

## SPC and its Products

Chris Hayes Novy

Southern Illinois University

Roger Edwards, David Imy and Stephen Goss

Storm Prediction Center

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*Note for MEA444: A color version of this document is available on the class web page.*

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1. [What is Severe Weather?](#)
  2. [Convective Outlooks](#)
    1. [Day 1 Convective Outlook](#)
    2. [Day 2 Convective Outlook](#)
    3. [Day 3 Convective Outlook](#)
    4. [Day 4-8 Severe Weather Outlook](#)
    5. [Levels of Risk](#)
    6. [Severe Thunderstorm Discussion](#)
    7. [Using the Technical Outlooks](#)
    8. [The Public Severe Weather Outlook \(PWO\)](#)
  3. [Mesoscale Discussions \(severe thunderstorms\)](#)
    1. [Heavy Rain MCD](#)
    2. [Winter Weather MCD](#)
  4. [Severe Weather Watches](#)
  5. [Watch Description](#)
  6. [Watch Probabilities](#)
  7. [Watch Status Messages](#)
- 

### What is Severe Weather?

If you were to ask ten different people what "severe weather" means you would probably get ten different answers. The NWS definition states that a "severe" thunderstorm is any storm that produces one or more of the following elements:

1. A tornado.
2. Damaging winds, or winds measured 50 knots (approx. 58 MPH) or more.
3. Hail three quarters (3/4) of an inch in diameter or larger.

Other forms of dangerous weather include heavy rain (flash flooding hazard), excessive heat and cold, tropical cyclones, and winter storms. Although forecasting these other types of dangerous weather is mainly the responsibility of other branches of NCEP, and of local NWS offices, the SPC also issues 1-6 hour short-term forecasts, or [mesoscale discussions](#) of certain heavy rain, heavy snow, freezing rain, and blizzard events in portions of states.

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## Convective Outlooks

The convective outlooks serve as guidance to the local NWS forecast offices and are used by emergency managers, private sector meteorologists, media, and other weather customers concerned with public safety. Three separate risk areas (slight, moderate, and high) are used to describe the expected coverage and intensity for the categorical severe weather threat on days 1-3 along with severe weather probabilities for the potential threat.

The Day 4-8 Severe Weather Outlook graphic depicts those days where a 30% or higher probability for severe storms is expected.

### Day 1 Convective Outlook

The [Day 1 Convective Outlook](#) consists of a narrative and a graphics depicting thunderstorm and severe thunderstorm threats across the continental United States. The narratives are written in technical language, intended for sophisticated weather users, and provide the meteorological reasoning for the risk areas. The text product also provides explicit information regarding the timing, the most likely severe weather hazard and the severity of the event, when possible. The graphics include a categorical forecast of the severe risk (slight, moderate, or high) along with a 10% or greater forecast for thunderstorms. Separate probabilities for severe hail, wind and tornadoes are also issued.

The Day 1 Convective Outlooks are issued 5 times daily: at 0600 UTC (initial issuance valid 1200 UTC that day until 1200 UTC the following day), 1300 UTC and 1630 UTC (the "morning updates," valid until 1200 UTC the next day), 2000 UTC (the "afternoon update," valid until 1200 UTC the next day), and the 0100 UTC (the "evening update," valid until 1200 UTC the following day).

Please click [here](#) to see the probability to categorical outlook conversion tables.

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### Day 2 Convective Outlook

The [Day 2 Convective Outlook](#) is similar to the Day 1 Outlook in terms of a text and graphics. The biggest difference is instead of forecasting separate probabilities for wind, hail and tornadoes, a single combined severe weather probability is issued on the Day 2 probability Outlook. Also, the Day 2 Outlook is issued only twice a day, at 100 am CST/CDT and 1730 UTC. This outlook covers the period from 1200 UTC the following day to 1200 UTC the day after that. For example, if today is Monday then the Day 2 Outlook will cover the period 1200 UTC Tuesday to 1200 UTC Wednesday.

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## Day 3 Convective Outlook

The [Day 3 Convective Outlook](#) text and probabilities are similar to the Day 2 Outlooks. However, the categorical outlook (slight, moderate and high graphic) does not include a thunder forecast and the outlook is only issued once a day, at 400 am CST/CDT.

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## Day 4-8 Severe Weather Outlook

The Day 4-8 graphic consists of one map depicting the severe weather threat during the forecast period. A single non-probability red line will be drawn on the graphic for each separate area where there is at least a 30% probability for severe thunderstorms. This is equivalent to a higher end slight risk threat. A text box is included with the severe weather area listing the day(s) of the potential severe weather threat.

