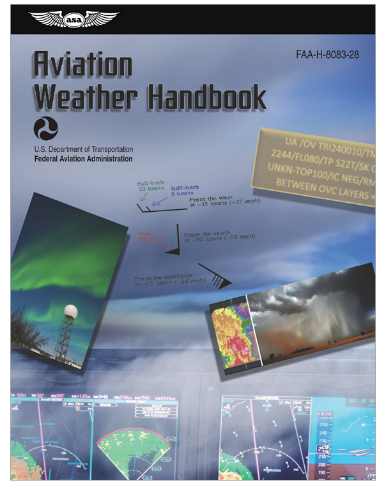
December 2024

UPDATE

Aviation Weather Handbook

Changes to FAA Handbooks can occur after the FAA publishes a new edition. ASA keeps you current by providing online Updates when a change has been made affecting the information in your books. This Update includes revisions from FAA-H-8083-28A published in December 2024.



Page iii—The preface is revised to read:

This handbook is designed as a technical reference for all who operate in the National Airspace System (NAS). Pilots, dispatchers, and operators will find this handbook a valuable resource for flight planning and decision making.

This handbook conforms to pilot weather training and certification concepts established by the Federal Aviation Administration (FAA). The discussion and explanations reflect the most commonly used weather products and information.

It is essential for persons using this handbook to also become familiar with and apply the pertinent parts of Title 14 of the Code of Federal Regulations (14 CFR) and the Aeronautical Information Manual (AIM). Title 14 CFR, the AIM, this handbook, current advisory circulars (AC), and other FAA technical references are available via the internet at the FAA home page at https://www.faa.gov.

This handbook is available for download in Portable Document Format (PDF) from the FAA's Regulations and Policies web page at https://www.faa.gov/regulations_policies/handbooks_manuals/aviation.

This handbook is published by the U.S. Department of Transportation (DOT), FAA Aviation Safety, Flight Standards Service (FS) Office of Safety Standards (OSS), Flight Technologies and Procedures Division.

The guidance and recommendations in this handbook are not legally binding in their own right and will not be relied upon by the FAA as a separate basis for affirmative enforcement action or other administrative penalty. Conformity with the guidance and recommendations is voluntary only and nonconformity will not affect rights and obligations under existing statutes and regulations.

Comments regarding this publication should be sent, in email form, to the following address: 9-AWA-AFS400-Coord@faa.gov.

Timothy R. Adams for
Lawrence Fields
Executive Director, Flight Standards Service
11/26/24

Page iv—A disclaimer note is added to read:

As revision A to this handbook was being processed and finalized, the National Weather Service's (NWS) Aviation Weather Center's (AWC) website was updated. There are numerous and significant changes to that website. This revision may not accurately reflect the AWC website at this time. The FAA is working with the NWS to ensure that this handbook properly describes the AWC website and that the AWC website includes appropriate aviation weather information. When those discussions are finished, the FAA will update this handbook. Until that occurs, please refer to the updated AWC website when referenced in this handbook (also refer to https://aviationweather.gov/help/#tutorial for the tutorial for the updated AWC website).

Page 3-2—A new section is added to read:

3.2.1 Understanding Weather Forecasts

To forecast means to make a prediction about the future state of something. In weather forecasting, the meteorologist is trying to predict the future state of the atmosphere. There are many different types of weather forecasts that exist, and we want to cover a basic distinction between deterministic and probabilistic forecasts.

- A deterministic forecast is one in which forecasters provide only a single solution. For example, "tonight's low will be 31 degrees Fahrenheit (°F)," "0.30 inches of rain will fall tomorrow," or "thunderstorms will happen at 3 pm tomorrow."
- A probabilistic forecast is one in which forecasters convey uncertainties by expressing forecasts as probabilities of various outcomes. For example, "the probability that tonight's low will be below 32 °F is 40 percent," "the probability of receiving at least 0.25 inches of rain tomorrow is 60 percent," or "the probability of thunderstorms for tomorrow afternoon is 70 percent."

Probabilistic forecasts allow meteorologists to acknowledge and express the fact that weather forecasts contain uncertainty, especially as you go out further in time. However, it is important that a probabilistic forecast has reliability (e.g., if the forecast of thunderstorms for a particular day, time, and location is 70 percent, then thunderstorms do in fact occur seven times out of ten).

