent areas where the surface temperature is below freezing with multiple freezing levels aloft.

5.16.3 Use.

Freezing-level graphics are used to assess the lowest freezing-level heights and their values relative to flight paths. Clear, rime, and mixed icing are found in layers with below-freezing (negative) temperatures and supercooled water droplets. Users should be aware that official forecast freezing-level information is specified within the AIRMET Zulu Bulletins (CONUS and Hawaii) and the AIRMET “**ICE AND FZLVL**” information embedded within the FAs (Alaska only).

Figure 5-52. Aviationweather.gov Freezing Level Graphic—Example

5.17 Upper-Air Forecasts.

NWP models, run on super computers, generate surface and upper-air forecasts, known as “Model Guidance” to meteorologists. The NWS NCO runs several models daily and produces hundreds of surface and upper-air guidance products, valid from model run time (i.e., 00-hour) out to several days or weeks (e.g., 340 hours after model run time) depending on the model. Their website, [Model Analyses and Guidance](#) (see Figure 5-53, NWS NCEP Central Operations Model Analyses and Guidance Website), contains a user’s guide as well as a product description link that provides details on the various products.

Figure 5-53. NWS NCEP Central Operations Model Analyses and Guidance Website

DOC NOAA NWS | NCEP Centers: AWC CPC EMC NCO NHC OPC SPC SWPC WPC
NCEP Home > NCO Home > Systems Integration Branch > Model Analyses and Guidance

Model Analyses and Guidance

+ Website Information

Check here for the Latest News

Select Model Guidance, Observations and Analyses, or Tropical Guidance

MODEL GUIDANCE	OBSERVATIONS AND ANALYSES	TROPICAL GUIDANCE
----------------	---------------------------	-------------------

Upcoming Changes | User's Guide | Frequently Asked Questions | Product Description Document

MAG v3.0.0

NOAA/National Weather Service
National Centers for Environmental Prediction
5830 University Research Court
College Park, MD 20740
NCEP Internet Services Team
Page last modified: May 20 2013 17:08 PM UTC.

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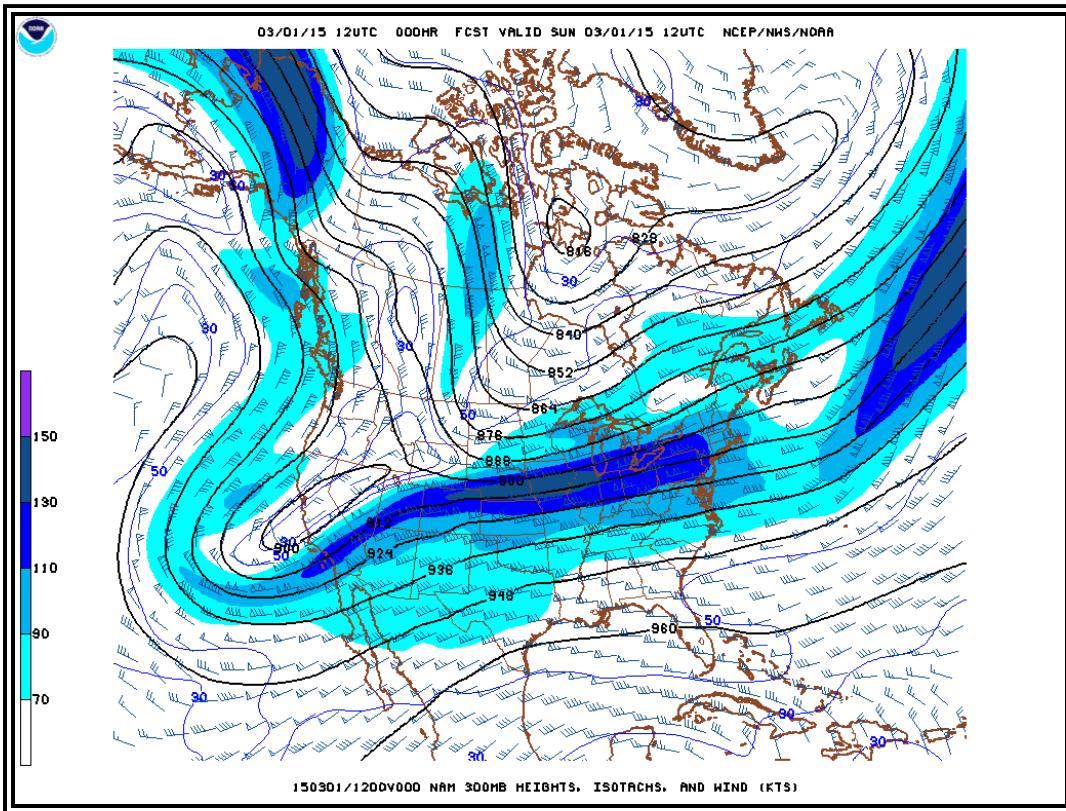
Privacy Policy
About Us
Career Opportunities

A user's guide, located within website Information (upper right corner), provides descriptions, details, and examples of the various products.

5.17.1 Constant Pressure Levels Forecasts.

Constant pressure level forecasts (see Figure 5-54, 300 MB Constant Pressure Forecast—Example) are just one of the many products produced by NWP models. Constant pressure level forecasts are the computer model's depiction of select weather (e.g., wind) at a specified constant pressure level (e.g., 300 MB), along with the altitudes (in meters) of the specified constant pressure level. Constant pressure level forecasts when considered together describe the three-dimensional aspect of pressure systems. Each product provides a plan-projection view of a specified pressure altitude at a given forecast time.

Figure 5-54. 300 MB Constant Pressure Forecast—Example



Contours of the height of the 300 MB surface are presented as solid lines. Windbarbs are used to show the direction and speed of the wind. Shading is done for wind speeds greater than 70 kts or greater and generally represents the jet stream. In this example, the jet stream extends from Alaska to Southern California to New England.

5.17.1.1 **Issuance.**

Constant pressure level forecasts are produced several times a day depending on the model. NCEP's Global Forecast System (GFS) model and North American Model (NAM) model produce forecasts four times per day, with initial times of 00, 06, 12, and 18 UTC. Other higher resolution models such as the High Resolution Rapid Refresh (HRRR) produce forecasts at hourly intervals.

5.17.1.2 **Content.**

Constant pressure level forecasts vary in content depending on the selected model and product. Most provide a wind forecast that may be combined with either temperature, relative humidity, or certain derived parameters (e.g., vorticity).

Many constant pressure levels are available for display depending on the model. For example, the NCEP's Model Analyses and Guidance website (see Figure 5-53) provides displays of NCEP's GFS model constant pressure levels contained in Table 5-22, Select Constant Pressure Levels From the GFS Model. It should be noted that the levels provided on the website are

only a subset of the levels available from the model that are routinely made available to NWS meteorologists and others (e.g., 400 millibars (mb), 600 mb).

Table 5-22. Select Constant Pressure Levels From the GFS Model

Constant Pressure Level	Approximate Altitude (MSL)
925 MB	2,500
850 MB	5,000
700 MB	10,000
500 MB	18,000
300 MB	30,000
250 MB	34,000
200 MB	39,000

5.17.1.3 Use.

Constant pressure level forecasts are used to provide an overview of weather patterns at specified times and pressure altitudes and are the source for wind and temperature aloft forecasts.

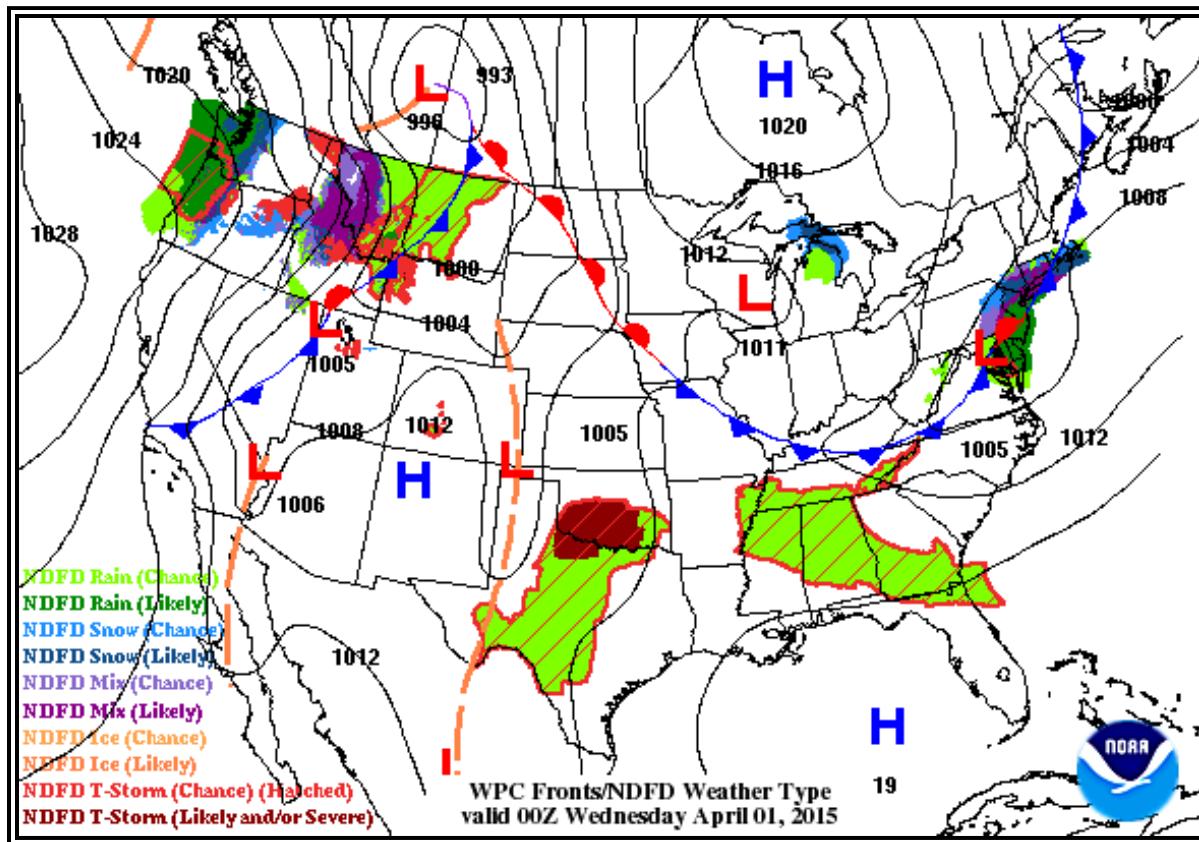
Pressure patterns cause and characterize much of the weather. Typically, lows and troughs are associated with clouds and precipitation while highs and ridges are associated with fair weather, except in winter when valley fog may occur. The location and strength of the jet stream can be viewed at 300 MB, 250 MB, and 200 MB levels.

5.18 Short-Range Surface Prognostic (Prog) Charts.

The NWS's WPC provides Short-Range Surface Prognostic (Prog) Charts (see Figure 5-55, NDFD Surface Prog Forecast—Example) of surface pressure systems, fronts, and precipitation for a 2½-day period. The forecast area covers the CONUS, the coastal waters. The forecasted conditions are divided into five forecast periods: 12, 18, 24, 48, and 60 hours. Each chart depicts a “snapshot” of weather elements expected at the specified valid time.

The Short-Range Surface Prognostic (Prog) Charts combine WPC forecasts of fronts, isobars, and high/low pressure systems with the NWS's National Digital Forecast Database (NDFD) digital forecasts from NWS WFO.

The Surface Prognostic (Prog) Charts are available at <http://www.aviationweather.gov>.

Figure 5-55. NDFD Surface Prog Forecast—Example

5.18.1 Content

5.18.1.1 **Precipitation.**

The Short-Range Surface Prog Forecast provides precipitation forecasts in the following depiction:

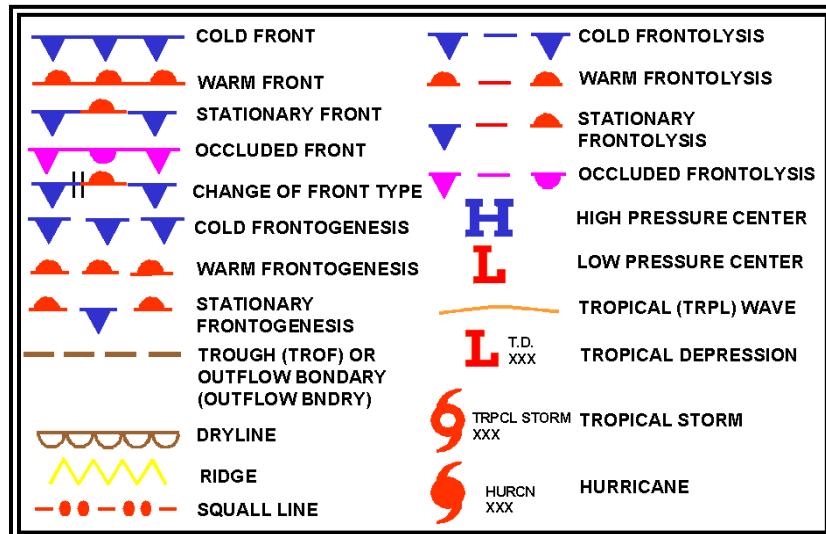
- NDFD Rain (Chance)–(light green)–There is a 25 to less than 55 percent probability of measurable rain ($\geq 0.01"$) at the valid time.
- NDFD Rain (Likely)–(dark green)–There is a greater than or equal to 55 percent probability for measurable rain ($\geq 0.01"$) at the valid time.
- NDFD Snow (Chance)–(light blue)–There is a 25 to less than 55 percent probability of measurable snowfall ($\geq 0.01"$ liquid equivalent) at the valid time.
- NDFD Snow (likely)–(dark blue)–There is a greater than or equal to 55 percent probability of measurable snow ($\geq 0.01"$ liquid equivalent) at the valid time.
- NDFD Mix (Chance)–(light purple)–There is a 25 to less than 55 percent probability of measurable mixed precipitation ($\geq 0.01"$ liquid equivalent) at the valid time.

the valid time. “Mixed” can refer to precipitation where a combination of rain and snow, rain and sleet, or snow and sleet are forecast.

- NDFD Mix (Likely)—(dark purple)—There is a greater than or equal to 55 percent probability of measurable mixed precipitation (≥ 0.01 ” liquid equivalent) at the valid time. “Mixed” can refer to precipitation where a combination of rain and snow, rain and sleet, or snow and sleet are forecast.
- NDFD Ice (Chance)—(light brown)—There is a 25 to less than 55 percent probability of measurable freezing rain (≥ 0.01 ”) at the valid time.
- NDFD Ice (Likely)—(brown)—There is a greater than or equal to 55 percent probability of measurable freezing rain (≥ 0.01 ”) at the valid time.
- NDFD T-Storm (Chance)—(red hatching)—There is a 25 to less than 55 percent probability of thunderstorms at the valid time. Areas are displayed with diagonal red hatching enclosed in red border.
- NDFD T-Storm (Likely and/or Severe)—(dark red)—There is a greater than or equal to 55 percent probability of thunderstorms and/or the potential exists for some storms to reach severe levels at the valid time.

5.18.1.2 Symbols.

Figure 5-56. Surface Prog Forecast Symbols



5.18.1.3 Pressure Systems.

Pressure systems are depicted by pressure centers, troughs, isobars, drylines, tropical waves, tropical storms, and hurricanes using standard symbols (see Figure 5-56, Surface Prog Forecast Symbols). Isobars are denoted by solid thin black lines and labeled with the appropriate pressure in millibars. The central pressure is plotted near the respective pressure center.

5.18.1.4 Fronts.

Fronts are depicted using the standard symbols in Figure [5-56](#).

5.18.1.5 Squall Lines.

Squall lines are denoted using the standard symbol in Figure 5-56.

5.18.2 Issuance.

The Short-Range Surface Prognostic (Prog) Forecasts are issued by the WPC in College Park, MD. Table 5-23, Short-Range Surface Prog Forecast Schedule, provides the product schedule. The 12- and 24-Hour Surface Prognostic (Prog). They are available on the WPC website.

Table 5-23. Short-Range Surface Prog Forecast Schedule

Product	Issuance Times (UTC)
6 and 12 hour forecasts	0200 and 1400
18 and 24 hour forecasts	0430 and 1630
30, 36 and 48 hour forecasts	0730 and 1930
60 hour forecast	0900 and 2100

5.18.3 Use.

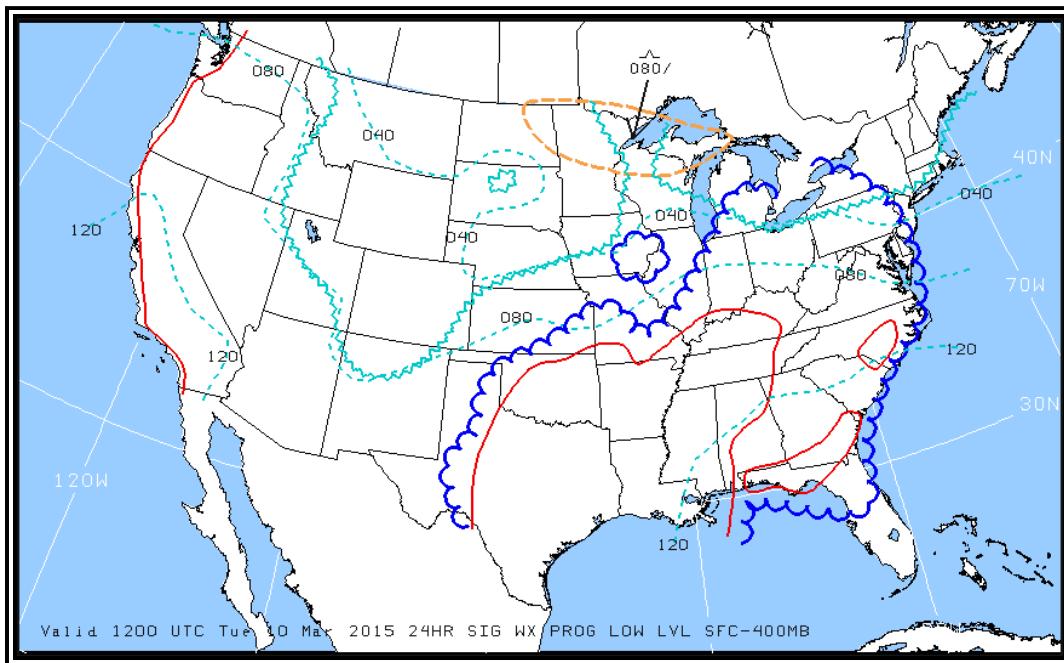
Short-Range Surface Prognostic (Prog) Forecasts can be used to obtain an overview of the progression of surface weather features during the next 2½-days hours. The progression of weather is the change in position, size, and intensity of weather with time.

5.19 Significant Weather (SIGWX) Forecast.

Note: Significant Weather Forecasts may be depicted in monochrome or color display. The colors used for symbols and as well as the color and style of lines is not standard. The colors of jet streams, turbulence, cloud cover, and other elements may vary depending on the website and service provider. The examples shown in this paragraph are from the NWS AWC's and AAWU's Web pages. Users of Significant Weather Forecasts should always refer to any legend or Help Page or user information on the website for details on the content and display of the weather information.

5.19.1 Low-Level Significant Weather (SIGWX) Charts.

The Low-Level Significant Weather (SIGWX) Charts (see Figure [5-57](#), 12-Hour Low-Level SIGWX Chart—Example) provide a forecast of aviation weather hazards primarily intended to be used as guidance products for pre-flight briefings. The forecast domain covers the CONUS and the coastal waters for altitudes FL240 and below. Each depicts a “snapshot” of weather expected at the specified valid time.

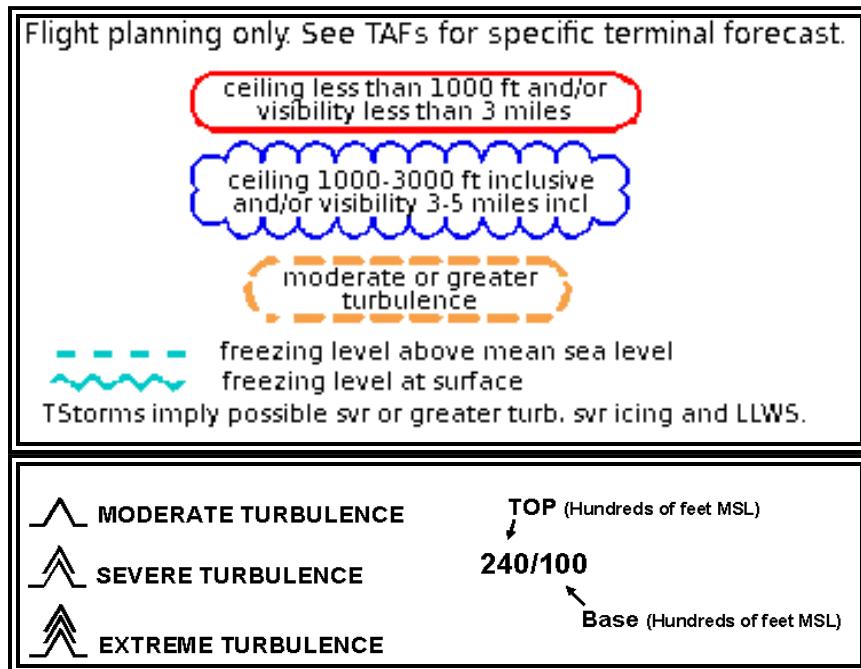
Figure 5-57. 12-Hour Low-Level SIGWX Chart—Example

5.19.1.1 Content.

Low-Level SIGWX Charts depict weather flying categories, turbulence, and freezing levels (see Figure 5-58, Low-Level SIGWX Chart Symbols). In flight icing is *not* depicted on the Low-Level SIGWX Chart.

Depending on the website or service provider, the Low-Level SIGWX Charts may be combined with Surface Prognostic (PROG) Charts to create a four-panel presentation. For example, the left two panels represents the 12-hour forecast interval and the right two panels the 24-hour forecast interval. The upper two panels depict the SIGWX Charts and the lower two panels the Surface Prog.

Figure 5-58. Low-Level SIGWX Chart Symbols

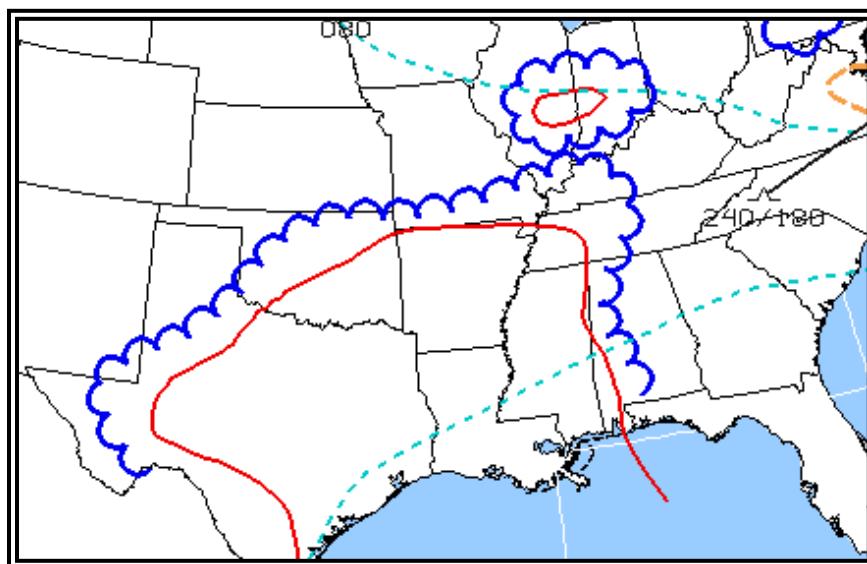


Note: The colors used in the Low-Level Significant Weather Charts may vary depending on the website or service provider.

5.19.1.1.1 Flying Categories.

IFR areas are outlined with a solid red line, marginal VFR (MVFR) areas are outlined with a scalloped blue line, and VFR areas are not depicted (see Figure 5-59, Low-Level SIGWX Chart Flying Categories—Example).

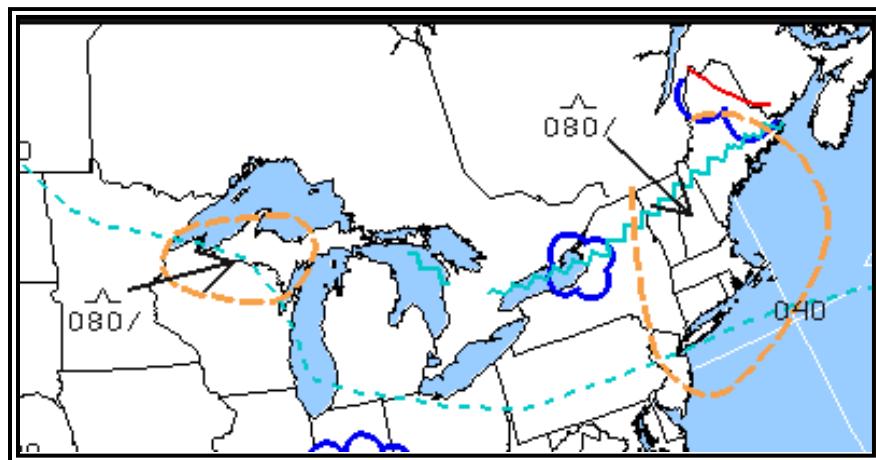
Figure 5-59. Low-Level SIGWX Chart Flying Categories—Example



5.19.1.1.2 Turbulence.

Areas of moderate or greater turbulence are enclosed by bold, dashed, brown lines (see Figure 5-60, Low-Level SIGWX Chart Turbulence Forecast—Example). Turbulence intensities are identified by standard symbols (see Figure 5-58). The vertical extent of turbulence layers is specified by top and base heights separated by a slant. The intensity symbols and height information may be located within or adjacent to the forecasted areas of turbulence. If located adjacent to an area, an arrow will point to the associated area. Turbulence height is depicted by two numbers separated by a solidus (/). For example, an area on the chart with turbulence indicated as **240/100** indicates that the turbulence can be expected from the top at FL240 to the base at 10,000 ft MSL. When the base height is omitted, the turbulence is forecast to reach the surface. For example, **080/** identifies a turbulence layer from the surface to 8,000 ft MSL. Turbulence associated with thunderstorms is not depicted on the chart.

Figure 5-60. Low-Level SIGWX Chart Turbulence Forecast—Example



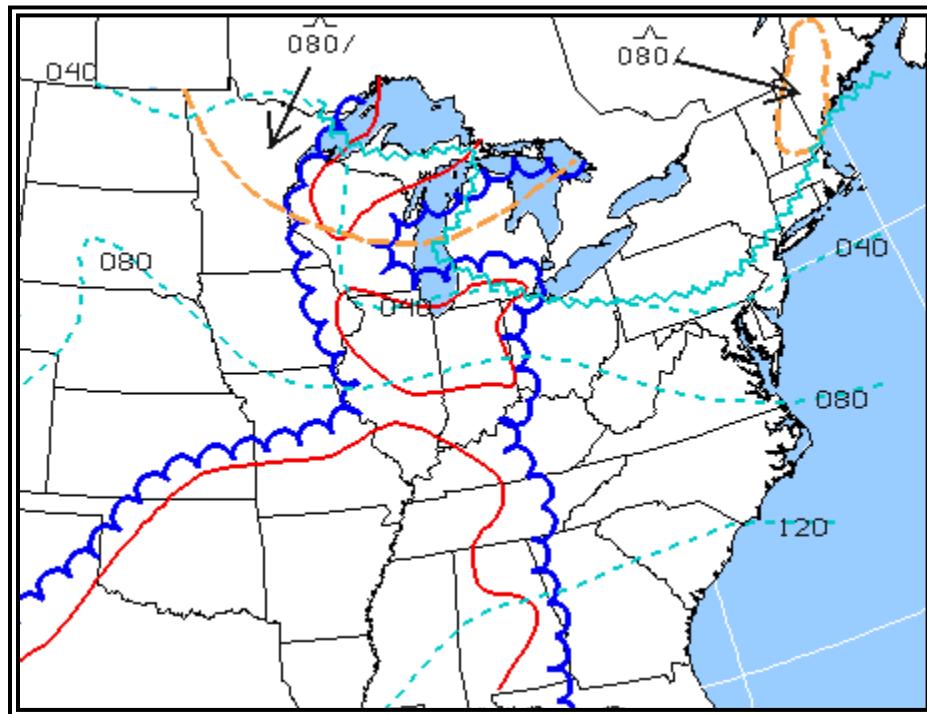
5.19.1.1.3 Freezing Levels.

The freezing level at the surface is depicted by a blue, saw-toothed symbol (see Figure 5-61, Low-Level SIGWX Chart Freezing Level Forecast—Example). The surface freezing level separates above-freezing from below-freezing temperatures at the Earth's surface.

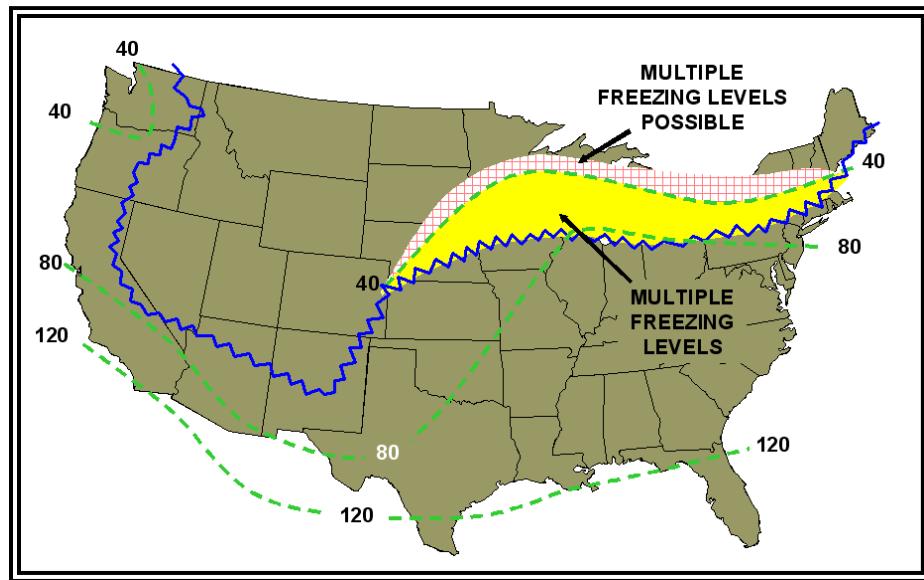
Freezing levels above the surface are depicted by blue dashed lines labeled in hundreds of feet MSL beginning at 4,000 ft using 4,000-foot intervals (see Figure 5-61). If multiple freezing levels exist, these lines are drawn to the highest freezing level. For example, **80** identifies the 8,000-foot freezing level contour (see Figure 5-61). The lines are discontinued where they intersect the surface.

The freezing level for locations between lines is determined by interpolation. For example, the freezing level midway between the 4,000 and 8,000 foot lines is 6,000 ft.

Figure 5-61. Low-Level SIGWX Chart Freezing Level Forecast—Example



Multiple freezing levels occur when the temperature is 0 °C at more than one altitude aloft. Multiple freezing levels can be forecasted on the Low-Level Significant Weather Prog Charts in situations where the temperature is below freezing (negative) at the surface with multiple freezing levels aloft.

Figure 5-62. Low-Level SIGWX Chart Multiple Freezing Levels—Example

The words “Multiple Freezing Levels Possible” and/or “Multiple Freezing Levels,” and/or associated shading and hatched area do not appear on the chart. Note: The colors used in this example are different from those used in other examples.

On the chart, areas with multiple freezing levels are located on the below-freezing side of the surface freezing level contour and bounded by the 4,000-ft freezing level. Multiple freezing levels are **possible** beyond the 4,000 ft freezing level (i.e., below 4,000 ft MSL), but the exact cutoff cannot be determined (see Figure 5-62, Low-Level SIGWX Chart Multiple Freezing Levels—Example).

5.19.1.2 **Issuance.**

Low-Level SIGWX Charts are issued four times per day by the NWS AWC (see Table 5-24, Low-Level SIGWX Chart Issuance Schedule). Two charts are issued; a 12-hour and a 24-hour prog. Both are available on the <http://www.aviationweather.gov>.

Table 5-24. Low-Level SIGWX Chart Issuance Schedule

		Issuance Time			
		~1720Z	~2310Z	~0530Z	~0935Z
Chart		Valid Time			
12-Hour Prog		00Z	06Z	12Z	18Z
24-Hour Prog		12Z	18Z	00Z	06Z

5.19.1.3 **Use.**

The Low-Level SIGWX Charts provide only an overview of selected aviation weather hazards up to FL240 at 12 and 24 hours into the future. More detailed and timely products should be used for actual flight planning.