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## Levels of Risk

Risk areas come in five varieties and are based on the expected number and intensity of severe thunderstorm reports over an area:

1. GEN TSTMS (not labelled on the [graphic outlook](#) but listed in the [discussion](#)) - General (non-severe) thunderstorms
2. SEE TEXT - A label on the graphic only
3. SLGT - Slight risk, both graphic and text
4. MDT - Moderate risk, both graphic and text
5. HIGH - High risk, both graphic and text

The SEE TEXT label appears only on the graphic map. Although there is no categorical line drawn for the labeled area, you should read the text of the outlook discussion to be aware of the potential for a threat to develop, if environmental conditions come together. As a rule, the "SEE TEXT" is used on Days 1-3 for areas where severe weather may be possible, but enough forecast uncertainty exists (variability in model guidance, capping, moisture return, or other such factors) to not issue a risk area. Note that the SPC severe thunderstorms outlooks are not meant to cover every single possibility of a severe thunderstorm -- otherwise, severe and general thunder outlooks would often be the same.

A SLGT risk implies that well-organized severe thunderstorms are expected but in relatively small numbers/coverage, or a small chance of a more significant severe event. Not all severe storm events will be covered with a SLGT risk, especially during the summer when short-lived, "pulse-type" severe storms are relatively common during the afternoon.

A MDT risk implies a greater concentration of severe thunderstorms, and in most situations, greater magnitude of severe weather and greater forecaster confidence compared to a SLGT risk. A MDT risk is usually reserved for days with substantial severe storm coverage, or an enhanced

chance for a significant severe storm outbreak. Typical MDT risk days include multiple tornadic supercells with very large hail, or intense squall lines with widespread damaging winds.

The HIGH risk implies that a major severe weather outbreak is expected, with large coverage of severe weather and the likelihood of extreme severe (i.e., violent tornadoes or very damaging convective wind events). The HIGH risk category is reserved for the most extreme events with the least forecast uncertainty, and is only used a few times each year.

The outlook categories are related to the specific tornado, damaging wind, and large hail probability forecast graphics on Day 1, and the total severe storm probabilities for the Day 2 and Day 3 outlooks.

In addition to the severe risk areas, general thunderstorms (non-severe) are outlined, but with no label on the graphic map. Within this area, a 10% or greater probability of thunderstorm occurrence is forecast.

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## Severe Thunderstorm Discussion

...SEVERE THUNDERSTORM FORECAST DISCUSSION...

...SYNOPSIS...

UPPER FLOW IS LOSING AMPLITUDE OVER U.S. AS STRONGER WLYS SHIFT NWD INTO SRN CANADA. FORMER HURRICANE JIM...NOW A MARGINAL TROPICAL STORM...IS WEAKENING AS IT MOVES NNEWD ACROSS FL KEYS/STRAITS. COLD FRONT CONTINUES TO PUSH E AND S ACROSS N-CENTRAL U.S. WITH MOIST/UNSTABLE AIR MASS AVAILABLE IN WARM SECTOR. SIGNIFICANT FRONTOLYSIS IS EXPECTED TO BE UNDERWAY OVER OH VALLEY BY END OF PERIOD.

...WRN GREAT LAKES TO CNTRL PLAINS....

VERY MOIST AND POTENTIALLY UNSTABLE LOW LEVEL AIR MASS CONTINUES AHEAD OF COLD FRONT NOW LOCATED FROM CENTRAL UPPER MI SWWD INTO SERN NEB. AS AMBIENT FLOW WEAKENS GRADUALLY THROUGH PERIOD...VERTICAL SHEAR PROFILES OVER MOST OF THE REGION WILL ONLY marginally support a SEVERE THREAT...HOWEVER CONVECTIVE INSTABILITY WILL REMAIN FAVORABLE. FORECAST MLCAPE IN 2500-3500 J/KG RANGE WILL BE COMMON BY MID/LATE AFTERNOON PERIOD OF PEAK DIABATIC HEATING...WHILE SURFACE DEW POINTS WILL STAY IN 70-75 DEG F RANGE. THERE SHOULD BE SUFFICIENT CONVERGENCE ALONG OR JUST AHEAD OF SURFACE FRONT TO INITIATE SEVERE MULTICELL STORMS...WHICH WILL BE OUTFLOW-DOMINANT GIVEN WEAK STORM-RELATIVE INFLOW AND LARGE DEW POINT DEPRESSIONS. DAMAGING DOWNDRAFTS WILL BE THE MAIN THREAT...AND A FEW LARGE HAIL EVENTS ARE POSSIBLE AS WELL. SEVERE THREAT SHOULD DIMINISH SHORTLY AFTER DUSK...WITH LITTLE ADDITIONAL DEVELOPMENT EXPECTED ALONG RESIDUAL OUTFLOW BOUNDARIES. MODIFIED FORECAST SOUNDINGS INDICATE INSTABILITY WILL DISAPPEAR WITH A FEW DEGREES OF NOCTURNAL DIABATIC COOLING IN THE BOUNDARY LAYER.