Page 3-2—Sections 3.2.1 and 3.2.2 are renumbered as 3.2.2 and 3.2.3.

Page 3-33—The Observations row of Table 3-23 is revised to read:

Pressure Information Contained In:	Type	Summary
Observations		
METAR, SPECI (ASOS, AWOS, RTMA, ATIS)	T, G, V	Altimeter setting is included. Sea level pressure included in the RMK section of the METAR.

Page 4-2—The first four rows of Table 4-1 are revised to read:

Gas	Symbol	Content (by Volume)
Nitrogen	N_2	78.081%
Oxygen	O_2	20.945%
Argon	Ar	0.932%
Carbon Dioxide	CO_2	0.042%

Page 13-11—A new section is added to read:

13.6 Convection

Convection is generally described as the transport of heat and moisture by the movement of a fluid. In meteorology, the term is used specifically to describe vertical transport of heat and moisture in the atmosphere, especially by updrafts and downdrafts in an unstable atmosphere. The terms "convection" and "thunderstorms" often are used interchangeably, although thunderstorms are only one form of convection. Cumulonimbus clouds, towering cumulus clouds, and altocumulus clouds all are visible forms of convection. However, convection is not always made visible by clouds. Convection occurring without cloud formation is called dry convection, while the visible convection processes referred to above are forms of moist convection.

13.6.1 Surface-Based Convection

Surface-based convection occurs within a surface-based layer (i.e., a layer in which the lowest portion is based at or very near the Earth's surface) and is primarily generated by the daily heating of the surface of the Earth by the energy from the Sun.

13.6.2 Elevated Convection

Elevated convection occurs within an elevated layer (i.e., a layer in which the lowest portion is based above the Earth's surface). Elevated convection often occurs when air near the ground is relatively cool and stable (e.g., during periods of isentropic lift, when an unstable layer of air is present aloft, etc.). In cases of elevated convection, stability indices based on near-surface measurements (such as the LI) will typically underestimate the amount of instability present. Severe weather is possible from elevated convection but is less likely than with surface-based convection.

13.6.3 Level of Free Convection (LFC)

The LFC is the level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

13.6.4 Popcorn Convection

Popcorn convection is a term often used for showers and thunderstorms that form on a scattered basis with little or no apparent organization, usually during the afternoon in response to diurnal heating. Individual thunderstorms are sometimes referred to as air mass thunderstorms. They are small, short-lived, very rarely severe, and they almost always dissipate near or just after sunset.

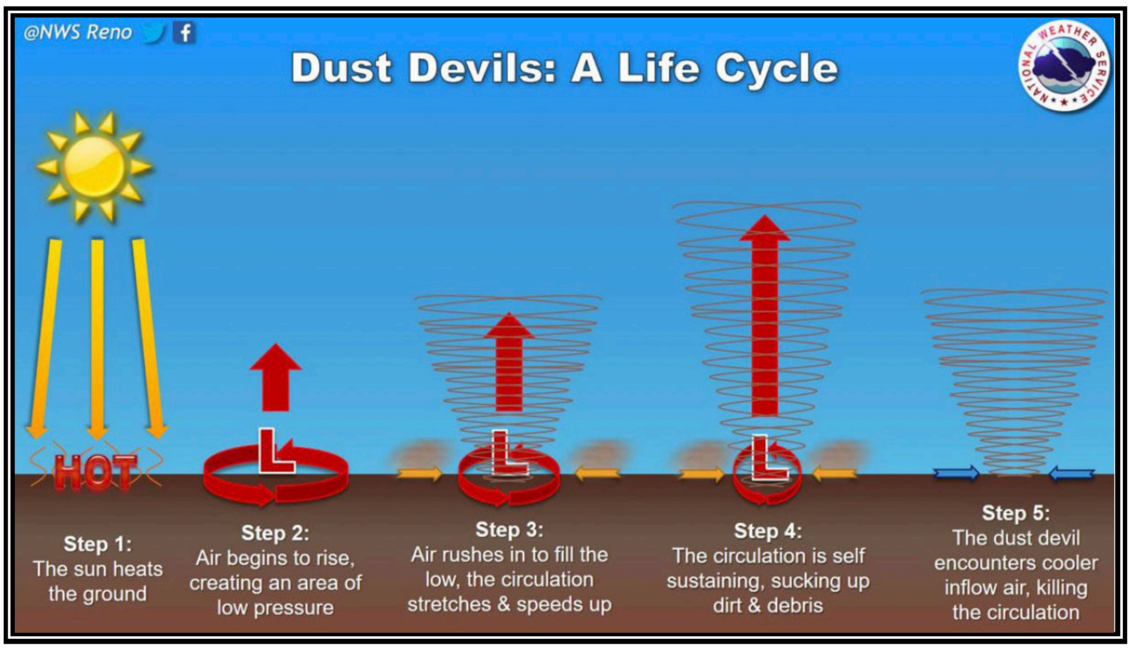
Page 13-11—Sections 13.6 is renumbered as 13.7.

