

Aviation Weather Services

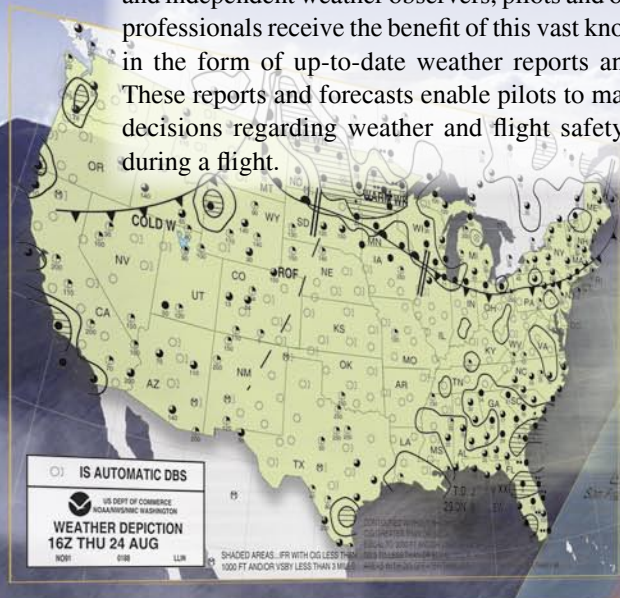
Introduction

In aviation, weather service is a combined effort of the National Weather Service (NWS), Federal Aviation Administration (FAA), Department of Defense (DOD), other aviation groups, and individuals. Because of the increasing need for worldwide weather services, foreign weather organizations also provide vital input.

While weather forecasts are not 100 percent accurate, meteorologists, through careful scientific study and computer modeling, have the ability to predict weather patterns, trends, and characteristics with increasing accuracy. Through a complex system of weather services, government agencies, and independent weather observers, pilots and other aviation professionals receive the benefit of this vast knowledge base in the form of up-to-date weather reports and forecasts. These reports and forecasts enable pilots to make informed decisions regarding weather and flight safety before and during a flight.

Symbol	Meaning
(none)	Light
+	Moderate
++	Heavy
X	Very Heavy
XX	Intense
	Extreme

Contraction	Operational Status
PPINE	Radar is operating normally but there are echoes being detected.
PPINA	Radar observation is not available.
PPIOM	Radar is inoperative or out of service.
AUTO	Automated radar report from WSR-88D.



Observations

The data gathered from surface and upper altitude observations form the basis of all weather forecasts, advisories, and briefings. There are four types of weather observations: surface, upper air, radar, and satellite.

Surface Aviation Weather Observations

Surface aviation weather observations (METARs) are a compilation of elements of the current weather at individual ground stations across the United States. The network is made up of government and privately contracted facilities that provide continuous up-to-date weather information. Automated weather sources, such as the Automated Weather Observing Systems (AWOS), Automated Surface Observing Systems (ASOS), Air Route Traffic Control Center (ARTCC) facilities, as well as other automated facilities, also play a major role in the gathering of surface observations.

Surface observations provide local weather conditions and other relevant information for a radius of five miles of a specific airport. This information includes the type of report, station identifier, date and time, modifier (as required), wind, visibility, runway visual range (RVR), weather phenomena, sky condition, temperature/dew point, altimeter reading, and applicable remarks. The information gathered for the surface observation may be from a person, an automated station, or an automated station that is updated or enhanced by a weather observer. In any form, the surface observation provides valuable information about individual airports around the country. Although the reports cover only a small radius, the pilot can generate a good picture of the weather over a wide area when many reporting stations are looked at together.

Air Route Traffic Control Center (ARTCC)

The ARTCC facilities are responsible for maintaining separation between flights conducted under instrument flight rules (IFR) in the en route structure. Center radars (Air Route Surveillance Radar (ARSR)) acquire and track transponder returns using the same basic technology as terminal radars. Earlier center radars displayed weather as an area of slashes (light precipitation) and Hs (moderate rainfall). Because the controller could not detect higher levels of precipitation, pilots had to be wary of areas showing moderate rainfall. Newer radar displays show weather as three shades of blue. Controllers can select the level of weather to be displayed. Weather displays of higher levels of intensity make it difficult for controllers to see aircraft data blocks, so pilots should not expect air traffic control (ATC) to keep weather displayed continuously.

Upper Air Observations

Observations of upper air weather are more challenging than surface observations. There are only two methods

by which upper air weather phenomena can be observed: radiosonde observations and pilot weather reports (PIREPs). A radiosonde is a small cubic instrumentation package which is suspended below a six foot hydrogen or helium filled balloon. Once released, the balloon rises at a rate of approximately 1,000 feet per minute (fpm). As it ascends, the instrumentation gathers various pieces of data such as air temperature and pressure, as well as wind speed and direction. Once the information is gathered, it is relayed to ground stations via a 300 milliwatt radio transmitter.

The balloon flight can last as long as 2 hours or more and can ascend to altitudes as high as 115,000 feet and drift as far as 125 miles. The temperatures and pressures experienced during the flight can be as low as -130 °F and pressures as low as a few thousandths of what is experienced at sea level.

Since the pressure decreases as the balloon rises in the atmosphere, the balloon expands until it reaches the limits of its elasticity. This point is reached when the diameter has increased to over 20 feet. At this point, the balloon pops and the radiosonde falls back to Earth. The descent is slowed by means of a parachute. The parachute aids in protecting people and objects on the ground. Each year over 75,000 balloons are launched. Of that number, 20 percent are recovered and returned for reconditioning. Return instructions are printed on the side of each radiosonde.

Pilots also provide vital information regarding upper air weather observations and remain the only real-time source of information regarding turbulence, icing, and cloud heights. This information is gathered and filed by pilots in flight. Together, PIREPs and radiosonde observations provide information on upper air conditions important for flight planning. Many domestic and international airlines have equipped their aircraft with instrumentation that automatically transmits inflight weather observations through the DataLink system to the airline dispatcher who disseminates the data to appropriate weather forecasting authorities.

Radar Observations

Weather observers use four types of radar to provide information about precipitation, wind, and weather systems.

1. The WSR-88D NEXRAD radar, commonly called Doppler radar, provides in-depth observations that inform surrounding communities of impending weather. Doppler radar has two operational modes: clear air and precipitation. In clear air mode, the radar is in its most sensitive operational mode because a slow antenna rotation allows the radar to sample the atmosphere longer. Images are updated about every 10 minutes in this mode.

Precipitation targets provide stronger return signals therefore the radar is operated in the Precipitation mode when precipitation is present. A faster antenna rotation in this mode allows images to update at a faster rate, approximately every 4 to 6 minutes. Intensity values in both modes are measured in dBZ (decibels of Z) and depicted in color on the radar image. [Figure 12-1] Intensities are correlated to intensity terminology (phraseology) for air traffic control purposes. [Figure 12-2 and 12-3]

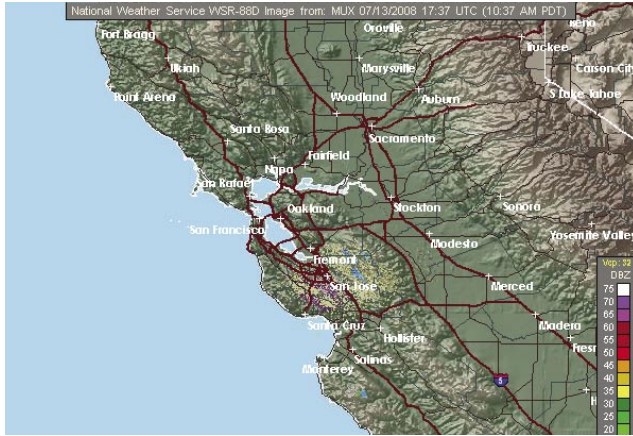


Figure 12-1. Example of a weather radar scope.

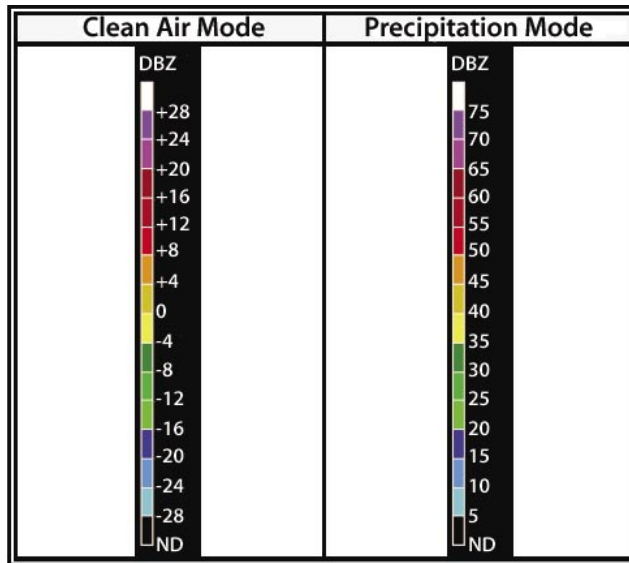


Figure 12-2. WSR-88D Weather Radar Echo Intensity Legend.

2. FAA terminal doppler weather radar (TDWR), installed at some major airports around the country, also aids in providing severe weather alerts and warnings to ATC. Terminal radar ensures pilots are aware of wind shear, gust fronts, and heavy precipitation, all of which are dangerous to arriving and departing aircraft.

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

Figure 12-3. WSR-88D Weather Radar Precipitation Intensity Terminology.

3. The third type of radar commonly used in the detection of precipitation is the FAA airport surveillance radar. This radar is used primarily to detect aircraft, but it also detects the location and intensity of precipitation which is used to route aircraft traffic around severe weather in an airport environment.
4. Airborne radar is equipment carried by aircraft to locate weather disturbances. The airborne radars generally operate in the C or X bands (around 6 GHz or around 10 GHz, respectively) permitting both penetration of heavy precipitation, required for determining the extent of thunderstorms, and sufficient reflection from less intense precipitation.

Satellite

Advancement in satellite technologies has recently allowed for commercial use to include weather uplinks. Through the use of satellite subscription services, individuals are now able to receive satellite transmitted signals that provide near real-time weather information for the North American continent.

Satellite Weather

Recently private enterprise and satellite technology have expanded the realm of weather services. Pilots now have the capability of receiving continuously updated weather across the entire country at any altitude. No longer are pilots restricted by radio range or geographic isolations such as mountains or valleys.

In addition, pilots no longer have to request specific information from weather briefing personnel directly. When the weather becomes questionable, radio congestion often increases, delaying the timely exchange of valuable inflight weather updates for a pilot's specific route of flight. Flight Service Station (FSS) personnel can communicate with only one pilot at a time, which leaves other pilots waiting and flying in uncertain weather conditions. Satellite weather provides the pilot with a powerful resource for enhanced situational awareness at any time. Due to continuous satellite broadcasts, pilots can obtain a weather briefing by looking at a display screen. Pilots have a choice between FAA-certified devices or portable receivers as a source of weather data.

Satellite Weather Products

Significant Meteorological Information (SIGMET)

SIGMETs are weather advisories issued concerning weather significant to the safety of all aircraft. SIGMET advisories can cover an area of at least 3,000 square miles and provide data regarding severe and extreme turbulence, severe icing, and widespread dust or sandstorms that reduce visibility to less than three miles. [Figure 12-4]



Figure 12-4. Satellite SIGMET.

Airmen's Meteorological Information (AIRMET)

AIRMETs are weather advisories issued only to amend the area forecast concerning weather phenomena which are of operational interest to all aircraft and potentially hazardous to aircraft having limited capability because of lack of equipment, instrumentation, or pilot qualifications. AIRMETs concern weather of less severity than that covered by SIGMETs or convective SIGMETs. AIRMETs cover moderate icing, moderate turbulence, sustained winds of 30 knots or more at the surface, widespread areas of ceilings less than 1,000 feet and/or visibility less than three miles, and extensive mountain obscurement. [Figure 12-5]



Figure 12-5. Satellite AIRMET.

Service Outlets

Service outlets are government or private facilities that provide aviation weather services. Several different government agencies, including the FAA, National Oceanic and Atmospheric Administration (NOAA), and the NWS work in conjunction with private aviation companies to provide different means of accessing weather information.

Automated Flight Service Station (AFSS)

The AFSS is the primary source for preflight weather information. A preflight weather briefing from an AFSS can be obtained 24 hours a day by calling 1-800-WX BRIEF from almost anywhere in the United States. In areas not served by an AFSS, NWS facilities may provide pilot weather briefings. Telephone numbers for NWS facilities and additional numbers for AFSS can be found in the Airport/Facility Directory (A/FD) or in the United States Government section of the telephone book.