Each risk area has its own detailed discussion describing the factors expected to produce severe weather and the type and timing of severe weather expected.

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The convective outlook risk categories are based on the probability of particular kinds of severe weather **within 25 miles of a point**.

### Day 1 Probability to Categorical Outlook Conversion

(SIGNIFICANT SEVERE area needed where denoted by hatching - otherwise default to next lower category)

| Outlook Probability | TORN            | WIND            | HAIL            |
|---------------------|-----------------|-----------------|-----------------|
| 2%                  | <b>SEE TEXT</b> | NOT USED        | NOT USED        |
| 5%                  | <b>SLGT</b>     | <b>SEE TEXT</b> | <b>SEE TEXT</b> |
| 10%                 | <b>SLGT</b>     | NOT USED        | NOT USED        |
| 15%                 | <b>MDT</b>      | <b>SLGT</b>     | <b>SLGT</b>     |
| 30%                 | <b>HIGH</b>     | <b>SLGT</b>     | <b>SLGT</b>     |
| 45%                 | <b>HIGH</b>     | <b>MDT</b>      | <b>MDT</b>      |
| 60%                 | <b>HIGH</b>     | <b>HIGH</b>     | <b>MDT</b>      |

### Day 2 Probability to Categorical Outlook Conversion

(SIGNIFICANT SEVERE area needed where denoted by hatching - otherwise default to next lower category)

| Outlook Probability | Combined TORN, WIND, and HAIL |
|---------------------|-------------------------------|
| 5%                  | <b>SEE TEXT</b>               |
| 15%                 | <b>SLGT</b>                   |
| 30%                 | <b>SLGT</b>                   |
| 45%                 | <b>MDT</b>                    |
| 60%                 | <b>HIGH</b>                   |

### Day 3 Probability to Categorical Outlook Conversion

(SIGNIFICANT SEVERE area needed where denoted by hatching - otherwise default to next lower category)

| Outlook Probability | Combined TORN, WIND, and HAIL |
|---------------------|-------------------------------|
| 5%                  | <b>SEE TEXT</b>               |
| 15%                 | <b>SLGT</b>                   |
| 30%                 | <b>SLGT</b>                   |
| 45%                 | <b>MDT</b>                    |

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## Using the Technical Outlooks

SPC outlooks are issued daily, in UTC time (subtract 6 hours for CST, 5 for CDT):

1. The Day 1 Outlooks will be issued at 0600 UTC, 1300 UTC, 1630 UTC, 2000 UTC and 0100 UTC year-round.
2. The Day 2 Outlooks will be issued at 0700 (0600 UTC daylight time) and 1730 UTC.

SPC outlooks are designed for more sophisticated weather customers -- although they are widely available on the Internet -- and are considered "guidance" products. The discussions are technical and useful in judging one's chances of being included in a watch later in the day. Spotters can be notified that "today is a day to keep in touch" when there is a risk over your local area. This tends to increase spotter turnout when a watch is issued. Like all guidance products, the outlooks are not a guarantee for severe weather. The Outlook must be used in conjunction with other products to get the full picture. It is a forecast product and is subject to change as additional data is evaluated. For example, what appeared to be a MDT risk situation at 0600 UTC may be downgraded to a SLGT risk at 1630 UTC as the 1200 UTC upper air soundings might show the atmosphere had stabilized more than previously forecast. The opposite can happen also.

It is important not to rigidly associate the type of risk area (SLGT, MDT, HIGH) with the severe potential for any given thunderstorm in the risk area. That is, just because a SLGT risk is forecast does not necessarily mean that the thunderstorms within the risk area will be slightly severe. Sometimes, violent tornadoes occur in SLGT or MDT risk areas as opposed to HIGH. The reason for this is the synoptic situation producing the violent tornadoes may be confined to a relatively small area. Another SLGT risk area may cover several states in which only one or two tornadoes may develop. Some SLGT situations won't involve a threat of tornadoes or supercells, but sustained multicell storms with a threat for severe hail and wind damage. HIGH risk situations, which are rarely forecast, signifies that either an outbreak of tornadoes or extreme and widespread severe wind event is likely.

