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***In this Issue**:*

Thunderstorms and Weather Events

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/*TFR/E This annual refresher prepares air traffic controllers for the correct application of weather-related procedures and changes to weather intensity phraseology. Federal Aviation Administration Order (FAAO) JO 7110.65, Air Traffic Control, and the Aeronautical Information Manual (AIM) contain standardized weather phraseology. This refresher emphasizes the impact dynamic weather, associated with thunderstorms, has on the National Airspace System (NAS) especially in the spring and summer months.

Thunderstorms form when unstable atmospheric conditions exist. A classic example is when cold, dry air overlays a layer of warm, moist air. As cold air sinks, the warmer air is displaced upward, bringing with it the necessary moisture for a thunderstorm to develop. With sufficient meteorological data, a weather forecaster can objectively determine stability and moisture content; judging the *lifting mechanism* possesses a greater challenge. Meteorologists evaluate all conditions to decide whether convective Significant Meteorological Information (SIGMET) should be issued. These data are also used to prepare an Aviation Terminal Forecast, and Center Weather Advisory (CWA).

The atmosphere can be in a stable, neutral, or unstable state. Visualize a fairly large volume of air, which meteorologists refer to as a parcel (approximately 1,000 to 2,000 feet on each side). "Lifting" the parcel causes it to cool as it rises upward. The temperature of the parcel may become different than that of the surrounding air as it rises. If the temperature is the same, the atmosphere is neutral and the parcel remains where it was lifted. If the parcel is cooler than the surrounding air, it will sink, and the atmosphere is considered stable. If the parcel is warmer than the surrounding air, then the atmosphere is considered unstable and will continue to rise, condensate to form clouds, and possibly develop into thunderstorms. The greater the temperature difference between the warm cloud and its surrounding air, the more vigorous the thunderstorm.

There are many lifting mechanisms to force parcels of air upward to generate thunderstorms, such as heating, orographic, sea breeze, and frontal lifting. Lift caused by heating usually develops in the late afternoon as the sun heats the earth's surface. Thunderstorms formed in this way are often called air mass thunderstorms and show little movement over the ground. Orographic lifting occurs when air flows from lower to higher terrain. Thunderstorms formed in this way are often found along the tops of ridges or mountain ranges, and generally remain over the ridges or migrate to the leeward side. Sea breeze-generated thunderstorms are common over Florida, a few miles inland from the coast. A frontal lift, the boundary between air masses of contrasting

temperature and moisture content, are the most vigorous source of lifting. The most severe thunderstorms occur in a warm, moist air mass before a fast-moving cold front is pushed by a cold air mass.

One of the greatest tools available to all aviation interests (pilots, controllers, and meteorologists) to detect, measure, and follow thunderstorms is weather radar. Weather radar can show where thunderstorms are, how widespread they may be, and how tall they are. Observing thunderstorms over a period of time allows an opportunity to determine their movements and trends. A thunderstorm trend refers to its development and dissipation. All thunderstorms have a life cycle: formation, development, maturation, and dissipation. Next Generation Weather Radar is best known to provide thunderstorm coverage, movement, trend, and height information. The weather radars operated by the FAA are more attuned to detecting gust fronts, wind shear, and microbursts--hazards that impact the terminal environment. The FAA operates Terminal Doppler Weather Radar (TDWR) and the Weather System Processor, which is an enhancement of the weather channel of an airport surveillance radar. The Low Level Wind Shear Alert System (LLWAS) detects the hazards, but it is not radar.

An automated weather system now in use is the Integrated Terminal Weather System (ITWS), which generates a variety of weather products for the terminal area, including wind shear, microburst, precipitation, airport and terminal winds, lightning detection, gust fronts, and thunderstorm motion. Recently, ITWS incorporated the terminal convective weather forecast product into all of its operational sites. This product provides air traffic managers and controllers with the capability to identify thunderstorm and convective weather activity in and around the airport and to generate 60-minute forecasts of storm activity. This type of weather information is essential in allowing controllers to develop effective arrival and departure plans, which result in vastly-improved air traffic efficiency and capacity around the terminal area.