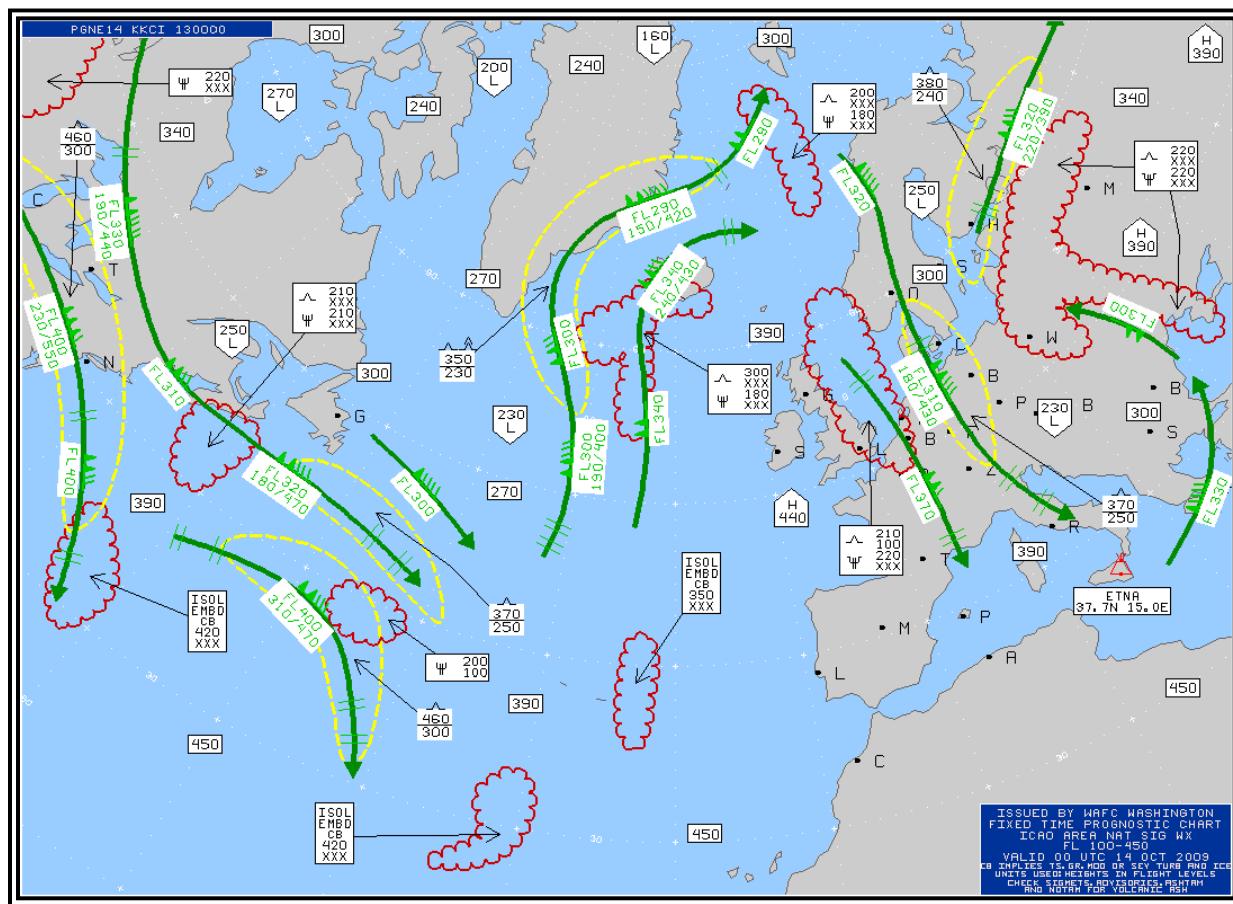
5.19.2 Mid-Level Significant Weather (SIGWX) Chart

The Mid-Level Significant Weather (SIGWX) Chart (see Figure 5-63, Mid-Level SIGWX Chart—Example) is a product of ICAO's WAFS. The Mid-Level SIGWX Chart is also known as the Medium-Level SIGWX Chart.

The Mid-Level SIGWX Chart provides a forecast of significant en route weather phenomena over a range of flight levels from 10,000 ft MSL to FL450. The chart depicts a “snapshot” of weather expected at the specified valid time.

The Mid-Level SIGWX Chart is available on <http://www.aviationweather.gov>.

Figure 5-63. Mid-Level SIGWX Chart—Example



5.19.2.1 Content.

The Mid-Level SIGWX Chart depicts numerous weather elements that can be hazardous to aviation. The weather elements and their presentation are the same as in the High-Level SIGWX Charts (see paragraph [5.19.3](#)) except for the addition of Non-Convective clouds with moderate or severe icing and/or moderate or severe turbulence. See paragraph [5.19.3.1](#) for details on these other weather elements.

5.19.2.1.1 Non-Convective Cloud With Moderate or Severe Icing and/or Moderate or Severe Turbulence.

Areas of Non-Convective clouds with moderate or severe icing and/or moderate or severe turbulence are depicted by enclosed (red) scalloped lines (see Figure [5-63](#)). The type of icing, i.e., rime, clear or mixed, is not forecast.

Note: CB clouds are also depicted by enclosed (red) scalloped lines.

The identification and characterization of each area appears within or adjacent to the outlined area. If the identification and characterization is adjacent to an outlined area, an arrow points to the appropriate area.

The identification box uses the standard icing symbol (see Table 5-25, Icing and Turbulence Intensity Symbols). The vertical extent of the icing layer is specified by top and base heights. When the bases extend below 10,000 ft MSL, they are identified with XXX.

Table 5-25. Icing and Turbulence Intensity Symbols

Intensity	Icing Symbol	Turbulence Symbol
Moderate		
Severe		

5.19.2.2 Issuance.

The AWC in Kansas City, MO, has the responsibility, as part of the WAFC, Washington, to provide global weather forecasts of significant weather phenomena. The AWC issues a 24-hour Mid-Level SIGWX chart, four times daily, for the North Atlantic Ocean Region (NAT) (see Table [5-26](#), Mid-Level SIGWX Chart Issuance Schedule).

Table 5-26. Mid-Level SIGWX Chart Issuance Schedule

Issued (UTC)	Valid (UTC)
0800	0000 (next day)
1400	0600 (next day)
2000	1200 (next day)
0200	1800

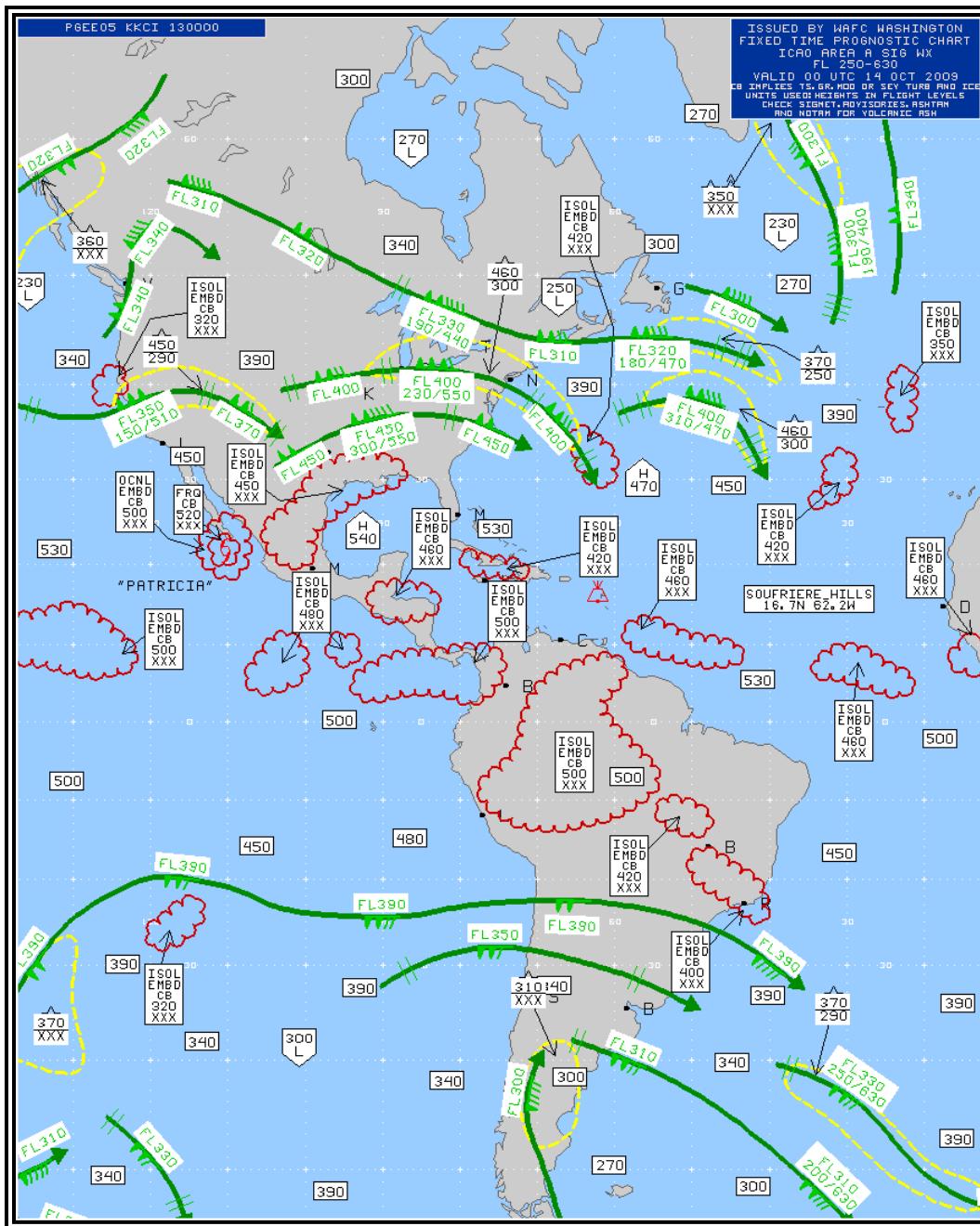
5.19.2.3 Use.

The Mid-Level SIGWX Chart is used to determine an overview of selected flying weather conditions between 10,000 ft MSL and FL450. It can be used by airline dispatchers for flight planning and weather briefings before departure and by flightcrew members during flight.

5.19.3 High-Level Significant Weather (SIGWX) Charts.

High-Level SIGWX Charts (see Figure 5-64, High-Level SIGWX Chart—Example) provide a forecast of significant en route weather phenomena over a range of flight levels from FL250 to FL630. Each chart depicts a “snapshot” of weather expected at the specified valid time. They are available on <http://www.aviationweather.gov>.

Figure 5-64. High-Level SIGWX Chart—Example



5.19.3.1 Content.

5.19.3.1.1 Thunderstorms and Cumulonimbus Clouds.

The abbreviation **CB** is only included where it refers to the expected occurrence of an area of widespread cumulonimbus clouds, cumulonimbus along a line with little or no space between individual clouds, cumulonimbus embedded in cloud layers, or cumulonimbus concealed by haze. It does not refer to isolated cumulonimbus not embedded in cloud layers or concealed by haze.

Each cumulonimbus area is identified with **CB** and characterized by coverage, bases, and tops.

Coverage is identified as isolated (**ISOL**) meaning less than 4/8th, occasional (**OCNL**) meaning 4/8th to 6/8th, and frequent (**FRQ**) meaning more than 6/8th coverage. Isolated CBs can only be depicted when they are embedded (**EMBD**) in clouds or concealed by haze. Occasional CBs can be depicted with or without embedded (**EMBD**).

The vertical extent of cumulonimbus layer is specified by top and base heights. Bases that extend below FL250 (the lowest altitude limit of the chart) are encoded **XXX**.

CBs are depicted by enclosed (red) scalloped lines. The identification and characterization of each **CB** area will appear within or adjacent to the outlined area. If the identification and characterization is adjacent to an outlined area, an arrow will point to the associated cumulonimbus area.

On significant weather charts, the inclusion of **CB** shall be understood to include all weather phenomena normally associated with cumulonimbus (i.e., thunderstorm, moderate or severe icing, moderate or severe turbulence, and hail).

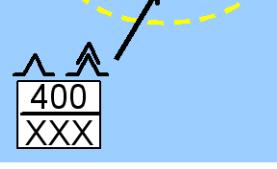
5.19.3.1.2 Moderate or Severe Turbulence.

Forecast areas of moderate or severe turbulence (see Figure [5-65](#), High-Level SIGWX Chart Turbulence—Examples) associated with windshear zones and/or mountain waves are enclosed by bold yellow dashed lines. Intensities are identified by standard symbols (see Table [5-25](#)).

The vertical extent of turbulence layers is specified by top and base heights, separated by a horizontal line. Turbulence bases that extend below FL250 are identified with **XXX**.

Convective or thunderstorm turbulence is not identified.

Figure 5-65. High-Level SIGWX Chart Turbulence—Examples

DEPICTION	MEANING
 <p>1.</p>	MODERATE TURBULENCE FROM FL380 TO FL270.
 <p>2.</p>	MODERATE TO SEVERE TURBULENCE FROM FL400 TO BELOW LOWER LIMIT OF THE PROG (FL250). REFER TO LOW-LEVEL PROG FOR TURBULENCE FORECASTS FOR FL240 AND BELOW.

5.19.3.1.3 Moderate or Severe Icing.

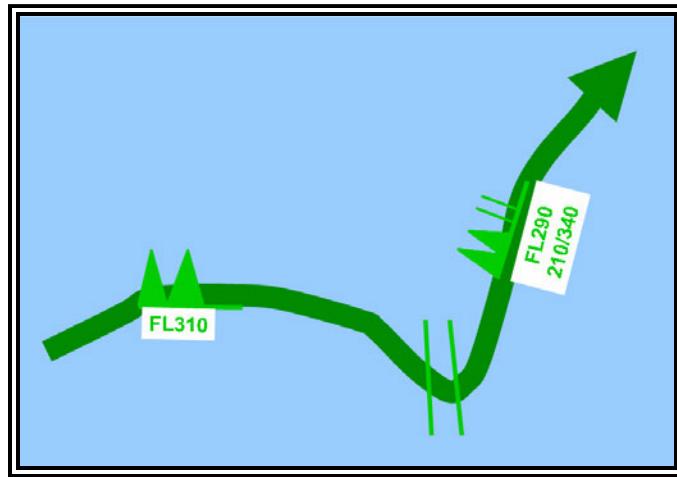
Moderate and severe icing (outside of thunderstorms) above FL240 is rare and is not generally forecasted on High-Level SIGWX charts.

5.19.3.1.4 Jet Streams.

A jet stream axis with a wind speed of more than 80 kts is identified by a bold (green) line. An arrowhead is used to indicate wind direction. Wind change bars (double-hatched, light green lines) positioned along a jet stream axis identifies 20-knot wind speed changes (see Figure [5-66](#), High-Level SIGWX Chart Jet Stream—Example).

Symbols and altitudes are used to further characterize a jet stream axis. A standard wind symbol (light green) is placed at each pertinent position to identify wind velocity. The flight level is placed adjacent to each wind symbol to identify the altitude of the jet stream core or axis.

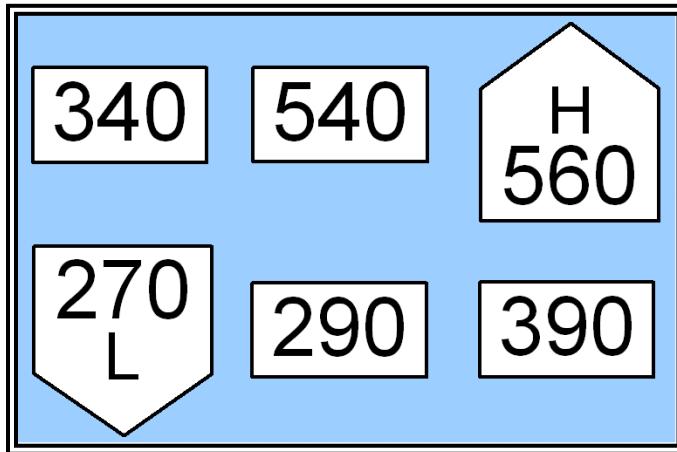
Jet stream vertical depth forecasts are included when the maximum speed is 120 kts or more. Jet depth is defined as the vertical depths to the 80-knot wind field above and below the jet stream axis using flight levels. Jet depth information is placed at the maximum speed point only, normally at one point on each jet stream. When the jet stream is very long and there are several wind maxima, then each maximum should include forecasts of the vertical depth.

Figure 5-66. High-Level SIGWX Chart Jet Stream—Example

Forecast maximum speeds of 100 kts at FL310 at one location and 120 kts at FL290 at another location. At the latter location, the base of the 80-knot wind field is FL210, and the top of the 80-knot wind field is FL340.

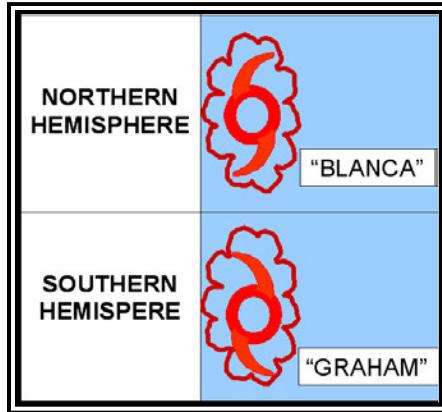
5.19.3.1.5 Tropopause Heights.

Tropopause heights are plotted at selected locations on the chart. They are enclosed by rectangles and plotted in hundreds of feet MSL (see Figure 5-67, High-Level SIGWX Chart Tropopause Height—Examples). Centers of high (H) and low (L) tropopause heights are enclosed by polygons and plotted in hundreds of feet MSL.

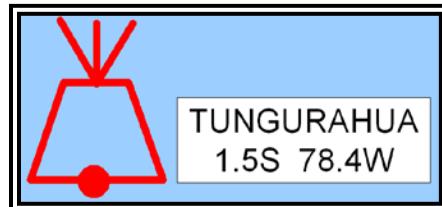
Figure 5-67. High-Level SIGWX Chart Tropopause Height—Examples

5.19.3.1.6 Tropical Cyclones.

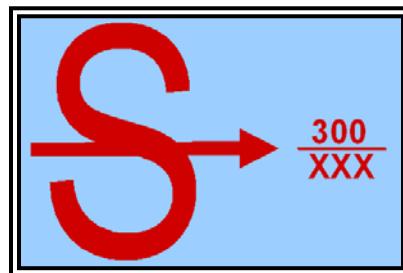
Tropical cyclones, i.e., with surface wind speed 34 kts or greater, are depicted by the symbol depicted in Figure 5-68, High-Level SIGWX Chart Tropical Cyclone—Examples, with the storm's name positioned adjacent to the symbol. Cumulonimbus clouds meeting chart criteria are identified and characterized relative to each storm.

Figure 5-68. High-Level SIGWX Chart Tropical Cyclone—Examples**5.19.3.1.7 Volcanic Eruption Sites.**

Volcanic eruption sites are identified by a trapezoidal symbol depicted in Figure 5-69, High-Level SIGWX Chart Volcanic Eruption Site—Example. The dot on the base of the trapezoid identifies the location of the volcano. The name of the volcano, its latitude, and its longitude are noted adjacent to the symbol.

Figure 5-69. High-Level SIGWX Chart Volcanic Eruption Site—Example**5.19.3.1.8 Widespread Sandstorms and Duststorms.**

Widespread sandstorms and duststorms are labeled with the symbol depicted in Figure 5-70, High-Level SIGWX Chart Widespread Sandstorm and Duststorm—Example. The vertical extent of sand or dust is specified by top and base heights, separated by a horizontal line. Sand or dust that extends below the lower limit of the chart (FL250) is identified with XXX.

Figure 5-70. High-Level SIGWX Chart Widespread Sandstorm and Duststorm—Example

5.19.3.2 **Issuance.**

In accordance with the WAFS of the ICAO, High-Level SIGWX forecasts are provided for the en route portion of international flights.

High-Level SIGWX forecasts are issued as a global data set in digital format by two WAFCs, one at NWS's AWC and the other at the United Kingdom's Meteorological Office. Each center produces a global data set of significant weather that is then made available (displayed) in chart form for different areas of the globe. These charts are available on <http://www.aviationweather.gov>.

Corrections are issued for format errors or missing information. These charts are not amended.

Table 5-27. High-Level SIGWX FORECAST Issuance Schedule

Issued (UTC)	Valid (UTC)
0800	0000 (next day)
1400	0600 (next day)
2000	1200 (next day)
0200	1800

5.19.3.3 **Use.**

High-Level SIGWX forecasts are provided for the en route portion of international flights. These products are used directly by airline dispatchers for flight planning and weather briefings before departure and by flightcrew members during flight.

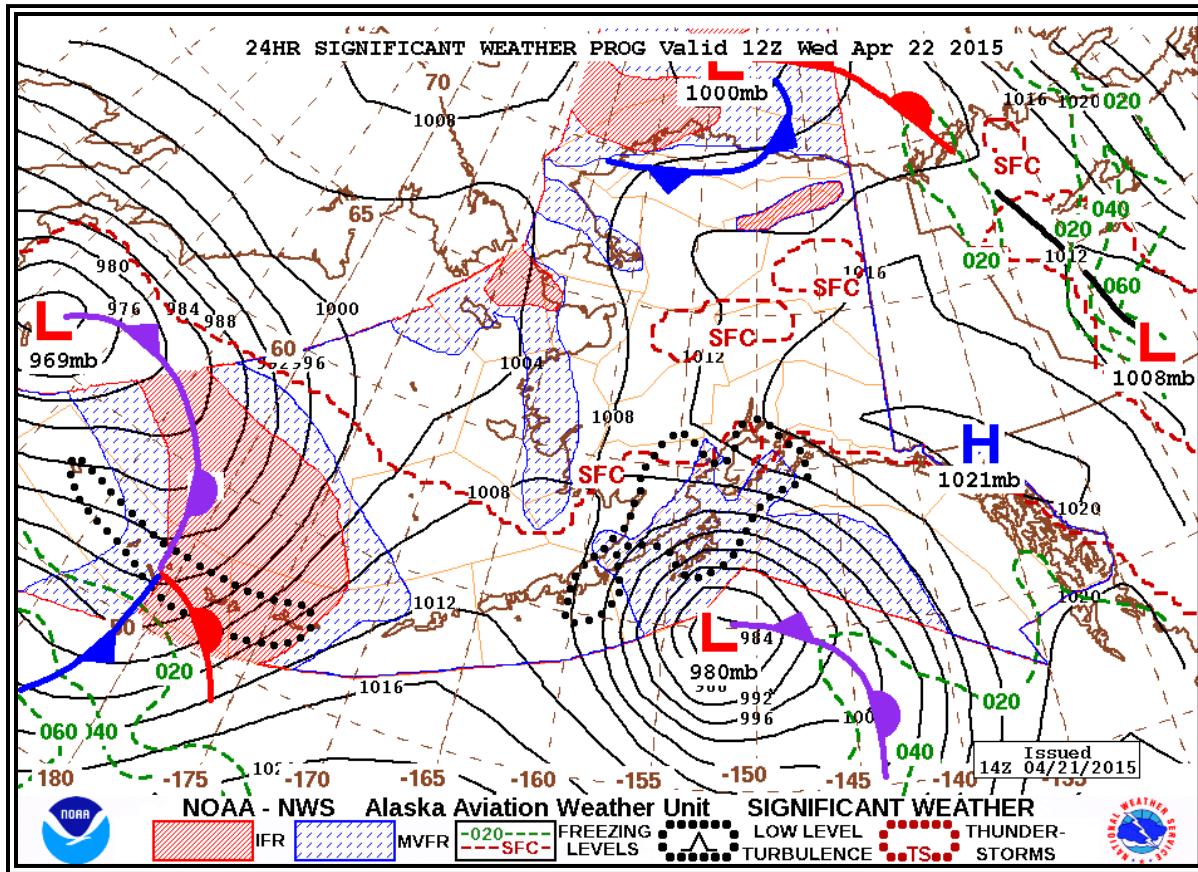
5.19.4 Alaska Significant Weather (SIGWX) Charts.

The Alaska SIGWX charts (see Figure 5-71, Alaska Significant Weather Chart—Example) are a series of four forecasts (24-hour, 36-hour, 48-hour, and 60-hour) valid at specified times. These charts provide a graphical overview of the specified forecast weather primarily for lower flight altitudes.

5.19.4.1 **Issuance.**

The AAWU issues the Alaska SIGWX charts. These charts are issued twice a day at 0530 and 1330 UTC during Alaska Standard Time, and 0430 and 1230 UTC during Alaska Daylight Time. The 1330/1230 UTC-issued 24-hour SIGWX chart may be updated around 2145/2045 UTC valid at 1200 UTC the next day.

Figure 5-71. Alaska Significant Weather Chart—Example



5.19.4.2 Content.

5.19.4.2.1 Surface Pressure Systems and Fronts.

Pressure systems and fronts are depicted using standard symbols. Isobars are denoted by solid thin black lines and labeled with the appropriate pressure in millibars. The central pressure is plotted near the respective pressure center.

5.19.4.2.2 Areas of IFR and MVFR Weather Conditions.

Areas of forecast **IFR** and **MVFR** conditions are shown in red and blue hatching, respectively.

5.19.4.2.3 Freezing Levels.

Forecast freezing levels are depicted for the surface (dashed red line) and at 2,000-foot intervals (dashed green lines).

Note: Areas of in-flight icing forecasts are not included in the Alaska SIGWX forecasts.

5.19.4.2.4 Low-Level Turbulence.

Areas of forecast moderate or greater Non-Convective low-level turbulence are depicted with black dots. Turbulence altitudes are not included but can be

considered as turbulence that is near the surface as a result of wind interactions with the terrain. In most cases, it would be within 6,000 ft above the terrain.

5.19.4.2.5 Thunderstorms

Areas of forecast thunderstorms are depicted with red dots. Thunderstorm areal coverage, cloud bases, and tops are not included.

5.19.4.2.6 Use

These charts provide a graphical overview of the specified forecast weather primarily for lower flight altitudes.

5.20 World Area Forecast System (WAFS)

ICAO's WAFS supplies aviation users with global aeronautical meteorological en route forecasts suitable for use in flight-planning systems and flight documentation.

Two WAFCs, WAFC Washington and WAFC London, have the responsibility to issue the WAFS forecasts. WAFC Washington is operated by the NWS's NCO in College Park, MD, and the AWC in Kansas City, MO. WAFC London is operated by the United Kingdom's Meteorological Office in Exeter, United Kingdom.

5.20.1 WAFS Forecasts

Both WAFC Washington and WAFC London issue the following WAFS forecasts in accordance with ICAO Annex 3, Meteorological Service for International Air Navigation.

- Global forecasts of:
 - Upper wind and temperature (i.e., wind and temperature aloft, which is also issued in chart form for select areas);
 - Upper-air humidity;
 - Geopotential altitude of flight levels;
 - Flight level and temperature of tropopause (i.e., tropopause forecast);
 - Direction, speed, and flight level of maximum wind;
 - Cumulonimbus clouds;
 - Icing; and
 - Turbulence.
- Global forecasts of Significant Weather (SIGWX), i.e., High-Level Significant Weather (SIGWX) forecasts (see paragraph [5.19.3](#)).
- Select regional areas of Medium-Level Significant Weather (SIGWX) forecasts (see paragraph [5.19.2](#)).

Note: See paragraphs [5.19.2](#) and [5.19.2.1](#) for details on the WAFS High-Level and Medium-Level SIGWX forecasts.

5.20.1.1 Issuance.

The WAWS forecasts of upper wind, temperature, and humidity; direction, speed, and flight level of maximum wind; flight level and temperature of tropopause; areas of cumulonimbus clouds; icing; turbulence; and geopotential altitude of flight levels are issued four times a day by both WAFC Washington and WAFC London.

These forecasts are produced from weather computer models and are not modified by WAFC forecasters. WAFC Washington's is from the GFS model. These forecasts are issued in grid-point format, i.e., WMO GRIB2 format.

The grid-point horizontal resolution for the WAWS forecast is 1.25 degree latitude by 1.25 degree longitude. This is equivalent to a 75 x 75 NM grid box at the equator with the grid boxes becoming progressively smaller toward the poles.

These forecasts are valid for fixed valid times at 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, and 36 hours after the time (0000, 0600, 1200, and 1800 UTC) on which the forecasts were based.

5.20.1.2 WAWS Wind and Temperature.

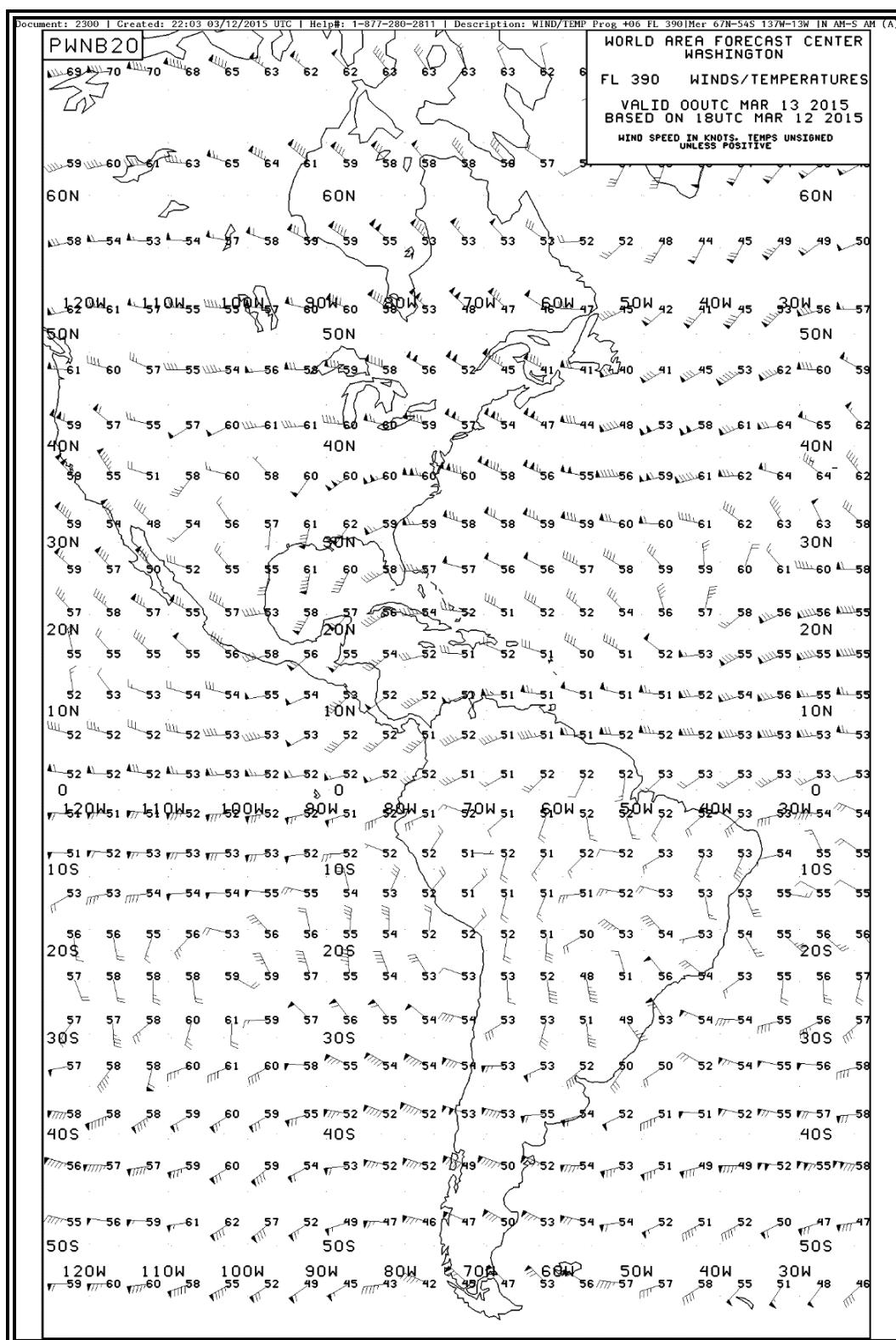
Wind and temperature forecasts are issued for flight levels (FL) 050 (850 MB), 100 (700 MB), 140 (600 MB), 180 (500 MB), 240 (400MB), 270 (350 MB), 300 (300 MB), 320 (275 MB), 340 (250 MB), 360 (225 MB), 390 (200 MB), 410 (175 MB), 450 (150 MB) and 530 (100 MB).

Note: ICAO uses flight levels below 18,000 MSL for global weather products.

WAFC wind and temperature forecasts use a plotting model where the air temperature (degrees Celsius) is the center of the data point and the wind direction and speed follows the standard model (see Figure 5-72, WAWS Wind and Temperature 6-Hour Forecast at FL 390—Example) with the exception that wind speed for points in the Southern Hemisphere is flipped. Note the data points do not correspond to any airports or reference points with names or identifiers.

WAWS global wind and temperature forecasts are provided in grid point format (e.g., computer format) for use in flight-planning systems. Chart format is also provided on the AWC's Web page (under "Flight Folder").

Figure 5-72. WAFS Wind and Temperature 6-Hour Forecast at FL390—Example



5.20.1.3 Humidity, Maximum Wind, Tropopause Forecasts.

No specific charts are issued for global upper-air humidity, maximum wind, height of tropopause, and altitude of flight levels. These products are provided in grid point format (e.g., computer format) for use in flight-planning systems. Data from these forecasts are used by the WAFC forecasters to produce the High-Level and Medium-Level SIGWX forecasts, which contain tropopause and jet stream forecasts.

Humidity data is produced for FLs 50 (850 MB), 100 (700 MB), 140 (600 MB), and 180 (500 MB).

5.20.1.4 WAFS Turbulence, Icing, and Cumulonimbus Cloud Forecasts.

WAFS global turbulence, icing, and cumulonimbus cloud forecasts are provided in grid point format (e.g., computer format) for use in flight-planning systems, but the AWC does make these available on their website in Web display format and not chart format. The Web display allows the user to select various products and flight levels and view the forecasts as single time steps or in a movie loop sequence. More detailed information is provided on <http://www.aviationweather.gov> under WAFS Forecasts.