The AFSS also provides inflight weather briefing services, as well as scheduled and unscheduled weather broadcasts. An AFSS may also furnish weather advisories to flights within the AFSS region of authority.

Transcribed Information Briefing Service (TIBS)

The Transcribed Information Briefing Service (TIBS) is a service prepared and disseminated by selected AFSS. It provides continuous telephone recordings of meteorological and aeronautical information. Specifically, TIBS provides area and route briefings, airspace procedures, and special announcements. It is designed to be a preliminary briefing tool and is not intended to replace a standard briefing from a FSS specialist. The TIBS service is available 24 hours a day and is updated when conditions change, but it can only be accessed by a touchtone phone. The phone numbers for the TIBS service are listed in the A/FD.

Direct User Access Terminal Service (DUATS)

The Direct User Access Terminal Service (DUATS), which is funded by the FAA, allows any pilot with a current medical certificate to access weather information and file a flight plan via computer. Two methods of access are available to connect with DUATS. The first is via the Internet at <http://www.duats.com>. The second method requires a modem and a communications program supplied by a DUATS provider. To access the weather information and file a flight plan by this method, pilots use a toll free telephone number to connect the user's computer directly to the DUATS computer. The current vendors of DUATS service and the associated phone numbers are listed in Chapter 7, Safety of Flight, of the Aeronautical Information Manual (AIM).

En Route Flight Advisory Service (EFAS)

A service specifically designed to provide timely en route weather information upon pilot request is known as the en route flight advisory service (EFAS), or Flight Watch. EFAS provides a pilot with weather advisories tailored to the type of flight, route, and cruising altitude. EFAS can be one of the best sources for current weather information along the route of flight.

A pilot can usually contact an EFAS specialist from 6 a.m. to 10 p.m. anywhere in the conterminous United States and Puerto Rico. The common EFAS frequency, 122.0 MHz, is established for pilots of aircraft flying between 5,000 feet above ground level (AGL) and 17,500 feet mean sea level (MSL).

Hazardous Inflight Weather Advisory (HIWAS)

Hazardous Inflight Weather Advisory (HIWAS) is a national program for broadcasting hazardous weather information continuously over selected navigation aids (NAVAIDs). 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 a FSS or EFAS for detailed information. NAVAIDs that have HIWAS capability are depicted on sectional charts with an “H” in the upper right corner of the identification box. [Figure 12-6]

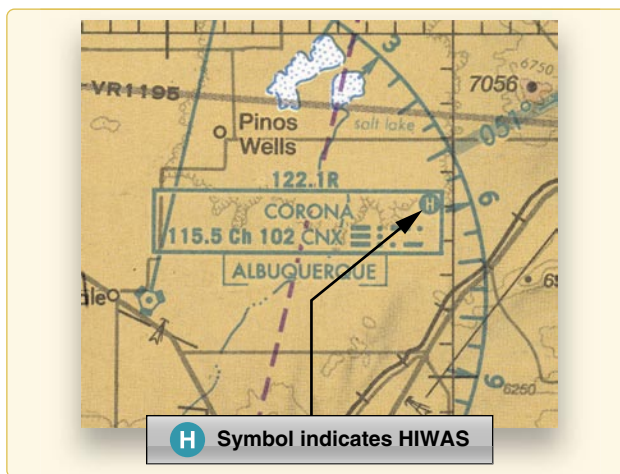


Figure 12-6. HIWAS availability is shown on sectional chart.

Transcribed Weather Broadcast (TWEB) (Alaska Only)

Equipment is provided in Alaska by which meteorological and aeronautical data are recorded on tapes and broadcast continuously over selected low or medium frequency (L/MF) and very high frequency (VHF) omnidirectional radio range navigation system (VOR) facilities. Broadcasts are made from a series of individual tape recordings, and changes, as they occur, are transcribed onto the tapes. The information provided varies depending on the type equipment available.

Generally, the broadcast contains a summary of adverse conditions, surface weather observations, PIREPS, and a density altitude statement (if applicable). At the discretion of the broadcast facility, recordings may also include a synopsis, winds aloft forecast, en route and terminal forecast data, and radar reports. At selected locations, telephone access to the TWEB has been provided (TEL-TWEB). Telephone numbers for this service are found in the Supplement Alaska A/FD. These broadcasts are made available primarily for preflight and inflight planning, and as such, should not be considered as a substitute for specialist-provided preflight briefings.

Weather Briefings

Prior to every flight, pilots should gather all information vital to the nature of the flight. This includes an appropriate weather briefing obtained from a specialist at a FSS, AFSS, or NWS.

For weather specialists to provide an appropriate weather briefing, they need to know which of the three types of briefings is needed—standard, abbreviated, or outlook. Other helpful information is whether the flight is visual flight rules (VFR) or IFR, aircraft identification and type, departure point, estimated time of departure (ETD), flight altitude, route of flight, destination, and estimated time en route (ETE).

This information is recorded in the flight plan system and a note is made regarding the type of weather briefing provided. If necessary, it can be referenced later to file or amend a flight plan. It is also used when an aircraft is overdue or is reported missing.

Standard Briefing

A standard briefing is the most complete report and provides the overall weather picture. 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 in sequential order if it is applicable to the route of flight.

1. 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, such as thunderstorms or aircraft icing, or other important items such as airport closings.
2. VFR flight not recommended—if the weather for the route of flight is below VFR minimums, or if it is doubtful the flight could be made under VFR conditions due to the forecast weather, the briefer may state that VFR is not recommended. It is the pilot's decision whether or not to continue the flight under VFR, but this advisory should be weighed carefully.

3. **Synopsis**—an overview of the larger weather picture. Fronts and major weather systems that affect the general area are provided.
4. **Current conditions**—this portion of the briefing contains the current ceilings, visibility, winds, and temperatures. If the departure time is more than 2 hours away, current conditions are not included in the briefing.
5. **En route forecast**—a summary of the weather forecast for the proposed route of flight.
6. **Destination forecast**—a summary of the expected weather for the destination airport at the estimated time of arrival (ETA).
7. **Winds and temperatures aloft**—a report of the winds at specific altitudes for the route of flight. The temperature information is provided only on request.
8. **Notices to Airmen (NOTAM)**—information pertinent to the route of flight which has not been published in the NOTAM publication. Published NOTAM information is provided during the briefing only when requested.
9. **ATC delays**—an advisory of any known ATC delays that may affect the flight.
10. **Other information**—at the end of the standard briefing, the FSS specialist provides the radio frequencies needed to open a flight plan and to contact EFAS. Any additional information requested is also provided at this time.

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 weather information is needed to update the previous briefing. When this is the case, the weather specialist needs to know the time and source of the previous briefing so the necessary weather information will not be omitted inadvertently. It is always a good idea to update weather whenever a pilot has additional time.

Outlook Briefing

An outlook briefing should be requested when a planned departure is 6 hours or more 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 prudent pilot requests a follow-up briefing prior to departure since an outlook briefing generally only contains information based on weather trends and existing weather in geographical areas at or near the departure airport. A standard briefing near the time of departure ensures that the pilot has the latest information available prior to their flight.

Aviation Weather Reports

Aviation weather reports are designed to give accurate depictions of current weather conditions. Each report provides current information that is updated at different times. Some typical reports are METAR, PIREPs, and radar weather reports (SDs).

Aviation Routine Weather Report (METAR)

A METAR is an observation of current surface weather reported in a standard international format. While the METAR code has been adopted worldwide, each country is allowed to make modifications to the code. Normally, these differences are minor but necessary to accommodate local procedures or particular units of measure. This discussion of METAR will cover elements used in the United States.

Metars are issued hourly unless significant weather changes have occurred. A special METAR (SPECI) can be issued at any interval between routine METAR reports.

Example:

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METAR KGGG 161753Z AUTO 14021G26 3/4SM
+TSRA BR BKN008 OVC012CB 18/17 A2970 RMK
PRESFR
```

A typical METAR report contains the following information in sequential order:

1. **Type of report**—there are two types of METAR reports. The first is the routine METAR report that is transmitted every hour. The second is the aviation selected SPECI. This is a special report that can be given at any time to update the METAR for rapidly changing weather conditions, aircraft mishaps, or other critical information.
2. **Station identifier**—a four-letter code as established by the International Civil Aviation Organization (ICAO). In the 48 contiguous states, a unique three-letter identifier is preceded by the letter “K.” For example, Gregg County Airport in Longview, Texas, is identified by the letters “KGGG,” K being the country designation and GGG being the airport identifier. In other regions of the world, including Alaska and Hawaii, the first two letters of the four-letter ICAO identifier indicate the region, country, or state. Alaska identifiers always begin with the letters “PA” and Hawaii identifiers always begin with the letters “PH.” A list of station identifiers can be found at an FSS or NWS office.

3. Date and time of report—depicted in a six-digit group (161753Z). The first two digits are the date. The last four digits are the time of the METAR, which is always given in coordinated universal time (UTC). A “Z” is appended to the end of the time to denote the time is given in Zulu time (UTC) as opposed to local time.
4. Modifier—denotes that the METAR came from an automated source or that the report was corrected. If the notation “AUTO” is listed in the METAR, the report came from an automated source. It also lists “AO1” or “AO2” in the remarks section to indicate the type of precipitation sensors employed at the automated station.

When the modifier “COR” is used, it identifies a corrected report sent out to replace an earlier report that contained an error (for example: METAR KGGG 161753Z COR).

5. Wind—reported with five digits (14021) unless the speed is greater than 99 knots, in which case the wind is reported with six digits. The first three digits indicate the direction the true wind is blowing in tens of degrees. If the wind is variable, it is reported as “VRB.” The last two digits indicate the speed of the wind in knots unless the wind is greater than 99 knots, in which case it is indicated by three digits. If the winds are gusting, the letter “G” follows the wind speed (G26). After the letter “G,” the peak gust recorded is provided. If the wind varies more than 60° and the wind speed is greater than six knots, a separate group of numbers, separated by a “V,” will indicate the extremes of the wind directions. *Figure 12-7* shows how the TDWR/Weather System Processor (WSP) determines the true wind, as well as gust front/wind shear location.

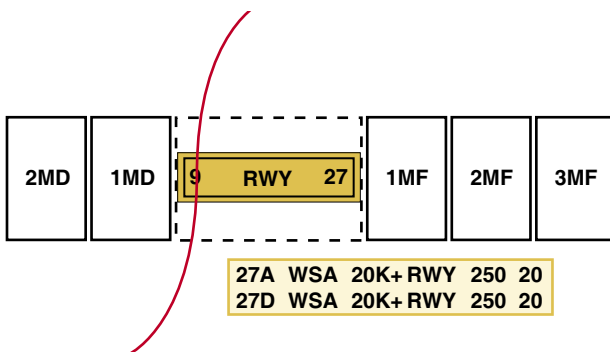


Figure 12-7. Example of what the controller sees on the ribbon display in the tower cab.

6. Visibility—the prevailing visibility ($\frac{3}{4}$ SM) is reported in statute miles as denoted by the letters “SM.” It is reported in both miles and fractions of miles. At times, runway visual range (RVR) is reported following the

prevailing visibility. RVR is the distance a pilot can see down the runway in a moving aircraft. When RVR is reported, it is shown with an R, then the runway number followed by a slant, then the visual range in feet. For example, when the RVR is reported as R17L/1400FT, it translates to a visual range of 1,400 feet on runway 17 left.

7. Weather—can be broken down into two different categories: qualifiers and weather phenomenon (+TSRA BR). First, the qualifiers of intensity, proximity, and the descriptor of the weather will be given. The intensity may be light (-), moderate (), or heavy (+). Proximity only depicts weather phenomena that are in the airport vicinity. The notation “VC” indicates a specific weather phenomenon is in the vicinity of five to ten miles from the airport. Descriptors are used to describe certain types of precipitation and obscurations. Weather phenomena may be reported as being precipitation, obscurations, and other phenomena such as squalls or funnel clouds. Descriptions of weather phenomena as they begin or end, and hailstone size are also listed in the remarks sections of the report. [*Figure 12-8*]
8. Sky condition—always reported in the sequence of amount, height, and type or indefinite ceiling/height (vertical visibility) (BKN008 OVC12CB). The heights of the cloud bases are reported with a three-digit number in hundreds of feet AGL. Clouds above 12,000 feet are not detected or reported by an automated station. The types of clouds, specifically towering cumulus (TCU) or cumulonimbus (CB) clouds, are reported with their height. Contractions are used to describe the amount of cloud coverage and obscuring phenomena. The amount of sky coverage is reported in eighths of the sky from horizon to horizon. [*Figure 12-9*]
9. Temperature and dew point—the air temperature and dew point are always given in degrees Celsius (C) or (°C 18/17). Temperatures below 0 °C are preceded by the letter “M” to indicate minus.
10. Altimeter setting—reported as inches of mercury (“Hg) in a four-digit number group (A2970). It is always preceded by the letter “A.” Rising or falling pressure may also be denoted in the remarks sections as “PRESRR” or “PRESFR” respectively.
11. Zulu time—a term used in aviation for UTC which places the entire world on one time standard.

Qualifier		Weather Phenomena		
Intensity or Proximity 1	Descriptor 2	Precipitation 3	Obscuration 4	Other 5
– Light	MI Shallow	DZ Drizzle	BR Mist	PO Dust/sand whirls
Moderate (no qualifier)	BC Patches	RA Rain	FG Fog	SQ Squalls
+ Heavy	DR Low drifting	SN Snow	FU Smoke	FC Funnel cloud
VC in the vicinity	BL Blowing	SG Snow grains	DU Dust	+FC Tornado or waterspout
	SH Showers	IC Ice crystals (diamond dust)	SA Sand	SS Sandstorm
	TS Thunderstorms	PL Ice pellets	HZ Haze	DS Dust storm
	FZ Freezing	GR Hail	PY Spray	
	PR Partial	GS Small hail or snow pellets	VA Volcanic ash	
		UP *Unknown precipitation		

The weather groups are constructed by considering columns 1–5 in this table in sequence: intensity, followed by descriptor, followed by weather phenomena (e.g., heavy rain showers(s) is coded as +SHRA).
* Automated stations only

Figure 12-8. Descriptors and weather phenomena used in a typical METAR.

Sky Cover	Contraction
Less than 1/8 (Clear)	SKC, CLR, FEW
1/8–2/8 (Few)	FEW
3/8–4/8 (Scattered)	SCT
5/8–7/8 (Broken)	BKN
8/8 or (Overcast)	OVC

Figure 12-9. Reportable contractions for sky condition.

- Remarks—the remarks section always begins with the letters “RMK.” Comments may or may not appear in this section of the METAR. The information contained in this section may include wind data, variable visibility, beginning and ending times of particular phenomenon, pressure information, and various other information deemed necessary. An example of a remark regarding weather phenomenon that does not fit in any other category would be: OCNL LTGICCG. This translates as occasional lightning in the clouds and from cloud to ground. Automated stations also use the remarks section to indicate the equipment needs maintenance.

Example:

METAR KGGG 161753Z AUTO 14021G26 3/4SM
+TSRA BR BKN008 OVC012CB 18/17 A2970 RMK
PRESFR

Explanation:

Routine METAR for Gregg County Airport for the 16th day of the month at 1753Z automated source. Winds are

140 at 21 knots gusting to 26. Visibility is 3/4 statute mile. Thunderstorms with heavy rain and mist. Ceiling is broken at 800 feet, overcast at 1,200 feet with cumulonimbus clouds. Temperature 18 °C and dew point 17 °C. Barometric pressure is 29.70 "Hg and falling rapidly.

Pilot Weather Reports (PIREPs)

PIREPs provide valuable information regarding the conditions as they actually exist in the air, which cannot be gathered from any other source. Pilots can confirm the height of bases and tops of clouds, locations of wind shear and turbulence, and the location of inflight icing. If the ceiling is below 5,000 feet, or visibility is at or below five miles, ATC facilities are required to solicit PIREPs from pilots in the area. When unexpected weather conditions are encountered, pilots are encouraged to make a report to a FSS or ATC. When a pilot weather report is filed, the ATC facility or FSS will add it to the distribution system to brief other pilots and provide inflight advisories.

PIREPs are easy to file and a standard reporting form outlines the manner in which they should be filed. *Figure 12-10* shows the elements of a PIREP form. Item numbers 1 through 5 are required information when making a report, as well as at least one weather phenomenon encountered. A PIREP is normally transmitted as an individual report, but may be appended to a surface report. Pilot reports are easily decoded and most contractions used in the reports are self-explanatory.

Encoding Pilot Weather Reports (PIREPS)			
1	XXX	3-letter station identifier	Nearest weather reporting location to the reported phenomenon
2	UA	Routine PIREP, UUA-Urgent PIREP.	
3	/OV	Location	Use 3-letter NAVAID idents only. a. Fix: /OV ABC, /OV ABC 090025. b. Fix: /OV ABC 045020-DEF, /OV ABC-DEF-GHI
4	/TM	Time	4 digits in UTC: /TM 0915.
5	/FL	Altitude/Flight level	3 digits for hundreds of feet. If not known, use UNKN: /FL095, /FL310, /FLUNKN.
6	/TP	Type Aircraft	4 digits maximum. If not known, use UNKN: /TP L329, /TP B727, /TP UNKN.
7	/SK	Sky cover/Cloud layers	Describe as follows: a. Height of cloud base in hundreds of feet. If unknown, use UNKN. b. Cloud cover symbol. c. Height of cloud tops in hundreds of feet.
8	/WX	Weather	Flight visibility reported first: Use standard weather symbols; intensity is not reported: /WX FV02 R H, /WX FV01 TRW.
9	/TA	Air temperature in Celsius (C)	If below zero, prefix with a hyphen: /TA 15, /TA -06.
10	/WV	Wind	Direction in degrees magnetic north and speed in six digits: /WV 270045, WV 280110.
11	/TB	Turbulence	Use standard contractions for intensity and type (use CAT or CHOP when appropriate). Include altitude only if different from /FL, /TB EXTREME, /TB LGT-MDT BLO 090.
12	/IC	Icing	Describe using standard intensity and type contractions. Include altitude only if different than /FL: /IC LGT-MDT RIME, /IC SVR CLR 028-045.
13	/RM	Remarks	Use free from to clarify the report and type hazardous elements first: /RM LLWS -15KT SFC-030 DURC RNWY 22 JFK.

Figure 12-10. PIREP encoding and decoding.

Example:

UA/OV GGG 090025/TM 1450/FL 060/TP C182/SK
080 OVC/WX FV 04R/TA 05/WV 270030/TB LGT/RM
HVY RAIN

Explanation:

Type:Routine pilot report
Location: 25 NM out on the 090° radial,
Gregg County VOR
Time: 1450 Zulu
Altitude or Flight Level: 6,000 feet
Aircraft Type:Cessna 182
Sky Cover:8,000 overcast
Visibility/Weather:4 miles in rain
Temperature:5 °Celsius
Wind:270° at 30 knots
Turbulence:Light
Icing: None reported
Remarks: Rain is heavy

Radar Weather Reports (RAREP)

Areas of precipitation and thunderstorms are observed by radar on a routine basis. Radar weather reports (RAREPs) or storm detections (SDs) are issued by radar stations at 35 minutes past the hour, with special reports issued as needed.

RAREPs provide information on the type, intensity, and location of the echo top of the precipitation. [Figure 12-11] These reports may also include direction and speed of the area of precipitation, as well as the height and base of the precipitation in hundreds of feet MSL. RAREPs are especially valuable for preflight planning to help avoid areas of severe weather. However, radar only detects objects

Symbol	Meaning
R	Rain
RW	Rain Shower
S	Snow
SW	Snow Shower
T	Thunderstorm
Symbol	Intensity
-	Light
(none)	Moderate
+	Heavy
++	Very Heavy
x	Intense
xx	Extreme
Contraction	Operational Status
PPINE	Radar is operating normally but there are no echoes being detected.
PPINA	Radar observation is not available.
PPIOM	Radar is inoperative or out of service.
AUTO	Automated radar report from WSR-88D.

Figure 12-11. Radar weather report codes.

in the atmosphere that are large enough to be considered precipitation. Cloud bases and tops, ceilings, and visibility are not detected by radar.

A typical RAREP will include:

- Location identifier and time of radar observation
- Echo pattern
 1. Line (LN)—a line of precipitation echoes at least 30 miles long, at least four times as long as it is wide, and at least 25 percent coverage within the line.
 2. Area (AREA)—a group of echoes of similar type and not classified as a line.
 3. Single cell (CELL)—a single isolated convective echo such as a rain shower.
- Area coverage in tenths
- Type and intensity of weather
- Azimuth, referenced to true north and range, in nautical miles from the radar site of points defining the echo pattern. For lines and areas, there will be two azimuth and range sets that define the pattern. For cells, there will be only one azimuth and range set.
- Dimension of echo pattern—given when the azimuth and range define only the center line of the pattern.
- Cell movement—movement is coded only for cells; it will not be coded for lines or areas.
- Maximum top of precipitation and location—maximum tops may be coded with the symbols “MT” or “MTS.” If it is coded with “MTS,” it means that satellite data, as well as radar information was used to measure the top of the precipitation.
- If the contraction “AUTO” appears in the report, it means the report is automated from WSR-88D weather radar data.
- The last section is primarily used to prepare radar summary charts, but can be used during preflight to determine the maximum precipitation intensity within a specific grid box. The higher the number, the greater the intensity. Two or more numbers appearing after a grid box reference, such as PM34, indicates precipitation in consecutive grid boxes.

Example:

```
TLX 1935 LN 8 TRW++ 86/40 199/115  
20W C2425 MTS 570 AT 159/65 AUTO  
^MO1 NO2 ON3 PM34 QM3 RL2=
```

Explanation:

The radar report gives the following information: The report is automated from Oklahoma City and was made at 1935 UTC. The echo pattern for this radar report indicates a line of echos covering 86% of the area. Thunderstorms and very heavy rain showers are indicated. The next set of numbers indicates the azimuth that defines the echo (86° at 40 NM and 199° at 115 NM). The dimension of this echo is given as 20 NM wide (10 NM on either side of the line defined by the azimuth and range). The cells within the line are moving from 240° at 25 knots. The maximum top of the precipitation, as determined by radar and satellite, is 57,000 feet and it is located on the 159° radial, 65 NM out. The last line indicates the intensity of the precipitation, for example in grid QM the intensity is 3, or heavy precipitation. (1 is light and 6 is extreme.)

Aviation Forecasts

Observed weather condition reports are often used in the creation of forecasts for the same area. A variety of different forecast products are produced and designed to be used in the preflight planning stage. The printed forecasts that pilots need to be familiar with are the terminal aerodrome forecast (TAF), aviation area forecast (FA), inflight weather advisories (SIGMET, AIRMET), and the winds and temperatures aloft forecast (FD).

Terminal Aerodrome Forecasts (TAF)

A TAF is a report established for the five statute mile radius around an airport. TAF reports are usually given for larger airports. Each TAF is valid for a 30-hour time period, and is updated four times a day at 0000Z, 0600Z, 1200Z, and 1800Z. The TAF utilizes the same descriptors and abbreviations as used in the METAR report. The TAF includes the following information in sequential order:

1. Type of report—a TAF can be either a routine forecast (TAF) or an amended forecast (TAF AMD).
2. ICAO station identifier—the station identifier is the same as that used in a METAR.
3. Date and time of origin—time and date of TAF origination is given in the six-number code with the first two being the date, the last four being the time. Time is always given in UTC as denoted by the Z following the number group.
4. Valid period date and time—the valid forecast time period is given by a six-digit number group. The first two numbers indicate the date, followed by the two-digit beginning time for the valid period, and the last two digits are the ending time.

5. Forecast wind—the wind direction and speed forecast are given in a five-digit number group. The first three indicate the direction of the wind in reference to true north. The last two digits state the windspeed in knots as denoted by the letters “KT.” Like the METAR, winds greater than 99 knots are given in three digits.
6. Forecast visibility—given in statute miles and may be in whole numbers or fractions. If the forecast is greater than six miles, it will be coded as “P6SM.”
7. Forecast significant weather—weather phenomena are coded in the TAF reports in the same format as the METAR. If no significant weather is expected during the forecast time period, the denotation “NSW” is included in the “becoming” or “temporary” weather groups.
8. Forecast sky condition—given in the same manner as the METAR. Only cumulonimbus (CB) clouds are forecast in this portion of the TAF report as opposed to CBs and towering cumulus in the METAR.
9. Forecast change group—for any significant weather change forecast to occur during the TAF time period, the expected conditions and time period are included in this group. This information may be shown as from (FM), becoming (BECMG), and temporary (TEMPO). “FM” is used when a rapid and significant change, usually within an hour, is expected. “BECMG” is used when a gradual change in the weather is expected over a period of no more than 2 hours. “TEMPO” is used for temporary fluctuations of weather, expected to last less than one hour.
10. Probability forecast—a given percentage that describes the probability of thunderstorms and precipitation occurring in the coming hours. This forecast is not used for the first 6 hours of the 24-hour forecast.

Example:

```
TAF
KPIR 111130Z 111212 15012KT P6SM BKN090
TEMPO 1214 5SM BR
FM1500 16015G25KT P6SM SCT040 BKN250
FM0000 14012KT P6SM BKN080 OVC150 PROB40 0004
3SM TSRA BKN030CB
FM0400 1408KT P6SM SCT040 OVC080
TEMPO 0408 3SM TSRA OVC030CB
BECMG 0810 32007KT=
```

Explanation:

Routine TAF for Pierre, South Dakota...on the 11th day of the month, at 1130Z...valid for 24 hours from 1200Z on the 11th to 1200Z on the 12th...wind from 150° at 12 knots...visibility greater than 6 sm...broken clouds at 9,000

feet...temporarily, between 1200Z and 1400Z, visibility 5 sm in mist...from 1500Z winds from 160° at 15 knots, gusting to 25 knots visibility greater than 6 sm...clouds scattered at 4,000 feet and broken at 25,000 feet...from 0000Z wind from 140° at 12 knots...visibility greater than 6 sm...clouds broken at 8,000 feet, overcast at 15,000 feet...between 0000Z and 0400Z, there is 40 percent probability of visibility 3 sm...thunderstorm with moderate rain showers...clouds broken at 3,000 feet with cumulonimbus clouds...from 0400Z...winds from 140° at 8 knots...visibility greater than 6 miles...clouds at 4,000 scattered and overcast at 8,000...temporarily between 0400Z and 0800Z...visibility 3 miles...thunderstorms with moderate rain showers...clouds overcast at 3,000 feet with cumulonimbus clouds...becoming between 0800Z and 1000Z...wind from 320° at 7 knots...end of report (=).

Area Forecasts (FA)

The FA gives a picture of clouds, general weather conditions, and visual meteorological conditions (VMC) expected over a large area encompassing several states. There are six areas for which area forecasts are published in the contiguous 48 states. Area forecasts are issued three times a day and are valid for 18 hours. This type of forecast gives information vital to en route operations, as well as forecast information for smaller airports that do not have terminal forecasts.

Area forecasts are typically disseminated in four sections and include the following information:

1. Header—gives the location identifier of the source of the FA, the date and time of issuance, the valid forecast time, and the area of coverage.

Example:

```
DFWC FA 120945
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 130400
CLDS/WX VALID UNTIL 122200...OTLK VALID
122200-130400
OK TX AR LA MS AL AND CSTL WTRS
```

Explanation:

The area forecast shows information given by Dallas Fort Worth, for the region of Oklahoma, Texas, Arkansas, Louisiana, Mississippi, and Alabama, as well as a portion of the Gulf coastal waters. It was issued on the 12th day of the month at 0945. The synopsis is valid from the time of issuance until 0400 hours on the 13th. VFR clouds and weather information on this area forecast are valid until 2200 hours on the 12th and the outlook is valid until 0400 hours on the 13th.

2. Precautionary statements—IFR conditions, mountain obscurations, and thunderstorm hazards are described in this section. Statements made here regarding height are given in MSL, and if given otherwise, AGL or ceiling (CIG) will be noted.

Example:

SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.

TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.

NON MSL HGTS DENOTED BYAGL OR CIG.

Explanation:

The area forecast covers VFR clouds and weather, so the precautionary statement warns that AIRMET Sierra should be referenced for IFR conditions and mountain obscuration. The code TS indicates the possibility of thunderstorms and implies there may be occurrences of severe or greater turbulence, severe icing, low-level wind shear, and IFR conditions. The final line of the precautionary statement alerts the user that heights, for the most part, are MSL. Those that are not MSL will be AGL or CIG.

3. Synopsis—gives a brief summary identifying the location and movement of pressure systems, fronts, and circulation patterns.

Example:

SYNOPSIS...LOW PRES TROF 10Z OK/TX PNHDL AREA FCST MOV EWD INTO CNTRL-SWRN OK BY 04Z. WRMFNT 10Z CNTRL OK-SRN AR-NRN MS FCST LIFT NWD INTO NERN OK-NRN AR EXTRM NRN MS BY 04Z.

Explanation:

As of 1000Z, there is a low pressure trough over the Oklahoma and Texas panhandle area, which is forecast to move eastward into central southwestern Oklahoma by 0400Z. A warm front located over central Oklahoma, southern Arkansas, and northern Mississippi at 1000Z is forecast to lift northwestward into northeastern Oklahoma, northern Arkansas, and extreme northern Mississippi by 0400Z.

4. VFR Clouds and Weather—This section lists expected sky conditions, visibility, and weather for the next 12 hours and an outlook for the following 6 hours.

Example:

S CNTRL AND SERN TX

AGL SCT-BKN010. TOPS 030. VIS 3-5SM BR. 14-16Z BECMG AGL SCT030. 19Z AGL SCT050.

OTLK...VFR

OK

PNDLAND NW...AGL SCT030 SCT-BKN100.

TOPS FL200.

15Z AGL SCT040 SCT100. AFT 20Z SCT TSRA DVLPG..

FEW POSS SEV. CB TOPS FL450.

OTLK...VFR

Explanation:

In south central and southeastern Texas, there is a scattered to broken layer of clouds from 1,000 feet AGL with tops at 3,000 feet, visibility is 3 to 5 sm in mist. Between 1400Z and 1600Z, the cloud bases are expected to increase to 3,000 feet AGL. After 1900Z, the cloud bases are expected to continue to increase to 5,000 feet AGL and the outlook is VFR.

In northwestern Oklahoma and panhandle, the clouds are scattered at 3,000 feet with another scattered to broken layer at 10,000 feet AGL, with the tops at 20,000 feet. At 1500 Z, the lowest cloud base is expected to increase to 4,000 feet AGL with a scattered layer at 10,000 feet AGL. After 2000Z, the forecast calls for scattered thunderstorms with rain developing and a few becoming severe; the CB clouds will have tops at flight level 450 or 45,000 feet MSL.

It should be noted that when information is given in the area forecast, locations may be given by states, regions, or specific geological features such as mountain ranges. *Figure 12-12* shows an area forecast chart with six regions of forecast, states, regional areas, and common geographical features.

Inflight Weather Advisories

Inflight weather advisories, which are provided to en route aircraft, are forecasts that detail potentially hazardous weather. These advisories are also available to pilots prior to departure for flight planning purposes. An inflight weather advisory is issued in the form of either an AIRMET, SIGMET, or convective SIGMET.

AIRMET

AIRMETs (WAs) are examples of inflight weather advisories that are issued every 6 hours with intermediate updates issued as needed for a particular area forecast region. The information contained in an AIRMET is of operational interest to all aircraft, but the weather section concerns phenomena considered potentially hazardous to light aircraft and aircraft with limited operational capabilities.

An AIRMET includes forecast of moderate icing, moderate turbulence, sustained surface winds of 30 knots or greater, widespread areas of ceilings less than 1,000 feet and/or visibilities less than three miles, and extensive mountain obscurement.

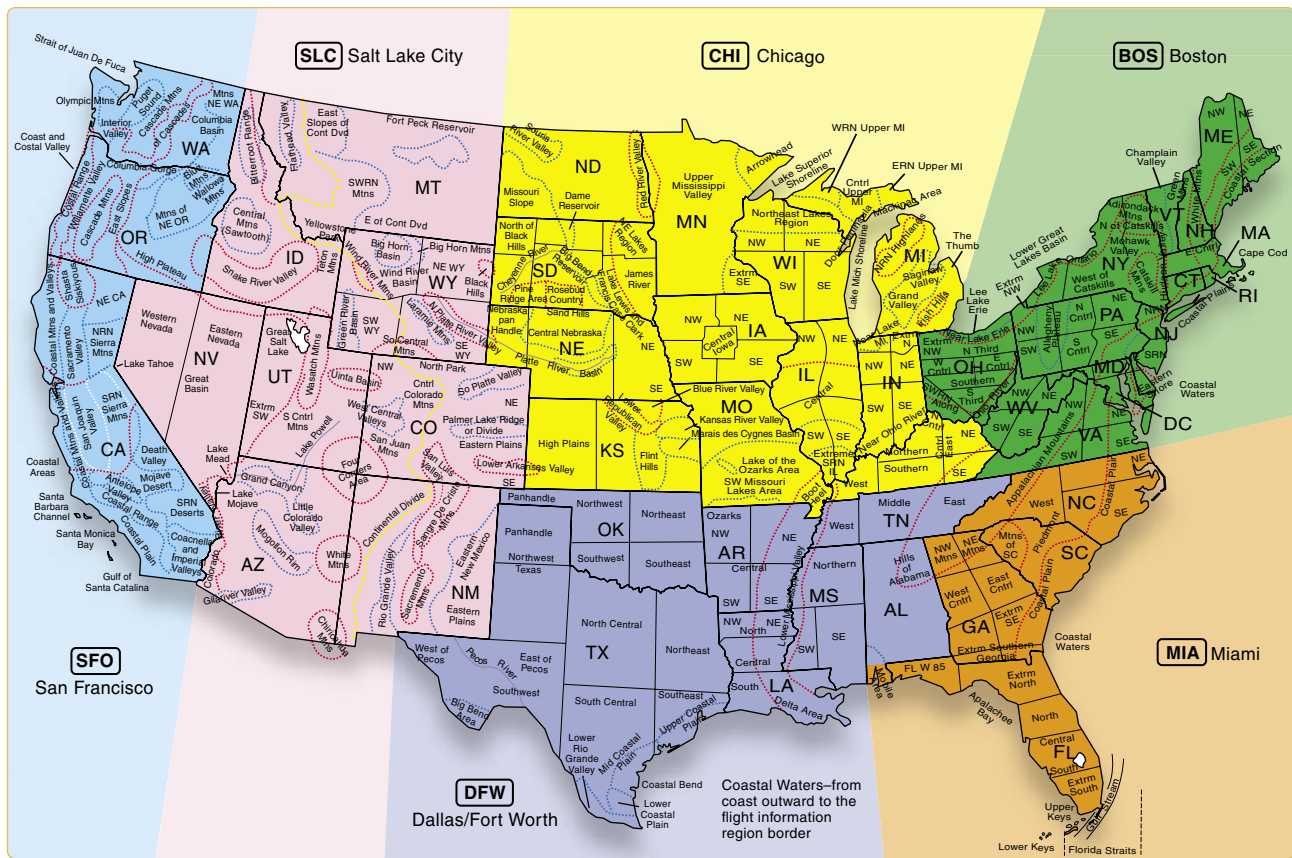


Figure 12-12. Area forecast region map.

Each AIRMET bulletin has a fixed alphanumeric designator, numbered sequentially for easy identification, beginning with the first issuance of the day. Sierra is the AIRMET code used to denote IFR and mountain obscuration; Tango is used to denote turbulence, strong surface winds, and low-level wind shear; and Zulu is used to denote icing and freezing levels.

Example:

DFW TWA 241650
 AIRMET TANGO UPDT 3 FOR TURBC... STG
 SFC WINDS AND LLWS VALID UNTIL 242000
 AIRMET TURBC... OK TX... UPDT
 FROM OKC TO DFW TO SAT TO MAF TO CDS
 TO OKC OCNL MDT TURBC BLO 60 DUE TO
 STG AND GUSTY LOW LVL WINDS. CONDS
 CONTG BYD 2000Z

Explanation:

This AIRMET was issued by Dallas–Fort Worth on the 24th day of the month, at 1650Z time. On this third update, the AIRMET Tango is issued for turbulence, strong surface winds, and low-level wind shear until 2000Z on the same day. The turbulence section of the AIRMET is an update for Oklahoma and Texas. It defines an area from Oklahoma City to Dallas, Texas, to San Antonio, to Midland, Texas,

to Childress, Texas, to Oklahoma City that will experience occasional moderate turbulence below 6,000 feet due to strong and gusty low-level winds. It also notes that these conditions are forecast to continue beyond 2000Z.

SIGMET

SIGMETs (WSs) are inflight advisories concerning non-convective weather that is potentially hazardous to all aircraft. They report weather forecasts that include severe icing not associated with thunderstorms, severe or extreme turbulence or clear air turbulence (CAT) not associated with thunderstorms, dust storms or sandstorms that lower surface or inflight visibilities to below three miles, and volcanic ash. SIGMETs are unscheduled forecasts that are valid for 4 hours, but if the SIGMET relates to hurricanes, it is valid for 6 hours.

A SIGMET is issued under an alphabetic identifier, from November through Yankee, excluding Sierra and Tango. The first issuance of a SIGMET is designated as an Urgent Weather SIGMET (UWS). Reissued SIGMETs for the same weather phenomenon are sequentially numbered until the weather phenomenon ends.

Example:

SFOR WS 100130
SIGMET ROMEO2 VALID UNTIL 100530
OR WA
FROM SEA TO PDT TO EUG TO SEA
OCNL MOGR CAT BTN 280 AND 350 EXPCD
DUE TO JTSTR.
CONDS BGNG AFT 0200Z CONTG BYD 0530Z .

Explanation:

This is SIGMET Romeo 2, the second issuance for this weather phenomenon. It is valid until the 10th day of the month at 0530Z time. This SIGMET is for Oregon and Washington, for a defined area from Seattle to Portland to Eugene to Seattle. It calls for occasional moderate or greater clear air turbulence between 28,000 and 35,000 feet due to the location of the jet stream. These conditions will be beginning after 0200Z and will continue beyond the forecast scope of this SIGMET of 0530Z.

Convective Significant Meteorological Information (WST)

A convective SIGMET (WST) is an inflight weather advisory issued for hazardous convective weather that affects the safety of every flight. Convective SIGMETs are issued for severe thunderstorms with surface winds greater than 50 knots, hail at the surface greater than or equal to 3/4 inch in diameter, or tornadoes. They are also issued to advise pilots of embedded thunderstorms, lines of thunderstorms, or thunderstorms with heavy or greater precipitation that affect 40 percent or more of a 3,000 square foot or greater region.