Page 16-13—A new section is added to read as below, including the addition of new Figures 16-13 and 16-14.

16.2.6.3.1 Dust Devils

A common wind phenomenon that occurs throughout much of the world, including the desert Southwest, is dust devils, sometimes known as whirlwinds. These dust-filled vortices, created by strong surface heating, are generally smaller and less intense than a tornado. Typical diameters of dust devils range from 10 to 300 ft, with an average height of approximately 500 to 1,000 ft. In most locations, dust devils typically last only a few minutes before dissipating, although in deserts typical of northern Arizona, dust devils can reach heights of several thousand feet and last an hour or more. Wind speeds in larger dust devils can reach 60 mph or greater. Even though they are generally smaller than tornadoes, dust devils can still be destructive as they lift dust and other debris into the air. Small structures can be damaged, and even destroyed, if they are in the path of a strong dust devil.

Dust devils form in areas of strong surface heating, usually at the interface between different surface types such as asphalt and dirt, or even irrigated fields and dirt roads. Typically, they occur under clear skies and light winds, when the ground can warm the air to temperatures much higher than the temperatures just above the ground. This is a very unstable condition, since the heated air is less dense and lighter than the cooler air above it. If the temperature of the ground becomes much warmer than the air above it, vertical mixing will take place to release this unstable configuration. Once the ground heats up enough, a localized pocket of air will quickly rise through the cooler air above it. The sudden uprush of hot air causes air to speed horizontally inward to the bottom of the newly forming vortex. This rapidly rising pocket of air may begin to rotate, and if it continues to be stretched in the vertical direction, it will increase in rotation speed. This increase in rotation speed from vertical stretching is similar to the increased spinning of an ice skater as they bring their arms in toward their bodies. As more hot air rushes in toward the developing vortex to replace the air that is rising, this spinning effect is intensified. The air cools as it rises, and will eventually descend back through the center of the vortex. Under optimal conditions, a balance between the hot air rising along the outer wall of the vortex and the cooler air sinking in the vortex occurs. The dust devil then begins to move across the ground, picking up more and more dust, highlighting the vortex and making it visible to the eye. The dust devil, once formed, is a funnel-like chimney through which hot air moves both upward and circularly. If a steady supply of warm unstable air is available for the dust devil, it will continue to move across the ground. However, once the warm unstable air is depleted or the balance is broken in some other way, the dust devil will break down and dissipate.



(Photo courtesy of NWS Reno)

Figure 16-13. NWS Dust Devils: A Life Cycle

It is important to note that not all dust devils may be easily visible. Some may have no or very little debris. Pilots should try their best to avoid dust devils. They should not fly through them and should scan takeoff and landing areas.

(Photo courtesy of the National Transportation Safety Board (NTSB))

Figure 16-14. Accident Damage Caused by a Dust Devil

Page 20-7—A new Figure 20-3 is added to the end of section 20.4.1.