The WAFS global turbulence, icing, and cumulonimbus cloud forecasts are actually a blend of the WAFC Washington global turbulence, icing, and cumulonimbus cloud forecasts and the WAFC London global turbulence, icing, and cumulonimbus cloud forecasts. In other words, each WAFC produces their own global turbulence, icing, and cumulonimbus cloud forecasts using their own global computer models (WAFC Washington uses NCEP's GFS model). The two WAFC's forecasts, for turbulence, icing, and cumulonimbus cloud *only*, are then merged together to eliminate any differences between the two sets of forecasts.

WAFCs provide written guidance material on these WAFS forecasts, available on ICAO's Meteorology Web page. Consult the Guidance on the Harmonized WAFS Grids for Cumulonimbus Cloud, Icing and Turbulence Forecasts - 11 September 2012 at http://www.icao.int/safety/meteorology/WA_FSOPOSG/Pages/GuidanceMaterial.aspx.

5.20.1.4.1 WAFS Turbulence.

Two kinds of turbulence forecasts are provided: Clear Air Turbulence (CAT) and in-cloud turbulence.

Clear Air Turbulence.

As of 2015, WAFS CAT forecasts are derived from an algorithm that is based on the Ellrod Index. The Ellrod Index results from an objective technique for forecasting CAT. The index is calculated based on the product of horizontal deformation and vertical windshear derived from numerical model forecast winds aloft. Future upgrades to this product are planned, which may include

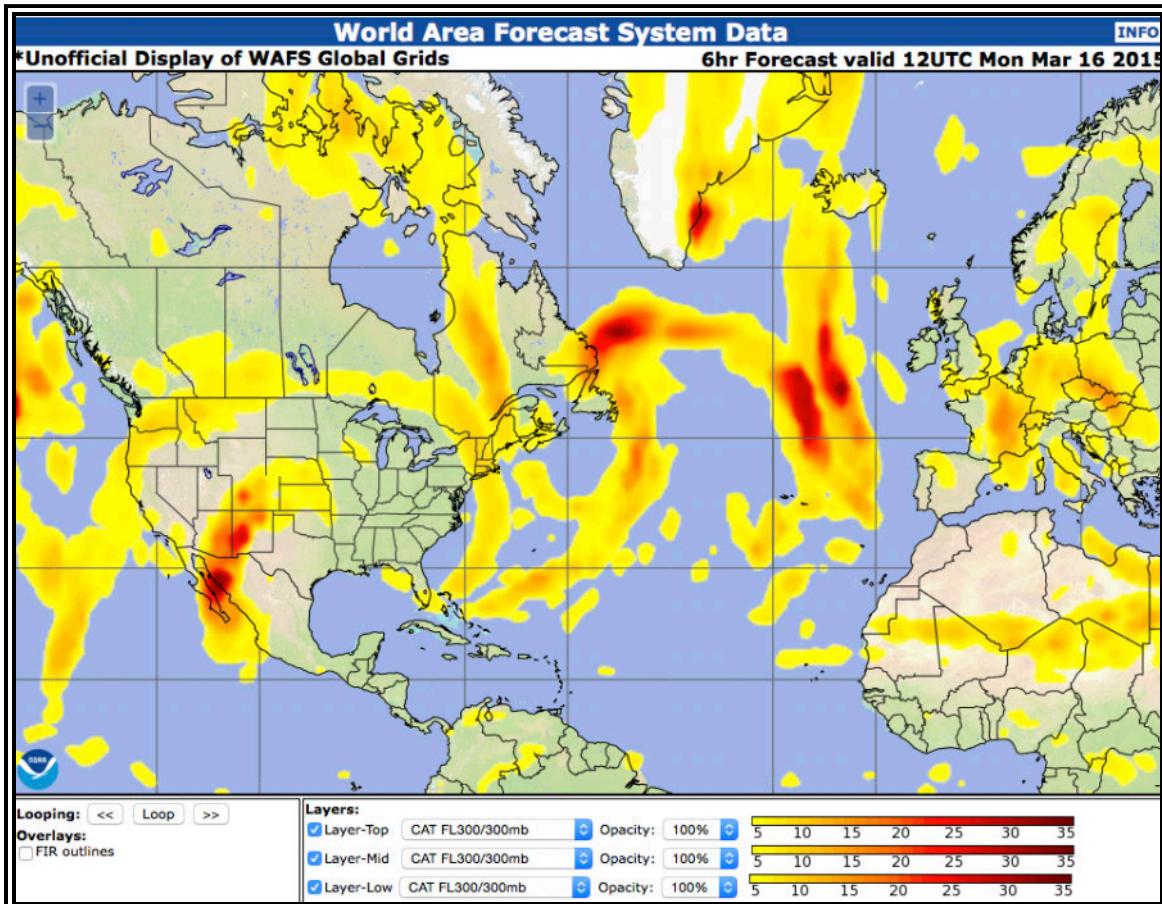
replacing the Ellrod Index with global version of the GTG forecast (see paragraph [5.21.2](#)).

The theoretical limit to the data range is zero to 99, but over 98 percent of the values will be below 11, and they will rarely exceed 40. The numbers are not a probability but are instead a potential of encountering turbulence of any severity. The WAFCs suggests that a value of 6 should be considered as a threshold for moderate or greater turbulence. AWC's WAFS website provides a display (see Figure [5-73](#), WAFS CAT Forecast—Example) of WAFS forecasts, which includes CAT forecasts with values from 5 to 35.

CAT forecasts are produced for six vertical layers, each having a depth of 50 MB (see Table 5-28, WAFS Clear Air Turbulence Forecasts). Approximate equivalent flight levels for each of the layers are shown in the right column of the table. AWC's WAFS website provides a display of WAFS forecasts, which includes CAT forecasts.

Table 5-28. WAFS Clear Air Turbulence Forecasts

Layer centred at (MB)	Layers from (MB)	Approximate Flight level
150	125-175	410-480
200	175-225	360-410
250	225-275	320-360
300	275-325	280-320
350	325-375	250-280
400	375-425	220-250

Figure 5-73. WAFS CAT Forecast—Example

WAFS CAT 6-hour forecast for a layer centered at FL300 (300MB), i.e., from FL280 to FL320, for values from 5 (yellow shade) to 35 (red shade).

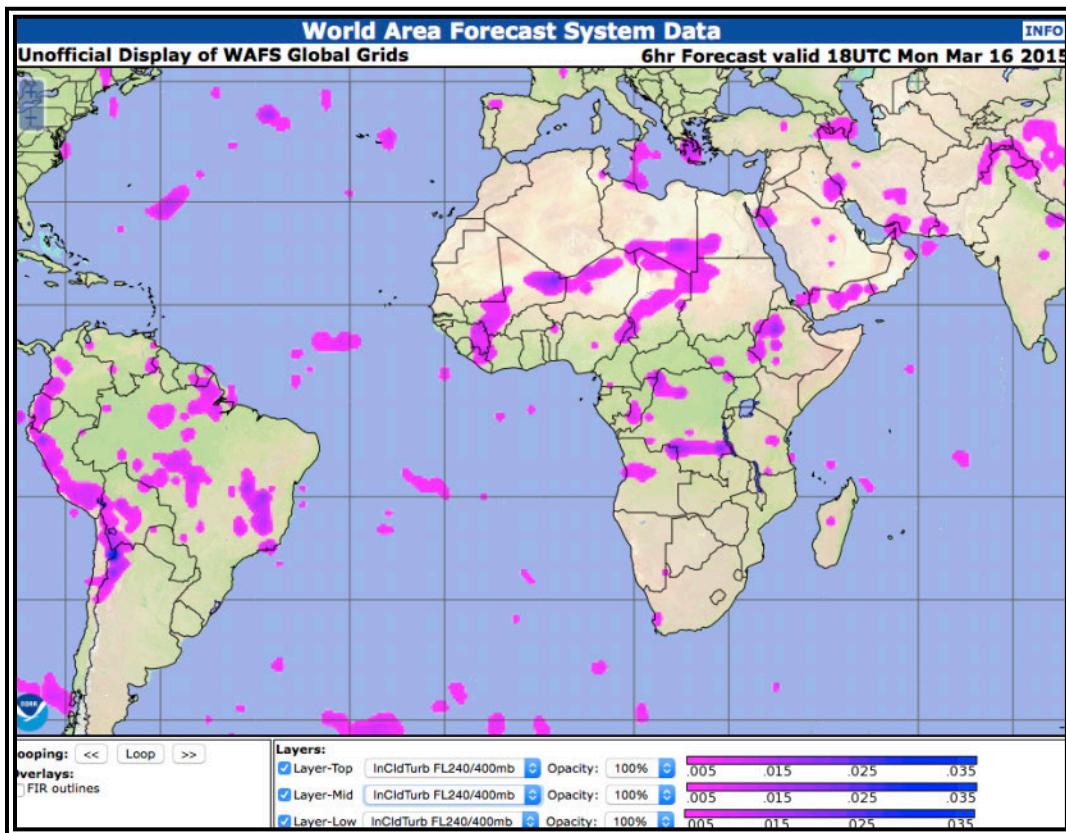
In-Cloud Turbulence.

The in-cloud turbulence algorithms are based on the model indicating the presence of a cloud and the change in potential energy with height, which is a measure of instability. The range of values in the data is from 0 to 1 and is a potential for encountering in-cloud turbulence. AWC's WAFS website provides a display of WAFS forecasts, which includes in-cloud turbulence. In-cloud turbulence values from .005 to .035 are displayed (see Figure [5-74](#), WAFS Turbulence Forecast—Example).

In-cloud turbulence forecasts are produced for five vertical layers, each having a depth of 100 MB. Approximate equivalent flight levels for each of the layers are shown in the right column of Table [5-29](#), WAFS In-Cloud Turbulence Forecasts.

Table 5-29. WAFS In-Cloud Turbulence Forecasts

Layers centred at (MB)	Layers from (MB)	Approximate Flight level
300	250-350	270-340
400	350-450	210-270
500	450-550	160-210
600	550-650	120-160
700	650-750	080-120

Figure 5-74. WAFS Turbulence Forecast—Example

WAFS In-Cloud Turbulence 6-hour forecast (purple shade) for a layer centered at FL240 (400MB), i.e., from FL210 to FL270.

5.20.1.4.2 Icing

The icing forecasts are derived from algorithms that are based on a combination of cloud condensate (ice and water), temperature, relative humidity, and vertical motion parameters that predict the presence of supercooled liquid droplets. The output is in a value range from 0 to 1 and is a potential for the presence of icing. The higher the value, the greater the risk of encountering icing. Future upgrades are planned to this model to change the output to indicate the severity of icing.

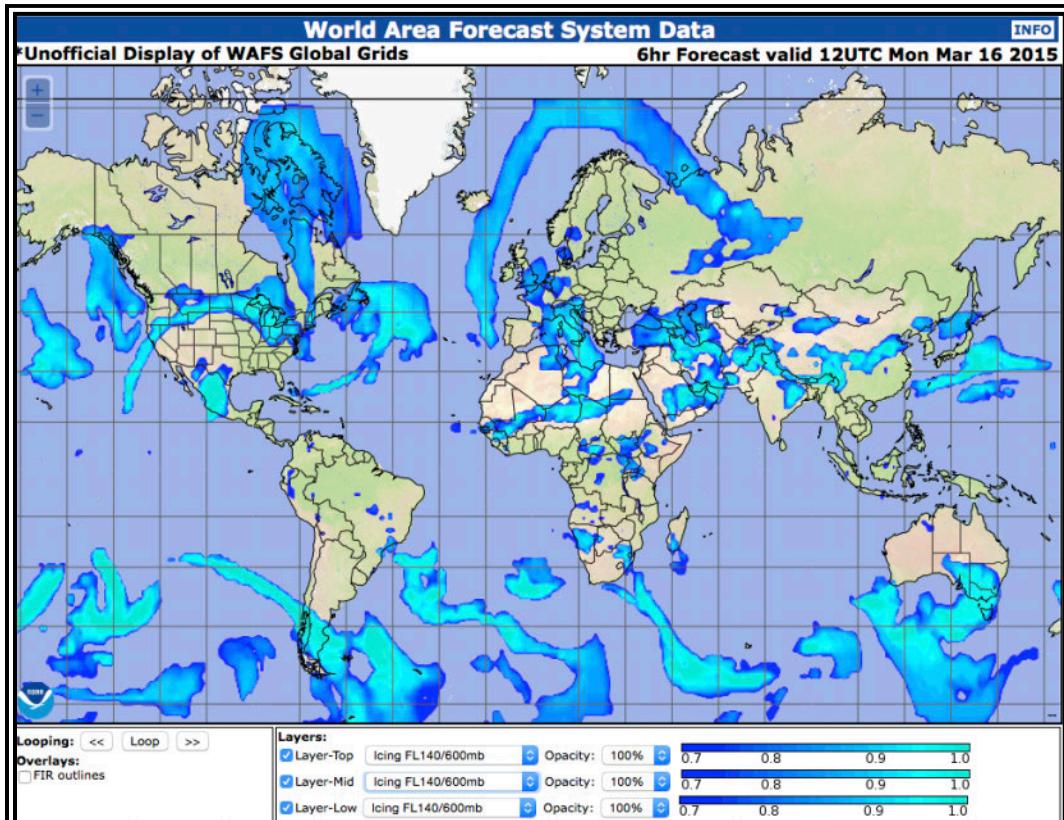
WAFS global icing forecasts are produced for six vertical layers, each having a depth of 100 MB (see Table 5-30, WAFS Global Icing Forecasts).

Approximate equivalent flight levels for each of the layers are given in the column of the Table 5-30. AWC's WAFS website provides a display of icing forecasts using a threshold of 0.7 or greater (see Figure 5-75, WAFS Icing Forecast—Example).

Table 5-30. WAFS Global Icing Forecasts

Layer centered at (MB)	Layers from (MB)	Approximate flight levels
300	250-350	270-340
400	350-450	210-270
500	450-550	160-210
600	550-650	120-160
700	650-750	080-120
800	750-850	050-080

Figure 5-75. WAFS Icing Forecast—Example



A 6-hour forecast of icing (blue shade) for a layer centered at FL140 (600MB), i.e., from FL120 to FL160, using a threshold of 0.7 or greater.

5.20.1.4.3 Cumulonimbus Cloud (CB) Forecasts.

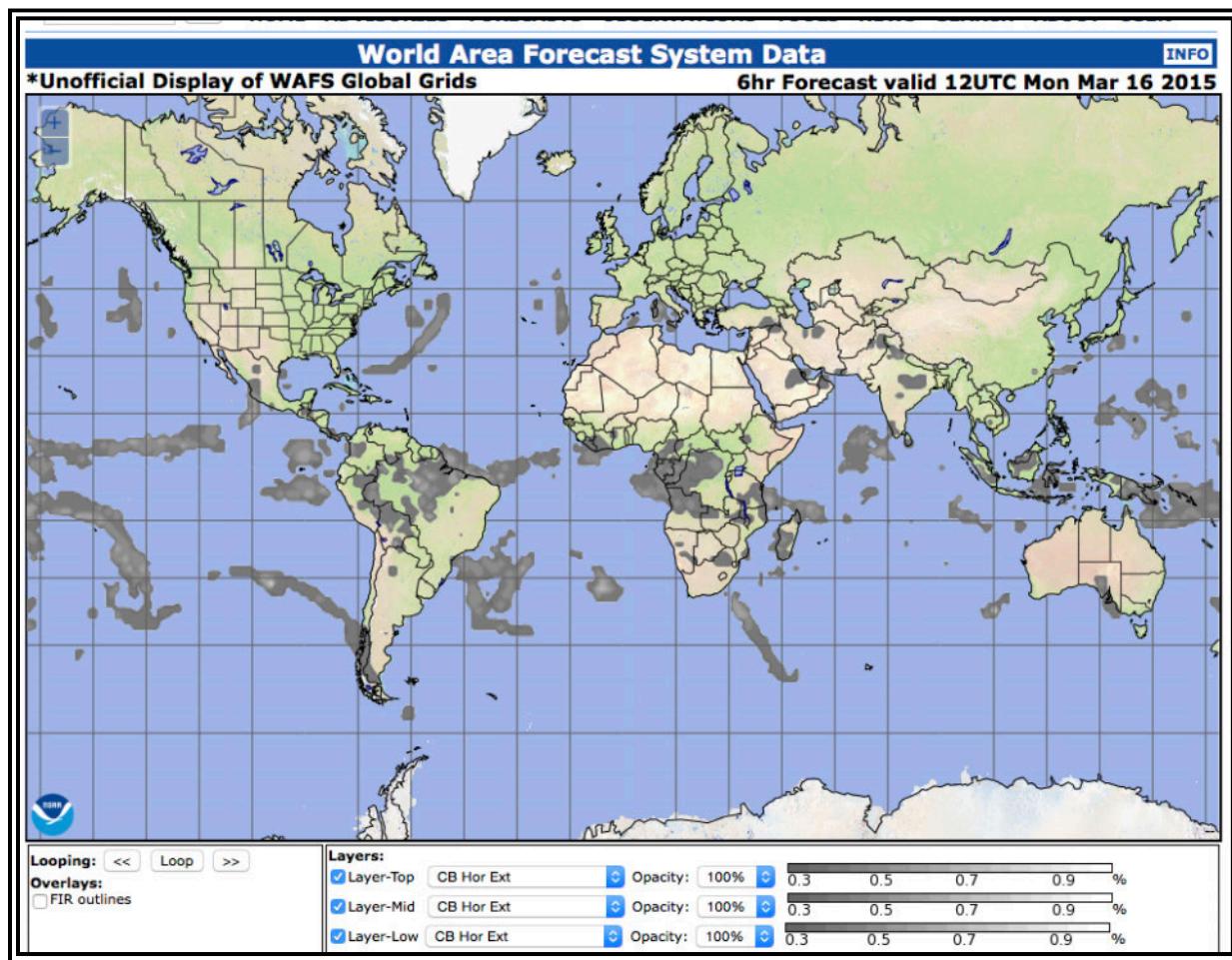
CB cloud forecasts are based on an algorithm that gives information relating to base, top, and horizontal extent (coverage) of any expected CB clouds. The algorithm is based on Convective rainfall rates.

The horizontal extent component is expressed as a value between 0 and 1, representing the fraction of sky covered by CB cloud within a grid box.

A value of 0.5 implies 50 percent coverage of CB cloud in that grid box (a grid box is 1.25 degrees latitude by 1.25 degrees longitude in size).

Where CB clouds are forecast to exist, a base and a top of the CB cloud is provided, represented by a height that can be converted into a flight level. CB base and top forecasts are provided in meters above MSL. AWC's WAWS website provides a display of CB cloud forecasts with the CB tops shown in flight levels (see Figure 5-76, WAWS CB Cloud Forecast—Example).

Figure 5-76. WAWS CB Cloud Forecast—Example



A 6-hour forecast of CB clouds (grey shade) where coverage is more than 0.3, i.e., 30 percent.

5.20.1.5 Use.

WAFFS forecasts are for use in flight planning and flight documentation for international air navigation.

5.21 Additional Products for Icing and Turbulence.

SIGMETs and AIRMETs are produced by NWS forecasters and are the advisory products for turbulence and icing information for aviation users. The NWS also produces icing and turbulence products that are derived from NWP model data with no forecaster modifications. This paragraph provides information on the following icing and turbulence products:

- Current Icing Product (CIP);
- Forecast Icing Product (FIP); and
- Graphical Turbulence Guidance (GTG).

By design, the CIP, FIP, and GTG do not use the intensity level severe. Pilots should always refer to SIGMETs for information on severe icing and severe turbulence.

CIP and FIP products contain a heavy intensity level. Heavy icing has been defined, in part, as the rate of ice accumulation that requires maximum use of ice protection systems to minimize ice accretions on the airframe. Immediate exit from the conditions should be considered. Heavy icing is not an intensity level used in PIREPs.

These icing and turbulence products will continue to evolve over the coming years with increased model resolutions, additional horizontal layers, and improvements to the algorithms and/or data sets used to produce the product. Along with these improvements may come a slight change in references to the product update version (e.g., GTG to GTG2, GTG2 to GTG3). Users can find additional information on these products and any changes on the AWC's icing and turbulence Web pages.

5.21.1 Current and Forecast Icing Products (CIP/FIP).

The CIP combines sensor and NWP model data to provide an hourly three-dimensional diagnosis of the icing environment. This information is displayed on a suite of graphics available for the CONUS, much of Canada and Mexico, and their respective coastal waters. The FIP provides the same suite of products describing the icing environment in the future and is solely NWP model based. The CIP/FIP product suites are automatically produced with no human modifications. Information on the graphics is determined from NWP model output; observational data, including WSR-88D radar; satellite, PIREPs, and surface weather reports; and lightning network data.

Note: CIP is sometimes referred to as an analysis, but it is actually a 0-hour forecast.

5.21.1.1 Issuance.

The CIP and FIP product suites are issued hourly about 15 minutes after the hour by the AWC. The products are available on their website. Gridded

versions of these products are also delivered for users who wish to integrate CIP and FIP products with flight-planning systems.

5.21.1.2 Content.

The CIP/FIP product suite as appears on <http://www.aviationweather.gov> consists of five graphics, including:

- Icing Probability;
- Icing Severity;
- Icing Severity—Probability > 25 percent;
- Icing Severity—Probability > 50 percent; and
- Icing Severity plus Supercooled Large Drop (SLD).

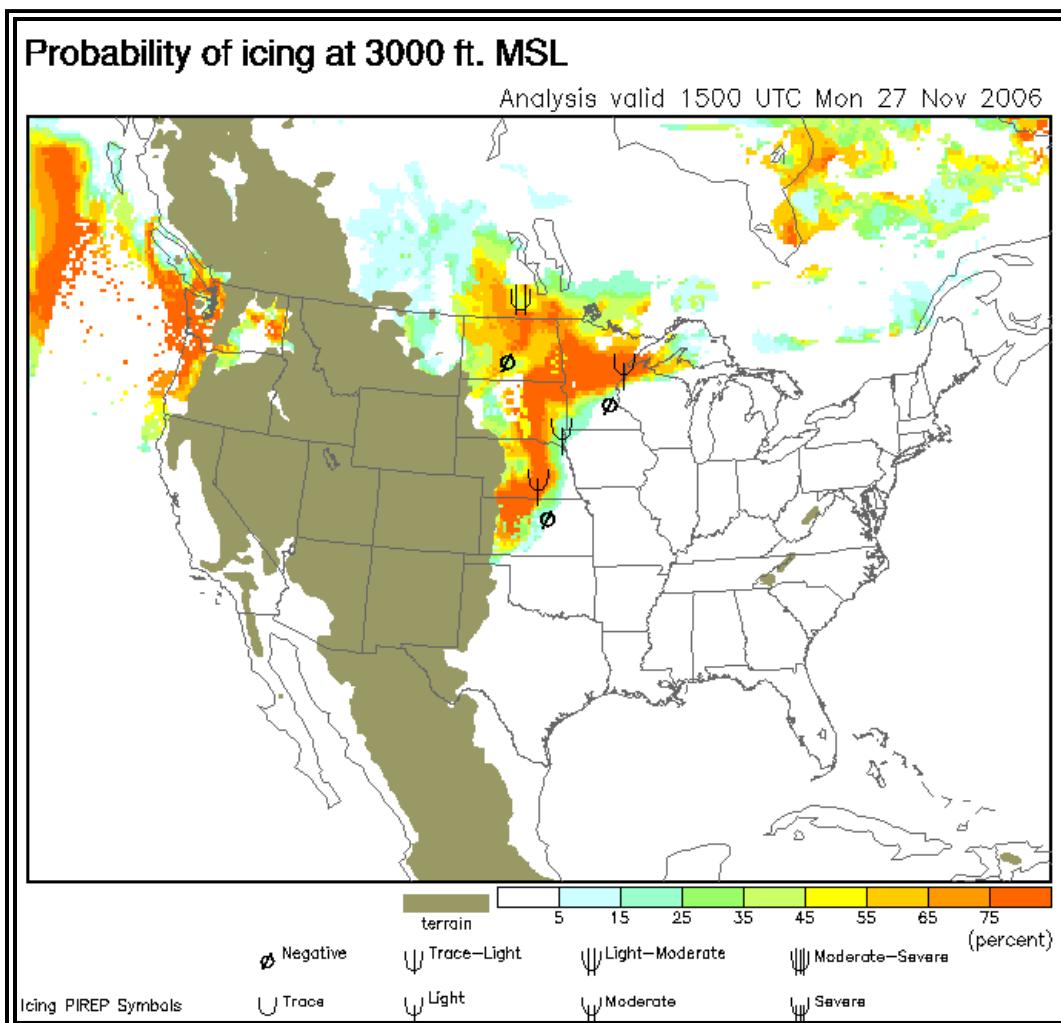
The CIP/FIP products are generated for individual altitudes from 1,000 ft MSL to FL 300 at intervals of 1,000 ft. FIP products are available at 1, 2-, 3-, 6-, 9-, 12-, and 18-hour forecast lead times.

The CIP/FIP products can be viewed at single altitudes and FLs or as a composite of all altitudes from 1,000 ft MSL to FL300, which is referred to as the maximum or max. Single altitudes are referenced to MSL from 1,000 to 17,000 ft and FLs above 17,000 ft. The AWC's website allows for access to every other altitude (1,000 FT, 3,000 FT, 5,000 FT, etc.). However, vertical cross sections and presentation of all altitudes can be viewed using the Flight Path Tool (see paragraph [6.2](#)) on <http://www.aviationweather.gov>.

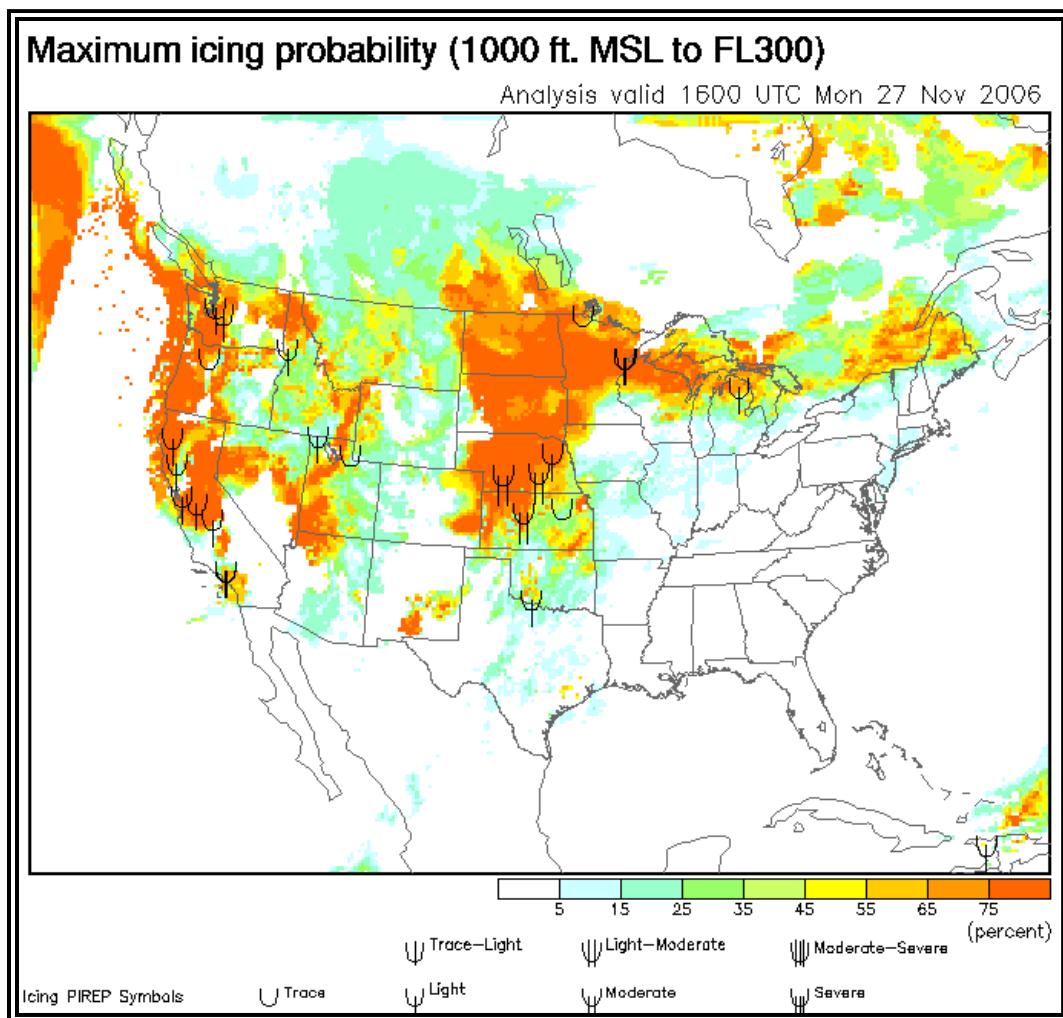
Icing PIREPs are plotted on a single altitude CIP graphic if the PIREP is within 1,000 ft of the selected altitude and has been observed within 75 minutes of the chart's valid time. Icing PIREPs for all altitudes (i.e., 1,000 ft MSL to FL300) are displayed, except negative reports are omitted to reduce clutter. The PIREP legend is located on the bottom of each graphic.

5.21.1.2.1 Icing Probability.

The icing probability product displays the probability of icing at *any* level of intensity. Probabilities range from 0 percent (no icing expected) to 85 percent or greater (nearly certain icing). The product is available on <http://www.aviationweather.gov> in single altitudes, e.g., 3,000 ft MSL (see Figure [5-77](#), CIP/FIP Icing Probability (3,000 Feet MSL)—Example), or a composite of all altitudes from 1,000 ft MSL to FL300, i.e., max level (see Figure [5-78](#), CIP/FIP Icing Probability—Max Example).

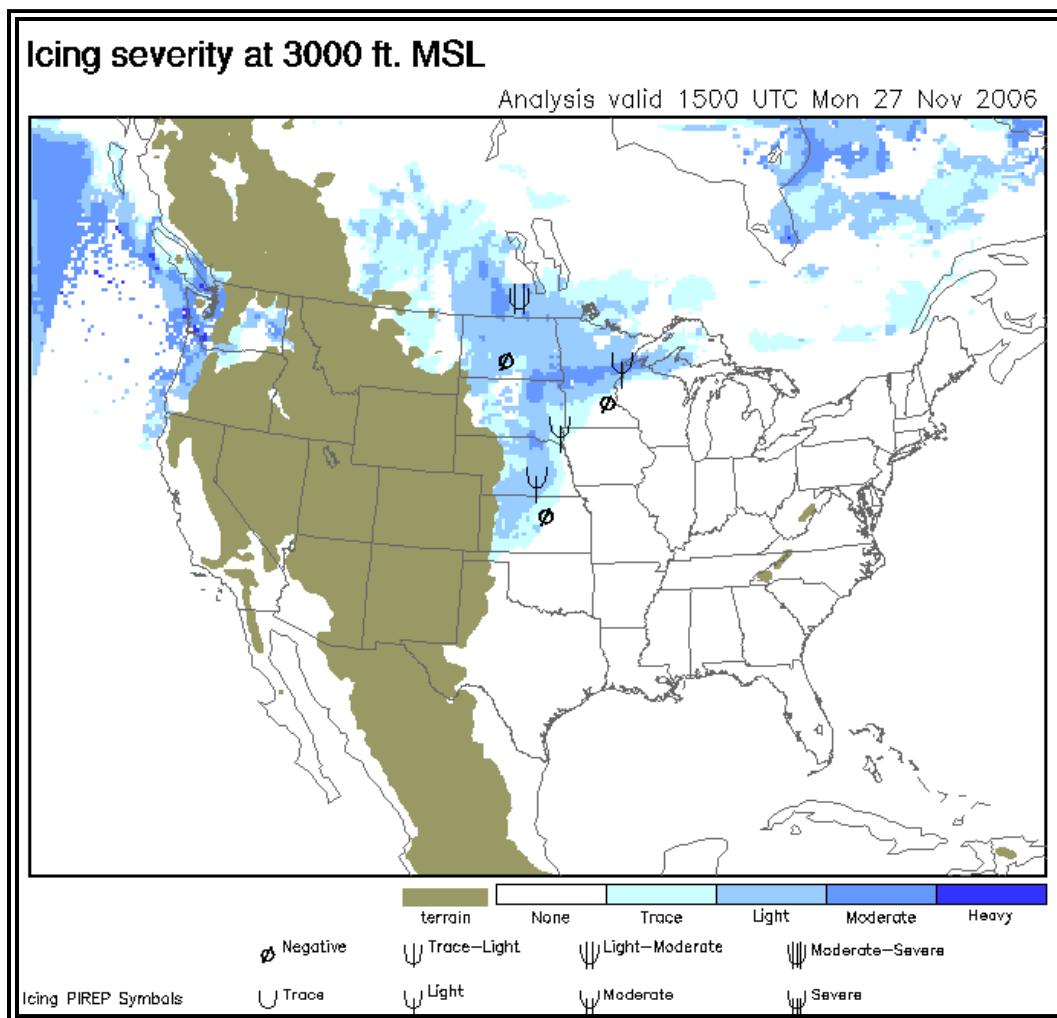
Figure 5-77. CIP/FIP Icing Probability (3,000 Feet MSL)—Example

“Cool” colors (e.g., blue and green) represent low probabilities and “warm” colors (orange and red) represent higher probabilities. Probabilities do not reach 100 percent because the data used to determine the probability of icing cannot diagnose, with absolute certainty, the presence of icing conditions at any location and altitude. White regions indicate where no probability of icing exists. Brown regions indicate where higher-elevation terrain extends above the altitude of the particular graphic.