Convective SIGMETs are issued for each area of the contiguous 48 states but not Alaska or Hawaii. Convective SIGMETs are issued for the eastern (E), western (W), and central (C) United States. Each report is issued at 55 minutes past the hour, but special reports can be issued during the interim for any reason. Each forecast is valid for 2 hours. They are numbered sequentially each day from 1–99, beginning at 00Z time. If no hazardous weather exists, the convective SIGMET is still issued; however, it states “CONVECTIVE SIGMET...NONE.”

Example:

MKCC WST 221855
CONVECTIVE SIGMET 21C
VALID UNTIL 2055
KS OK TX
VCNTY GLD-CDS LINE
NO SGFNT TSTMS RPRTD
LINE TSTMS DVLPG BY 1955Z WILL MOV EWD
30-35 KT THRU 2055Z
HAIL TO 2 IN PSBL

Explanation:

The WST indicates this report is a convective SIGMET. The current date is the 22nd of the month and it was issued at 1855Z. It is convective SIGMET number 21C, indicating that it is the 21st consecutive report issued for the central United States. This report is valid for 2 hours until 2055Z time. The convective SIGMET is for an area from Kansas to Oklahoma to Texas, in the vicinity of a line from Goodland, Kansas, to Childress, Texas. No significant thunderstorms are being reported, but a line of thunderstorms will develop by 1955 Zulu time and will move eastward at a rate of 30–35 knots through 2055Z. Hail up to 2 inches in size is possible with the developing thunderstorms.

Winds and Temperature Aloft Forecast (FD)

Winds and temperatures aloft forecasts (FD) provide wind and temperature forecasts for specific locations in the contiguous United States, including network locations in Hawaii and Alaska. The forecasts are made twice a day based on the radiosonde upper air observations taken at 0000Z and 1200Z.

Through 12,000 feet are true altitudes and above 18,000 feet are pressure altitudes. Wind direction is always in reference to true north and wind speed is given in knots. The temperature is given in degrees Celsius. No winds are forecast when a given level is within 1,500 feet of the station elevation. Similarly, temperatures are not forecast for any station within 2,500 feet of the station elevation.

If the wind speed is forecast to be greater than 100 knots but less than 199 knots, the computer adds 50 to the direction and subtracts 100 from the speed. To decode this type of data group, the reverse must be accomplished. For example, when the data appears as “731960,” subtract 50 from the 73 and add 100 to the 19, and the wind would be 230° at 119 knots with a temperature of –60 °C. If the wind speed is forecast to be 200 knots or greater, the wind group is coded as 99 knots. For example, when the data appears as “7799,” subtract 50 from 77 and add 100 to 99, and the wind is 270° at 199 knots or greater. When the forecast wind speed is calm or less than 5 knots, the data group is coded “9900,” which means light and variable. [Figure 12-13]

FD KWBC 151640 BASED ON 151200Z DATA VALID 151800Z FOR USE 1700-2100Z TEMPS NEGATIVE ABV 24000							
FD	3000	6000	9000	12000	18000	24000	30000
AMA		2714	2725+00	2625-04	2531-15	2542-27	265842
DEN			2321-04	2532-08	2434-19	2441-31	235347

Figure 12-13. Winds and temperature aloft report.

Explanation of Figure 12-13:

The heading indicates that this FD was transmitted on the 15th of the month at 1640Z and is based on the 1200Z radiosonde. The valid time is 1800Z on the same day and should be used for the period between 1700Z and 2100Z. The heading also indicates that the temperatures above 24,000 feet MSL are negative. Since the temperatures above 24,000 feet are negative, the minus sign is omitted.

A four-digit data group shows the wind direction in reference to true north and the wind speed in knots. The elevation at Amarillo, Texas (AMA) is 3,605 feet, so the lowest reportable altitude is 6,000 feet for the forecast winds. In this case, “2714” means the wind is forecast to be from 270° at a speed of 14 knots.

A six-digit group includes the forecast temperature aloft. The elevation at Denver (DEN) is 5,431 feet, so the lowest reportable altitude is 9,000 feet for the winds and temperature forecast. In this case, “2321-04” indicates the wind is forecast to be from 230° at a speed of 21 knots with a temperature of -4 °C.

Weather Charts

Weather charts are graphic charts that depict current or forecast weather. They provide an overall picture of the United States and should be used in the beginning stages of flight planning. Typically, weather charts show the movement of major weather systems and fronts. Surface analysis, weather depiction, and radar summary charts are sources of

current weather information. Significant weather prognostic charts provide an overall forecast weather picture.

Surface Analysis Chart

The surface analysis chart depicts an analysis of the current surface weather. [Figure 12-14] This chart is a computer prepared report that is transmitted every 3 hours and covers the contiguous 48 states and adjacent areas. A surface analysis chart shows the areas of high and low pressure, fronts, temperatures, dew points, wind directions and speeds, local weather, and visual obstructions.

Surface weather observations for reporting points across the United States are also depicted on this chart. Each of these reporting points is illustrated by a station model. [Figure 12-15] A station model includes:

- Type of observation—a round model indicates an official weather observer made the observation. A square model indicates the observation is from an automated station. Stations located offshore give data from ships, buoys, or offshore platforms.
- Sky cover—the station model depicts total sky cover and is shown as clear, scattered, broken, overcast, or obscured/partially obscured.
- Clouds—represented by specific symbols. Low cloud symbols are placed beneath the station model, while middle and high cloud symbols are placed directly above the station model. Typically, only one type of cloud will be depicted with the station model.

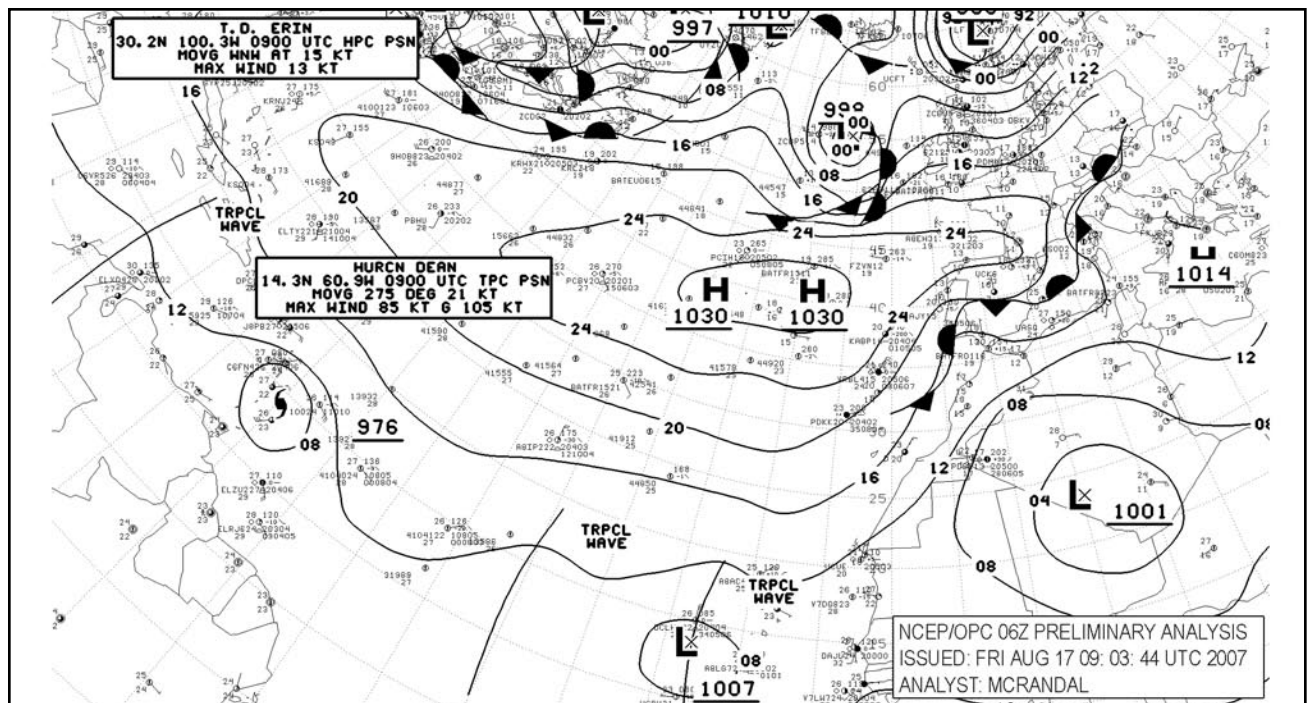


Figure 12-14. Surface analysis chart.

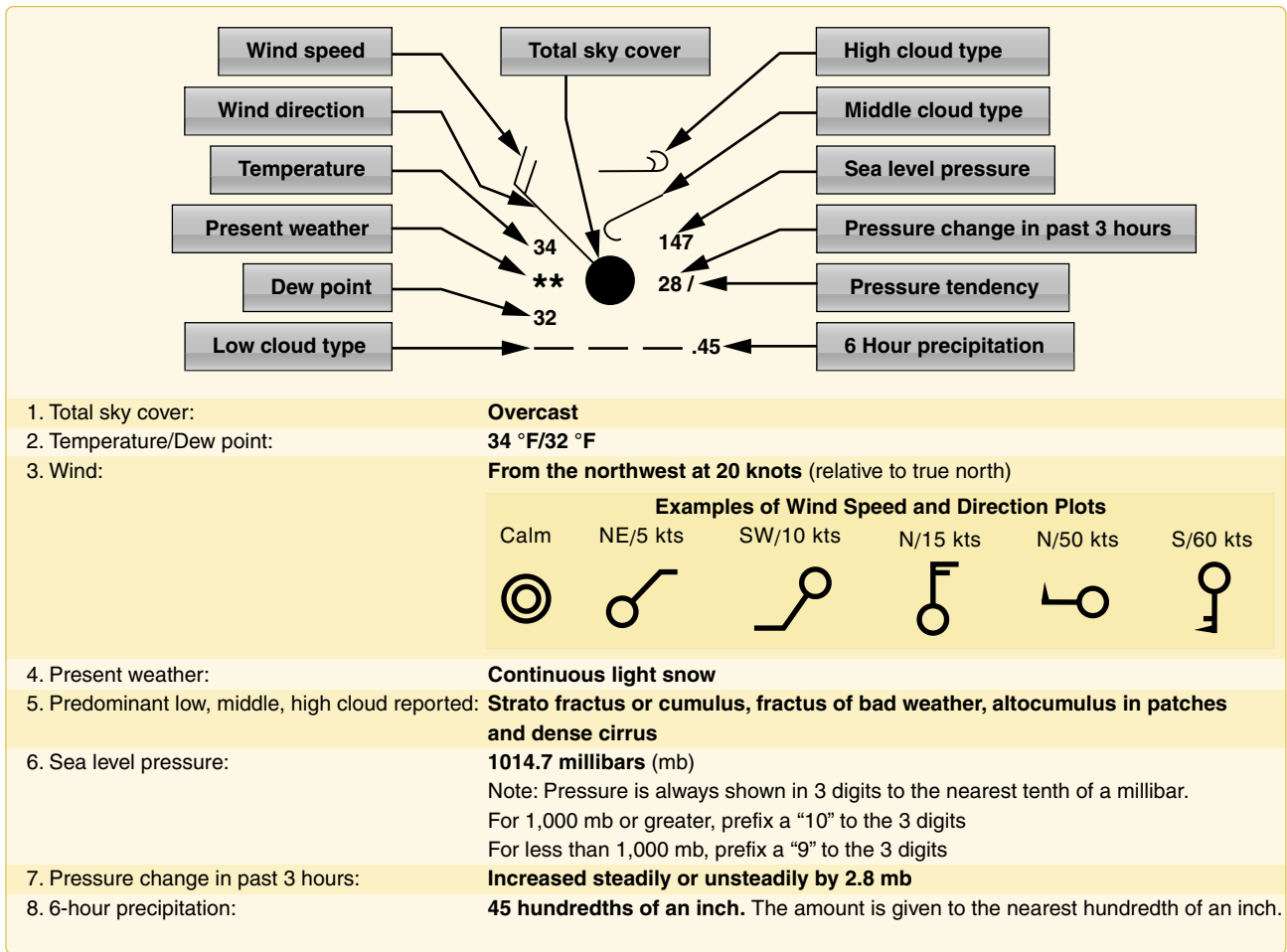


Figure 12-15. Sample station model and weather chart symbols.

- Sea level pressure—given in three digits to the nearest tenth of a millibar (mb). For 1,000 mbs or greater, prefix a 10 to the three digits. For less than 1,000 mbs, prefix a 9 to the three digits.
- Pressure change/tendency—pressure change in tenths of mb over the past 3 hours. This is depicted directly below the sea level pressure.
- Precipitation—a record of the precipitation that has fallen over the last 6 hours to the nearest hundredth of an inch.
- Dew point—given in degrees Fahrenheit.
- Present weather—over 100 different weather symbols are used to describe the current weather.
- Temperature—given in degrees Fahrenheit.
- Wind—true direction of wind is given by the wind pointer line, indicating the direction from which the wind is coming. A short barb is equal to 5 knots of wind, a long barb is equal to 10 knots of wind, and a pennant is equal to 50 knots.

Weather Depiction Chart

A weather depiction chart details surface conditions as derived from METAR and other surface observations. The weather depiction chart is prepared and transmitted by computer every 3 hours beginning at 0100Z time, and is valid at the time of the plotted data. It is designed to be used for flight planning by giving an overall picture of the weather across the United States. [Figure 12-16]

This type of chart typically displays major fronts or areas of high and low pressure. The weather depiction chart also provides a graphic display of IFR, VFR, and MVFR (marginal VFR) weather. Areas of IFR conditions (ceilings less than 1,000 feet and visibility less than three miles) are shown by a hatched area outlined by a smooth line. MVFR regions (ceilings 1,000 to 3,000 feet, visibility 3 to 5 miles) are shown by a nonhatched area outlined by a smooth line. Areas of VFR (no ceiling or ceiling greater than 3,000 feet and visibility greater than five miles) are not outlined.

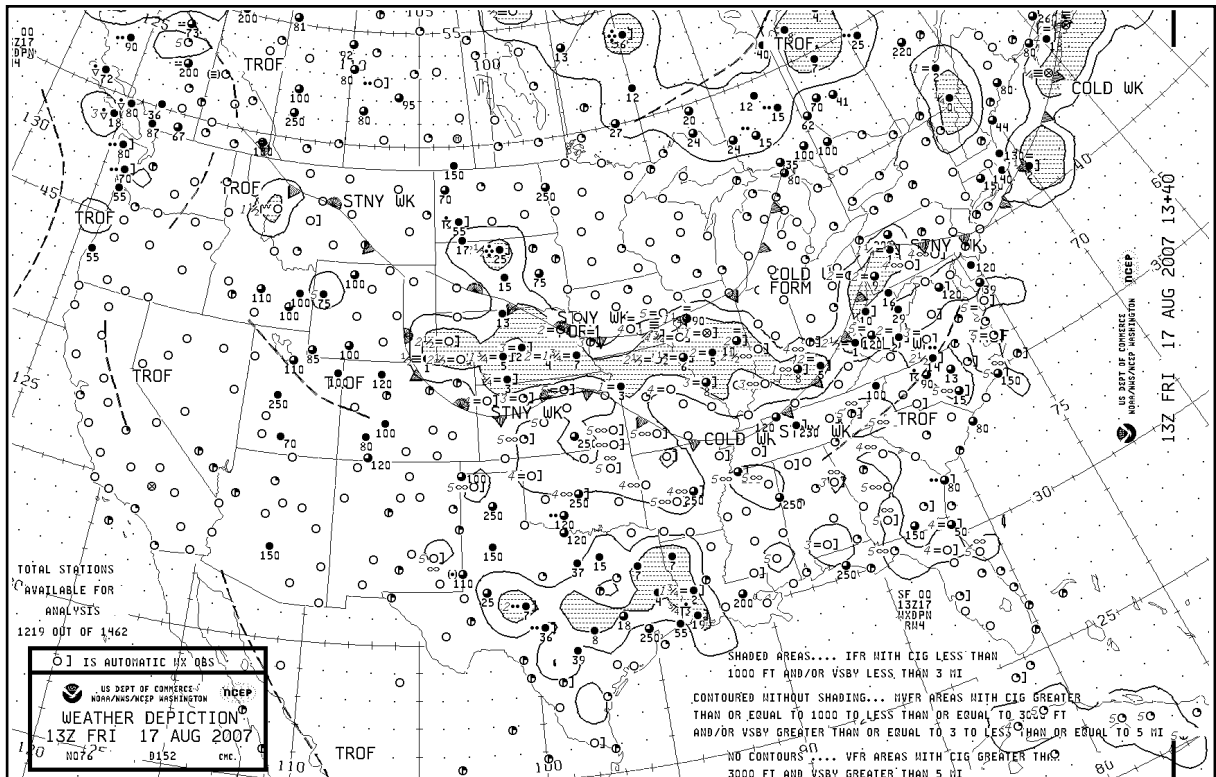


Figure 12-16. Weather depiction chart.

Weather depiction charts show a modified station model that provides sky conditions in the form of total sky cover, cloud height or ceiling, weather, and obstructions to visibility, but does not include winds or pressure readings like the surface analysis chart. A bracket (]) symbol to the right of the station indicates the observation was made by an automated station. A detailed explanation of a station model is depicted in the previous discussion of surface analysis charts.

Radar Summary Chart

