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EYE ON THE SKY

Thunderstorm avoidance is easiest when you see them a ways off. Some folks in Oklahoma look for storms eight days in advance.

by Scott C. Dennstaedt

I felt a bit like a Rodney Dangerfield. My buddy Ken and I were visiting the Storm Prediction Center (SPC) in Norman, Okla. — the heart of Tornado Alley — and there wasn't a single thunderstorm anywhere in the lower 48. No convective outlooks, no mesoscale discussions, no severe thunderstorm or tornado watches. No respect.

Except for a few strikes way off the East Coast, the National Lightning Detection Network (NLDN) display at the SPC was completely blank. It was a blessing in disguise, though, because I spent all day talking with the forecasters who are normally up to their armpits in convection keeping an eye on the sky.

The SPC is not aviation-centric like its sister organization, the Aviation Weather Center (AWC) in Kansas City, Mo. Don't let that fool you. The SPC products are just as critical to aviation operations as are the convective SIGMETs issued hourly by the AWC. Besides fire weather forecasts, the SPC generates three products useful to all aviators. These products include severe weather watches (WWs), mesoscale discussions (MDs), and convective outlooks.

Severe Weather Watches

Severe weather watches come in two flavors: severe thunderstorm watches and tornado watches (http://www.spc.noaa.gov/products/watch/). Certain meteorological criteria or parameters must be met before these unscheduled severe weather forecasts are issued.

A severe thunderstorm watch will be issued when six or more three-quarter inch diameter or larger hailstones and/or damaging winds of 50 knots or stronger are expected to occur with organized convection within the watch area.

A tornado watch will be issued when three or more weak, brief tornadoes or at least one tornado capable of producing F2 or greater damage are forecast to occur with organized convection within the watch area.

Watches will average 25,000 square miles in size, but should be at least 8,000 square miles and not greater than 35,000 square miles. The minimum duration of a watch is two hours, but the average is six to eight hours. Watches always expire at the top of the hour; however, it is not unusual to see a watch issued slightly longer into the evening to cover the diurnal convective cycle.

Mesoscale Discussions

Mesoscale discussions (MDs) are precursors to severe thunderstorm and tornado watches (http://www.spc.noaa.gov/products/md). MDs don't imply any "official" warning or guidance and only serve to describe the severe threat that will likely precipitate. They focus on the zero- to six-hour time period with special emphasis on the next one to three hours.

An MD doesn't mean a future watch will be issued. Conditions may not develop or be intense enough to warrant a watch area. The forecaster's goal is to issue the MD one to three hours prior to watch issuance. In a rapid thunderstorm evolution, this may not be possible and a short mesoscale discussion is usually squeezed in.

When the forecaster is highly confident that the watch will be issued, the text of the MD will include a statement such as "WW will be required shortly" or "WW will be issued soon." On the other hand, if there is some uncertainty the text may say, "The area is being monitored for a possible watch," and spell out the reasons for the uncertainty.

The most important text for the pilot to absorb is the beginning. The first paragraph describes the "what," "where," and "when" of the event. Knowing the approximate timing, location, and movement of convection provides the pilot with an excellent planning resource.

The second paragraph contains "why" the event will occur and contains a technical discussion. While it is technical, I wouldn't be too quick to discount its value. For example, the MD might discuss a "bow echo," which implies a threat for high surface winds, or "elevated convection," which points out that the thunderstorms may have higher bases.

Right: *The "watch box" isn't really a box. The box is an approximate outline of the counties involved.*

WHAT'S WITH WATCHES VS. WARNINGS?

There has been some confusion by pilots as to the difference between a warning and a watch. The SPC issues severe thunderstorm watches and tornado watches, whereas severe thunderstorm warnings and tornado warnings are a product of the local Weather Forecast Offices (WFOs). Here's how it normally works.

A severe weather watch is issued by the SPC several hours in advance for a broad area of potential severe weather. As the severe weather begins to develop or move into the watch area, the local weather forecast offices take over at this point and issue severe thunderstorm warnings for cells or lines that exhibit severe characteristics. Similarly, tornado warnings are issued for tornadoes or funnel clouds seen by trained spotters or inferred by tornadic Doppler radar signatures.