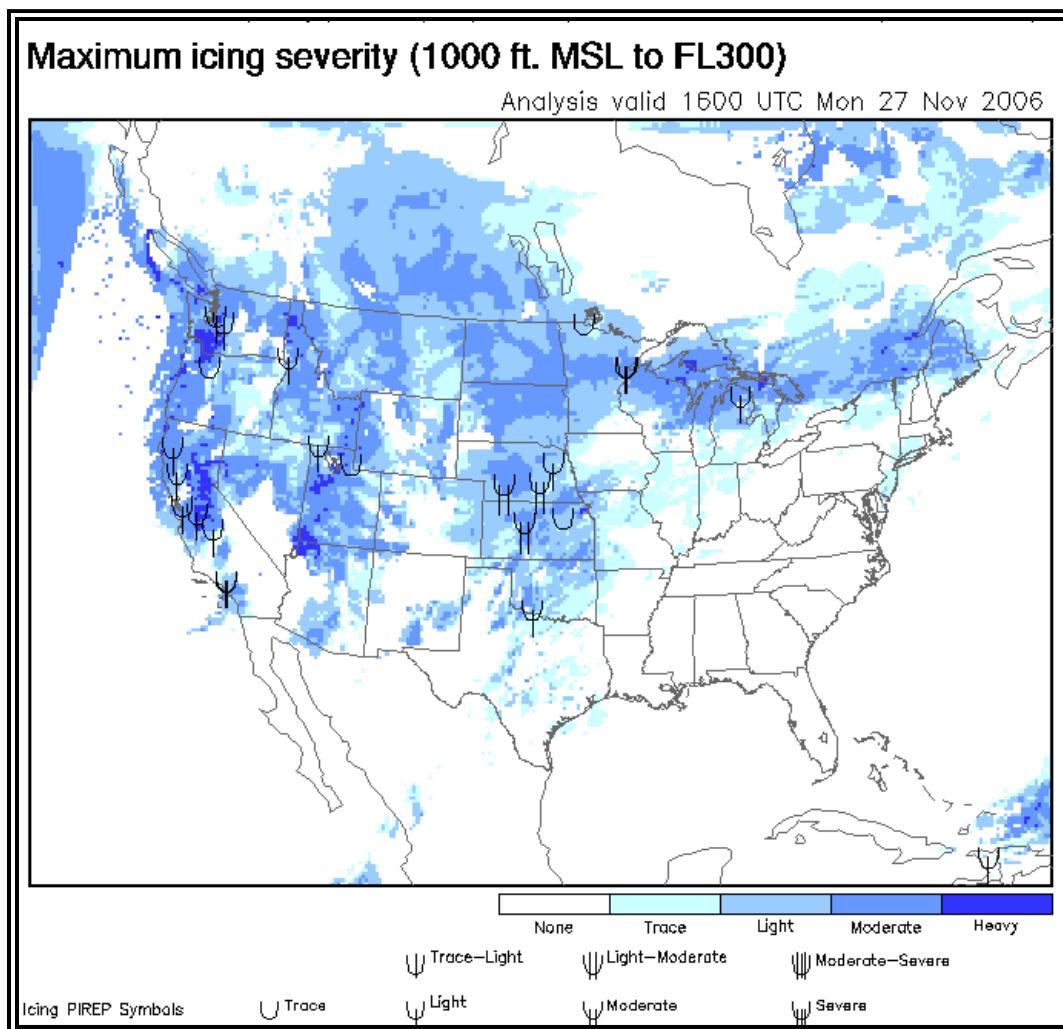
Figure 5-78. CIP/FIP Icing Probability—Max Example

5.21.1.2.2 Icing Severity.

The Icing Severity product depicts the icing intensity likelihood at locations where the icing probability product depicts possible icing. Icing intensity is displayed using icing intensity categories: trace, light, moderate, and heavy. The product is available on <http://www.aviationweather.gov> in single altitudes, e.g., 3,000 ft MSL (see Figure 5-79, CIP/FIP Icing Severity (3,000 Feet MSL)—Example), or a composite of all altitudes from 1,000 ft MSL to FL300, i.e., max level (see Figure 5-80, CIP/FIP Icing Severity—Max Example).

Figure 5-79. CIP/FIP Icing Severity (3,000 Feet MSL)—Example

The lightest blue color represents trace icing. As the blue-color shades become darker, the icing intensity increases. The darkest blue color represents heavy icing. White regions indicate where no probability of icing exists. Brown regions indicate where higher-elevation terrain extends above the altitude of the particular graphic.

Figure 5-80. CIP/FIP Icing Severity—Max Example

5.21.1.2.3 Icing Severity—Probability > 25 Percent

The Icing Severity—Probability > 25 percent product depicts where at least a 26 percent probability exists for the indicated icing intensity. Icing intensity is displayed using icing intensity categories: trace, light, moderate, and heavy.

The product is available on <http://www.aviationweather.gov> in single altitudes, e.g., 3,000 ft MSL, or a composite of all altitudes from 1,000 ft MSL to FL300, i.e., max level.

The lightest blue color represents trace icing. As the blue color shades become darker, the icing intensity increases. The darkest blue color represents heavy icing. White regions indicate where no probability of icing exists. Brown regions indicate higher-elevation terrain extending above the altitude of the particular graphic. A gray color is used to mask the intensity pixels where the probability of icing is 25 percent or less.

5.21.1.2.4 Icing Severity—Probability > 50 Percent.

The Icing Severity—Probability > 50 percent product depicts where the probability of the indicated icing intensity is at least 51 percent. Icing intensity is displayed using icing intensity categories: trace, light, moderate, and heavy. The product is available on <http://www.aviationweather.gov> in single altitudes, e.g., 3,000 ft MSL, or a composite of all altitudes from 1,000 ft MSL to FL300, i.e., max level.

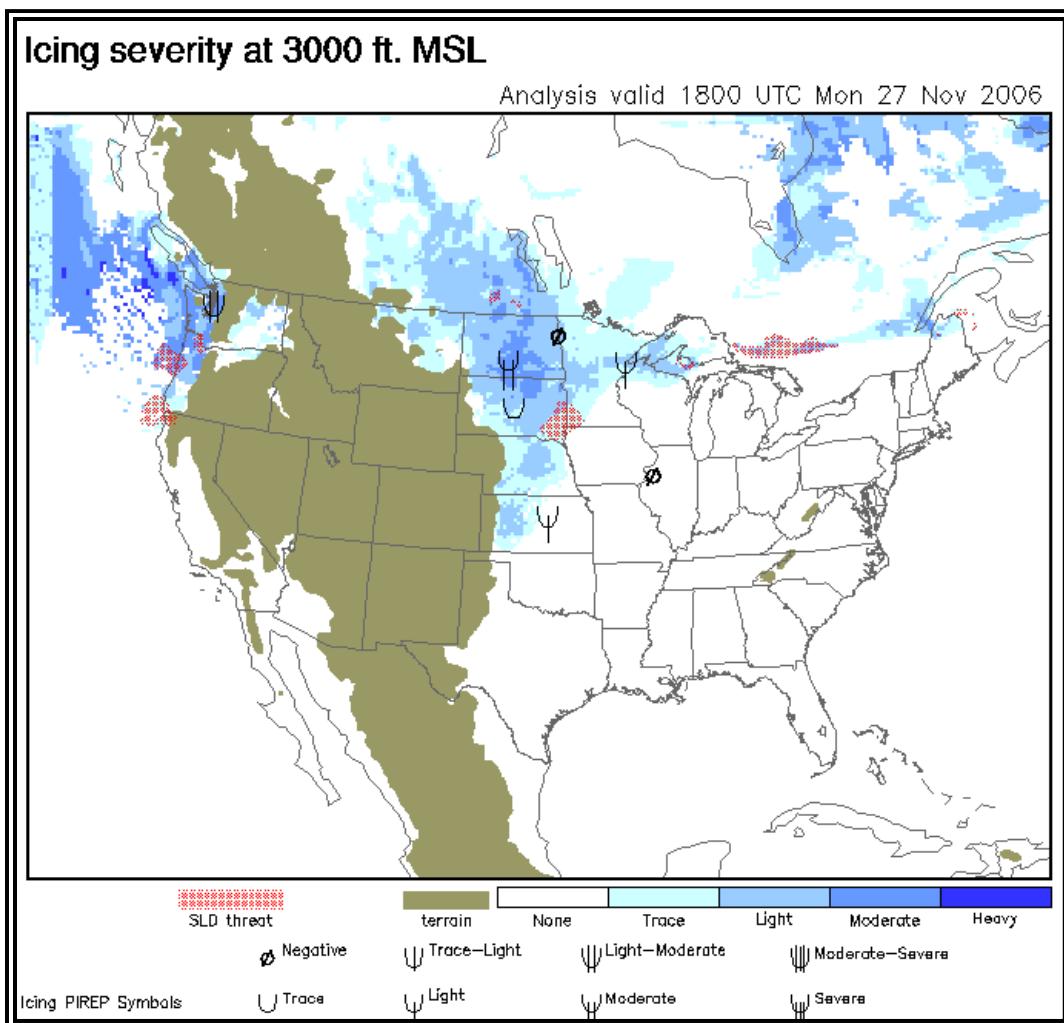
The lightest blue color represents trace icing. As the blue color shades become darker, the icing intensity increases. The darkest blue color represents heavy icing. White regions indicate where no probability of icing exists and, therefore, no intensity is necessary. Brown regions indicate where higher-elevation terrain extends above the altitude of the particular graphic. A gray color is used to mask the intensity pixels where the probability of icing is 50 percent or less.

5.21.1.2.5 Icing Severity Plus Supercooled Large Drops (SLD).

The Icing Severity plus SLD product depicts the intensity of icing expected as well as locations where a threat for SLD exists. The product is available on <http://www.aviationweather.gov> in single altitudes, e.g., 3,000 ft MSL (see Figure 5-81, CIP/FIP Icing Severity Plus Supercooled Large Drops (SLD)—Example), or a composite of all altitudes from 1,000 ft MSL to FL300, i.e., max level (see Figure 5-82, CIP/FIP Icing Severity Plus Supercooled Large Droplets (SLD)—Max Example).

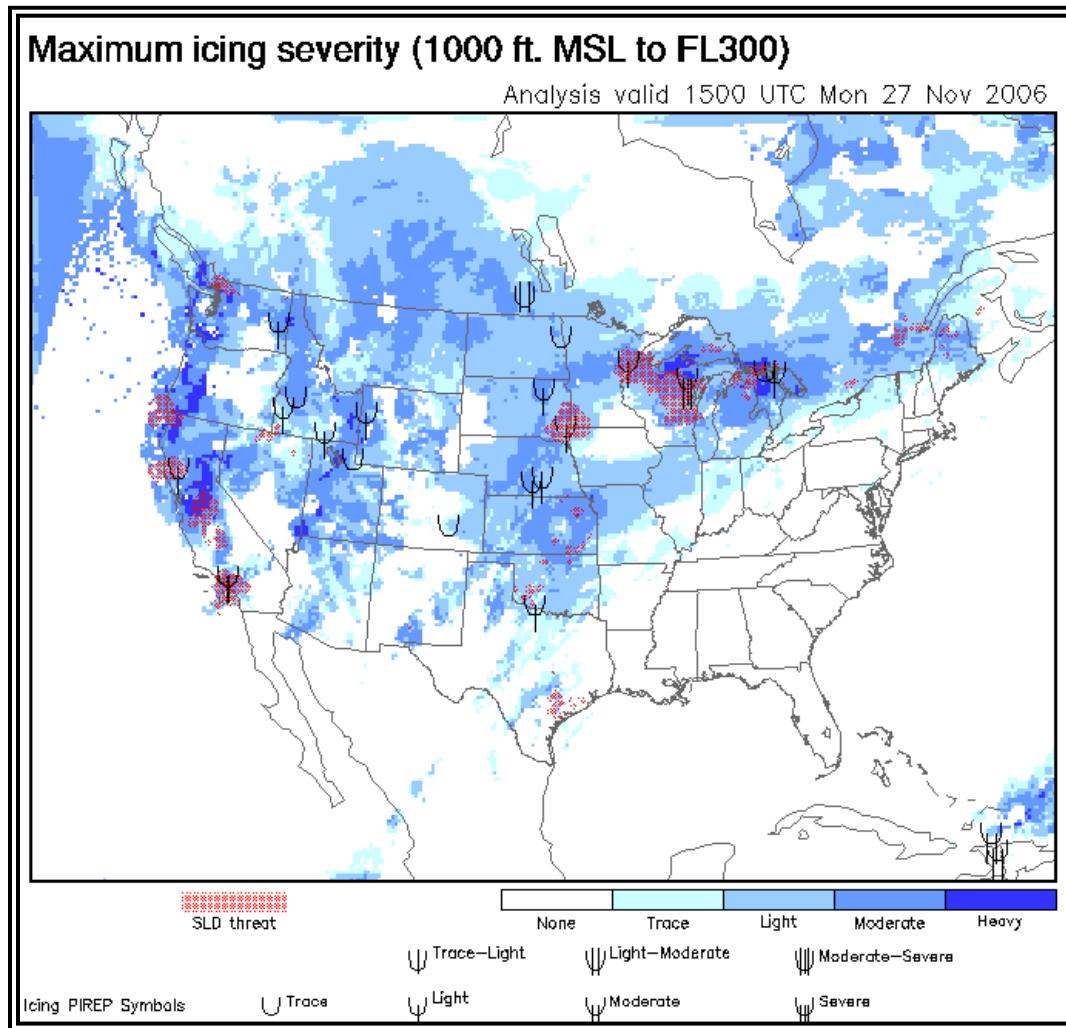
SLD is defined as supercooled water droplets larger than 50 micrometers in diameter. These size droplets include freezing drizzle and/or freezing rain aloft. SLD, which are outside the icing certification envelopes (14 CFR part 25 appendix C), can be particularly hazardous to some aircraft.

Icing intensity is displayed using icing intensity categories: trace, light, moderate, and heavy.

Figure 5-81. CIP/FIP Icing Severity Plus Supercooled Large Drops (SLD)—Example

The lightest blue color represents trace icing. As the blue color shades become darker, the icing intensity increases. The darkest blue color represents heavy icing. White regions indicate where no probability of icing exists. Brown regions indicate where higher-elevation terrain extends above the altitude of the particular graphic. Locations where a threat for SLD exists are depicted with red hatching.

Figure 5-82. CIP/FIP Icing Severity Plus Supercooled Large Droplets (SLD)—Max Example



5.21.1.3 Strengths and Limitations.

5.21.1.3.1 Strengths.

The CIP product suite is updated hourly and provides a diagnostic tool to assist in determining the probability for icing, the intensity of icing, and the threat for SLD.

5.21.1.3.2 Limitations.

Actual icing severity may be different than what is depicted on the CIP graphics and plotted PIREPS because:

- Different aircraft types experience different severities of icing in the same atmospheric environments. Severity definitions are currently pilot based and thus are a function of the aircraft type, flight phase (takeoff/landing,

cruise, etc.), aircraft configuration, as well as the pilot's experience and perception of the icing hazard.

- Assessing the amount and drop size of Supercooled Liquid Water (SLW) in the atmosphere is difficult.
- The Icing Severity products depict the severity of the meteorological icing environment and *not* the resultant icing that may occur on the aircraft.

5.21.1.4 **Uses.**

The CIP/FIP Icing Probability product can be used to identify the current and forecast three-dimensional probability of icing. The CIP/FIP should be used in conjunction with the report and forecast information contained in an AIRMET and SIGMET.

The CIP/FIP Icing Severity product can be used to determine the intensity of icing. The CIP/FIP Icing Severity—Probability > 25 percent or Probability > 50 percent depicts the probability of a given intensity of icing occurring.

Finally, the Icing Severity plus SLD product can help in determining the threat of SLD, which is particularly hazardous to some aircraft.

Icing PIREPs are plotted on single altitude graphics if the PIREP is within 1,000 ft of the graphic's altitude and has been observed within 75 minutes of the chart's valid time. On CIP/FIP max level product, PIREPs for all altitudes (i.e., 1,000 feet MSL to FL300) are displayed except negative reports do not appear to reduce clutter. The PIREP legend is located on the bottom of each graphic.

5.21.2 **Graphical Turbulence Guidance (GTG).**

The GTG product suite provides a four-dimensional diagnosis and forecast of Non-Convective turbulence intensity (as indicated by the estimated energy dissipation to the $1/3$ power—EDR in units of $\text{m}^{2/3} \text{ s}^{-1}$). GTG3 does not specifically predict turbulence associated with Convective clouds, or small-scale local terrain features, but does predict turbulence associated with upper-level clear and mountain wave sources.

Note: GTG3 is the third generation of the GTG product. Whereas the graphic examples in this paragraph state GTG3, this paragraph uses the general name of GTG in the description of the product.

The GTG is created using a combination of derived turbulence indicators from NCEP's Weather Research and Forecasting (WRF) Rapid Refresh (RAP) NWP model. The GTG product suite, which consists of 0-, 1-, 2-, 3-, 6-, 9-, 12-, and 18-hour forecasts, is automatically generated with no human modifications. It should be used in conjunction with the report and forecast information contained in an AIRMET and SIGMET. The GTG is available for the CONUS, much of Canada and Mexico, and their respective coastal waters.

5.21.2.1 Issuance.

The GTG product suite is issued and updated every hour by the AWC and is available through <http://www.aviationweather.gov>.

5.21.2.2 Content.

The GTG product (see Figure 5-83, GTG—Max Intensity Example CAT+MWT All Levels) can be viewed at single altitudes and FLs or as a composite of all altitudes from 10,000 ft MSL to FL450, which is referred to as a maximum or max (see Figure 5-84, CAT+MWT Low Levels Example (GA Users)). Single altitudes are referenced to MSL from 10,000 to 17,000 ft and FLs above 17,000 ft. The AWC’s website allows for access to every other altitude (11,000 FT, 13,000 FT, 15,000 FT, etc.). However, vertical cross sections and presentation of all altitudes can be viewed using the Flight Path Tool (see paragraph 6.2) on <http://www.aviationweather.gov>. Gridded versions of these products are also delivered for users who wish to integrate GTG with flight planning systems or to view the output in their own graphical display systems.

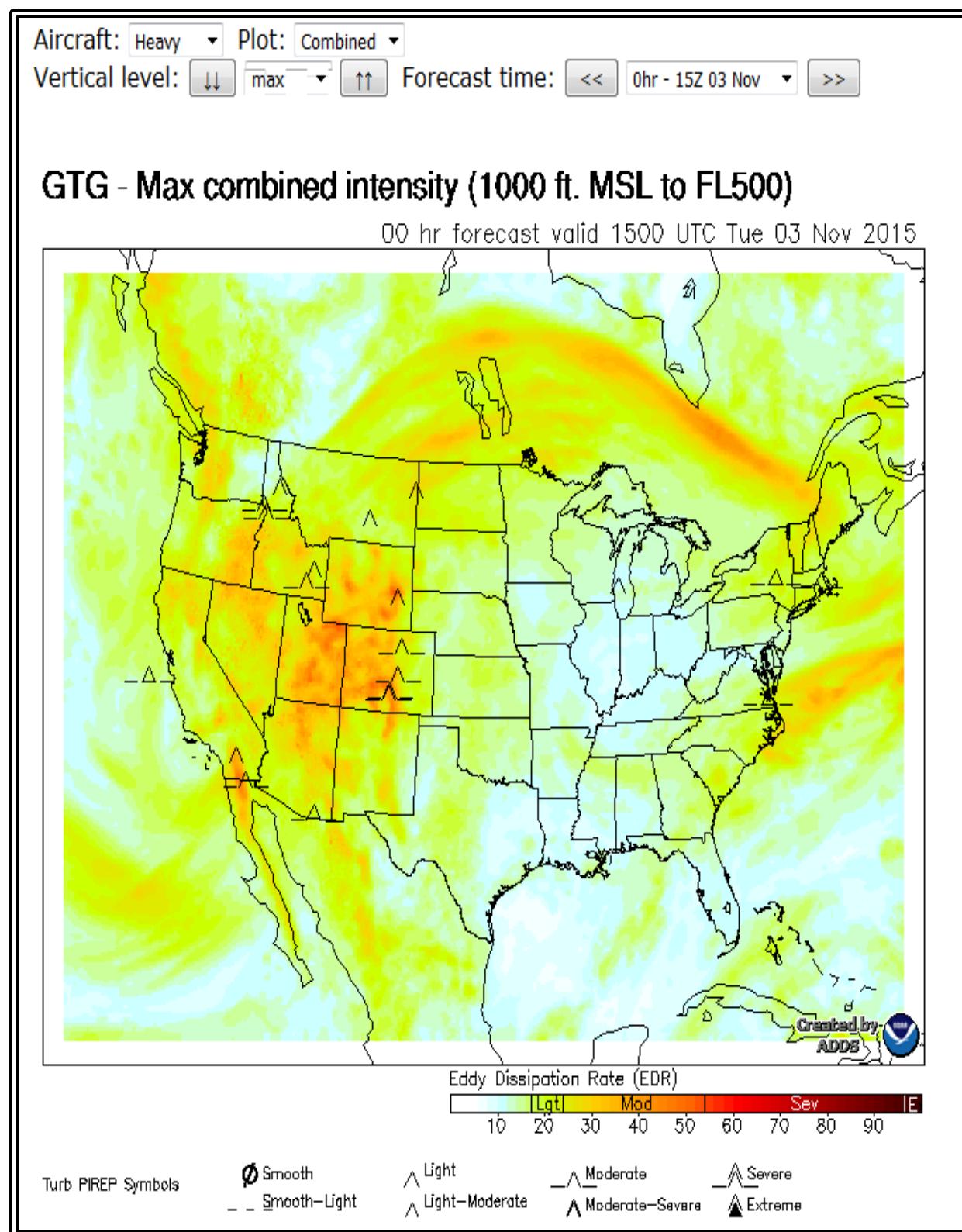
Figure 5-83. GTG—Max Intensity Example CAT+MWT All Levels

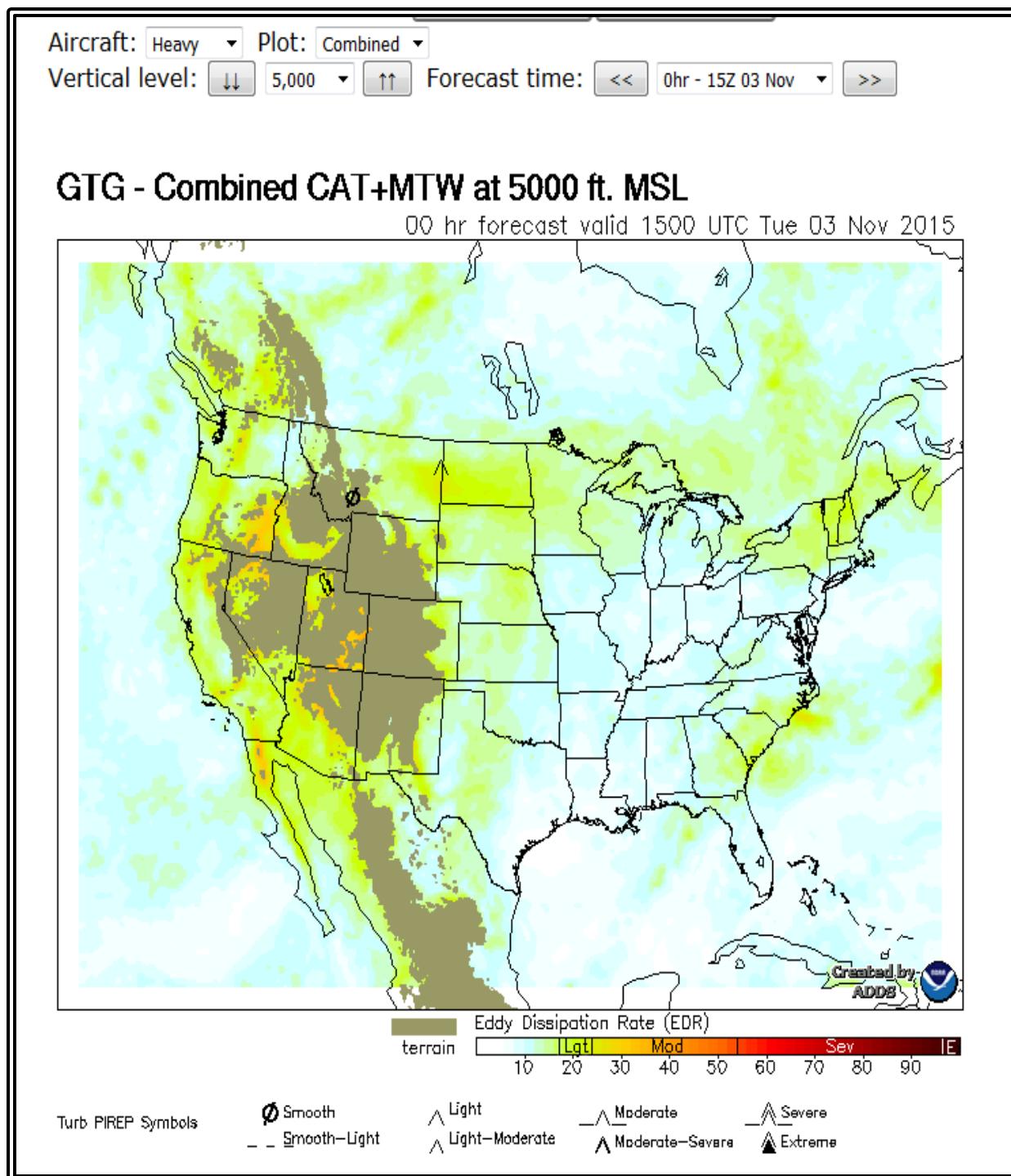
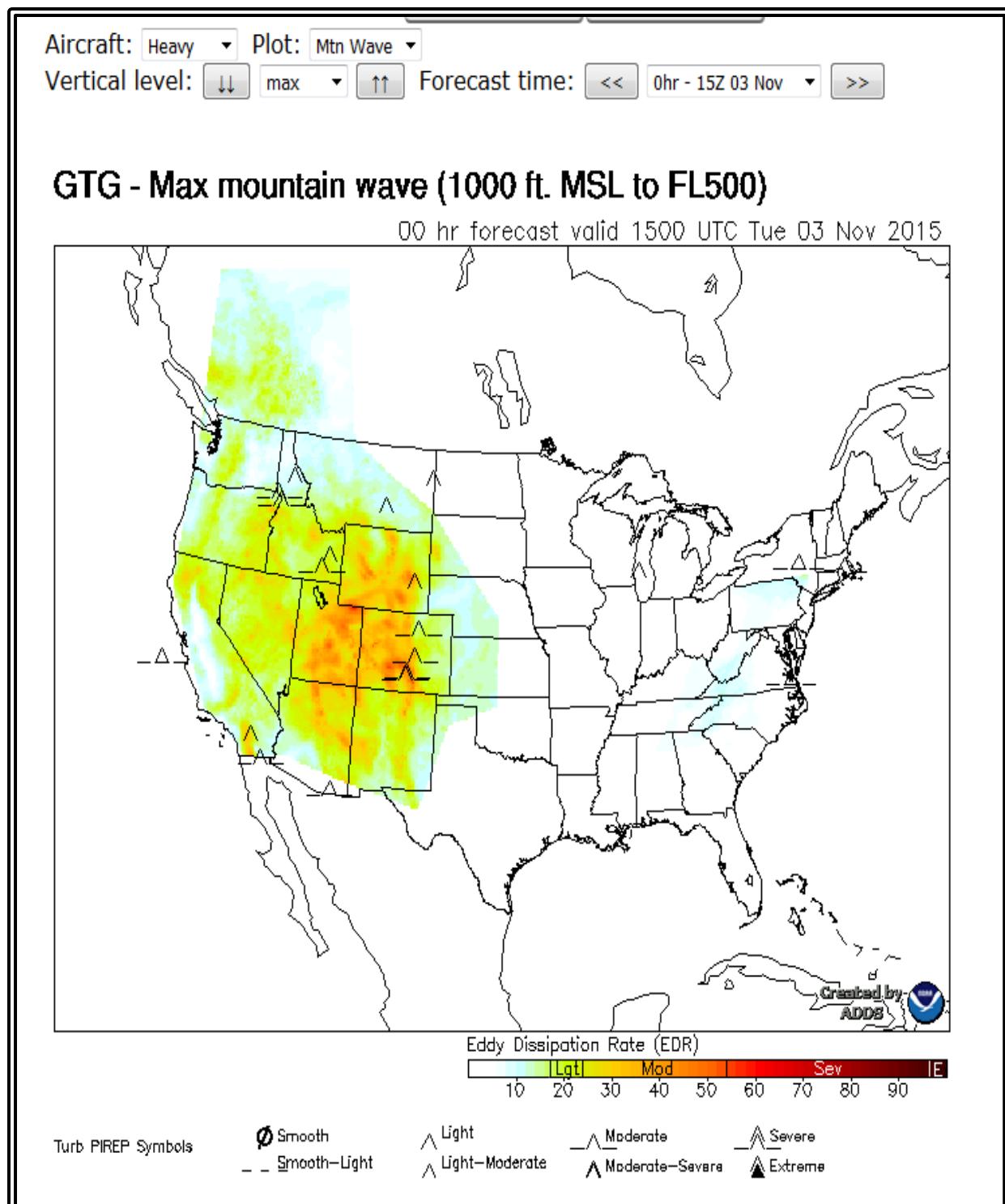
Figure 5-84. CAT+MWT Low Levels Example (GA Users)

Figure 5-85. Explicit MWT Forecasts Example

5.21.2.3 Strengths and Limitations.

The GTG provides an hourly, high-resolution product of EDR at and above 10,000 ft MSL in 1,000-ft intervals. The product is based on an ensemble of

turbulence indicators and, therefore, can capture more diverse sources of turbulence and provide a more reliable forecast than can be provided by a single indicator. However, it does not specifically predict turbulence associated with Convective clouds, or small-scale terrain features, but does predict turbulence associated with upper-level clear and mountain wave sources.

5.21.2.3.1 Strengths.

- The product is issued hourly out to a maximum 18-hour lead time.
- Turbulence is plotted to a high resolution.
- The product is based on an ensemble of turbulence indicators and, therefore, can capture more diverse sources of turbulence and provide a more reliable forecast than can be provided by a single indicator.

5.21.2.3.2 Limitations.

- The accuracy of the product depends on the accuracy of the computer model output used to create them.
- The product does not specifically predict turbulence associated with Convective clouds or small-scale local terrain features.

5.21.2.4 Use.

The maximum product can provide a quick method to determine what the greatest potential of turbulence is at a given location. However, to determine the turbulence potential at any given altitude, the individual altitude output must be viewed.

The AWC's website overlays turbulence PIREPS on the single altitude graphics. For the PIREP to be plotted on the single altitude product, it must be located within 1,000 ft vertically of the displayed altitude and have been reported within 90 minutes of the chart time. For example, if a user viewed the FL240 GTG product with a valid time of 1400Z, the displayed PIREPS could be located between FL230 and FL250 and reported between 1230Z and 1400Z.