A radar summary chart is a graphically depicted collection of radar weather reports (SDs). [Figure 12-17] The chart is published hourly at 35 minutes past the hour. It displays areas of precipitation, as well as information regarding the characteristics of the precipitation. [Figure 12-18] A radar summary chart includes:

- No information—if information is not reported, the chart will say “NA.” If no echoes are detected, the chart will say “NE.”
- Precipitation intensity contours—intensity can be described as one of six levels and is shown on the chart by three contour intervals.
- Height of tops—the heights of the echo tops are given in hundreds of feet MSL.

Movement of cells—individual cell movement is indicated by an arrow pointing in the direction of movement. The speed of movement in knots is the number at the top of the arrow head. “LM” indicates little movement.

- Type of precipitation—the type of precipitation is marked on the chart using specific symbols. These symbols are not the same as used on the METAR charts.
- Echo configuration—echoes are shown as being areas, cells, or lines.
- Weather watches—severe weather watch areas for tornadoes and severe thunderstorms are depicted by boxes outlined with heavy dashed lines.

The radar summary chart is a valuable tool for preflight planning. It does, however, contain several limitations for the usage of the chart. This chart depicts only areas of precipitation. It will not show areas of clouds and fog with no appreciable precipitation, or the height of the tops and bases of the clouds. Radar summary charts are a depiction of current precipitation and should be used in conjunction with current METAR and weather forecasts.

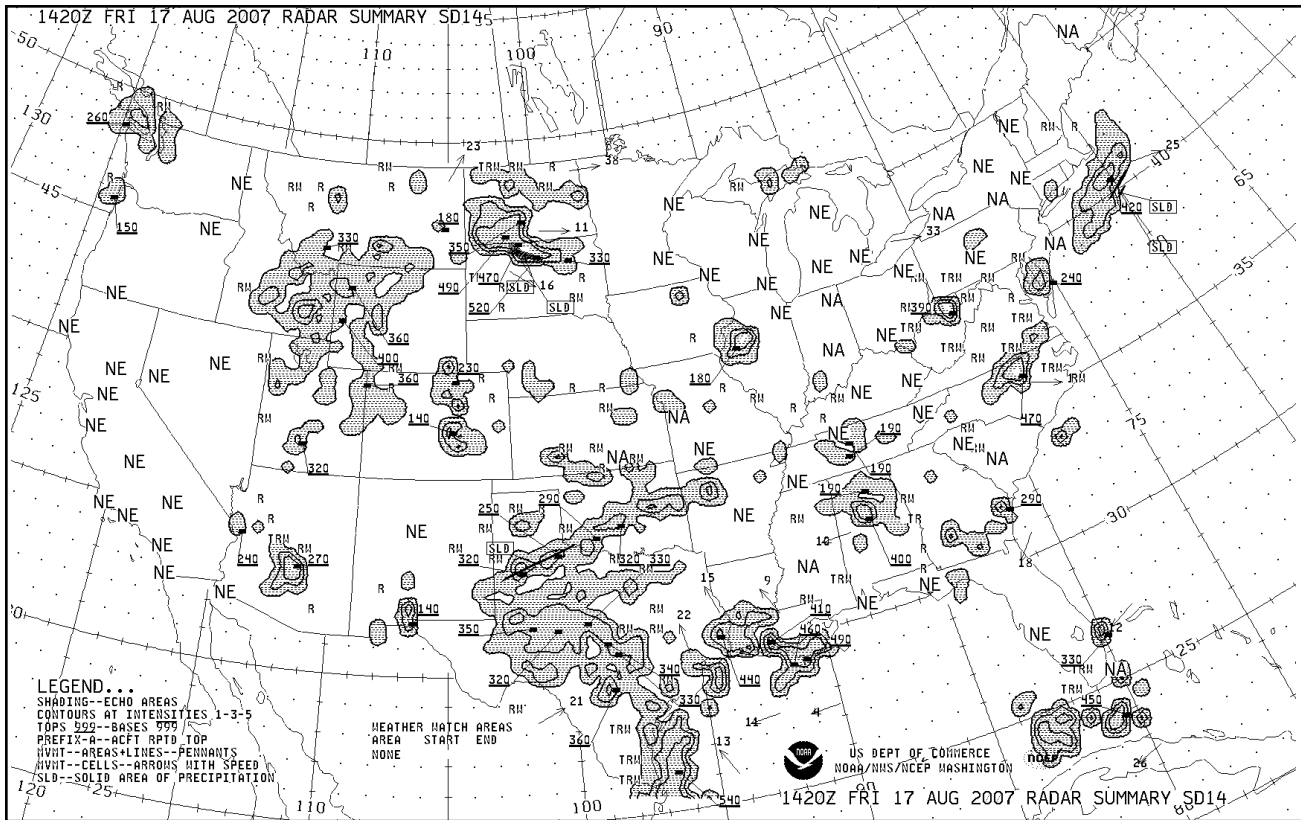


Figure 12-17. Radar summary chart.

Symbol	Meaning
R	Rain
RW	Rain shower
S	Snow
SW	Snow shower
T	Thunderstorm
NA	Not available
NE	No echoes
OM	Out for maintenance
↗ 35	Cell movement to the northeast at 35 knots
LM	Little movement
WS999	Severe thunderstorm watch number 999
WT210	Tornado watch number 210
SLD	8/10 or greater coverage in a line
↗	Line of echoes

Figure 12-18. Intensity levels, contours, and precipitation type symbols.

Significant Weather Prognostic Charts

Significant weather prognostic charts are available for low-level significant weather from the surface to FL 240 (24,000 feet), also referred to as the 400 mb level, and high-level significant weather from FL 250 to FL 600 (25,000 to 60,000

feet). The primary concern of this discussion is the low-level significant weather prognostic chart.

The low-level chart comes in two forms: the 12- and 24-hour forecast chart, and the 36- and 48-hour surface forecast chart. The first chart is a four-panel chart that includes 12- and 24-hour forecasts for significant weather and surface weather. Charts are issued four times a day at 0000Z, 0600Z, 1200Z, and 1800Z. The valid time for the chart is printed on the lower left corner of each panel.

The upper two panels show forecast significant weather, which may include nonconvective turbulence, freezing levels, and IFR or MVFR weather. Areas of moderate or greater turbulence are enclosed in dashed lines. Numbers within these areas give the height of the turbulence in hundreds of feet MSL. Figures below the line show the anticipated base, while figures above the line show the top of the zone of turbulence. Also shown on this panel are areas of VFR, IFR, and MVFR. IFR areas are enclosed by solid lines, MVFR areas are enclosed by scalloped lines, and the remaining, unenclosed area is designated VFR. Zigzag lines and the letters “SFC” indicate freezing levels in that area are at the surface. Freezing level height contours for the highest freezing level are drawn at 4,000-foot intervals with dashed lines.

The lower two panels show the forecast surface weather and depicts the forecast locations and characteristics of pressure systems, fronts, and precipitation. Standard symbols are used to show fronts and pressure centers. Direction of movement of the pressure center is depicted by an arrow. The speed in knots is shown next to the arrow. In addition, areas of forecast precipitation and thunderstorms are outlined. Areas of precipitation that are shaded indicate at least one-half of the area is being affected by the precipitation. Unique symbols indicate the type of precipitation and the manner in which it occurs.

Figure 12-19 depicts a typical significant weather prognostic chart as well as the symbols typically used to depict precipitation. Prognostic charts are an excellent source of information for preflight planning; however, this chart should be viewed in light of current conditions and specific local area forecasts.

The 36- and 48-hour significant weather prognostic chart is an extension of the 12- and 24-hour forecast. It provides information regarding surface weather forecasts and includes a discussion of the forecast. This chart is issued twice a day. It typically contains forecast positions and characteristics of pressure patterns, fronts, and precipitation. An example of a 36- and 48-hour surface prognostic chart is shown in Figure 12-20.

ATC Radar Weather Displays

Although ATC systems cannot always detect the presence or absence of clouds, they can often determine the intensity of a precipitation area, but the specific character of that area (snow, rain, hail, VIRGA, etc.) cannot be determined. For this reason, ATC refers to all weather areas displayed on ATC radar scopes as “precipitation.”

ARTCC facilities normally use a Weather and Radar Processor (WARP) to display a mosaic of data obtained from multiple NEXRAD sites. There is a time delay between actual conditions and those displayed to the controller. The precipitation data on the ARTCC controller’s display could be up to 6 minutes old. The WARP processor is only used in ARTCC facilities. All ATC facilities using radar weather processors with the ability to determine precipitation intensity, describe the intensity to pilots as:

- Light,
- Moderate,
- Heavy, or
- Extreme.

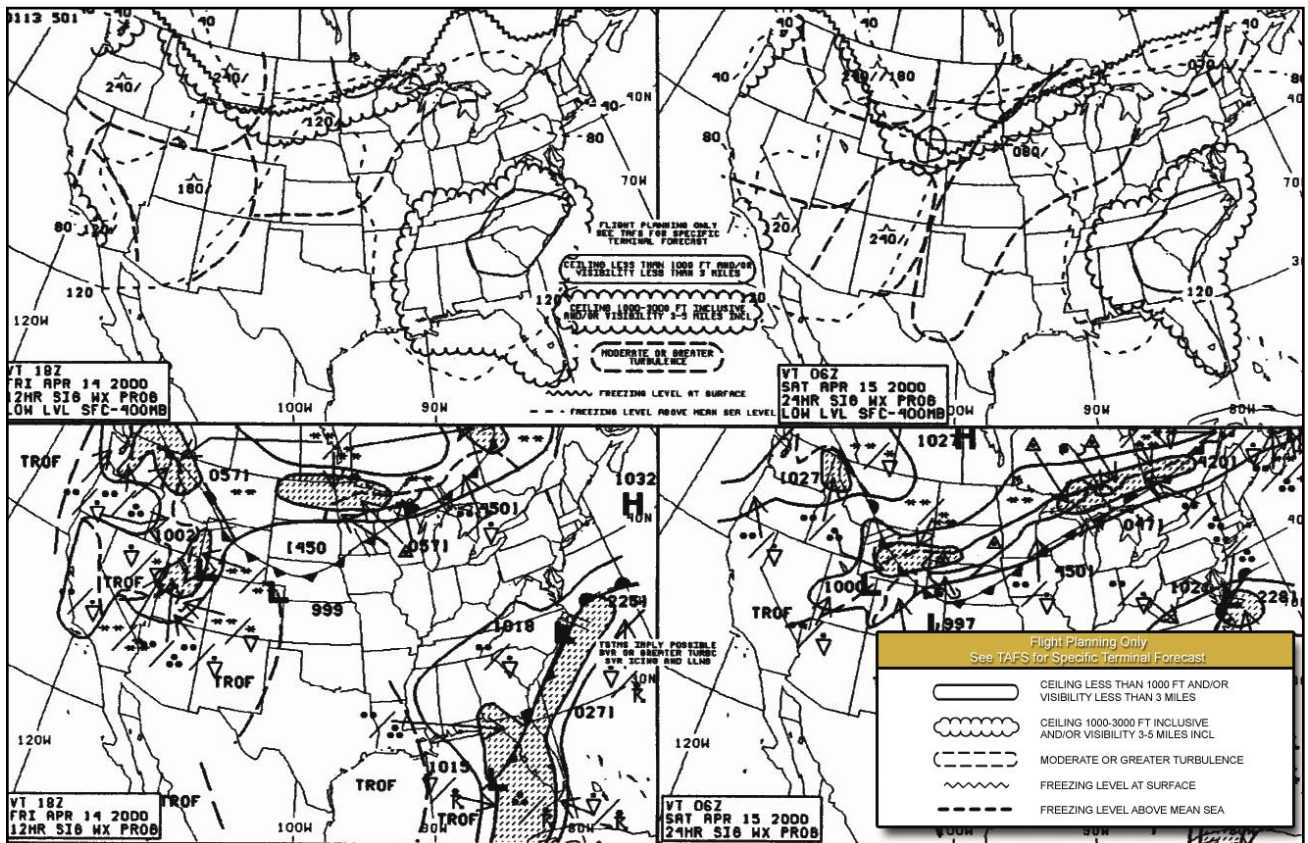


Figure 12-19. Significant weather prognostic chart and legend (inset).

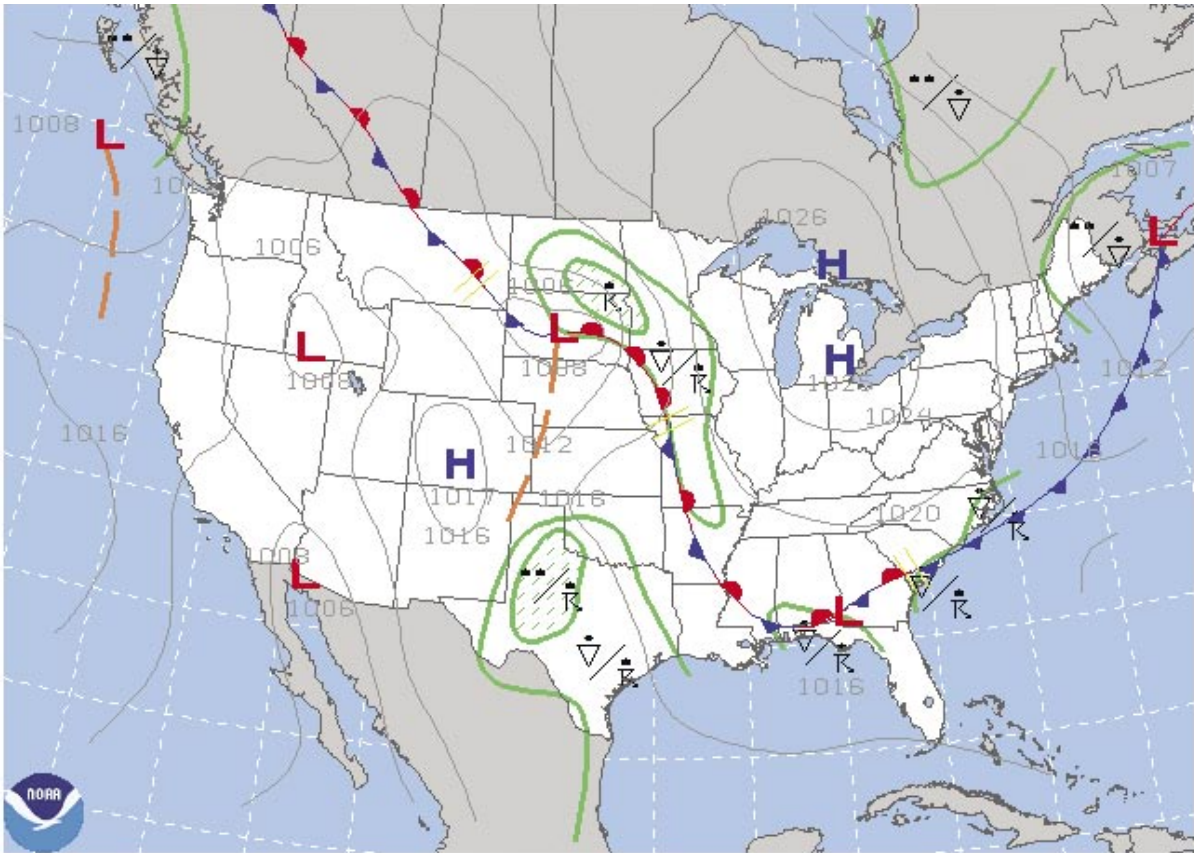
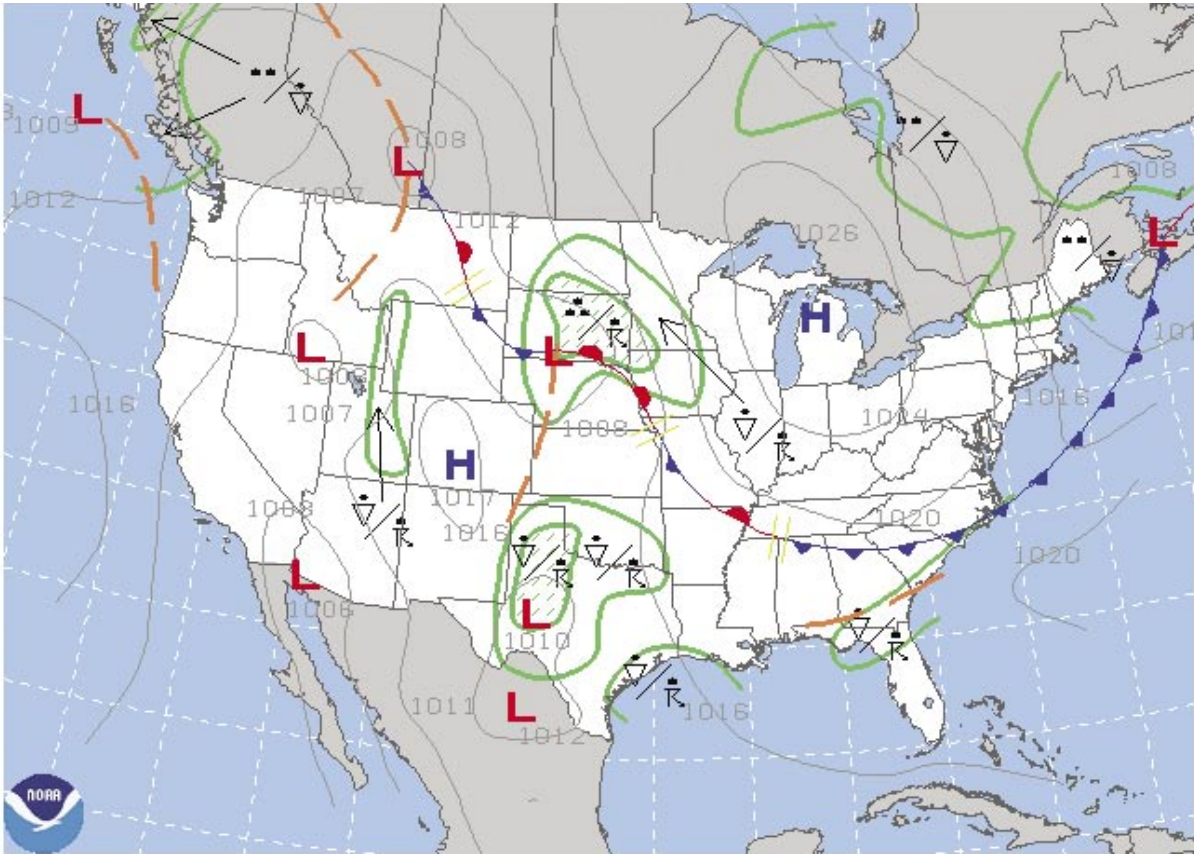


Figure 12-20. 36- (top) and 48-hour (bottom) surface prognostic chart.

When the WARP is not available, a second system, the narrowband Air Route Surveillance Radar (ARSR) can display two distinct levels of precipitation intensity that will be described to pilots as “MODERATE and “HEAVY TO EXTREME.”

ATC facilities that cannot display the intensity levels of precipitation due to equipment limitations will describe the location of the precipitation area by geographic position, or position relative to the aircraft. Since the intensity level is not available, the controller will state “INTENSITY UNKNOWN.”

ATC radar is not able to detect turbulence. Generally, turbulence can be expected to occur as the rate of rainfall or intensity of precipitation increases. Turbulence associated with greater rates of rainfall/precipitation will normally be more severe than any associated with lesser rates of rainfall/precipitation. Turbulence should be expected to occur near convective activity, even in clear air. Thunderstorms are a form of convective activity that imply severe or greater turbulence. Operation within 20 miles of thunderstorms should be approached with great caution, as the severity of turbulence can be much greater than the precipitation intensity might indicate.

Weather Avoidance Assistance

To the extent possible, controllers will issue pertinent information on weather and assist pilots in avoiding such areas when requested. Pilots should respond to a weather advisory by either acknowledging the advisory or by

acknowledging the advisory and requesting an alternative course of action as follows:

- Request to deviate off course by stating the number of miles and the direction of the requested deviation.
- Request a new route to avoid the affected area.
- Request a change of altitude.
- Request radar vectors around the affected areas.

It should be remembered that the controller’s primary function is to provide safe separation between aircraft. Any additional service, such as weather avoidance assistance, can only be provided to the extent that it does not detract from the primary function. It’s also worth noting that the separation workload is generally greater than normal when weather disrupts the usual flow of traffic. ATC radar limitations and frequency congestion may also be a factor in limiting the controller’s capability to provide additional service.