Remember that almost any thunderstorm can, at some point in its lifetime, produce severe or nearly severe weather. Any thunderstorm can kill. SPC severe weather outlooks, though, forecast the development of well-organized severe weather events, most capable of damage and injury from tornadoes, damaging winds or large hail. They are not meant to cover every isolated, brief or marginally severe thunderstorm; otherwise the general thunder and SLGT risk lines would nearly always be the same.

Pulse-type thunderstorms, consisting primarily of solitary brief severe updrafts (often found in environments with weak vertical wind shear) are not considered to be organized. Convection of this type, and isolated severe storms with marginal intensities or short durations, will likely not be included in a risk area. When an unusually dense or large area of marginally severe reports is anticipated, though, the area of concern will probably be included in a SLGT risk. Examples of "organized" convection include supercells, squall lines, and multicell thunderstorm complexes.

General thunderstorm outlooks are guidance for local forecasters concerning the possibility of more than very isolated or brief thunderstorms in or near their areas. General thunderstorm outlooks forecast thunderstorm coverage of 10% or more of the broad region drawn since almost any thunderstorm may produce a brief severe weather event, it doesn't necessarily mean there is a

conflict when a severe thunderstorm warning is issued by a local NWS office in an SPC general thunderstorm outlook.

In short, no two situations are alike, even within the same risk category. This is why a narrative discussion accompanies the outlook - to specifically describe and provide rationale for what kind of severe weather is expected and where/when it is most likely within the risk area.

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## Public Severe Weather Outlooks

The Public Severe Weather Outlooks (PWO) are issued for all high risks issuances for potential tornado outbreaks or widespread significant wind damage. This plain-language forecast is typically issued 12-24 hours prior to the event and is used to alert NWS field offices and other weather customers concerned with public safety of a potentially dangerous situation. A PWO is also issued for a moderate risk outlook which contains at least a 15% probability of tornadoes or a 45% probability of damaging wind gusts. The PWO is issued only for Day 1 Outlooks. If the probabilities support a PWO issuance on the 0600 UTC Day 1 Outlook, a PWO would be issued around 1000 UTC and updated around 1700 UTC. If the probabilities first support a PWO issuance on the 1300 UTC Day 1 Outlook, the PWO would be issued around 1300 UTC and updated around 1700 UTC. Below is an example of a PWO.

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## Mesoscale Discussions

When conditions appear favorable for severe storms development, SPC issues a [Mesoscale Discussion](#) (MCD), normally 1 to 3 hours before issuing a weather watch. SPC also puts out MCDs for mesoscale aspects of hazardous winter weather events including heavy snow, blizzards and freezing rain (see below). MCDs are also issued on occasion for heavy rainfall or convective trends.

The MCD basically describes what is currently happening, what is expected in the next few hours, the meteorological reasoning for the forecast, and when/where SPC plans to issue the watch (if dealing with severe thunderstorm potential). Severe thunderstorm MCDs provide extra lead time on the severe weather development and allow you to begin gearing up operations before a watch is issued.

```
ZCZC SPCSWOMCD ALL
ACUS11 KWNS 152317
^^SPC MCD 152317
SCZ000-NCZ000-160215-
```

```
MESOSCALE DISCUSSION 2065
NWS STORM PREDICTION CENTER NORMAN OK
0617 PM CDT TUE OCT 15 2002
```

```
AREAS AFFECTED...PAMLICO SOUND/OUTER BANKS OF NORTH
CAROLINA/CAROLINA COASTAL WATERS
```

```
CONCERNING...SEVERE THUNDERSTORM POTENTIAL
```

```
VALID 152317Z - 160215Z
```

WATERSPOUTS/STRONG WIND GUSTS WILL REMAIN POSSIBLE THROUGH 0200Z IN THE COASTAL WATERS OF SOUTH CAROLINA AND NORTH CAROLINA AS SURFACE LOW NOW ABOUT 80 ESE ILM TRACKS NORTHWARD TOWARD THE PAMLICO SOUND AREA THIS EVENING. SOME INCREASE IN THREAT OF TORNADOES WILL RESULT...ESPECIALLY LATER THIS EVENING.

INITIAL MCS BRUSHING THE OUTER BANDS IS JUST NORTHEAST OF MAIN SURFACE LOW. ENTIRE MCS SHOWS BROAD ROTATION IN RADAR IMAGERY...AND NUMEROUS EMBEDDED ROTATING STORMS ARE EVIDENT ABOUT 15-50 MILES OFFSHORE. DUE TO LARGE SHIELD OF MODERATE/HEAVY RAIN ON NORTHERN EDGE OF MCS OVER EASTERN NORTH CAROLINA... DESTABILIZATION PROCESS OVER LAND WILL BE SLOW DURING THE EVENING. STILL...A COUPLE OF THE ROTATING CELLS WITH AN OUTSIDE CHANCE OF A TORNADO WILL BRUSH NEAR THE OUTER BANKS IN THE NEXT FEW HOURS.