5.22 Additional Products for Clouds, Visibility, Weather, and Surface Wind Forecasts.

5.22.1 NWS Aviation Forecast Discussion.

Aviation Forecast Discussions describe the weather conditions within a multistate or substate sized area. They also may:

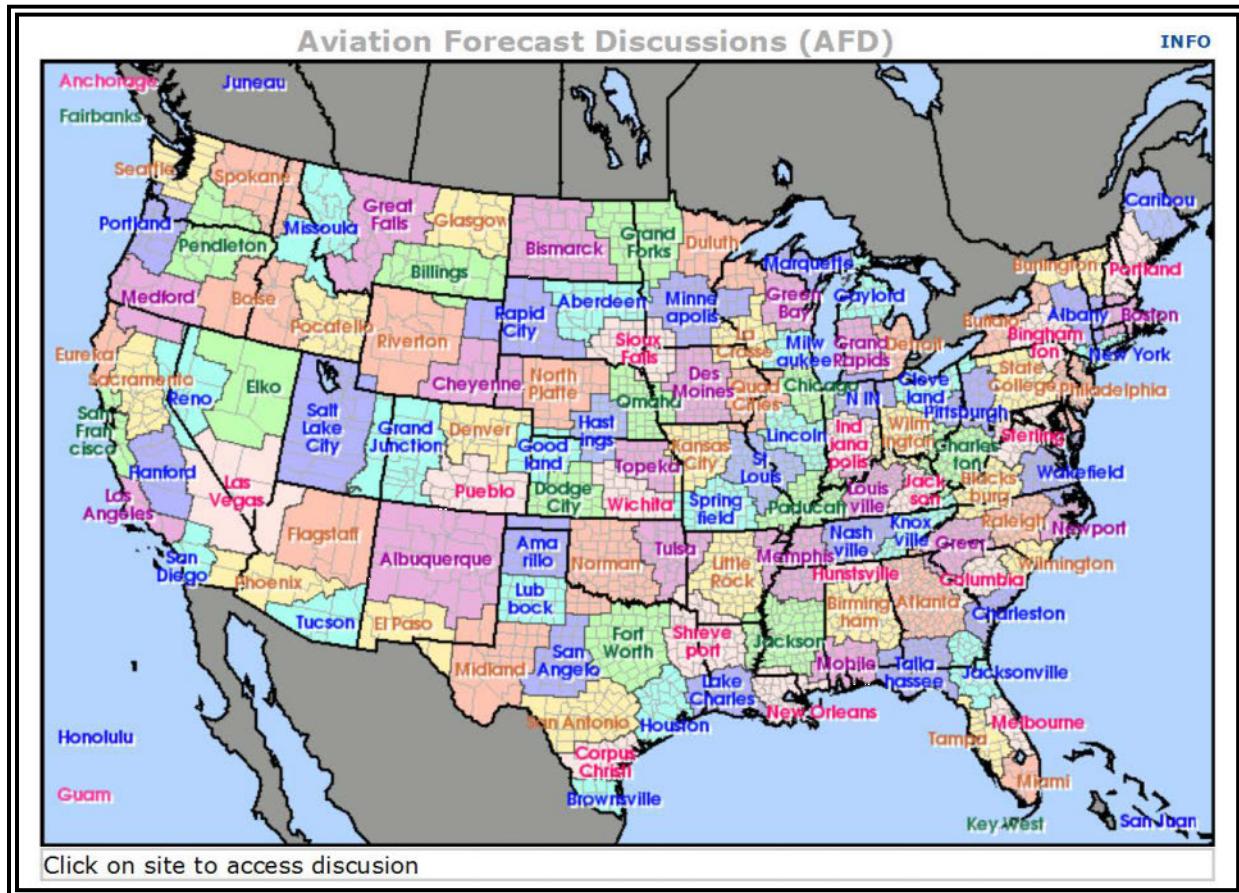
- Describe the weather conditions as they relate to a specific TAF (see paragraph [5.13](#)) or group of TAFs; and
- Provide additional aviation weather-related issues that cannot be encoded into the TAF, such as the reasoning behind the forecast.

Aviation Forecast Discussions are available at <http://www.aviationweather.gov> as well as each NWS WFO website.

5.22.1.1 **Issuance.**

Aviation Forecast Discussions are issued by each NWS WFO for their AOR (see Figure 5-86, Map of NWS Weather Forecast Office's Area of Responsibility). They are issued roughly every 6 hours and correspond to the issuance of TAFs from the respective NWS WFO.

Figure 5-86. Map of NWS Weather Forecast Office's Area of Responsibility



5.22.1.2 **Format.**

Aviation Forecast Discussions are a free-form plain language text product. Common or well-known aviation weather contractions are used as well as local or regional geographic names, such as valleys, mountain ranges, and bodies of water. Each NWS office may tailor the format to meet the needs of their local aviation users.

5.22.1.3 Examples.

NWS Boise, ID

COLD FRONT CURRENTLY OVER SW IDAHO WEST OF THE MAGIC VALLEY. IFR IN HEAVIER RAIN/SNOW SHOWERS BEHIND THE FRONT MOSTLY IN THE MTNS UNTIL THIS EVENING. OTHERWISE LOW VFR THROUGH TOMORROW WITH ISOLATED SHOWERS INTO THE EVENING. SURFACE WINDS...W TO NW WITH GUSTS 20-30 KTS...BECOMING 35-45 KTS IN THE UPPER TREASURE AND MAGIC VALLEYS FOR A FEW HOURS THIS AFTERNOON...DROPPING DOWN TO 20-30 KTS OVERNIGHT INTO THE MORNING IN THE MAGIC VALLEY AND 5-10 KTS ELSEWHERE. WINDS ALOFT NEAR 10K FT MSL...NW 30-40 KTS...40-50 KTS OVER THE UPPER TREASURE AND MAGIC VALLEYS OVERNIGHT...BECOMING 20-30 KTS BY 15/12Z.

NWS Buffalo, NY

EXPECT LIMITED LAKE EFFECT CLOUDS TO LINGER SOUTHEAST OF LAKE ONTARIO INTO THIS EVENING. EVEN SO...CONDITIONS SHOULD BE MAINLY VFR WITH CLOUD BASES JUST ABOVE 3K FT. AFTER THIS...SKIES WILL CLEAR OUT WITH A PROLONGED PERIOD OF VFR CONDITIONS LIKELY TO LAST THROUGH SUNDAY.

OUTLOOK...

SUNDAY NIGHT THROUGH TUESDAY...AREAS OF MVFR IN RAIN/SNOW SHOWERS. WEDNESDAY...VFR. THURSDAY...VFR/MVFR. A CHANCE OF RAIN.

NWS Chicago, IL

ORD AND MDW CONCERNS...UPDATED 20Z...

- * LAKE BREEZE INFLUENCED EAST-NORTHEAST WINDS THIS AFTERNOON GENERALLY 8-10 KT RANGE.
- * PRECIPITATION DEVELOPING MID-MORNING SUNDAY...COULD INCLUDE A MIX OF SLEET/SNOW FOR 1-2 HOURS AT ONSET BEFORE CHANGING TO ALL RAIN WITH TEMPERATURES ABOVE FREEZING.
- * VERY GUSTY SOUTHWEST WINDS SUNDAY...SUSTAINED 20 KT WITH GUSTS OVER 30 KT.

5.22.1.4 Use.

Aviation Forecast Discussions provide the aviation weather user with additional information regarding the weather affecting airports with TAF service as well as weather features affecting NWS WFO's AOR.

The AWC's website is the ideal location to access all Aviation Forecast Discussions.

5.22.2 NWS National Digital Forecast Database Graphic Products

The NWS's NDFD graphical products are a seamless mosaic of weather forecasts from NWS WFOs and the NWS's NCEP. The NDFD graphic products are derived from a prescribed set of data contained within the NWS's NDFD. The NDFD is NWS's official database of the 7-day public and select other forecasts for the 50 states, Guam, and Puerto Rico.

The NDFD graphical products complement the Short-Range Surface Prognostic Charts (see paragraph 5.18), which are also based on the NDFD. The NDFD graphical products can be found on all NWS WFO websites. A subset of these products (i.e., sky cover, predominant weather, surface winds) are available on <http://www.aviationweather.gov>, as well as the websites of Flight Service Station (FSS) service providers.

5.22.2.1 Issuance.

NWS offices and centers routinely update NDFD graphical products. NDFD graphical forecasts for days 1, 2, and 3 are provided for the following times: 0000, 0300, 0600, 0900, 1200, 1500, 1800, and 2100 UTC. NDFD graphical forecasts for days 4 through 7 are provided for 0000 and 1200 UTC. Proposals to provide day 1 and 2 NDFD graphical products at 1-hour time intervals are being considered by the NWS.

A subset of the NDFD graphical forecasts (i.e., cloud cover, predominant weather, surface winds), valid for three hourly time steps out to 18 hours, is available on <http://www.aviationweather.gov>, as well as the websites of Flight Service Station service providers.

5.22.2.2 Content.

The NDFD graphical product display is a Web-based seamless mosaic of weather forecasts from the NWS.

The NDFD graphical products can be displayed on a national display, regional display, and sub-regional display. A subset of the NDFD graphical forecasts (i.e., sky cover, predominant weather, surface winds) is available on <http://www.aviationweather.gov> in a CONUS projection as well as select regional projections.

NDFD graphical products are divided into the following categories: public, marine, fire weather, tropical, and hazardous. The NDFD public graphic products are available for the following:

- Maximum and minimum temperature;
- Temperature;
- Dewpoint;
- Relative humidity;
- Sky cover;
- Weather;
- Hazards;
- Probability of precipitation;
- Amount of precipitation;
- Snow amount;

- Snow level;
- Ice accumulation;
- Sky cover; and
- Surface wind direction, speed, and gusts.

The paragraph will describe the subset of the NDFD graphical forecasts available on <http://www.aviationweather.gov> in a CONUS projection as well as select regional projections. These subset products are sky cover, predominant weather, and surface winds.

Note: The regional examples shown in this paragraph are from the NWS's NDFD website. The areas depicted may be slightly different on <http://www.aviationweather.gov>, as well as the websites of FSS service providers.

5.22.2.2.1 Sky Cover.

The Sky Cover graphic (see Figure 5-87, NDFD Sky Cover Graphic Product—Example, and Figure 5-88, NDFD Sky Cover Graphic Product—Example) is the forecast of the amount of clouds (in percent) covering the sky valid for the indicated hour.

Figure 5-87. NDFD Sky Cover Graphic Product—Example

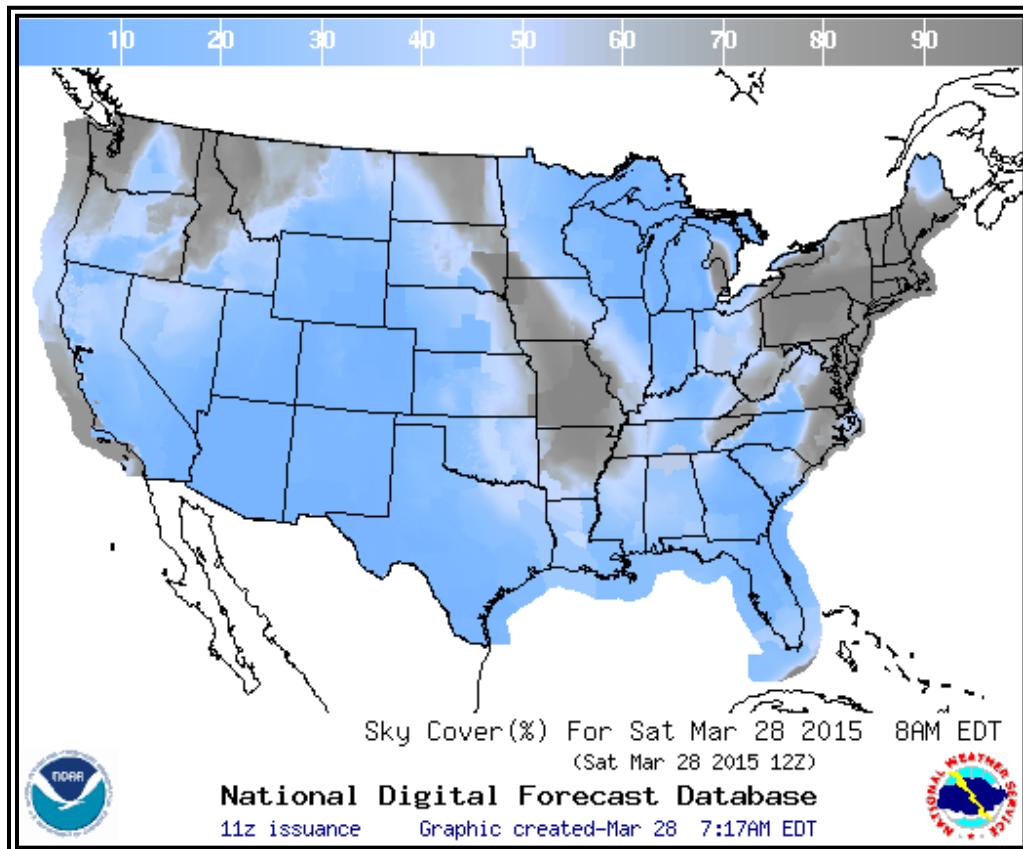
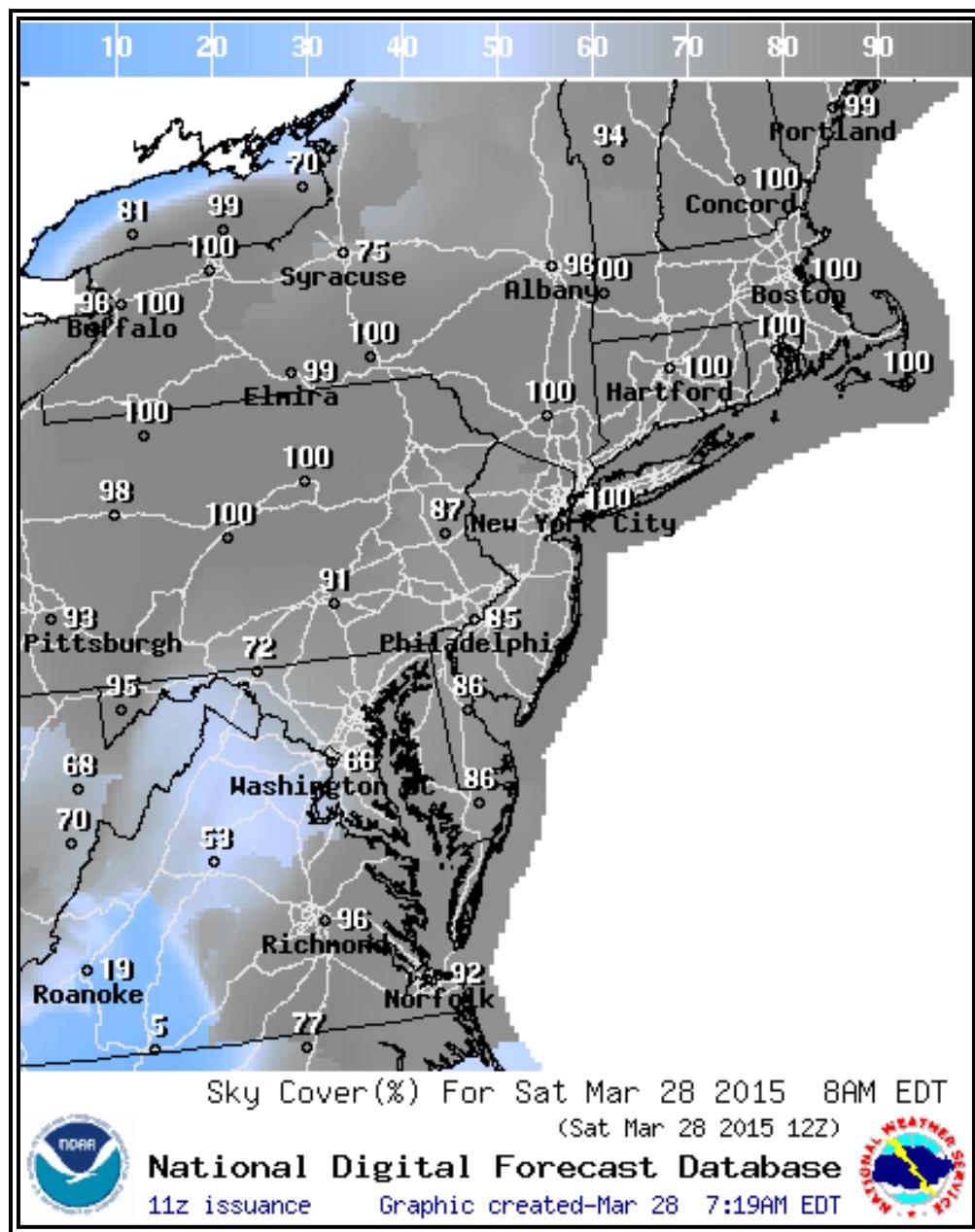


Figure 5-88. NDFD Sky Cover Graphic Product—Example

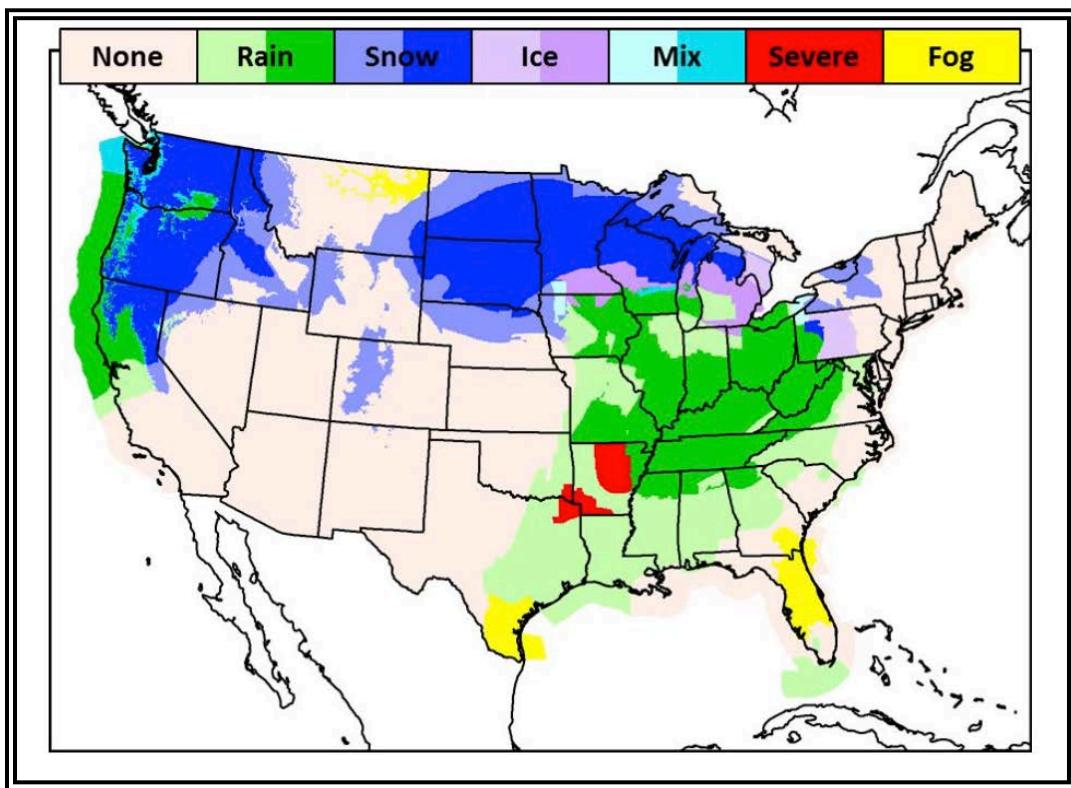


5.22.2.2 Weather

The Weather Graphic Product (see Figure 5-89, NDFD Weather Graphic Product—Example, Figure 5-90, NDFD Weather Graphic Product—Example, Figure 5-92, NDFD Weather Graphic Product—Example, Figure 5-93, NDFD Weather Graphic Product—Example, and Figure 5-94, NDFD Weather Graphic Product—Example) is the forecast predominance weather (precipitating or non-precipitating) valid at the indicated hour. The weather element includes type, intensity, and probability (see Figure 5-91, Legend for NDFD Weather Graphic). Darker shades of precipitation represent probabilities for 55 percent or greater.

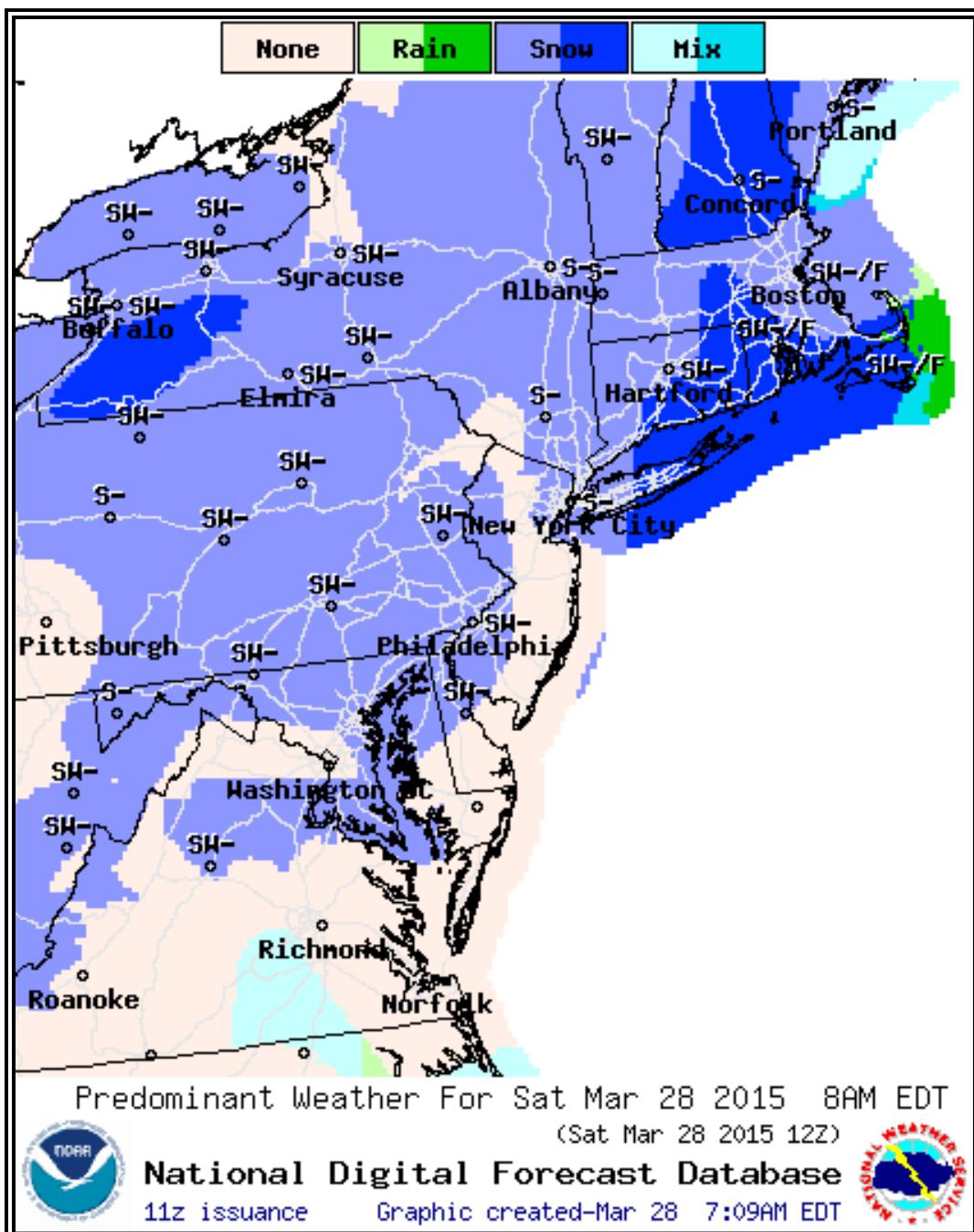
Note: The NDFD graphical products are directed to all users (e.g., public) and not specifically directed at aviation users. These graphics use weather symbology that differs from that used in Significant Weather (SIGWX) forecasts and METARs.

Figure 5-89. NDFD Weather Graphic Product—Example



The product's legend will change depending on the forecast weather, e.g., the legend box will have fog only when fog is forecast on the graphic.

Figure 5-90. NDFD Weather Graphic Product—Example



Forecast valid for day 1 at 8 a.m. EDT (i.e., 12Z or 1200 UTC). Snow showers are forecast to extend from Virginia up to and across New England. Mixed precipitation (combination of rain and snow, rain and sleet, or snow and sleet) is forecast over portions of North Carolina and southern Virginia as well as off the coast of New England. Darker shades indicate 55 percent or greater probability.

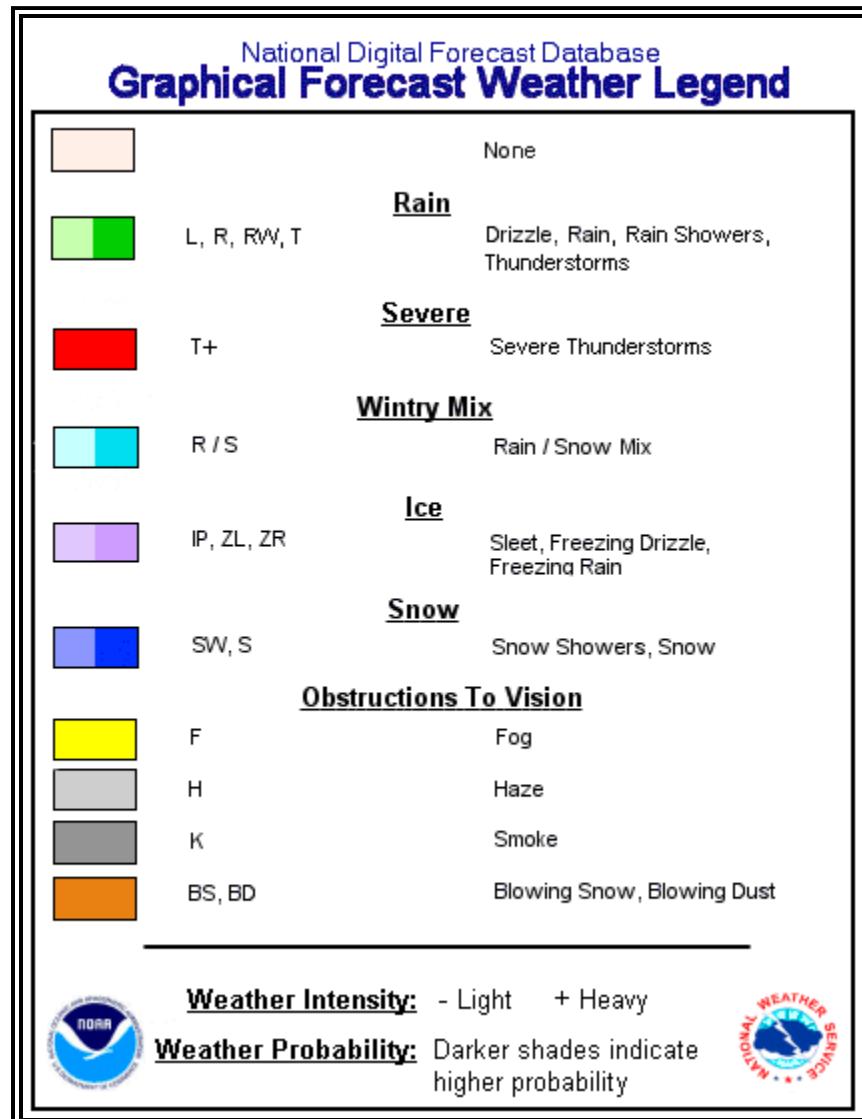
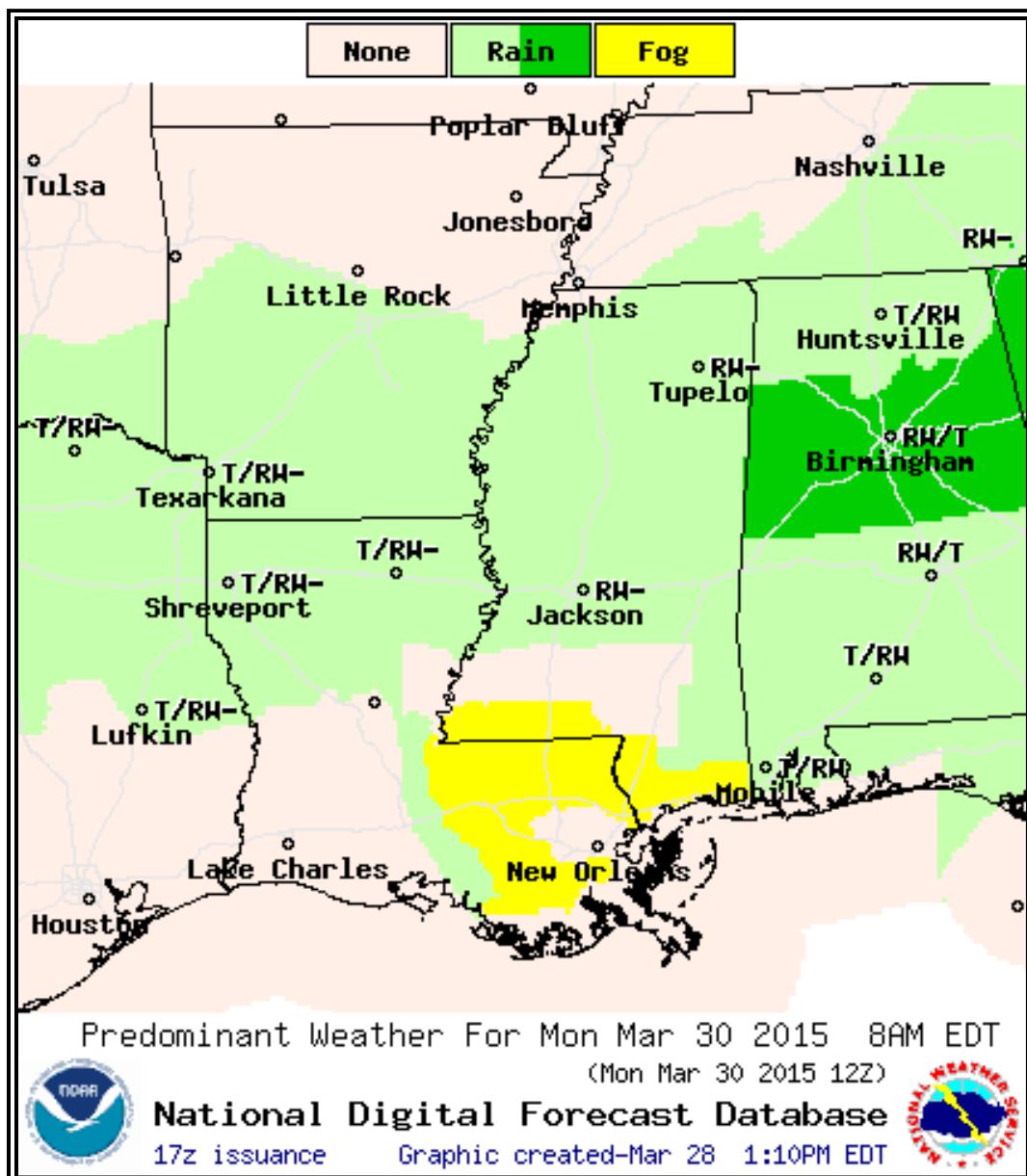
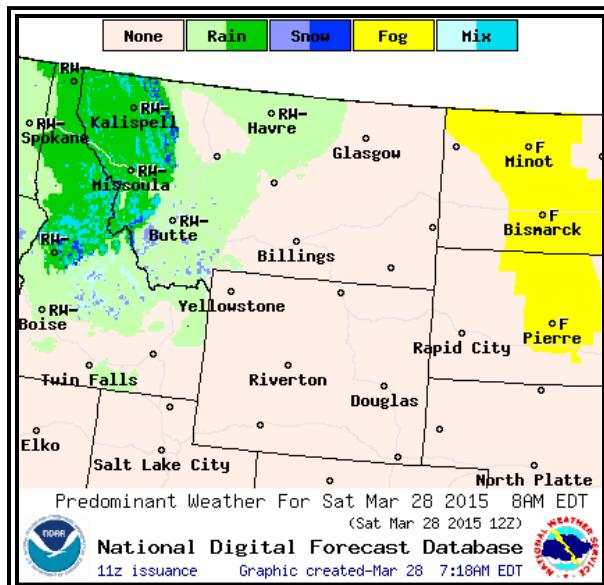
Figure 5-91. Legend for NDFD Weather Graphic

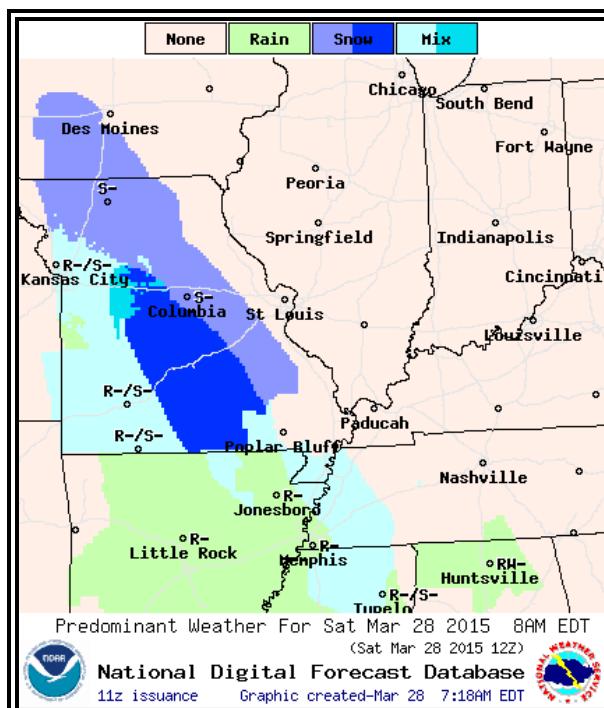
Figure 5-92. NDFD Weather Graphic Product—Example



Forecast valid for day 3 at 8 a.m. EDT (i.e., 12Z or 1200 UTC). Thunderstorms and light rain showers are forecast from Texas and Oklahoma to across the southeastern United States. Darker shades indicate 55 percent or greater probability. Fog is forecast across southern Mississippi and eastern Louisiana.

Figure 5-93. NDFD Weather Graphic Product—Example

Forecast valid for day 1 at 8 a.m. EDT (i.e., 12Z or 1200 UTC). Fog from North Dakota into South Dakota and light rain showers across the Northern Rockies. Darker shades indicate 55 percent or greater probability.

Figure 5-94. NDFD Weather Graphic Product—Example

Forecast valid for day 1 at 8 a.m. EDT (i.e., 12Z or 1200 UTC). Light snow is forecast from southern Iowa into central Missouri; a mix of precipitation (combination of rain and snow, rain and sleet, or snow and sleet) is forecast from western Missouri to northern Mississippi, along with light rain over most of Arkansas. Darker shades indicate 55 percent or greater probability.