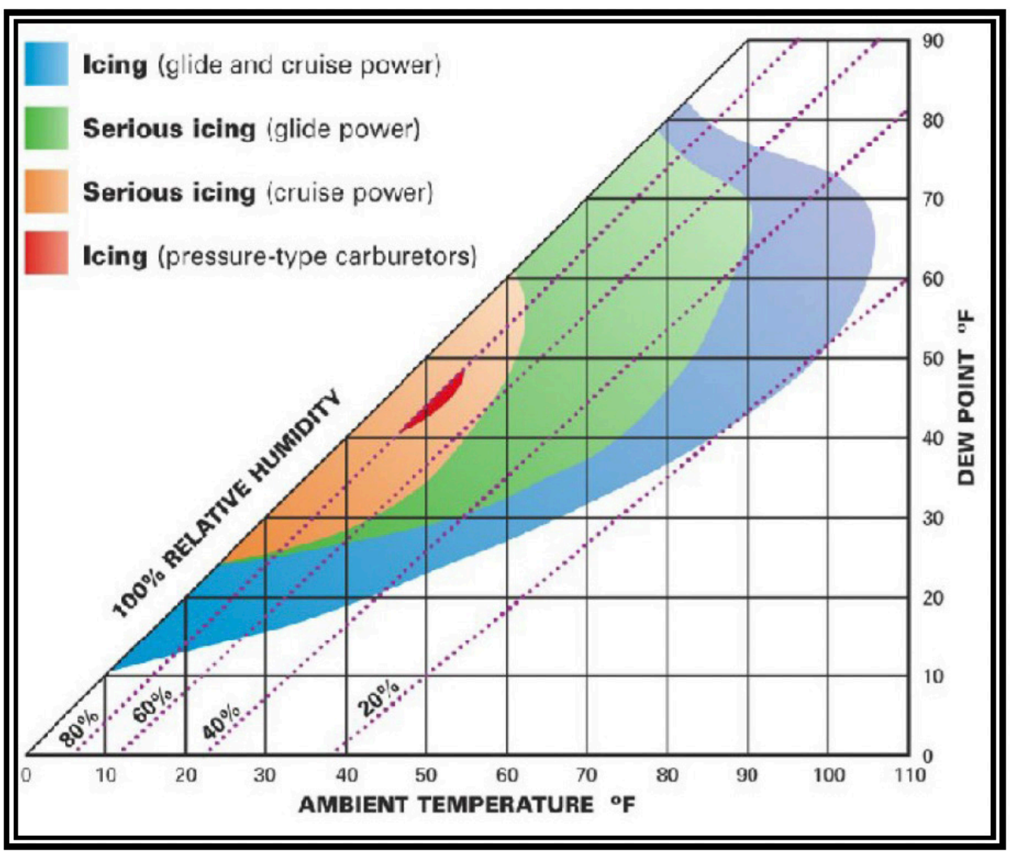


Figure 20-3. Carburetor Icing

Page 22-22—In the list beginning “If unable to avoid penetrating a thunderstorm,” item #3 is revised to read:

3. To avoid the most critical icing, establish a penetration altitude below the freezing level or above the level of -15 °C.

Page 24-3—Section 24.3.1.2, 3rd bullet is revised to read:

- Obstructions to vision: fog (**FG**), mist (**BR**), and haze (**HZ**).
  Note: FG is reported when visibility is less than 5/8 sm. Freezing fog (**FZFG**) is reported when temperature is below 0 °C. **BR** or **HZ** is reported for visibilities from 5/8 sm to less than 7 sm, depending on the difference between the temperature and dewpoint. If the difference is 4 °F (about 2 °C) or less, then **BR** is reported; otherwise, **HZ** is reported.

Page 24-6—The fourth row of Table 24-2 is revised to read:

4	**Tornado, Funnel Cloud, Waterspout, or Dust/Sand Whirl (Dust Devil)**	• Is observed. • Disappears from sight or ends.

Page 24-20—Section 24.4.3.13.2 is revised to read:

24.4.3.13.2 Funnel Cloud

At manual or augmented stations, when a certified weather observer is on duty, tornadoes, funnel clouds, and waterspouts are coded in the following format: tornadic activity; followed by **TORNADO**, **FUNNEL CLOUD**, **WATERSPOUT**, or **DUST/SAND WHIRL (DUST DEVIL)**; 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.

Page 24-27—Section 24.5.1.1.1, first bullet is revised to read:

- Tornadoes, funnel clouds, waterspouts, or dust/sand whirls (dust devils).