The area of a warning typically is the size of a county or some fraction thereof. The period of validity of the warning is roughly one hour.

As I elaborated in "Convective SIGMETs" (April 2005 *IFR*), thunderstorm severity is just one criterion for issuing a convective SIGMET. The main difference is that a convective SIGMET is issued only after convection has formed. As a result, they are more of a "nowcast" rather than a forecast.

A severe thunderstorm or tornado watch describes an area that has the potential for the development of thunderstorms that will likely ruin your day. Therefore, it is possible (and preferred) for a watch to be issued even before the first towering cumulus is ever spotted. This is not always possible and in some cases replacement watches are issued downwind to extend or replace existing watches when severe conditions are expected to persist and move out of the current watch area.

Convective SIGMETs are still paramount to aviation safety because they highlight large, general areas of thunderstorms including isolated severe cells and embedded thunderstorms. While extremely significant to aviation, severe thunderstorm or tornado watches emphasize only organized severe thunderstorms. —*S.D.*

Convective Outlooks

The SPC generates convective outlooks out to eight days (http://www.spc.noaa.gov/products/outlook). The Day 1 outlook is the one most critical to aviation and is issued five times a day.

The first issuance is at 0600 UTC and is valid for 24 hours starting at 1200 UTC through 1200 UTC the following day. It's reissued (updated) four more times throughout the day. The ending valid time remains anchored at 1200 UTC with each subsequent issuance. If you plan to fly in the afternoon, keep a close watch on the Day 1 outlook to check for any significant changes.

Day 2 outlooks are issued twice a day, at 0800 UTC and 1730 UTC and is valid for 24 hours beginning at 1200 UTC the following day. Night shift SPC forecasters issue a Day 3 outlook as well as a Day 4 through Day 8 thunderstorm outlook.

A convective outlook depicts thunderstorms and severe thunderstorm threats across the continental United States for a given period. The convective outlook consists of a categorical outlook and three probabilistic outlooks.

The categorical outlook says nothing about what severe weather hazards (large hailstones, damaging winds, and tornadoes) can be expected. That's described in a narrative and probabilistic graphical images.

The outlook narrative is written in technical language intended for sophisticated weather users and provides guidance to local NWS Weather Forecast Offices (WFOs), as well as other weather customers concerned about public safety. While the narrative may not be written in a language that pilots understand, it will often qualify the time of day that will be impacted by the severe weather. Reading the text is important as the outlook can cover a 24-hour period.

Thunderstorm lines on the outlook graphic depicts, to the right of the line, a 10 percent or higher probability of thunderstorms during the valid period. Three risk categories, slight (SLGT), moderate (MDT) and high (HIGH) are used to symbolize the coverage and intensity of the expected severe weather threat. If "SEE TEXT" appears on the outlook, it means severe storms are possible, but the coverage or intensity is expected to be minimal or there is too much uncertainty to issue a risk area at the time of the latest outlook.

The risk categories are added to the outlook when the forecaster expects organized convection with tornadoes, large hail, damaging winds, or all of these. Organized convection means supercells, squall lines, and multi-cell thunderstorm complexes. Isolated severe storms with marginal intensities or short durations of severe will likely not be included in any higher-risk area.

While the name is similar, note that the SPC convective outlooks are different products than the convective outlooks issued by the AWC.

Other Products

A Potentially Dangerous Situation (PDS) is a special class of severe weather watches issued by the SPC. PDS tornado watches are issued whenever there is a high-confidence forecast of two or more

F2 or greater tornadoes occurring within the watch area. A PDS severe thunderstorm watch is issued when radar shows a well-defined derecho (bow echo) moving over 47 knots that's predicted to last over an hour or when widespread, extreme, non-tornadic severe weather events are likely. This includes convective winds over 65 knots and/or hailstones greater than two inches in diameter.

Pilot's Perspective

What does it all mean for a pilot planning a flight during the spring, summer, and fall? Convective outlooks represent a tool for long-term planning. If you don't have any on-board weather or are a bit squeamish when it comes to thunderstorm avoidance, these outlooks can certainly help you manage your two- or three-day schedule or assist you in route or fuel-stop planning.