5.22.2.2.3 Wind.

Wind is provided in two graphics, one for surface wind speed and direction (see Figure 5-95, NDFD Surface Wind Speed and Direction—Example) and one for wind gusts (see Figure 5-97, NDFD Surface Wind Gust Graphic—Example). Symbols for wind speed and direction (see Figure 5-96, NDFD Wind Speed and Direction Graphic Product Plot Model) are plotted on the graphic. Wind speed and gust speed are also depicted using a color. Both wind speed and gusts are in knots.

Figure 5-95. NDFD Surface Wind Speed and Direction—Example

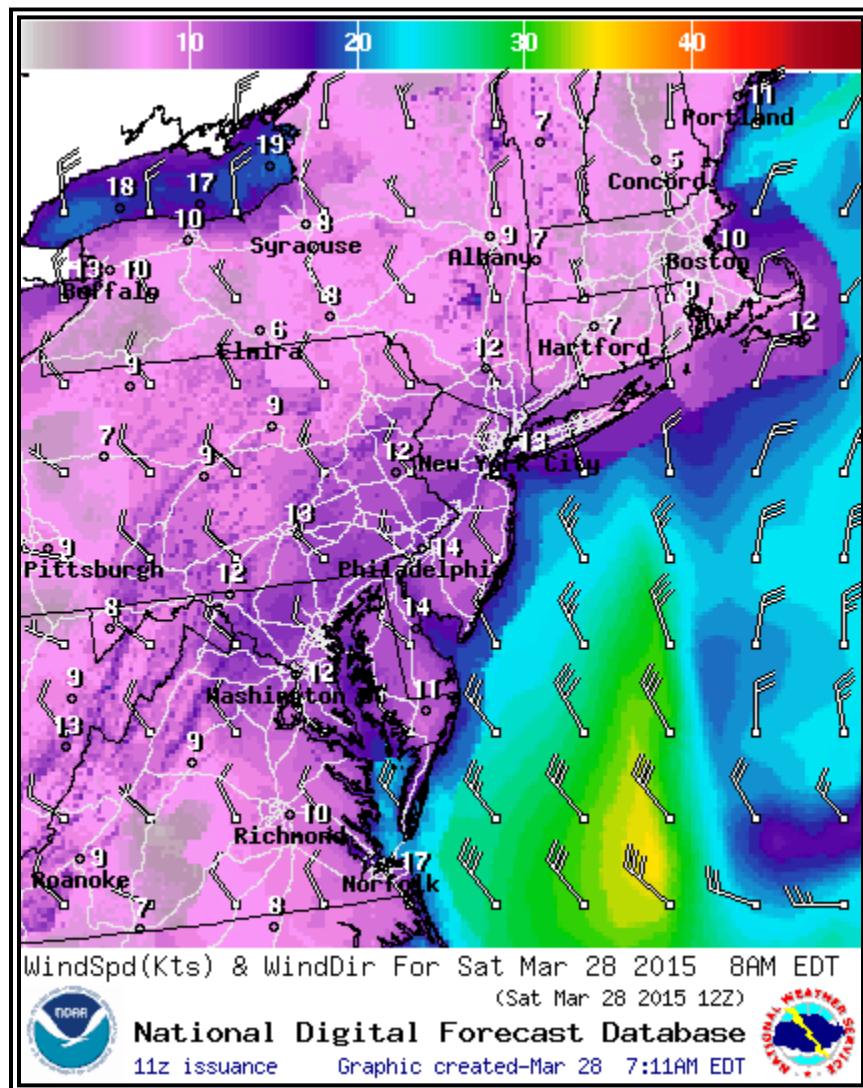


Figure 5-96. NDFD Wind Speed and Direction Graphic Product Plot Model

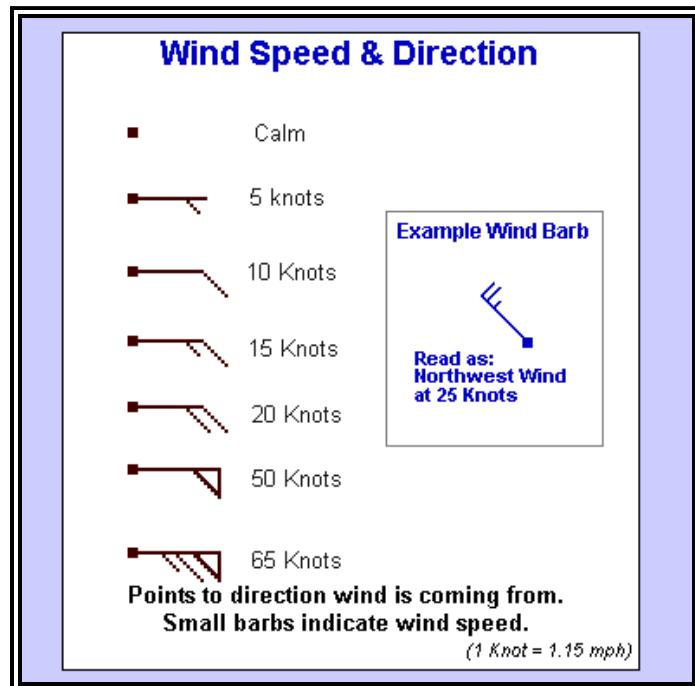
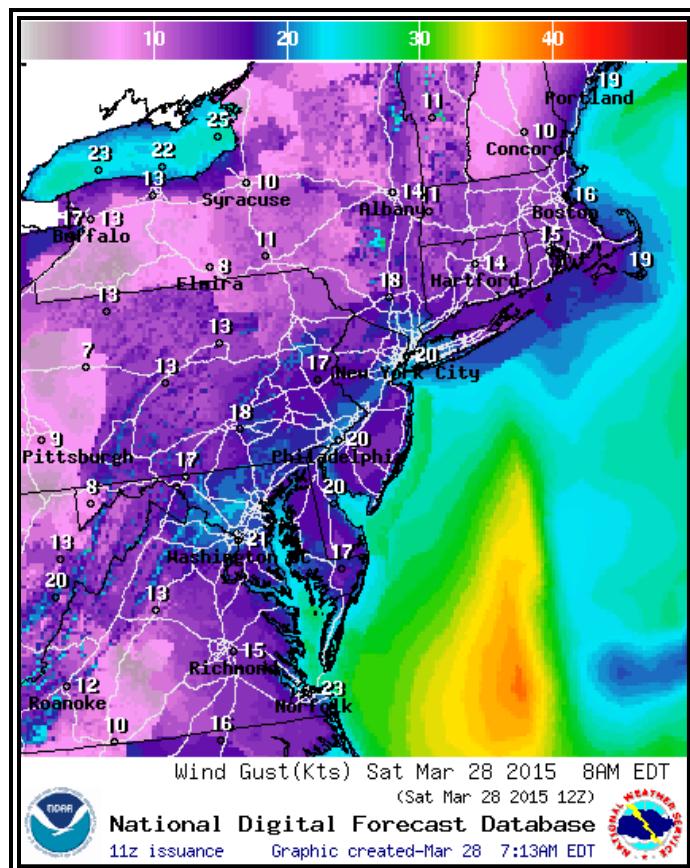


Figure 5-97. NDFD Surface Wind Gust Graphic—Example



5.22.2.3 Use.

Perhaps the adage “a picture is worth a thousand words” best describes the NDFD graphical products, which are one of the replacement products for the FA. The NDFD graphical products provide detailed forecasts of sky cover, weather, wind, and several other metrological elements, in a graphical Web-based format. Depending on the website, users can quickly scroll over or animate the products to view any changes in the forecast (e.g., movement, growth, or decay of areas of precipitation).

The NDFD graphical products complement the Short-Range Surface Prognostic Charts (see paragraph [5.18](#)), which are also based on the NDFD, by providing more detail and additional weather elements.

The NDFD Sky Cover graphical product is a good situational awareness source for total cloud cover en route as well as at airports without a TAF. Perhaps the best use of the NDFD Sky Cover graphical product is it provides forecasts of where the cloud cover is minimal, implying that VFR flight conditions are likely (except when smoke and haze exist or are expected). The NDFD Sky Cover graphical product does not provide cloud base height, cloud top height, or information on cloud layers.

The NDFD Weather graphical product is a good situational awareness source for weather (e.g., rain, snow, freezing rain, thunderstorm, fog, and surface wind) en route as well as at airports without a TAF. The NDFD Weather graphical product does not provide visibility forecasts associated with the forecast weather; thus, pilots should use this product in combination with the Low-Level Significant Weather (SIGWX) forecasts, AIRMETs and SIGMETs (including Convective SIGMETs) for possible Marginal Visual Flight Rules (MVFR) or IFR conditions.

Due to the graphical (and colorful) nature of these products, considerations have been made by the NWS for people who cannot distinguish colors. Despite these efforts, some shades may be somewhat more difficult to distinguish. A color blindness tool may assist in reading the graphics and can be obtained at <http://www.nws.noaa.gov/credits.php#plugins>.

5.22.3 Cloud Top Heights Product.

The Cloud Top Heights product provides a detailed set of forecasts of the heights of cloud tops using specified contours.

5.22.3.1 **Issuance.**

The NWS NCO produces the Cloud Top Heights forecast using the North American Mesoscale (NAM) NWP model.

The Cloud Top Heights forecast product is available on <http://www.aviationweather.gov>.

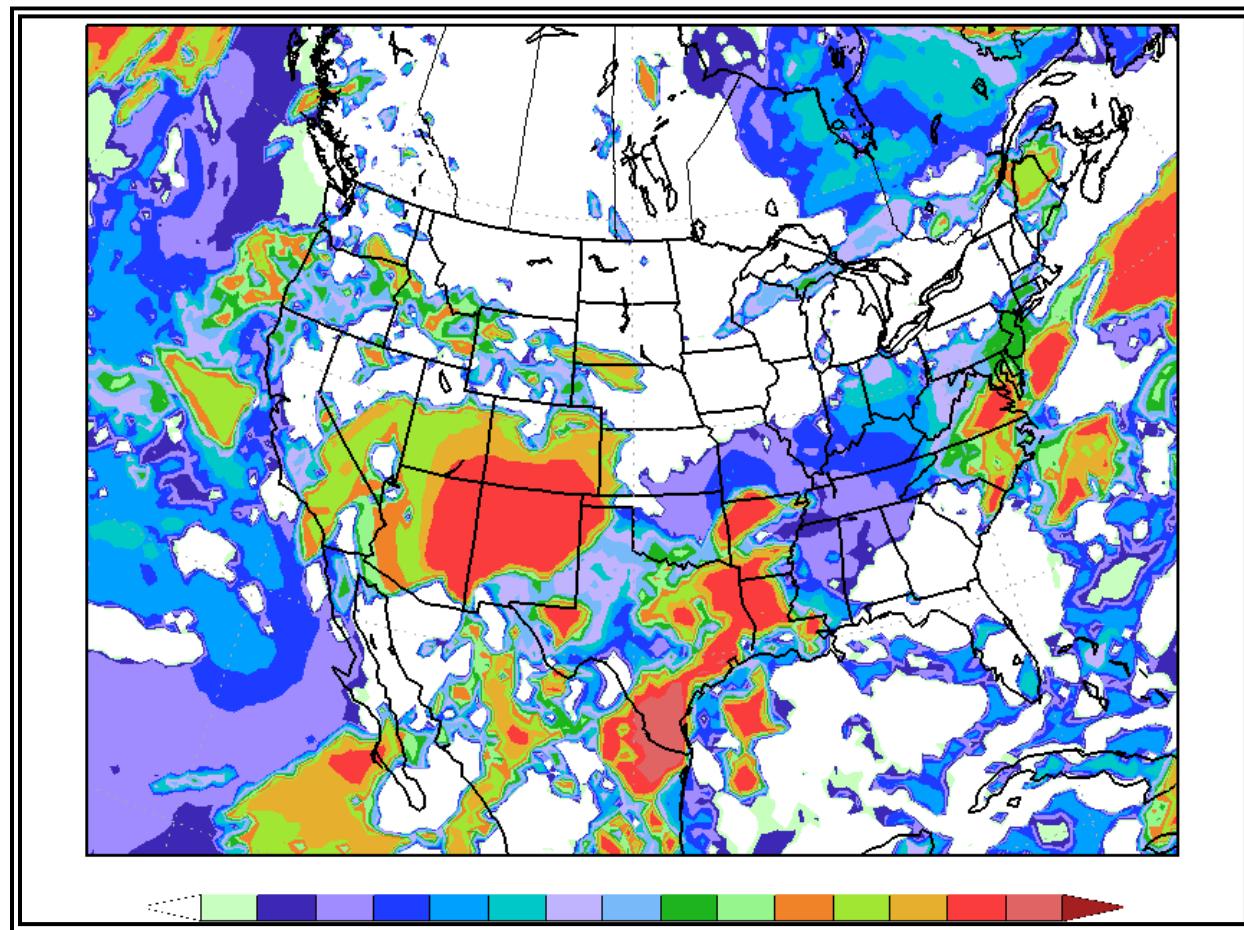
5.22.3.2 Content.

The Cloud Top Heights product (see Figure 5-98, Cloud Top Heights Product—Example) is a computer model forecast of the height of the tops of the clouds covering the sky valid for the indicated hour. The heights of cloud tops are depicted using color-shaded contours at specific intervals.

Forecasts are provided at select time step intervals.

Additional details on the content of this product are provided on <http://www.aviationweather.gov>.

Figure 5-98. Cloud Top Heights Product—Example



Actual colors and scale may vary depending on upgrades to the product. Refer to the AWC Web page for additional details.

5.22.3.3 Use.

The Cloud Top Heights product is a computer-generated forecast without input from meteorologists. It is the computer's "best guess" of where clouds will be as well as the height of the cloud tops.

NWP models are much more accurate forecasting winds aloft than they are forecasting cloud tops. Pilots should not expect an equally high degree of

accuracy with these forecasts, especially in areas where there is a high degree of variability in the forecast cloud top heights.

5.22.4 Cloud Layer Product.

The Cloud Layer product provides a detailed set of forecasts of cloud amount and layers using specified contours.

5.22.4.1 Issuance.

The NWS NCO produces the Cloud Layer forecast using a NWP model.

The Cloud Layer forecast product is available on
<http://www.aviationweather.gov>.

5.22.4.2 Content.

The Cloud Layer product is a computer model forecast of cloud amount and information on cloud layers, valid for the indicated hour.

Forecasts are provided at select time step intervals.

Additional details on the content of this product are provided on
<http://www.aviationweather.gov>.

5.22.4.3 Use.

The Cloud Layer product is a computer-generated forecast without input from meteorologists. It is the computer's "best guess" for cloud layers as their details.

NWP models are much more accurate forecasting winds aloft than they are forecasting cloud layers. Pilots should not expect an equally high degree of accuracy with these forecasts.

5.23 Airport Weather Warning (AWW).

The Airport Weather Warning (AWW) addresses weather phenomena that can adversely impact **airport ground operations**.

Note: The AWW is not to be confused with the SAW, which the NWS refers to as SAW but is also known by AWW on the websites of some weather provider services.

5.23.1 Issuance.

The Airport Weather Warning is issued for select larger airports and is available on NWS WFO websites who have responsibility for issuing the TAFs for that airport. The Airport Weather Warning is *not* available on <http://www.aviationweather.gov>.

Issuance criteria are established according to local airport requirements. Some examples of criteria are: strong surface winds, freezing rain, heavy snow, and lightning within 5 miles of the airport.

5.23.2 Airport Weather Warning (AWW) Format and Example.

The AWW is written in a plain language, free-text format.

WWUS82 KJAX 112212
AWWJAX
FLZ025-112315-

AIRPORT WEATHER WARNING FOR JACKSONVILLE INTERNATIONAL AIRPORT
NATIONAL WEATHER SERVICE JACKSONVILLE FL
612 PM EDT WED MAR 11 2015

...AN AIRPORT WEATHER WARNING HAS BEEN ISSUED FOR JACKSONVILLE
INTERNATIONAL AIRPORT FOR STRONG WINDS AND POSSIBLE WINDSHIFT
VALID UNTIL 700 PM...

A CLUSTER OF THUNDERSTORMS WILL MOVE EASTWARD AT 12 KNOTS AND

AFFECT JACKSONVILLE INTERNATIONAL AIRPORT BY 620 PM. WIND GUSTS
OVER 35 KNOTS ARE LIKELY WITH THESE STORMS...AS WELL AS CLOUD-
TO-GROUND LIGHTNING AND REDUCED VISIBILITIES FROM HEAVY RAIN.
WINDSHIFTS ACCOMPANYING THE THUNDERSTORMS MAY ALTER THE RUNWAY
LANDING PATTERN WITH SOME STRONG WESTERLY WIND GUSTS.

\$\$

5.23.3 Use.

Information contained in this product may be useful to airport managers, fixed-based operators, airline ground personnel, and others responsible for the safety of ground operations. Ground decisions supported by the AWW information may include: fueling delays during thunderstorms, de-icing frequency, and other similar ground operations. AWWs are **not intended for use by in-flight operations.**

5.24 Space Weather.

The expression Space Weather is used to designate processes occurring on the Sun, in Earth's magnetosphere, ionosphere, and thermosphere, which have the potential to affect the near-Earth environment.

For aviation users, Space Weather can affect GPS navigation and some communications; specifically, Space Weather can:

- Increase GPS uncertainty. During a severe space weather event, the ionosphere becomes highly disturbed, and GPS receivers cannot lock on the satellite signal, resulting in inaccurate position information as much as tens of meters or more.
- Result in severe downgrade or loss of high frequency (HF) radio communications, which is a mainstay of aviation, especially on polar and transoceanic routes.

The three primary types of space weather concerns for aviation are solar flares, radiation storms, and geomagnetic storms.

5.24.1 NOAA Space Weather Scales.

The NOAA Space Weather Scales communicate current and future space weather conditions and their possible effects on people and systems. The scales describe the

environmental disturbances for three event types: geomagnetic storms, solar radiation storms, and radio blackouts. The scales have numbered levels, analogous to hurricanes, tornadoes, and earthquakes that convey severity. Possible effects are provided as well as the average frequency of occurrence. These scales are not aviation specific but do address impacts to aviation systems.

5.24.2 Space Weather Products

The Space Weather Prediction Center (SWPC) provides a variety of space weather products that describe current and expected space weather activity for a wide range of users (i.e., both aviation and non-aviation).

Information on these products is provided on their Web page (<http://www.swpc.noaa.gov/communities/aviation-community-dashboard>), including intended usage, impacts on various systems (e.g., GPS), and details on issuance times and frequency.

5.24.2.1 Space Weather Messages

SWPC provides non-aviation-specific alerts, watches, and warnings about what to expect from space weather. These products provide levels of severity of the solar activity that can be expected to impact the Earth's environment. The products are text based and available on SWPC's website as well as through a subscription service.

SWPC's messages and forecasts are modeled after non-aviation services that the NOAA/NWS provide. They are as follows:

- **Watch messages** are issued with long lead times for the majority of all space weather activity predictions.
- **Warning messages** are issued when some condition is expected. The messages contain a warning period and other information of interest.
- **Alert messages** are issued when an event threshold is crossed and contain information that is available at the time of issue.
- **Summary messages** are issued after the event ends and contains additional information that was not available at the time of issue.

5.24.2.1.1 Formats and Examples of Space Weather Messages

Refer to NWS's SWPC website for additional information on these products.

Watch Message

Space Weather Message Code: WATA20
Serial Number: 604
Issue Time: 2015 Feb 26 0801 UTC

WATCH: Geomagnetic Storm Category G1 Predicted

Highest Storm Level Predicted by Day:

Feb 26: None (Below G1) Feb 27: None (Below G1) Feb 28: G1 (Minor)

THIS SUPERSEDES ANY/ALL PRIOR WATCHES IN EFFECT

NOAA Space Weather Scale descriptions can be found at
<http://www.swpc.noaa.gov/noaa-scales-explanation>

Potential Impacts: Area of impact primarily poleward of 60 degrees Geomagnetic Latitude.
Induced Currents - Weak power grid fluctuations can occur.
Spacecraft - Minor impact on satellite operations possible.
Aurora - Aurora may be visible at high latitudes, i.e., northern tier of the U.S. such as northern Michigan and Maine.

Warning Message

Space Weather Message Code: WARK06
Serial Number: 253
Issue Time: 2015 Mar 01 0755 UTC

WARNING: Geomagnetic K-Index of 6 expected
Valid From: 2015 Mar 01 0755 UTC
Valid To: 2015 Mar 01 1300 UTC
Warning Condition: Onset
NOAA Scale: G2 - Moderate

NOAA Space Weather Scale descriptions can be found at
<http://www.swpc.noaa.gov/noaa-scales-explanation>

Potential Impacts: Area of impact primarily poleward of 55 degrees Geomagnetic Latitude.
Induced Currents - Power grid fluctuations can occur. High-latitude power systems may experience voltage alarms.
Spacecraft - Satellite orientation irregularities may occur; increased drag on low Earth-orbit satellites is possible.
Radio - HF (high frequency) radio propagation can fade at higher latitudes.
Aurora - Aurora may be seen as low as New York to Wisconsin to Washington state.

Alert Message

Space Weather Message Code: ALTK05
Serial Number: 770
Issue Time: 2015 Mar 01 0145 UTC

ALERT: Geomagnetic K-index of 5
Threshold Reached: 2015 Mar 01 0145 UTC
Synoptic Period: 0000-0300 UTC

Active Warning: Yes
NOAA Scale: G1 - Minor

NOAA Space Weather Scale descriptions can be found at
<http://www.swpc.noaa.gov/noaa-scales-explanation>

Potential Impacts: Area of impact primarily poleward of 60 degrees Geomagnetic Latitude.
Induced Currents - Weak power grid fluctuations can occur.
Spacecraft - Minor impact on satellite operations possible.

Aurora - Aurora may be visible at high latitudes, i.e., northern tier of the U.S. such as northern Michigan and Maine.

Summary Messages

Space Weather Message Code: SUMXMS

Serial Number: 134

Issue Time: 2015 Mar 03 0158 UTC

SUMMARY: X-ray Event exceeded M5

Begin Time: 2015 Mar 03 0125 UTC

Maximum Time: 2015 Mar 03 0135 UTC

End Time: 2015 Mar 03 0142 UTC

X-ray Class: M8.2

Location: N22W94

NOAA Scale: R2 - Moderate

Comment: Region 2290, no optical flare reported.

NOAA Space Weather Scale descriptions can be found at
<http://www.swpc.noaa.gov/noaa-scales-explanation>

Potential Impacts: Area of impact centered primarily on sub-solar point on the sunlit side of Earth.

Radio - Limited blackout of HF (high frequency) radio communication for tens of minutes.

5.24.2.2 Forecast Discussion.

A plain language technical discussion that details observed data, analysis, and forecast rationale. Issued every 12 hours at 0030 UTC and 1230 UTC (and updated out-of-cycle as conditions warrant). Forecast and observed (summary) criterion is broken down into four sections by phenomenon type and two sub-sections; Summary and Forecast. This product is available on the NWS SWPC's website.

5.24.2.2.1 Format and Example of Forecast Discussion.

Forecast Discussion

Issued: 2015 Mar 11 1230 UTC

Prepared by the U.S. Dept. of Commerce, NOAA, Space Weather Prediction Center
.24 hr Summary...

Solar activity was at moderate levels during the period as Region 2297 (S16E21, Dkc/beta-gamma-delta) continued its trend of being the only active region on the visible disk. Region 2297 produced three M-class flares during the period, including an M2/Sf at 11/0006 UTC, an M1/1b flare at 11/0718 UTC, and an M2 flare at 11/0757 UTC. The M2/Sf flare that peaked at 11/0006 UTC also had associated Type II (est. shock speed 1512 km/s) and Type IV radio emissions, as well as a 350 sfu Tenflare. This region also produced over 15 low-level C-class flares over the past 24 hours. Additionally, an approximately 22 degree long solar filament, centered near N16W30, could be seen lifting off the visible disk in SDO/AIA 304 and GONG H-alpha imagery from approximately 11/0625-0815 UTC.

In addition to the three coronal mass ejections (CMEs) mentioned in the previous discussion, available LASCO C2 imagery indicated that two additional CMEs were observed departing the Sun's East limb. Both of

these recent transients appear to be narrow, directed mostly East of the Sun-Earth line, and should not have significant impacts on Earth. Analysis will be conducted on any additional CMEs observed when LASCO coronagraph imagery becomes available.

.Forecast...

Solar activity is expected to be at low levels with M-class (R1-R2/Minor-Moderate) flare activity likely. A slight chance for X-class (R3 or greater) flare activity remains for the next three days (11-13 Mar) as Region 2297 maintains its size and complex magnetic structure. The forecast remains unchanged for the previously mentioned CMEs as it appears that a combined impact of these transients may occur in the form of a glancing blow, mid to late on day two (12 Mar), with a passage expecting to last 24-36 hours at lower velocities.

Energetic Particle

.24 hr Summary...

The greater than 2 MeV electron flux reached high levels this period, peaking at 1,060 pfu. The greater than 10 MeV proton was at background levels throughout the period.

.Forecast...

The greater than 2 MeV electron flux is expected to be at normal to moderate levels with a chance for high levels over the next three days (11-13 Mar). There is a slight chance for S1 (Minor) solar radiation storms over the next three days (11-13 Mar) if Region 2297 produces significant flare activity.

Solar Wind

.24 hr Summary...

Solar wind parameters reflected ambient solar wind parameters through 11/0400 UTC. Solar wind velocities were steady near the 380 km/s range, IMF total field values were steady near 6 nT, while Bz varied slightly between +/- 5 nT. Shortly after 11/0400 UTC, weak enhancements in the geomagnetic field were observed, likely associated with a transient passing just close enough to Earth to cause the minor disturbances. Total field increased slightly to 10 nT, Bz saw a maximum southward deflection to near -10 nT, and wind velocities increased slightly to near 430 km/s for a short time. Most parameters have returned to near background levels with EPAM values leveling out as well. The phi angle was mostly positive (away) throughout the period.

.Forecast...

Near ambient conditions are expected to persist for the remainder of day one (11 Mar) through mid-day on day two (12 Mar) when the combined glancing blows from three CMEs are expected to arrive at Earth. Minor velocity and density enhancements are likely, with a greater magnetic response expected to be reflected in enhanced IMF total field and IMF Bz. The greatest response in Bt and subsequent sub-storms are anticipated for the early morning hours of day three (13 March).

Geospace

.24 hr Summary...

The geomagnetic field was at mostly quiet levels with an isolated unsettled period during 11/0300-11/0600 UTC.

.Forecast...

The geomagnetic field is expected to be quiet to unsettled for the remainder of day one (11 Mar) through mid-day on day two (12 Mar). Unsettled to active levels are forecast for the second half of day two as the combined glancing blows from three CMEs are expected to arrive at Earth. By day three (13 Mar), G1 (minor) geomagnetic storms are likely as the brunt of the CME impacts are expected to begin. A decrease to active levels is expected later in the period as impacts from the CME activity diminish.

Refer to NWS's SWPC website for additional information on this product.

5.24.2.3 **Three-Day Forecast.**

A plain language, single-page forecast text product issued every 12 hours, at 0030 and 1230 UTC, with both forecast and observed criterion now broken down for each of the three NOAA Space Weather Scale categories. This product is designed to be a simple look at the observed and forecast of space weather conditions. A brief description of why conditions occurred or are forecast is also included for each category. Users requiring a more detailed explanation of events should refer to the Forecast Discussion. This product is available on the NWS's SWPC website.

5.24.2.3.1 Format and Example of 3-Day Forecast.

3-Day Forecast

Issued: 2015 Mar 11 1230 UTC

Prepared by the U.S. Dept. of Commerce, NOAA, Space Weather Prediction Center

A. NOAA Geomagnetic Activity Observation and Forecast

The greatest observed 3 hr Kp over the past 24 hours was 3 (below NOAA Scale levels).

The greatest expected 3 hr Kp for Mar 11-Mar 13 2015 is 5 (NOAA Scale G1).

NOAA Kp index breakdown Mar 11-Mar 13 2015			
	Mar 11	Mar 12	Mar 13
00-03UT	1	2	5 (G1)
03-06UT	3	2	5 (G1)
06-09UT	2	2	4
09-12UT	2	2	4
12-15UT	1	4	4
15-18UT	2	4	4
18-21UT	2	4	3
21-00UT	2	4	3

Rationale: G1 (minor) geomagnetic storms are likely on day three (13 Mar) as the brunt of the CME impacts are expected to begin.

B. NOAA Solar Radiation Activity Observation and Forecast

Solar radiation, as observed by NOAA GOES-13 over the past 24 hours, was below S-scale storm level thresholds.

Solar Radiation Storm Forecast for Mar 11-Mar 13 2015

	Mar 11	Mar 12	Mar 13
S1 or greater	10%	10%	10%

Rationale: There is a slight chance for S1 (Minor) solar radiation storms over the next three days (11-13 Mar) if Region 2297 produces significant flare activity.

C. NOAA Radio Blackout Activity and Forecast

Radio blackouts reaching the R1 levels were observed over the past 24 hours. The largest was at Mar 11 2015 0002 UTC

Radio Blackout Forecast for Mar 11-Mar 13 2015

	Mar 11	Mar 12	Mar 13
R1-R2	60%	60%	60%
R3 or greater	10%	10%	10%

Rationale: (R1-R2/Minor-Moderate) radio blackouts are likely. A slight chance for (R3 or greater) radio blackouts remains for the next three days (11-13 Mar) as Region 2297 maintains its size and complex magnetic structure.

Refer to NWS's SWPC website for additional information on this product.

5.24.2.4 Other Space Weather Products.

SWPC provides many products on their website, some of which can be of interest to aviation users. These products and displays will continue to evolve and thus it is not practical to provide all the various product examples along with their description. Instead users should refer to the product descriptions provided on the SWPC website. It is important to state these products are intending for trained users, are not aviation-specific, and subject to change by the NWS.

5.24.3 Use.

At the time of this publication, there are no aviation-specific forecasts or advisory products, such as SIGMETs or AIRMETs, issued for space weather events. Until such time as aviation-specific space weather products are developed, pilots can refer to SWPC's Web page as well as their space weather alerts, watches, warnings, forecasts and forecast discussions, utilizing the NOAA's Space Weather Scales, for situational awareness with space weather.

SWPC has a free subscription service that provides a wide range of space weather products, including alerts, warnings, watches, and forecasts that users can receive through email within moments of being issued. Details on this service can be found on SWPC's website.

5.25 Soaring Forecast.

5.25.1 Issuance.

Select NWS WFOs issue soaring forecasts. These are automated forecasts primarily derived from the radiosonde observation or model generated soundings (see paragraph [3.6](#)).

5.25.2 Content and Format.

The content and format of soaring forecasts vary with the NWS WFO providing the forecast, based on the needs of their soaring community. It is beyond the scope of this AC to describe all the many variations of soaring forecasts and their content. Soaring pilots should consult with the NWS WFO in their soaring area for more information.

5.25.3 Example.

The following example is Albuquerque, NM:

SOARING FORECAST FOR ABQ DATE... 04/19/15...12Z

THERMAL INDEX....MINUS SIGN INDICATES INSTABILITY

5000 FT ASL.....	-10.0
6000 FT ASL.....	-9.0
10000 FT ASL.....	-3.5
15000 FT ASL.....	0.0

HEIGHT OF THE -3 INDEX....10800 FT ASL

TOP OF THE LIFT.....14600 FT ASL

ABQ MAX TEMPERATURE.....67 DEGREES F

FIRST USABLE LIFT.....59 DEGREES F

MAXIMUM LIFT.....509 FT/MIN

UPPER LEVEL WINDS

5000 FT ASL.....//	DEGREES AT //	KNOTS
10000 FT ASL.....	330 DEGREES AT 35	KNOTS

IT IS EMPHASIZED...THIS SOARING FORECAST INFORMATION IS VALID ONLY FOR THE RAOB SITE AREA AND FREQUENTLY WILL NOT APPLY TO OTHER AREAS IN THE STATE.

CHAPTER 6. AVIATION WEATHER TOOLS

Aviation weather tools are Web-based applications that incorporate multiple weather products into a Web-based interactive display. Chapter 6 will describe two tools, the helicopter emergency medical services (HEMS) Tool and the Flight Path Tool. Both of these tools can be found on the Aviation Weather Center's (AWC) website at <http://www.aviationweather.gov>.

6.1 Helicopter Emergency Medical Services (HEMS) Tool.

The HEMS Tool is specifically designed to display weather conditions for short-distance and low-altitude flights that are common for emergency first responders. HEMS operators are extremely sensitive to changing and/or adverse weather conditions and need weather information presented for non-weather experts quickly and effectively. To meet this need, the Flight Path Tool on the AWC's website was adapted and simplified to display high-resolution grids of critical weather parameters, particularly cloud ceiling and surface visibility. Using a highly interactive and intuitive tool that focuses on small, localized regions, HEMS operators gain critical weather awareness to make all their flights safe for crews and patients.

6.1.1 Availability.

The HEMS Tool is continuously updated and available through the AWC's website at <http://www.aviationweather.gov/hemst>.