Page 24-30—First paragraph on the page is revised to read:

If a funnel cloud is reported, it is coded **FC** following the /**WX** group and is spelled out as **FUNNEL CLOUD** after the /**RM** group. If a tornado or waterspout is reported, it is coded +**FC** following the /**WX** group, and **TORNADO** or **WATERSPOUT** is spelled out after the /**RM** group. If a dust/sand whirl (dust devil) is reported, it is coded **FC** following the /**WX** group, and **DUST/SAND WHIRL (DUST DEVIL)** is spelled out after the /**RM** group.

Page 24-30—The first bullet is revised to read:

- **TORNADO**, **WATERSPOUT**, **FUNNEL CLOUD**, or **DUST/SAND WHIRL (DUST DEVIL)**.

Page 24-40—Table 24.8 is revised to read:

Table 24-8. WSR-88D Weather Radar Precipitation Intensity Terminology

Reflectivity (dBZ) Ranges	Weather Radar Echo Intensity Terminology
<26 dBZ	Light
26–40 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.

Page 25-26—The first two paragraphs of Section 25.7 are revised to read:

RTMA is an hourly analysis system by the NWS' Environmental Modeling Center that produces analyses of surface weather elements. The FAA has determined that RTMA temperature and altimeter setting information is a suitable replacement for missing temperature and altimeter setting observations for a subset of airports. RTMA temperature and altimeter setting information is intended for use by operators, pilots, and aircraft dispatchers when an airport lacks a surface temperature and/or altimeter setting report from an automated weather system (e.g., ASOS or AWOS sensor) or human observer. Airports with RTMA data available are located in Alaska, Guam, Hawaii, Puerto Rico, and the CONUS.

RTMA is issued by the NWS every hour, 24 hours a day. Temperatures and altimeter settings are reported for an airport station including the latitude and the longitude. Temperatures are reported in degrees Celsius. Altimeter setting is reported in inches of mercury. See Figure 25-28 for an example RTMA temperature and altimeter setting report.

Page 25-27—Section 25.7.1 is added and Figure 25-28 is revised as follows:

25.7.1 Adjustments

The values found at the RTMA site are 95 percent accurate throughout the United States for both temperature and altimeter setting when using the following mitigations:

- Temperature requires adding 4 °C to the RTMA-derived temperature.
- Altimeter setting requires increasing the minimum descent altitude (MDA) or decision height (DH) value on the approach chart by 100 ft and increasing the required flight visibility minimums by ½ sm.