Remember these outlooks cover a large chunk of time (up to 24 hours). You must read through the text to identify the timing of the convective event. It doesn't necessarily matter what kind of severe event will occur since pilots want to avoid all thunderstorms, but knowing when and where the severe events may occur provides an accurate summary.

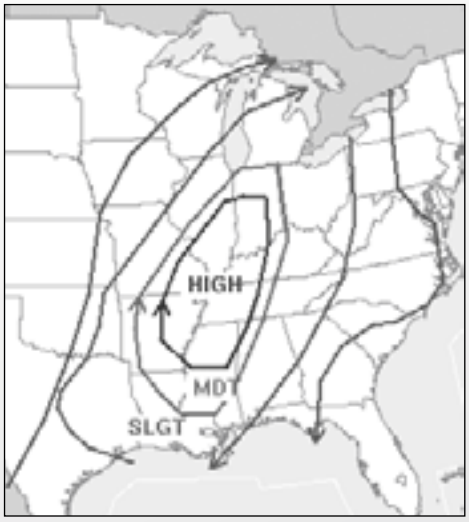
On the morning of your flight, take a look at the text and the graphic for the Day 1 convective outlook. If your flight is in the afternoon or evening you'll want monitor the updates that occur throughout the day, especially at 1630 UTC and 2000 UTC. The SPC will typically fine-tune the time, location, and coverage of the severe threat.

Monitor the MDs throughout the day. As the severe weather starts to become a reality, MDs are the first indication that organized convection is possible. MDs describe regions on a much smaller scale and focus on the next few hours. Once an MD is issued, flight through this region should be carefully watched or avoided. Certainly pilots without on-board weather should consider alternate plans.

CALL 'EM "MOTHER NATURE'S TFRS"

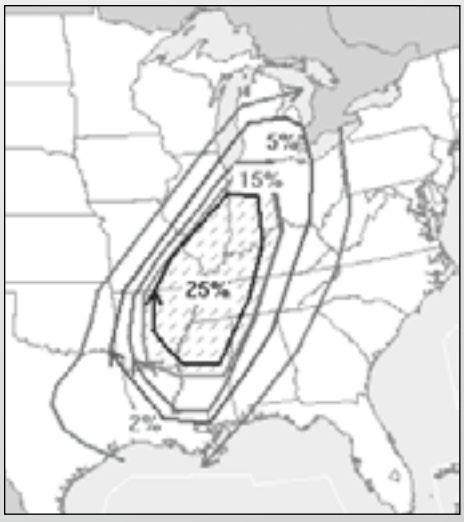
The Day 1 Categorical Outlook (upper) shows a general threat of thunderstorms to the right of a line extending north from Texas to Michigan and to the right of another line running from Lake Ontario to Florida. Between these lines there is a general threat of (non-severe) thunderstorms.

Within this area, the SPC identified SLGT (slight), MDT (moderate), and HIGH (high) risk areas of severe thunderstorms.



A SLGT risk implies that well-organized, severe thunderstorms are expected but in small numbers and/or low coverage. That still means five to 29 reports of hail one inch or larger and/or three to five tornadoes.

MDT risks imply a greater concentration of severe thunderstorms, and, in most situations, greater magnitude of severe weather. The HIGH risk area almost always means a major, severe weather outbreak is expected. Within a high-risk area, expect at least 20 tornadoes with at least two of them rated F3 or higher, or an extreme derecho (convective wind storm) with winds possibly reaching 70 knots.



The categorical outlook may show a SLGT risk, but it says nothing about what kind of threat is expected. The probabilistic outlook (lower) provides a forecast of specific severe threats.

Let's assume you are planning a flight through the 25-percent region on this probabilistic tornado outlook. Pick any point in this area and draw a circle with a 25-mile radius around this point. A 25-percent value means that you have a nearly one in four chance of seeing a tornado within this 25-mile circular region you just drew. A value of 35 percent means nearly a one in three chance of seeing a tornado within the 25-mile circle. —*S.D.*

Finally, as the SPC is convinced that the activity will come to fruition or is moving into an area, they will promptly issue severe weather watches. At this point, it is not a matter of if, but when convection will occur. Viewing the satellite and NEXRAD radar loops are the best way to monitor developing weather — and show it a little respect.

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