Electronic Flight Displays (EFD) /Multi-Function Display (MFD) Weather

Many aircraft manufacturers now include satellite weather services with new electronic flight display (EFD) systems. EFDs give a pilot access to many of the satellite weather services available.

Products available to a pilot on the display pictured in *Figure 12-21* are listed as follows. The letters in parentheses indicate the soft key to press in order to access the data.



Figure 12-21. Information page.

- Graphical NEXRAD data (NEXRAD)
- Graphical METAR data (METAR)
- Textual METAR data
- Textual terminal aerodrome forecasts (TAF)
- City forecast data
- Graphical wind data (WIND)
- Graphical echo tops (ECHO TOPS)
- Graphical cloud tops (CLD TOPS)
- Graphical lightning strikes (LTNG)
- Graphical storm cell movement (CELL MOV)
- NEXRAD radar coverage (information displayed with the NEXRAD data)
- SIGMETs/AIRMETs (SIG/AIR)
- Surface analysis to include city forecasts (SFC)
- County warnings (COUNTY)
- Freezing levels (FRZ LVL)
- Hurricane track (CYCLONE)
- Temporary flight restrictions (TFR)

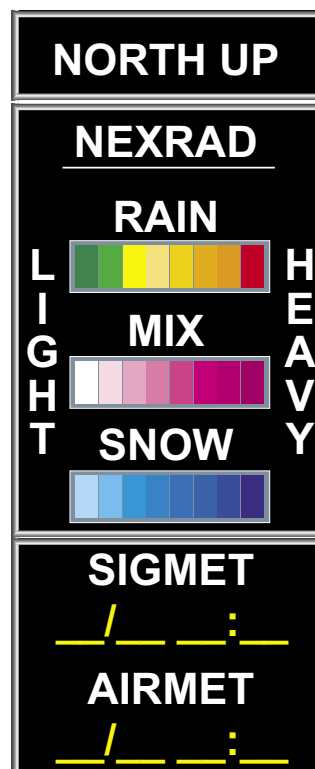


Figure 12-22. List of weather products and the expiration times of each.

Pilots must be familiar with any EFD or MFD used and the satellite weather products available on the display.

Weather Products Age and Expiration

The information displayed using a satellite weather link is near real time but should not be thought of as instantaneous up-to-date information. Each type of weather display is stamped with the age information on the MFD. The time is referenced from Zulu when the information was assembled at the ground station. The age should not be assumed to be the time when the FIS received the information from the satellite.

Two types of weather are displayed on the screen: “current” weather and forecast data. Current information is displayed by an age while the forecast data has a data stamp in the form of “_ / ___ : ___”. [Figure 12-22]

The Next Generation Weather Radar System (NEXRAD)

The NEXRAD system is comprised of a series of 159 Weather Surveillance Radar–1988 Doppler (WSR-88D) sites situated throughout the United States as well as selected overseas sites. The NEXRAD system is a joint venture between the United States Department of Commerce (DOC), the United States Department of Defense, (DOD) as well as the United States Department of Transportation (DOT). The individual agencies that have control over the system are the NWS, Air Force Weather Agency (AFWA) and the FAA. [Figure 12-23]

NEXRAD radar produces two levels of products: level II and level III.

Level II Data Products

All NEXRAD level-II data products are available through the National Climatic Data Center (NCDC). Level II data consists of the three meteorological base data quantities: reflectivity, mean radial velocity, and spectrum width.

Level III Data Products

There are 41 products routinely available through the NCDC. Level III graphic products are available as digital images, color hard copy, gray scale hard copy, or acetate overlay copies. This information is then encoded and disseminated through the satellite weather system as well as other sources.

NEXRAD level III data for up to a 2,000 mile range can be displayed. It is important to realize that the radar image is not real time and can be up to 5 minutes old. At no time should the images be used as storm penetrating radar nor to navigate through a line of storms. The images display should only be used as a reference.



Figure 12-23. NEXRAD radar display.

NEXRAD radar is mutually exclusive of Topographic (TOPO), TERRAIN and STORMSCOPE. When NEXRAD is turned on, TOPO, TERRAIN, and STORMSCOPE are turned off because the colors used to display intensities are very similar.

Lightning information is available to assist when NEXRAD is enabled. This presents a more vivid picture of the weather in the surrounding area.

In addition to utilizing the soft keys to activate the NEXRAD display, the pilot also has the option of setting the desired range. It is possible to zoom in on a specific area of the display in order to gain a more detailed picture of the radar display. [Figure 12-24]

NEXRAD Abnormalities

Although NEXRAD is a compilation of stations across the country, there can be abnormalities associated with the system. Some of the abnormalities are listed below.

- Ground clutter
- Strokes and spurious radar data
- Sun strokes, when the radar antenna points directly at the sun

- Interference from buildings or mountains, which may cause shadows
- Military aircraft which deploy metallic dust and may reflect the radar signature

NEXRAD Limitations

In addition to the abnormalities listed, the NEXRAD system does have some specific limitations.

Base Reflectivity

The NEXRAD base reflectivity does not provide adequate information from which to determine cloud layers or type of precipitation with respect to hail versus rain. Therefore, a pilot may mistake rain for hail.

In addition, the base reflectivity is sampled at the minimum antenna elevation angle. With this minimum angle, an individual site cannot depict high altitude storms directly over the station. This will leave an area of null coverage if an adjacent site does not also cover the affected area.



Figure 12-24. NEXRAD radar display (500 mile range). The individual color gradients can be easily discerned and interpreted via the legend in the upper right corner of the screen. Additional information can be gained by pressing the LEGEND soft key, which displays the legend page.

Resolution Display

The resolution of the displayed data will pose additional concerns when the range is decreased. The minimum resolution for NEXRAD returns is two kilometers. This means that when the display range is zoomed in to approximately ten miles, the individual square return boxes will be more prevalent. Each square will indicate the strongest display return within that two kilometer square area.

AIRMET/SIGMET Display

AIRMET/SIGMET information is available for the displayed viewing range on the MFD. Some displays are capable of displaying weather information for a 2,000 mile range. AIRMETS/SIGMETS are displayed by dashed lines on the map. [Figure 12-25]

The legend box denotes the various colors used to depict the AIRMETS such as icing, turbulence, IFR weather, mountain obscuration as well as surface winds. [Figure 12-26] The great advantage of the graphically displayed AIRMET/SIGMET boundary box is the pilot can see the extent of the area that the report covers. The pilot does not need to manually plot the points to determine the full extent of the coverage area.

Graphical METARs

METARs can be displayed on the multi-function display. Each reporting station that has a METAR/TAF available is depicted by a flag from the center of the airport symbol. Each flag is color coded to depict the type of weather that is currently reported at that station. A legend is available to assist users in determining what each flag color represents. [Figure 12-27]

The graphical METAR display shows all available reporting stations within the set viewing range. By setting the range knob up to a 2,000 mile range, pilots can pan around the display map to check the current conditions of various airports along the route of flight.

By understanding what each colored flag indicates, a pilot can quickly determine where weather patterns display marginal weather, IFR, or areas of VFR. These flags make it easy to determine weather at a specific airport should the need arise to divert from the intended airport of landing.

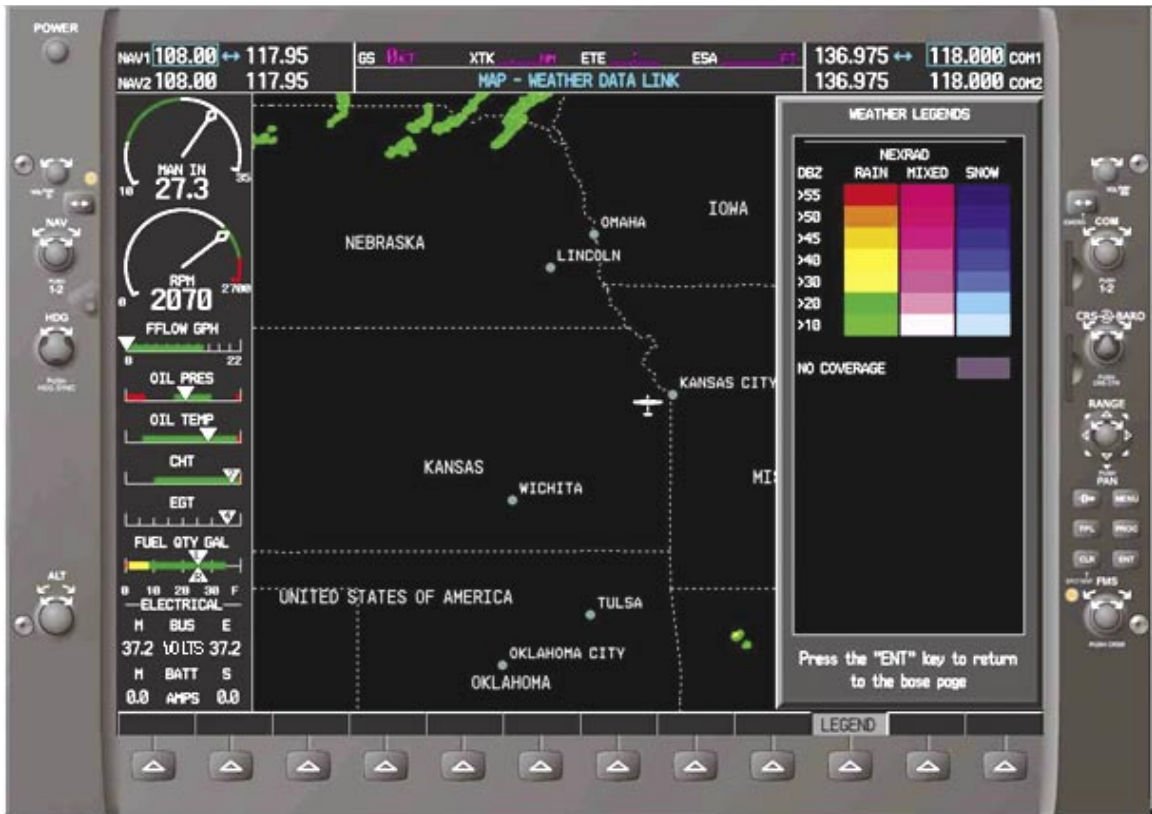


Figure 12-25. The AIRMET information box instructs the pilot to press the enter button to gain additional information on the selected area of weather. Once the enter soft key (ENT) is depressed, the specific textual information is displayed on the right side of the screen.



Figure 12-26. SIGMET/AIRMET legend display.



Figure 12-27. Graphical METAR legend display.

Chapter Summary

While no weather forecast is guaranteed to be 100 percent accurate, pilots have access to a myriad of weather information on which to base flight decisions. Weather products available for preflight planning to en route information received over the radio or via satellite link provide the pilot with the most accurate and up-to-date information available. Each report provides a piece of the weather puzzle. Pilots must use several reports to get an overall picture and gain an understanding of the weather that will affect the safe completion of a flight.