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*****************************************************************
RTMA 2m-temperature (degrees Celsius) and altimeter setting
(inHg)
COMPUTED: 1239Z 25 Jan 2024
VALID: 1239Z 25 Jan 2024 to 1339Z 25 Jan 2024
*****************************************************************
```

Station	Lat	Lon	2m-T	ALT
KABE	40.65	-75.44	3.43	30.19
KABI	32.41	-99.68	7.31	30.08
KABQ	35.04	-106.61	1.67	N/A
KABR	45.45	-98.42	-2.06	30.02
KABY	31.54	-84.19	19.07	30.15
KACK	41.25	-70.06	8.98	30.14
KACT	31.61	-97.23	10.00	30.06
KACV	40.98	-124.11	9.74	30.22
KACY	39.46	-74.58	11.59	30.17
KADS	32.97	-96.84	8.69	N/A
KAEX	31.33	-92.55	15.29	29.96
KAFW	32.99	-97.32	8.40	30.06
KAGS	33.37	-81.96	18.85	30.21
KAHN	33.95	-83.33	16.51	30.23
KAIA	42.05	-102.80	-4.11	29.94
KALB	42.75	-73.80	3.18	30.09
KALN	38.89	-90.05	3.02	30.12
KALO	42.56	-92.40	1.03	30.10

Figure 25-28. RTMA Surface Temperature and Altimeter Setting Example

Page 27-2—Section 27.1, added an item to the list of “Additional Convection Products” to read:

- ◦ Corridor Integrated Weather System (CIWS) and Consolidated Storm Prediction for Aviation (CoSPA).

Page 27-17—Fourth paragraph, revised the day of the month is corrected to read:

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 22nd day of the month from 1500 UTC to 1700 UTC.

Page 27-74—A new section and new figure are added as follows:

27.16.5 Corridor Integrated Weather System (CIWS) and Consolidated Storm Prediction for Aviation (CoSPA)

The CIWS and CoSPA are fully automated weather analysis and forecast systems developed for the FAA by the Massachusetts Institute of Technology (MIT) Lincoln Laboratory. These systems combine data from a wide variety of weather radars, satellites, surface observations, and numerical models to provide accurate, rapidly updating weather information to air traffic controllers, air traffic flow managers, and airline users. The state-of-the-art weather products allow managers to achieve more efficient tactical and strategic use of the airspace, reduce controller workload, and significantly reduce delays.

The CIWS provides deterministic 0- to 2-hour forecasts of precipitation, winter precipitation, and echo tops. The deterministic forecast portrays storms in the same format as a radar detection. Thus, the deterministic forecast is sometimes referred to as a “radar forward” depiction. The forecasts are provided as gridded maps or contour overlays on the current weather. An animated loop is available with 2 hours of past weather and forecasts out to 2 hours in the future, with 5-minute granularity. This forecast granularity can be set to 5 minutes, 10 minutes, 15 minutes, 30 minutes, or 1 hour, depending on the user’s needs.

CoSPA provides deterministic 0- to 8-hr forecasts of precipitation, winter precipitation, and echo tops. The animated loop allows the display of 8 hours of past weather and forecasts out to 8 hours in the future, with 15-minute granularity that can be set to 15 minutes, 30 minutes, or 1 hour. The first 2 hours of the CoSPA forecasts are identical to the CIWS forecasts.

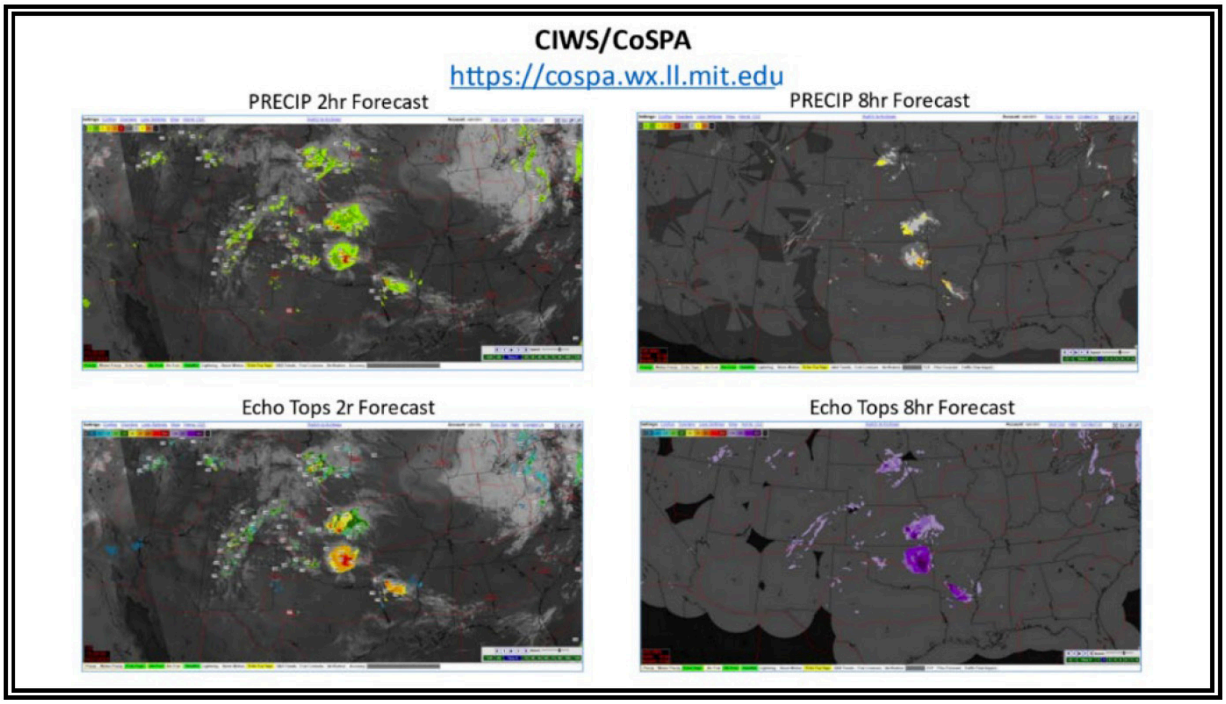

Figure 27-41. CIWS and CoSPA