6.1.2 Content.

The HEMS Tool can overlay multiple grids of various weather parameters, as well as NWS textual weather observations and forecasts including: ceiling, visibility, flight category, winds, relative humidity, temperature, icing, satellite, radar (base and Composite Reflectivity), Airmen's Meteorological Information (AIRMET) and significant meteorological information (SIGMET), Aviation Routine Weather Reports (METAR), Terminal Aerodrome Forecasts (TAF), Pilot Weather Reports (PIREP), NWS hazards, and Center Weather Advisories (CWA). Some gridded products (e.g., temperature, relative humidity, winds, and icing) are three-dimensional (3-D). Other gridded products are two-dimensional (2-D) and may represent a "composite" of a 3-D weather phenomenon or a surface weather variable, such as horizontal visibility. The tool also displays relevant NWS textual weather observations and forecasts needed for aviation. These data are either points of observed or forecast weather, often at airports, or regions of hazardous weather represented by 2-D polygons.

The default displays the most recent analysis of flight category; colored flight category dots are selected airports, radar loops, SIGMETs, and recent PIREPs. The map can be panned in any direction and zoomed by using the “+/-” buttons or the mouse scroll wheel.

All 3-D data are interpolated to above ground level (AGL) altitudes and can be sliced horizontally on 1,000-foot intervals up to 5,000 feet (ft). All data can be animated from 6 hours before to 6 hours after the current time.

6.1.2.1 Visibility and Flight Category.

Three products are available for the ceiling and visibility analysis (CVA) (see paragraph [4.2.1](#)). The ceiling, visibility, and flight category weather products originate from the CVA product, which is a gridded analysis of ceiling and visibility based on surface observations and satellite imagery, and is updated approximately every 5 minutes. The ceiling and visibility are used together to classify the flight category as visual flight rules (**VFR**), Marginal Visual Flight Rules (**MVFR**), instrument flight rules (**IFR**), and low instrument flight rules (**LIFR**). Due to limitations of the observations, the grid cells are approximately 5 kilometers (km) apart at best. In data sparse regions, the best possible estimate of ceiling and visibility is assumed from the nearest surrounding data and may not represent the actual conditions at a specific point. Analyses of these fields are not available if the time slider is moved into the future. Figure [6-1](#), HEMS Ceiling with Flight Category Overlay—Example, Figure [6-2](#), HEMS Visibility with Flight Category Overlay—Example, and Figure [6-3](#), HEMS Flight Category with Flight Category Overlay—Example, are examples of the different overlays.

By default, the HEMS Tool displays the most recent analysis of flight category colored distinctly for **VFR**, **MVFR**, **IFR**, and **LIFR**. The classifications (see Table 6-1, Flight Categories) are defined by certain cloud base ceilings and surface visibility values.

Table 6-1. Flight Categories

Flight Category Definitions			
Category	Ceiling		Visibility
LIFR* (magenta sky symbol)	below 500 feet AGL	and/or	less than 1 mile
IFR (red sky symbol)	500 to below 1,000 feet AGL	and/or	1 mile to less than 3 miles
MVFR (green sky symbol)	1,000 to 3,000 feet AGL	and/or	3 to 5 miles
VFR+ (blue sky symbol)	greater than 3,000 feet AGL	and	greater than 5 miles

* By definition, IFR applies when the ceiling is less than 1,000 feet AGL **and/or** visibility less than 3 miles, while LIFR is a sub-category of IFR.

+ By definition, VFR applies when the ceiling is greater than or equal to 1,000 feet AGL and visibility greater than or equal to 3 miles while MVFR is a sub-category of VFR.

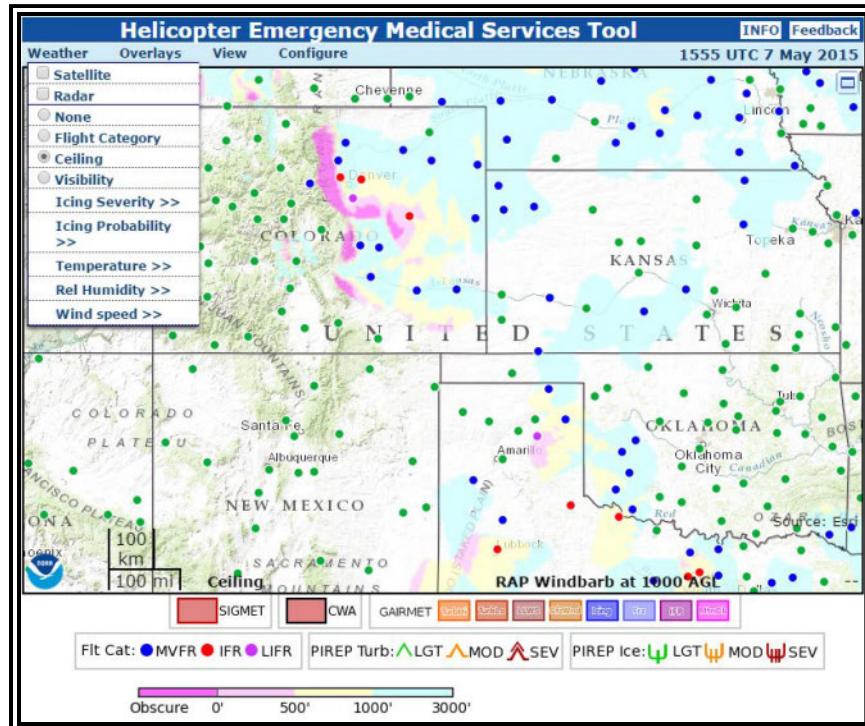
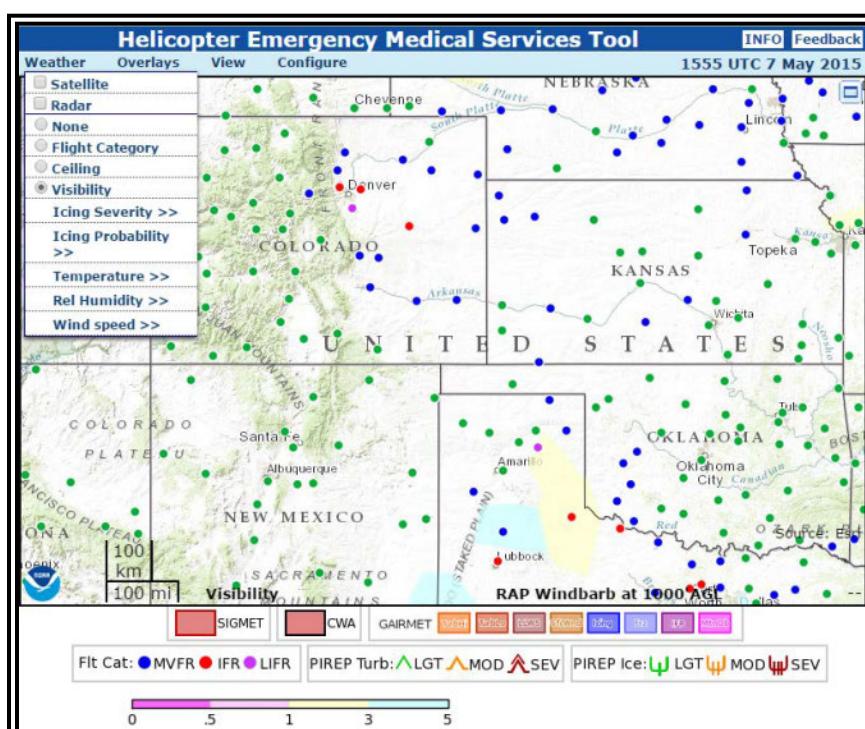
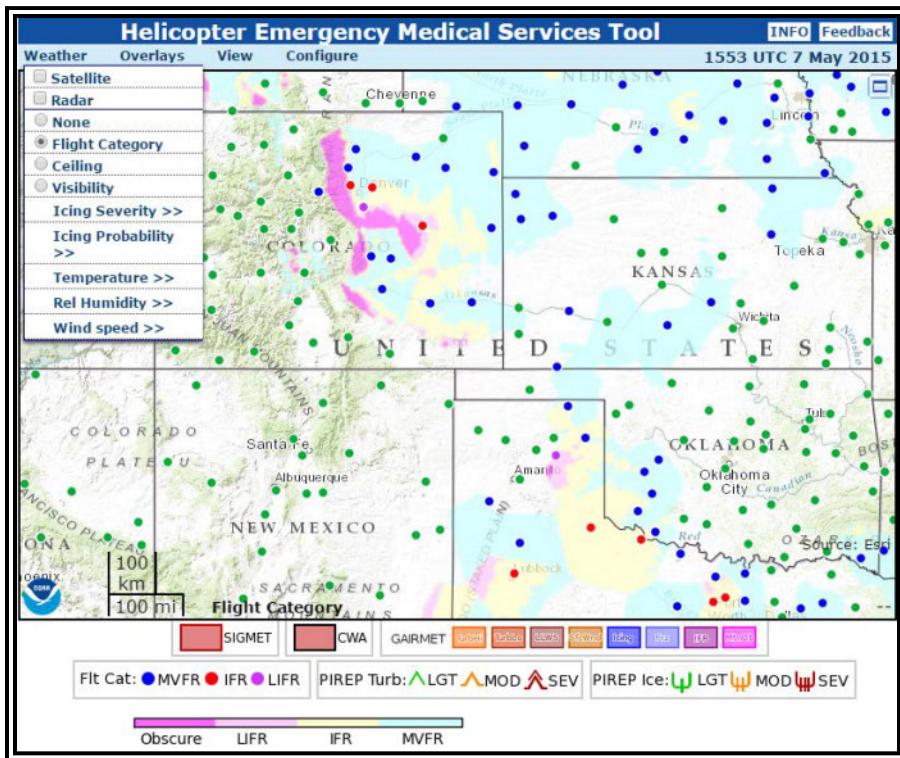
Figure 6-1. HEMS Ceiling with Flight Category Overlay—Example**Figure 6-2. HEMS Visibility with Flight Category Overlay—Example**

Figure 6-3. HEMS Flight Category with Flight Category Overlay—Example



Note: The flight category is colored for MVFR, IFR, and LIFR. The VFR areas are transparent. Yellow is used instead of red for coloring because it's more difficult to distinguish between red and magenta on the image backgrounds.

6.1.2.2 Radar.

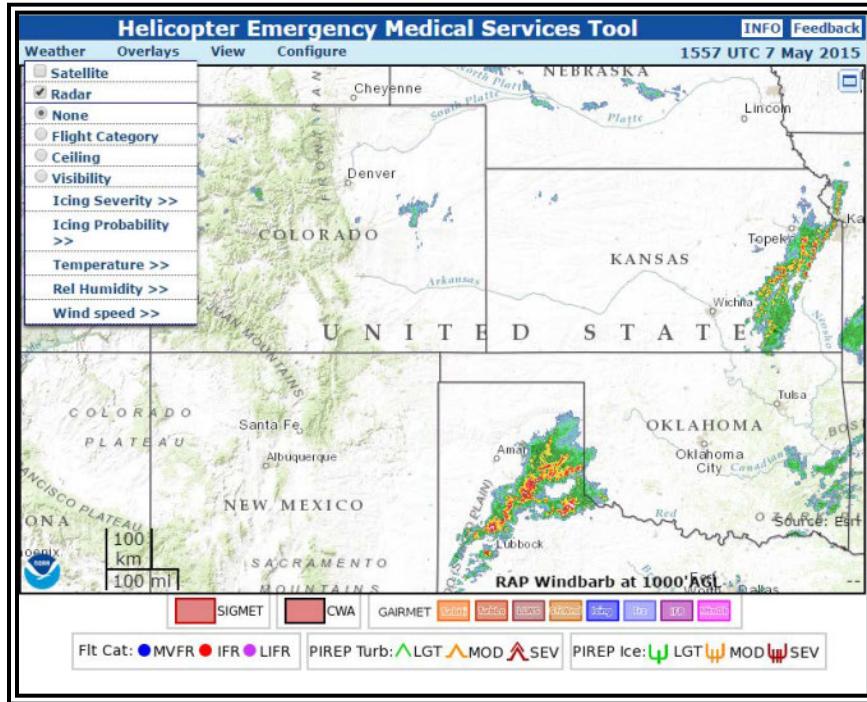
The HEMS Tool uses the Multi-Radar/Multi-System (MRMS) mosaic produced by NWS. The radar image combines more than 140 radars from around the country into a single image. Additional post-processing is performed to remove some ground clutter and Anomalous Propagation (AP). Due to limitations of the radar, such as blockage by mountains, spacing of radar locations, and over processing of clutter and AP, there may be precipitation when radar data does not detect or show a complete weather picture.

The image used in HEMS is the lowest reflectivity scan from the nearest radar. This is a 1 km image for the continental United States (CONUS). Like the satellite images, the radar mosaic is sliced up and put into the tile cache to provide the maximum resolution and optimal transmission bandwidth. The tile cache is only updated every 10 minutes (MRMS data is available every 2 minutes).

The HEMS display (see Figure 6-4, HEMS Radar Display—Example) incorporates the latest radar image plus the previous four into a loop of radar data showing the progression of precipitation echoes. By moving the time

slider into the past, the radar loop will always show the latest five images ending in the time shown in the slider box.

Figure 6-4. HEMS Radar Display—Example



6.1.2.3 Satellite.

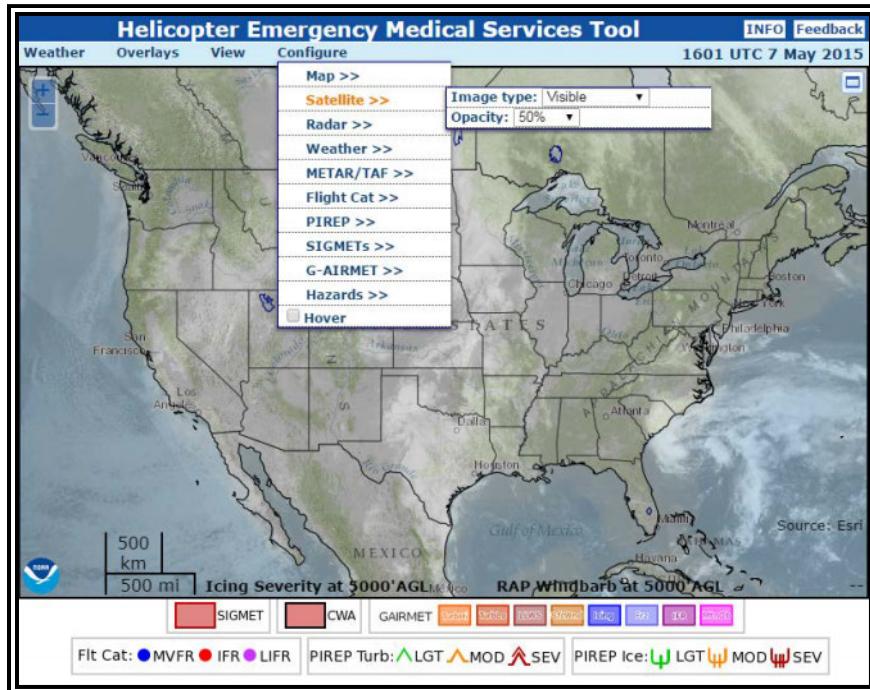
The HEMS Tool uses a global satellite mosaic constructed from the five geostationary satellites plus the appropriate polar global imagery. The resulting image is created every 30 minutes from the available imagery. Images are sliced up and provided through a progressive tile cache to optimize data transmission and image resolution.

Note: A limitation of the satellite imagery is that the European Meteosat imagery is only available every 3 hours; therefore, imagery over Europe and Central Asia may be up to 3 hours old.

There are three types of satellite imagery available in HEMS:

1. Infrared (IR): This is a 10 km image where brighter grays show colder cloud temperatures (see Figure 6-5, HEMS Satellite Imagery—Example).
2. Visible: This is a 5 km image showing visible reflection from clouds and the ground surface. Consequentially, these images will be black at night.
3. Water Vapor: This is a 10 km image where brighter grays show higher areas of water vapor.

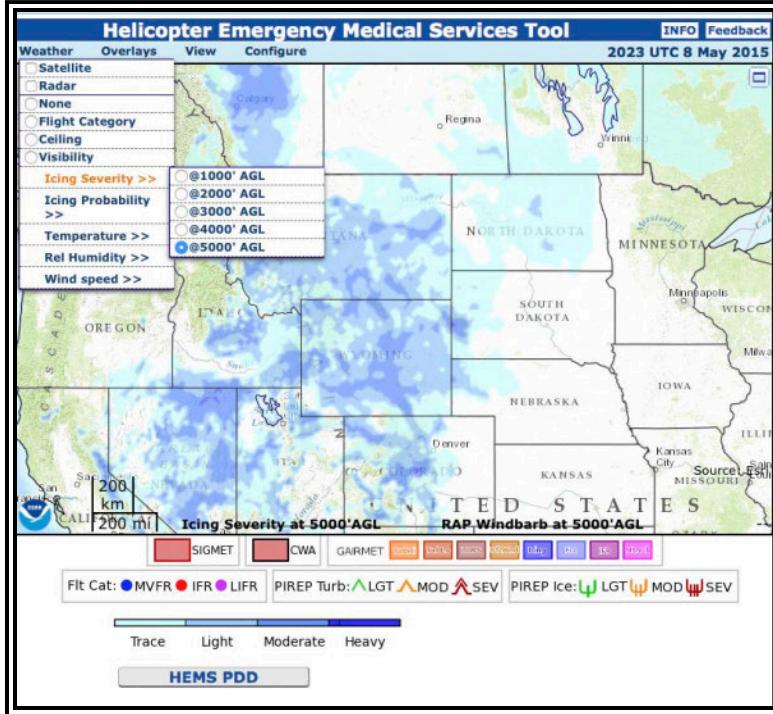
Figure 6-5. HEMS Satellite Imagery—Example



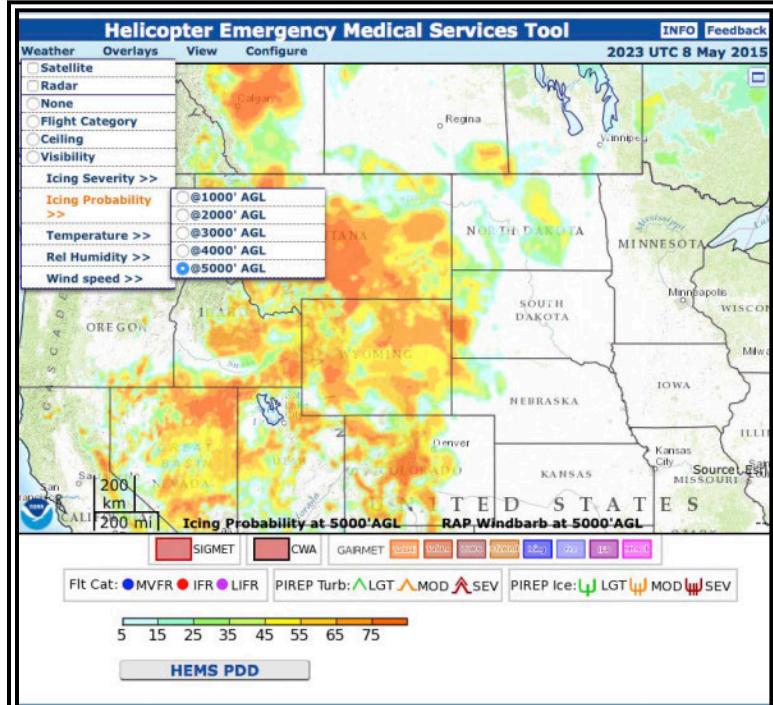
6.1.2.4 Icing.

The icing severity product is a 3-D product and provides depictions at specified altitudes AGL at 1,000 ft-intervals up to 5,000 ft. In regions of steep terrain, these altitudes may have significant deviations from actual height above terrain given the limiting factor of grid cell size, which is approximately 13 km, and the resolution of the topography in the model. The icing severity product (see Figure 6-6, HEMS Icing Severity—Example) combines a multitude of weather observations (e.g., temperature, humidity, satellite, observed surface weather and pilot reports, radar data) to diagnose areas of expected *trace, light, moderate, and heavy icing*. Separate overall icing probability (from 5 to 85 percent) (see Figure 6-7, HEMS Icing Probability—Example) is provided as well.

These products originate from the Current Icing Product (CIP) and Forecast Icing Product (FIP) (see paragraph 5.21.1). These products start with data from the Rapid Refresh (RAP) model, which is run hourly. FIP has forecasts at 1, 2, 3, 6, 9, 12, 15, and 18 hours. The time slider will use CIP for current and past times and time-adjusted FIP for future times.

Figure 6-6. HEMS Icing Severity—Example

The severity is colored in shades of blue, with the lightest for trace and the darkest for heavy.

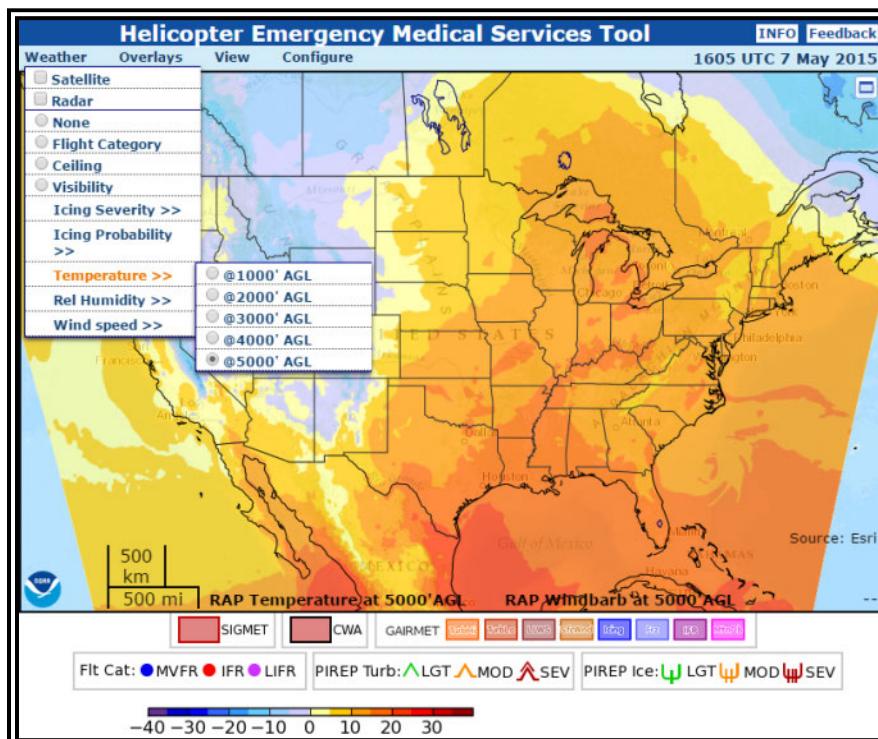
Figure 6-7. HEMS Icing Probability—Example

The probability is colored in shades starting at blue (5 percent), through yellow (50 percent), to orange (>75 percent).

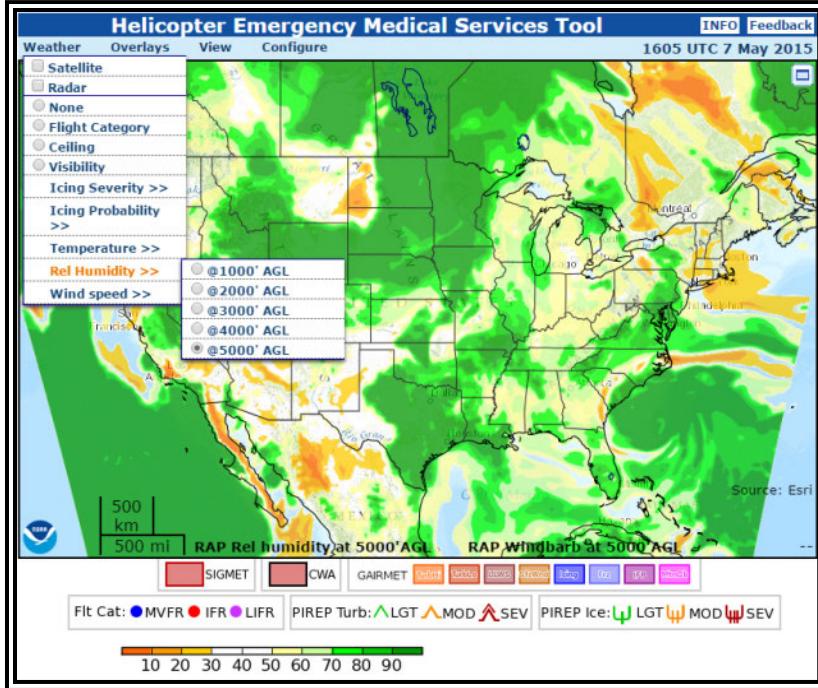
6.1.2.5 Temperature, Relative Humidity, and Wind Speed.

Temperature (see Figure 6-8, HEMS Temperature—Example), relative humidity (see Figure [6-9](#), HEMS Relative Humidity—Example), and wind speed data (see Figure [6-10](#), HEMS Wind Speed with Windbarb—Example) is derived from the AGL grids provided as part of the RAP model output. Data are presented on 1,000 ft AGL increments to 5,000 ft. These grids are available from the RAP model output every hour and forecasts run 7 hours into the future. If the time slider is moved into the past, the RAP analysis for that hour is shown.

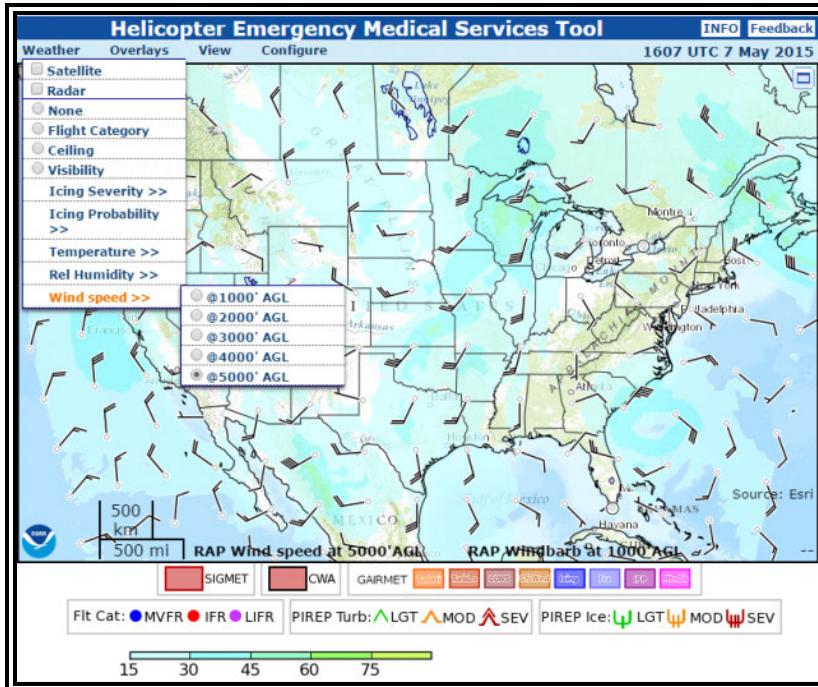
Figure 6-8. HEMS Temperature—Example



The temperature data are colored from blues for the coldest temperatures to reds for the warmest. Delineation between light blue and yellow is used to show the freezing level.

Figure 6-9. HEMS Relative Humidity—Example

The humidity data are colored from oranges for very dry, to yellow for 50 percent, to dark green for near 100 percent. Oranges would be more indicative of clear skies while greens would show cloud or low-visibility areas.

Figure 6-10. HEMS Wind Speed with Windbarb—Example

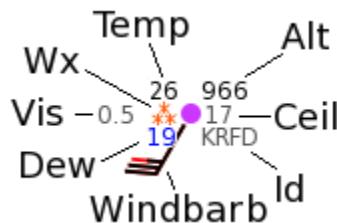
The wind speed data are colored from blues for the lightest winds to light green for stronger winds.

6.1.2.6 Data Overlays.

The HEMS Tool allows the user to select multiple fields to be overlaid on the grids including: METARs/TAFs, Flight Category, PIREPs, Windbarbs, SIGMETs and G-AIRMETs (Graphical Airmen's Meteorological Information), CWAs, and NWS hazards. These fields may be selected on or off in the drop-down Overlays menu. Figure 6-11, HEMS Data Overlays with Text METAR—Example, is an example.

6.1.2.6.1 METARs/TAFs.

The METAR observations plotted using the standard station model where temperature, dewpoint, winds, altimeter setting, weather, ceiling, and visibility are displayed around the station location.



The data plotted comes from the latest available observation, including Special Weather Reports (SPECI). The stations displayed follow a progressive priority scheme that will show more stations depending on how far the user zooms in. This density can be changed through the Configuration menu. If the time slider is moved into the past, the nearest observation before the listed time is displayed. If the slider is moved into the future, the TAF for that station is shown. It should be noted there are fewer TAF stations than available METAR sites. More configuration options are available, including parameters displayed, scale factor of graphic, and whether the TAF is included in the pop-up display.

6.1.2.6.2 Flight Category.

This displays only the flight conditions at a particular airport as a colored dot. The flight category display uses the same priority filter system as the METAR plots, but the density is much higher.

Flt Cat: ● VFR ● MVFR ● IFR ● LIFR

6.1.2.6.3 PIREPs.

This displays turbulence and icing PIREPs. The default is to show only PIREPs reported in the last 90 minutes, and only those below 12,500 ft. These options can be changed in the Configuration menu.

PIREP Turb: ▲ LGT ▲ MOD ▲ SEV PIREP Ice: ▲ LGT ▲ MOD ▲ SEV

6.1.2.6.4 SIGMETs.

This displays the current valid SIGMETs. This will show both domestic and international SIGMETs. Individual SIGMET types can be toggled on and off through the configuration menu. SIGMETs can be distinguished by their red outline and red labels.

SIGMET      

6.1.2.6.5 G-AIRMET.

This displays the current valid G-AIRMETs. This will show all G-AIRMET types, which can be cluttered. Each type can be toggled on and off through the Configuration menu.

GAIRMET        

6.1.2.6.6 Center Weather Advisories (CWA).

This displays the CWA issued by the Center Weather Service Units (CWSU) at each Air Route Traffic Control Center (ARTCC). CWAs can be distinguished by the black outline and black labels.

CWA    

6.1.2.6.7 NWS Hazards.

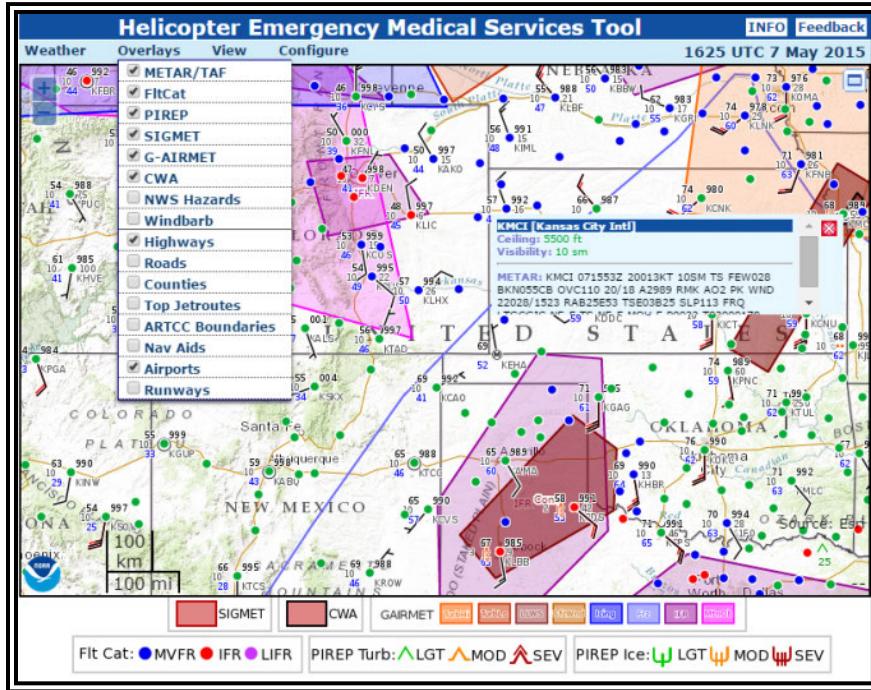
This displays all current warnings, watches, and advisories. The Configuration menu will allow the user to select “Warnings” which will only show tornado, severe thunderstorm, blizzard, winter storm, and ice storm warnings.

6.1.2.6.8 Windbarbs.

This displays windbarbs from the RAP model based on the height selected through one of the weather displays (CVA, Icing and RAP temperature, relative humidity (RH), and wind speed). If the user selects temperature at 2,000 ft AGL, the display would also show the winds at 2,000 ft AGL. The windbarbs are filtered based on zoom level. As the display is zoomed in, more windbarbs will show.