The procedures as specified in FAAO JO 7110.65, paragraph 2-6-4, standardize the descriptors of the precipitation intensity. Changes have been made to ensure en route, flight service, and terminal services provide equivalent information to pilots regardless of the source of precipitation radar data. Precipitation has four descriptions to address the various decibels of precipitation from the radar. Although some facilities will continue to display 6 levels of weather at certain terminal facilities and up to 12 levels at certain flight service stations (FSS), software enhancements have been installed to convert these levels to four descriptors for all systems. The exception is at en route facilities where weather and radar processing does not display light intensity. Also, at en route facilities, if issuing air route surveillance radar precipitation, only two descriptors are used.

A review of the following references will provide helpful information about air traffic control (ATC) procedures and phraseology during thunderstorm season. They include FAAO JO 7110.65, Paragraph 3-1-8, Low Level Wind Shear/ Microburst Advisories, and FAAO JO 7110.10, Flight Services, Paragraph 14-1-11, Radar. Information contained in the AIM includes various newer weather detection technology and the products they provide. References from the AIM include paragraphs 4-3-7 for LLWAS and TDWR; 7-1-26 for detection of microbursts, wind shear and gust fronts; 7-1-28 for thunderstorms; 7-1-29 for thunderstorm flying (from a pilot's perspective), and 7-1-14 for ATC inflight weather avoidance assistance.

Another valuable source to obtain weather information is through pilot reports (PIREP). The responsibility for soliciting and issuing PIREPs for automated flight service stations/FSS is contained in FAAO JO 7110.10, paragraph 9-2-3, and for controllers at airport traffic control towers, terminal radar approach control facilities, and air route traffic control centers, this information is contained in FAAO JO 7110.65, paragraph 2-6-3.

In addition, Hazardous Inflight Weather Advisory Service (HIWAS) provides weather advisories including summarized aviation weather warning, SIGMET, convective SIGMETs, CWA, Airmen's Meteorological Information, and Urgent Pilot Weather Reports. Controllers shall advise pilots of hazardous weather that may impact operations within 150 nautical miles of their sector or area of jurisdiction. Facilities shall review alert messages to determine the geographical area and operational impact for hazardous weather information broadcasts.

The broadcast is not required if aircraft on the facility's frequency(s) are not affected. HIWAS procedures are contained in FAAO JO 7110.10, chapter 2, section 4, and FAAO JO 7110.65, paragraph 2-6-2.

Controllers within commissioned HIWAS areas shall broadcast a HIWAS alert on all frequencies, except on the emergency frequency, upon receipt of hazardous weather information. Controllers are required to disseminate data based on the operational impact on the sector or area of control jurisdiction. The procedure to notify pilots of hazardous weather using the Automated Terminal Information Service (ATIS) is contained in FAAO JO 7110.65, paragraph 2-9-3. This paragraph addresses how the information is obtained and the instructions for the pilot to acknowledge receipt of the ATIS message. The ATIS message includes, if appropriate, hazardous weather information with an example of phraseology.

Controllers outside commissioned HIWAS areas shall advise pilots of the availability of hazardous weather advisories. Pilots requesting additional information should be directed to contact the nearest flight watch or FSS. Controllers shall also apply the same procedure when HIWAS outlets, or outlets with radio coverage extending into the facility's sector or airspace, are out of service. Further information is contained in FAAO JO 7110.65, paragraph 2-6-2.

In this publication, the option(s) for which a briefing is required are indicated by an asterisk (*) followed by one or more letter designators, i.e., ***T** *= Tower, combined tower/approach control,* ***R** *= TRACON,* ***E** *= ARTCC (En route), or* ***F** *= AFSS/FSS. (Reference FAAO 7210.3, para. 2-2-8.)*

This table lists Air Traffic Bulletins published since 2003. They can also be found on the Internet at http://www.faa.gov/airports_airtraffic/air_traffic/publications/.

2003		2004		2005		2006		2007		2008	
03-1	MAY	04-1	**MARCH	05-1	APRIL	06-1	FEBRUARY	07-1	**MAY	08-1	MARCH
03-2	**JUNE	04-2	**APRIL	05-2	MAY	06-2	JUNE	07-2	MAY	08-2	**MAY
03-3	AUGUST	04-3	MAY	05-3	**AUGUST	06-3	SEPTEMBER	07-3	SEPTEMBER		
03-4	OCTOBER	04-4	**JULY	05-4	**OCTOBER	06-4	DECEMBER	07-4	**NOVEMBER		
03-5	**NOVEMBER	04-5	AUGUST								
03-6	DECEMBER	04-6	OCTOBER								
		04-7	**NOVEMBER								

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