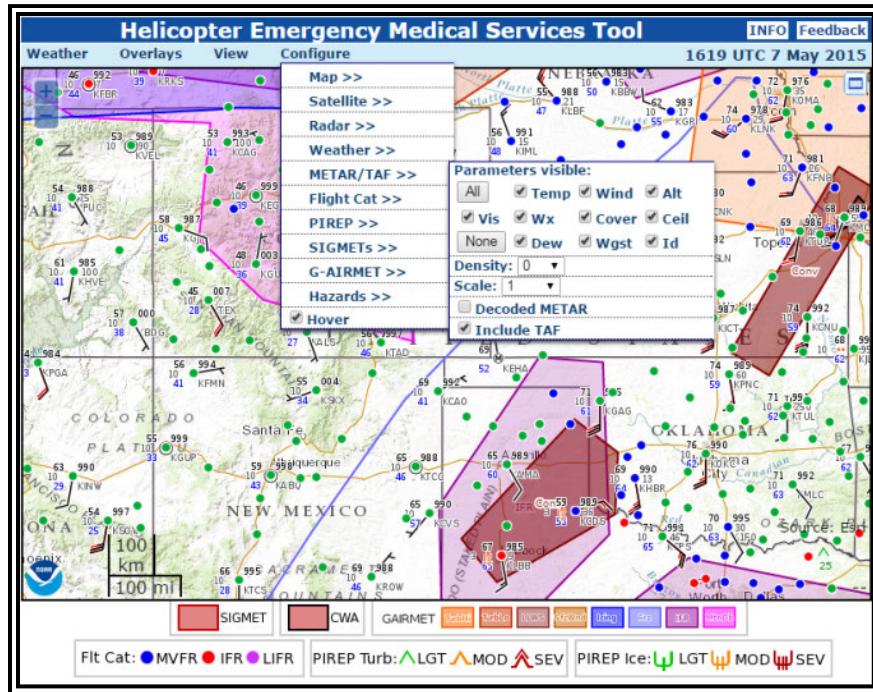
Wind  15knt  60knt 

Figure 6-11. HEMS Data Overlays with Text METAR—Example



Note: Text information from these fields can be accessed by clicking on the station or in the polygon, or by selecting “hover” in the Configure menu and scrolling the mouse over the area of interest.

Data can be customized in the Configure menu (see Figure 6-12, Configure Menu—Example). The user can select the type of background map; the level of transparency for the weather overlays; the types of SIGMETs, G-AIRMETs, PIREPs, and NWS hazards they wish to view; the preferred satellite view; and the density of observations.

Figure 6-12. Configure Menu—Example

6.1.2.7 **ESRI Basemaps and Overlays.**

The HEMS Tool has high-resolution basemaps for the entire United States. More detail is revealed as the user zooms in. The user can select their preferred Environmental Systems Research Institute (ESRI) basemap through the HEMS Configure menu. Options include Terrain, Road, or Satellite, and the user can select a light, dark, or simple map background. The default basemap is the ESRI Terrain view.

Map overlays include highways, roads, counties, top jet routes, ARTCC boundaries, Navigation Aids (NAVAID), airports, and runways. These can be toggled on or off in the Overlays menu.

6.1.3 Strengths and Limitations.

6.1.3.1 **HEMS Strengths.**

1. One-stop shop for multiple data fields.
2. Focused on low-altitude flights common to HEMS.
3. Simplified display for non-meteorologist users.
4. Available 24 hours a day, 7 days a week.

6.1.3.2 **HEMS Limitations.**

1. Due to limitations of the observations, the ceiling, visibility, and flight category grid cells are approximately 5 km apart. In data

sparse regions, the best possible estimate of ceiling and visibility is assumed from the nearest surrounding data and may not represent the actual conditions at a specific point.

2. Due to limitations of the radar, such as blockage by mountains, spacing of radar locations and over processing of clutter and AP, there may be precipitation when radar data does not detect or show a complete weather picture. The most commonly seen example is very shallow clouds with light precipitation, like freezing drizzle or snow. An excellent website with more information concerning radar technology and limitations is found at the NWS JetStream-Online School for Weather, under Radar Frequently Asked Questions (FAQ).
3. In regions of steep terrain, AGL altitudes may have significant deviations from actual height above terrain, given the limiting factor of grid cell size, which is approximately 13 km, and the resolution of the topography in the model.

6.1.4 Use.

The HEMS Tool has been specially designed to meet the needs of emergency first responders flying short-distance, low-altitude flight routes. This tool is **not** designed for General Aviation (GA) or commercial flights and does not constitute an official weather brief.

6.2 Flight Path Tool.

6.2.1 Description.

The FPT is a comprehensive, interactive, geographical display that brings together all of the weather products available at <http://www.aviationweather.gov/flightpath>. It runs as a Java desktop application on your computer for maximum performance.

The Flight Path Tool can overlay multiple fields of interest: icing (probability, severity, and Supercooled Large Drops (SLD)), turbulence potential, Convective diagnosis and forecast, ceiling, visibility, flight category, winds, relative humidity, temperature, radar (base and Composite Reflectivity), satellite observations (visible, infrared (IR), and water vapor wavelengths), AIRMETs and SIGMETs, METARS, TAFs, and PIREPs.

All 3-D data can be sliced horizontally at selected flight levels or vertically along a flight path. All data can be animated in time.

The tool lets you zoom in to any location on the globe. It automatically switches to the most appropriate projection for the viewed area. High-resolution base maps show selectively more detail as you zoom in.

In addition, the FPT can create vertical cross sections along your flight route.

Preferred views can be saved for quick recall later.

Discussion Credit: NOAA/NWS/AWC.

Figure 6-13. Flight Path Tool—Icing Severity Example (Image Credit: AWC)

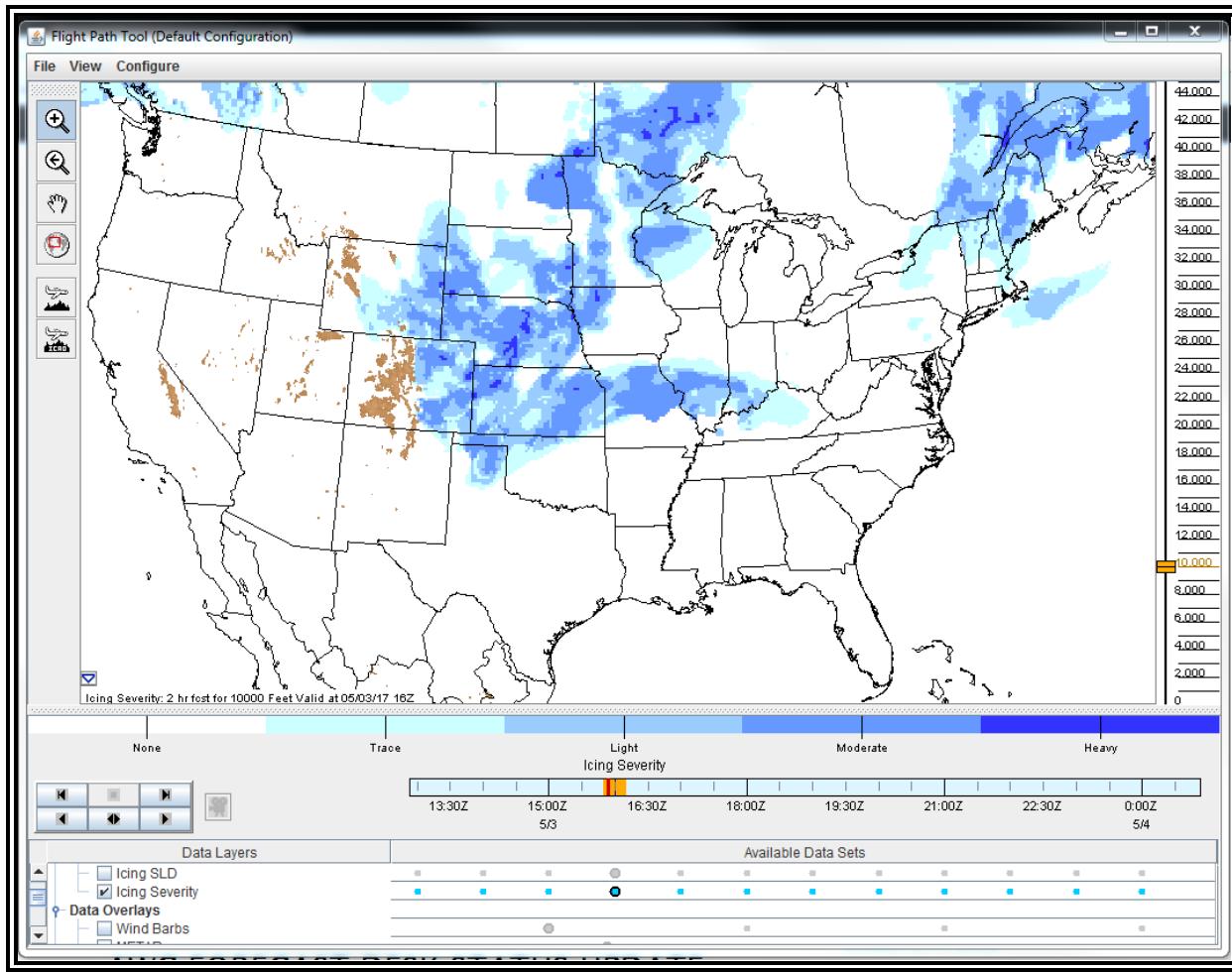


Figure 6-14. Flight Path Tool—Windbarbs Example (Image Credit: AWC)

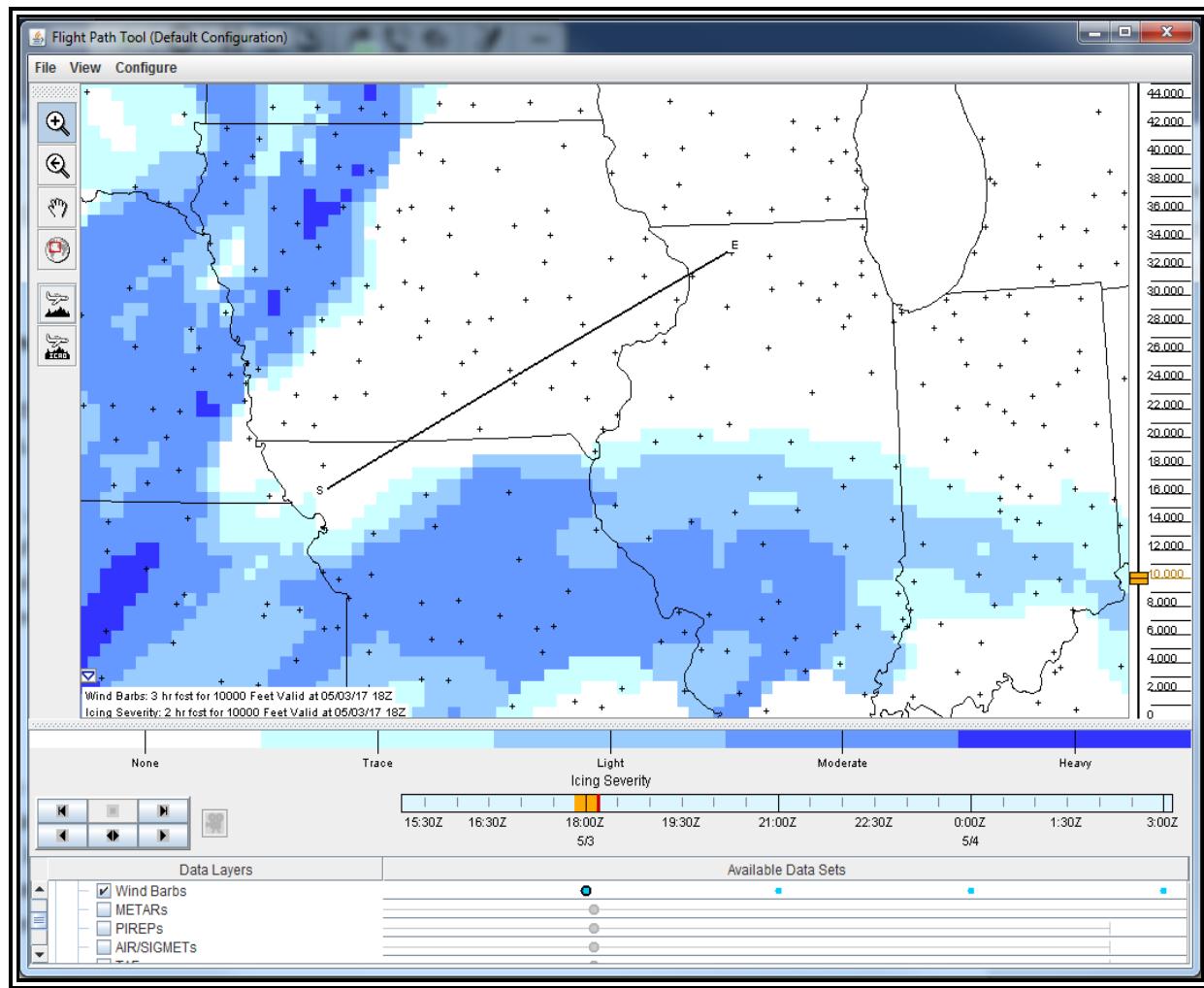
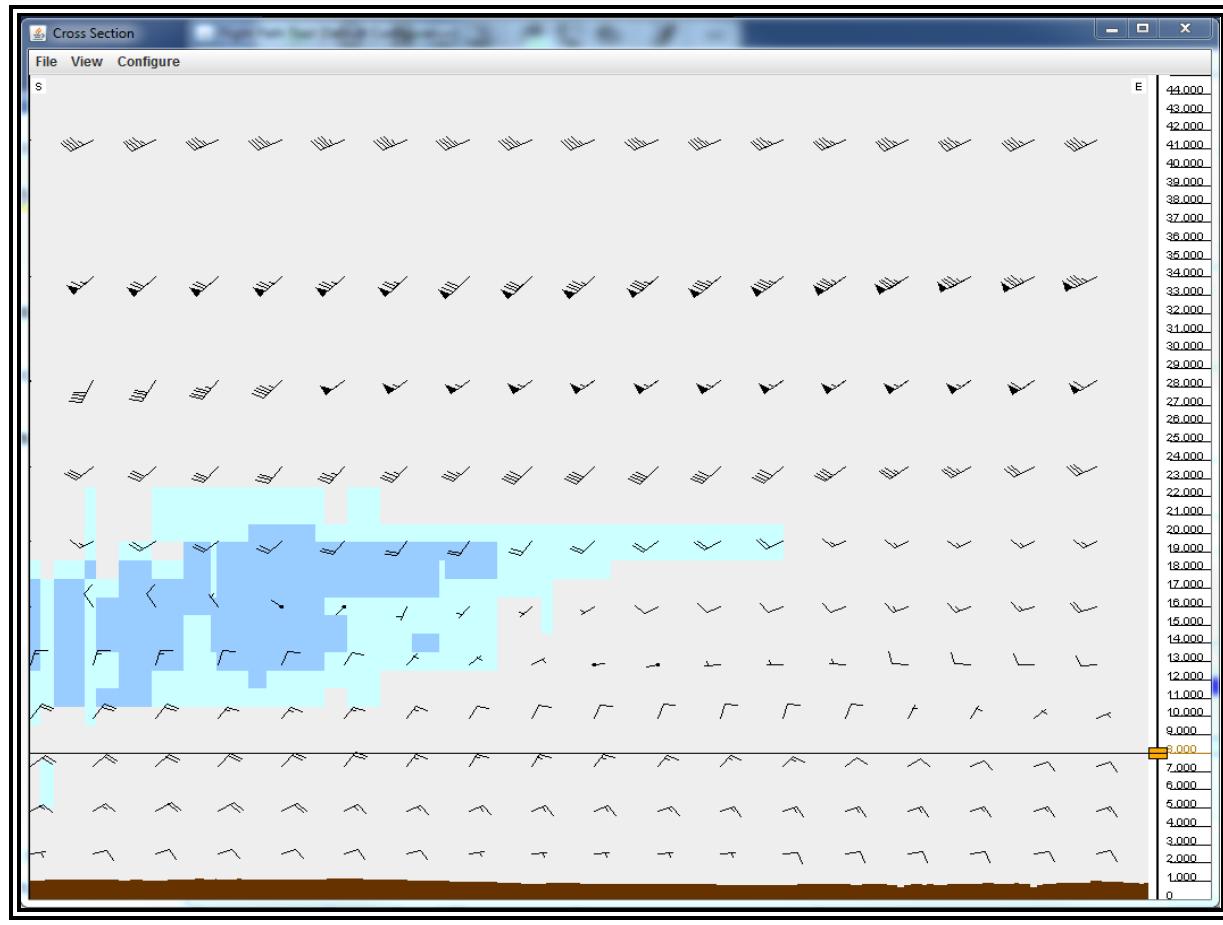


Figure 6-15. Flight Path Tool—Cross Section Example (Image Credit: AWC)



APPENDIX A. DEFINITION OF COMMON TERMS USED IN EN ROUTE FORECASTS AND ADVISORIES

**Table A-1. Definition of Common Terms Used in En Route Forecasts and Advisories
(FA, SIGMET, AIRMET, TCA, VAA, ROFOR)**

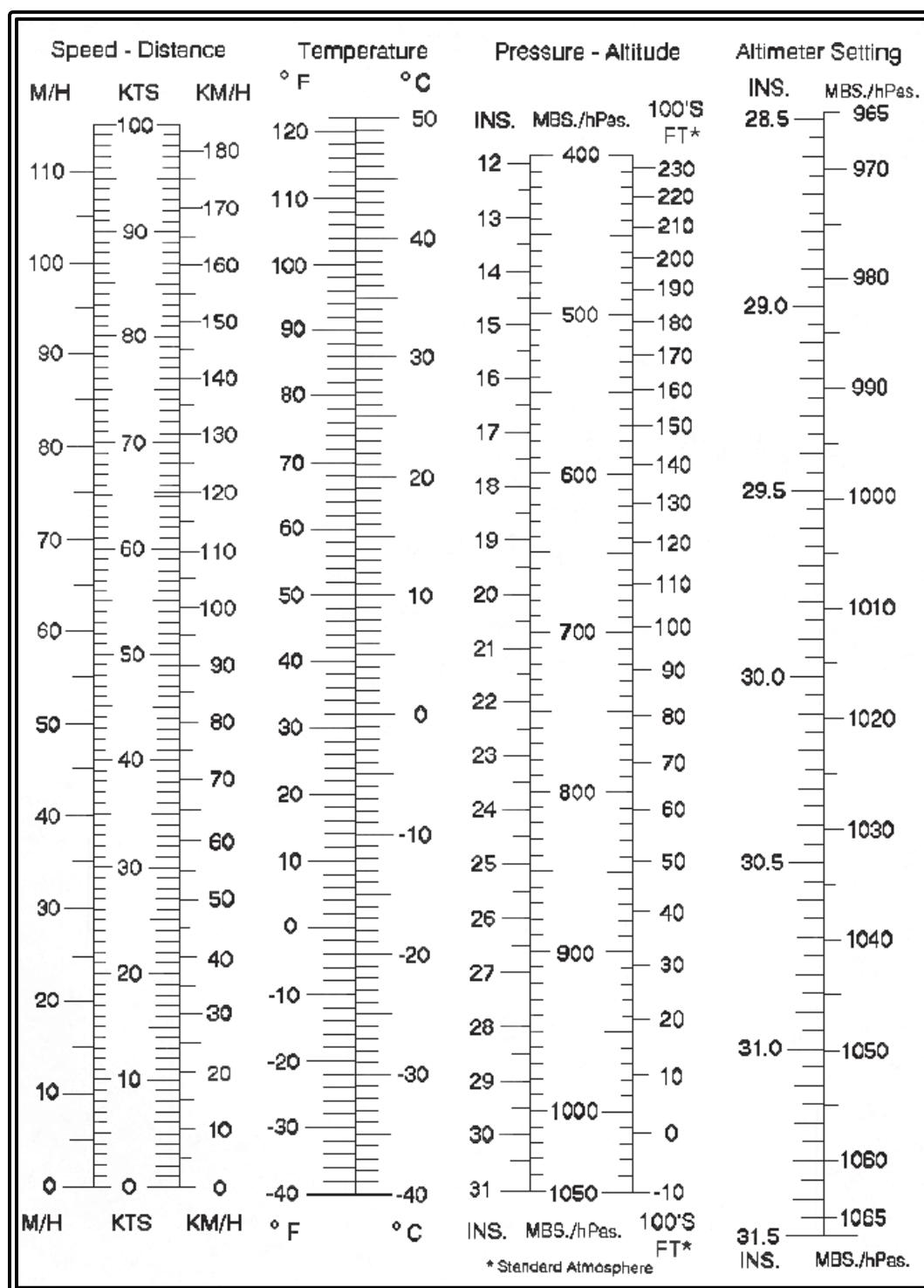
Contraction	Translation	Definition
EMBD	Embedded Thunderstorms or Cumulonimbus	Thunderstorms or cumulonimbus (CB) clouds that are embedded in cloud layers or concealed by haze.
EXTREME TURB	Extreme Turbulence	Turbulence in which aircraft is violently tossed about and is practically impossible to control. It may cause structural damage.
FIR	Flight Information Region	An airspace of defined dimensions within which flight information service and alerting service are provided.
FL	Flight Level	A surface of constant atmospheric pressure which is related to a specific pressure datum, 1013.2 hectopascals (hPa), and is separated from other such surfaces by specific pressure intervals.
FRQ	Frequent Thunderstorms or Cumulonimbus	Consisting of elements with little or no separation between adjacent thunderstorms with a maximum spatial coverage greater than 75 percent of the area affected by the phenomena at a fixed time or during the period of validity.
IMC	Instrument Meteorological Conditions	Ceiling greater than or equal to 500 feet to less than 1,000 feet and/or visibility greater than or equal to 1 to less than 3 miles. LIMC is a sub-category of IMC, thus, IMC conditions are ceiling less than 1,000 feet and/or visibility less than 3 miles.
ISOL	Isolated Thunderstorms or Cumulonimbus	Consisting of individual features affecting an area with a maximum spatial coverage less than 50 percent of the area affected by the phenomena at a fixed time or during the period of validity.
LINE TS	Line (of Thunderstorms)	A line of thunderstorms being at least 60 miles long with thunderstorms affecting at least 40 percent of its length.
LIMC	Low Instrument Meteorological Conditions	Ceiling less than 500 feet and/or visibility less than 1 SM. LIMC is a sub-category of Instrument Meteorological Conditions.
MVMC	Marginal Visual Meteorological Conditions	Ceiling greater than or equal to 1,000 feet to less than or equal to 3,000 feet and/or visibility greater than or equal to 3 to less than or equal to 5 miles.

Contraction	Translation	Definition
MOD ICE	Moderate Icing	The rate of accumulation is such that even short encounters become potentially hazardous and use of deicing/anti-icing equipment or diversion is necessary.
MOD TURB	Moderate Turbulence	Turbulence that causes changes in attitude (pitch, roll, yaw) and/or altitude, but the aircraft remains in positive control at all times. It usually causes variations in indicated airspeed.
MT OBSC	Mountain Obscuration	Conditions over significant portions of mountainous geographical areas are such that pilots in-flight should not expect to maintain visual meteorological conditions or visual contact with mountains or mountain ridges near their route of flight.
OBSC	Obscured Thunderstorm or Cumulonimbus	Obscured by haze, smoke, or cloud or cannot be readily seen due to darkness.
OCNL	Occasional Thunderstorms or Cumulonimbus	An area with a maximum spatial coverage between 50 and 75 percent of the area affected by the phenomena at a fixed time of during the period of validity.
SCT	Scattered	25 to 50 percent of area affected.
SEV ICE	Severe Icing	The rate of accumulation is such that normal deicing/anti-icing equipment fails to reduce or control the hazard. Immediate diversion is necessary.
SEV TURB	Severe Turbulence	Turbulence that causes large, abrupt changes in altitude and/or attitude. It usually causes large variations in indicated airspeed. Aircraft may be momentarily out of control.
VMC	Visual Meteorological Conditions	Ceiling greater than 3,000 feet and visibility greater than 5 miles.
VOLCANIC ERUPTION	Volcanic Eruption	A volcano eruption has occurred when an eruption report is received from a volcano observatory. A volcanic eruption is also considered to have occurred regardless of volcano observatory notification if reported by PIREP, or ground observer, or if remote sensing data indicates that an eruption has occurred based on satellite imagery or WSR-88D radar data or any other reliable sources are identified.

Contraction	Translation	Definition
VOLCANIC ASH	Volcanic Ash	Any ash that can be seen by any one or more of the following: satellite imagery (visible, IR, multi-channel or TOMS), PIREPs, ground observations, radar and VAFTAD (In the event volcanic ash is entrained in clouds, the volcanic ash will be treated as visible using the VAFTAD as guidance).
WDLY SCT	Widely Scattered	Less than 25 percent of area affected.
WDSPR	Widespread	50 percent or greater of the area affected.

APPENDIX B. STANDARD CONVERSION CHART

Figure B-1. Standard Conversion Chart

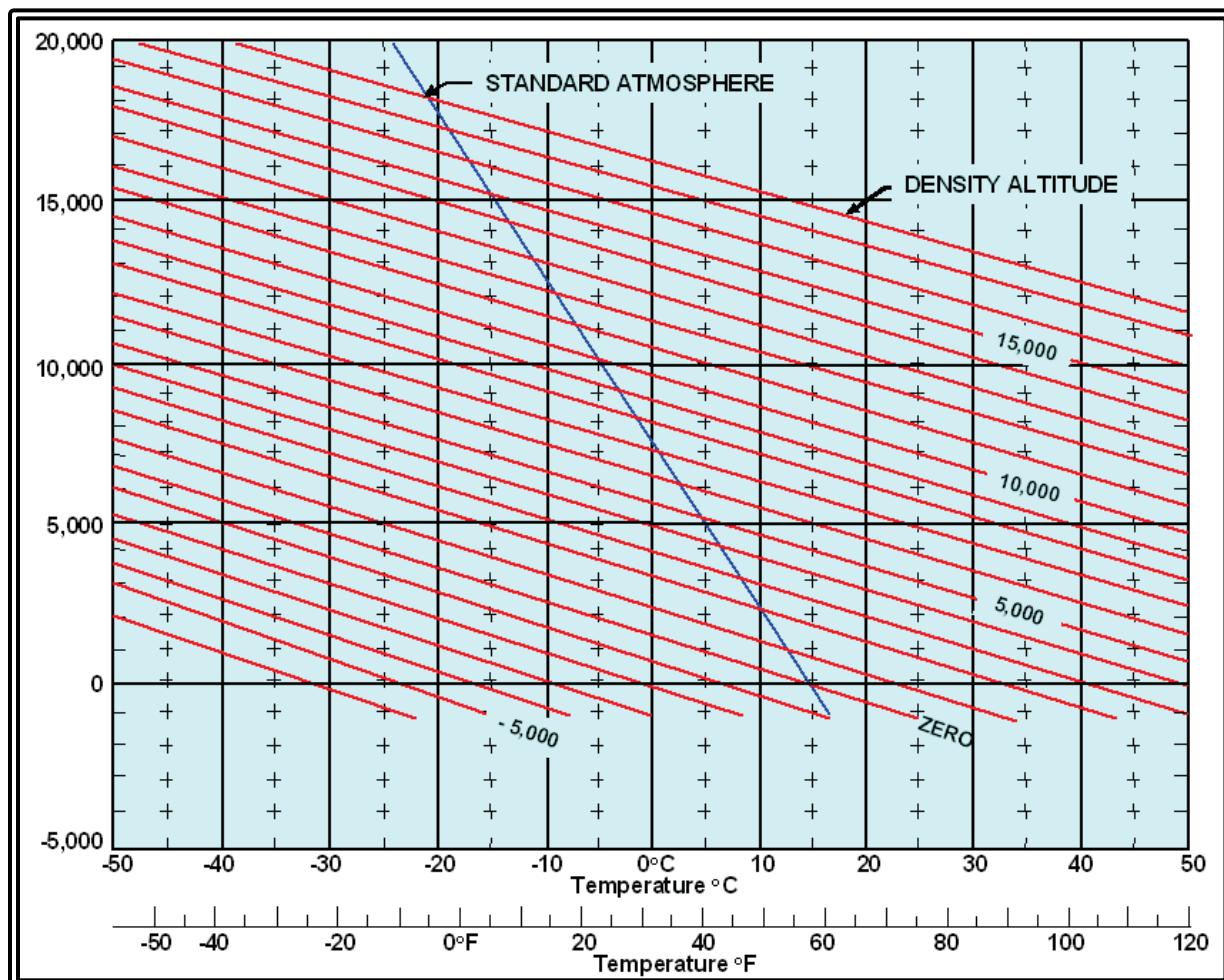


APPENDIX C. DENSITY ALTITUDE CALCULATION

To determine density altitude:

1. Set the aircraft's altimeter to 29.92 inches of Mercury. The altimeter will indicate pressure altitude.
2. Read the outside air temperature.
3. Mark the intersection of pressure altitude (horizontal) and temperature (vertical) lines on the chart.
4. Read the density altitude from the diagonal lines.

Figure C-1. Density Altitude Computation Chart



APPENDIX D. INTERNET LINKS**Table D-1. Selected National Weather Service (NWS) Links**

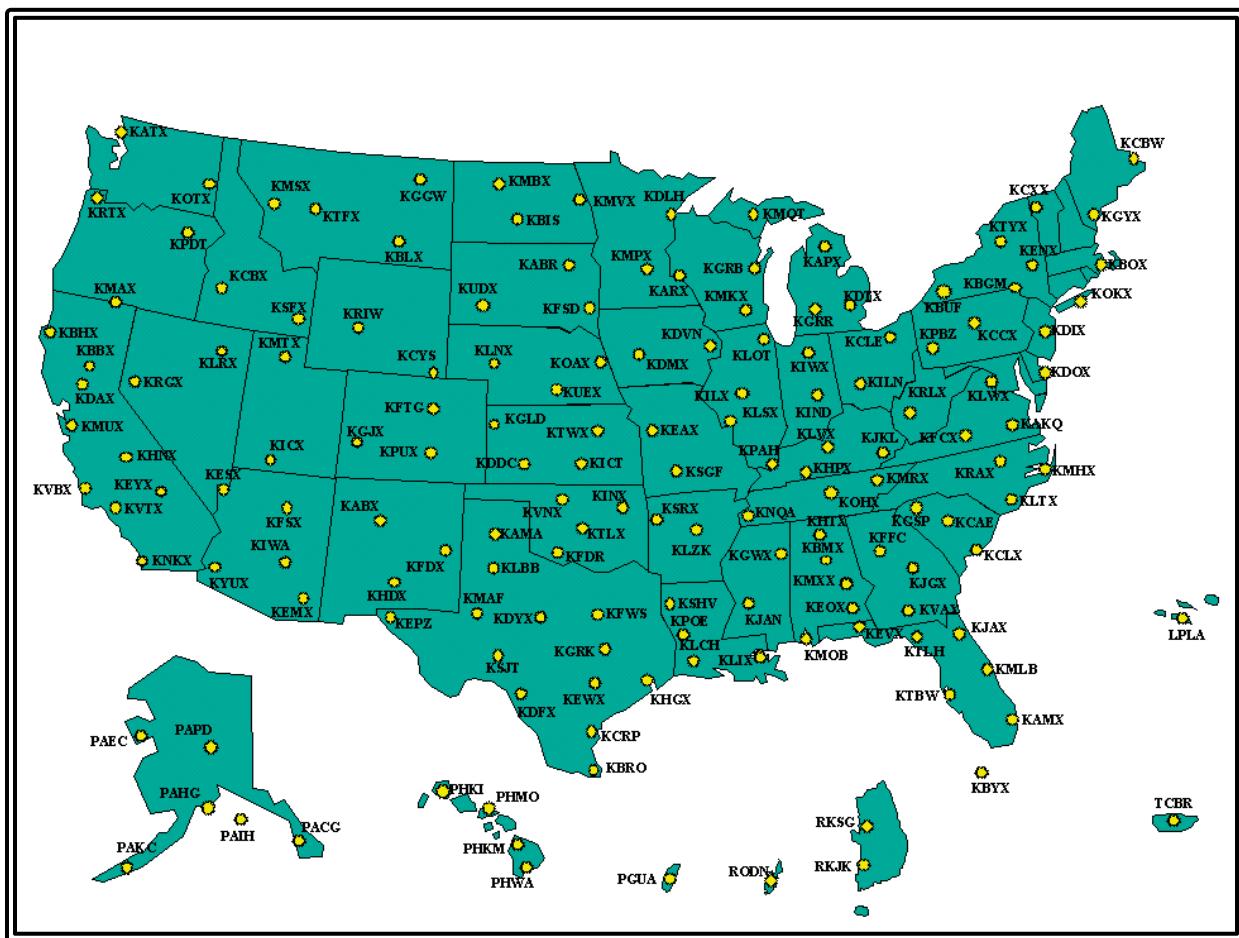
NWS WEBSITE LINKS
National Weather Service (NWS)
Aviation Digital Data Service (ADDS)
Aviation Weather Center (AWC)
Storm Prediction Center (SPC)
Alaska Aviation Weather Unit (AAWU)
Center Weather Service Units (CWSU)
Weather Forecast Office (WFO)
Weather Forecast Office (WFO) Honolulu, HI –Aviation Products

Table D-2. Selected Federal Aviation Administration (FAA) Links

FAA WEBSITE LINKS
Federal Aviation Administration (FAA)
Air Traffic Control System Command Center (ATCSCC)
Flight Service Operations

APPENDIX E. WSR-88D WEATHER RADAR NETWORK

Figure E-1. WSR-88D Weather Radar Network Sites



Advisory Circular Feedback Form

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by contacting the Flight Technologies and Procedures Division (AFS-400) at 9-AWA-AFS-400-COORD@faa.gov or the Flight Standards Directives Management Officer at 9-AWA-AFS-140-Directives@faa.gov.

Subject: AC 00-45H CHG 1, Aviation Weather Services

Date: _____

Please check all appropriate line items:

- An error (procedural or typographical) has been noted in paragraph _____ on page _____.
 Recommend paragraph _____ on page _____ be changed as follows:

- In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

- Other comments:

- I would like to discuss the above. Please contact me.

Submitted by: _____

Date: _____