NORTH-SOUTH BAND OF THUNDERSTORMS THAT HAS MOVED OFFSHORE OF THE FLORIDA ATLANTIC COAST LIKELY MARKS THE LEADING EDGE OF THE REGION OF UPWARD MOTION THAT WILL CAUSE SIGNIFICANT DEEPENING OF THE SURFACE LOW AS IT SPREADS TOWARD THE NORTH CAROLINA COASTAL WATERS LATER TONIGHT. CELL 75 S CHS HAS SHOWN SOME SUPERCELL CHARACTERISTICS AS IT TRACKS ALONG SURFACE FRONT. EXPECT INCREASING THREAT OF WATERSPOUTS ABOUT 50 MILES OFFSHORE WITH THIS CONVECTION IN THE NEXT FEW HOURS AS WELL.

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## Heavy Rain MCD

SPC heavy rain MCDs are typically issued for:

- 1) 1) Rainfall rates up to 3 inches per hour are expected with slow moving convection (e.g., storms moving at 10 knots or less),
- 2) 2) rainfall amounts of at least 2 inches expected at any one location within one hour,
- 3) 3) rainfall rates of at least 1 « inches/hour are expected to last at least 3 hours with a total rainfall of at least 4.5 inches, or
- 4) 4) the forecast of an end to a heavy rain event.

Heavy Rain MCDs will contain the expected location, rainfall rates, durations and, most importantly, the reasoning for the forecast heavy rain episode. They're written for somewhat narrower space and time frames than severe weather MCDs: 0-3 hours, and specific sets of counties where the greatest rains are expected. The heavy rain MD is intended as forecast guidance to local NWS offices about the most significant heavy rainfall area; and is not intended to focus on large areas of heavy rain or to be a QPF product.

If heavy rains have already occurred, a heavy rain MCD usually will not be written, unless:

- 1) 1) Changing meteorological parameters that indicate an end to heavy rains,
- 2) 2) A heavy rain episode threatens within an area of severe thunderstorms,
- 3) 3) Additional storms with heavy rains are expected across the same area where recent heavy rains have occurred, or
- 4) 4) Heavy rains are expected to continue while moving into a different area.

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## Winter Weather MCD

Winter weather MCD's focus on the meteorological processes expected to cause hazardous winter weather: the where, when, what, and (most importantly) why. The meaning of "hazardous weather" varies; but discussions on heavy snow are issued for lake effect snowstorms, climatologically anomalous events or unexpected events. Winter weather MCDs are also issued for forecast snowfall rates of at least 1" per hour in the lowlands and plains, and 2" per hour for areas higher than 4000 feet. Winter MCDs are also issued for freezing rain events especially when amounts are expected to greater than 0.05" per three hours, or for blizzard conditions lasting over three hours.

If hazardous winter weather has already occurred, a MCD usually will not be written, except for:

1. 1) Changing meteorological parameters that indicate an end to the event
2. 2) An episode that may have been overlooked,
3. 3) Further hazardous winter weather across the same area where recent heavy snow, freezing rain or blizzard conditions have occurred, or
4. 4) When an event is expected to continue and shift into a different area.

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## Severe Weather Watches

When conditions become favorable for organized severe thunderstorms and tornadoes to develop, the SPC issues a severe thunderstorm or tornado watch. A tornado can occur in either type of watch, but tornado watches are issued when conditions are especially favorable for either multiple and or strong tornadoes. Watches encourage the general public to stay alert for changing weather conditions and possible warnings. For emergency managers, storm spotters, and the broadcast media, watches provide valuable lead time to gear up operations and increase staffing. Although the general watch area is approximated through the issuance of a parallelogram, the actual watch is issued by counties and collaborated with local NWS offices. Therefore, some counties in the watch may be outside the parallelogram, while come counties in the parallelogram may not be in the actual watch issuance. The watch issued by counties provides a more precise area for the severe threat than the parallelogram.

A typical watch ranges in size from 20,000 to 40,000 square miles, though some are smaller and others larger, depending on the meteorological situation. In most years, a total of 800 to 1000 severe thunderstorm and tornado watches will be issued. Watches are numbered sequentially, with the count reset at the beginning of each year. In the watch header below, the last digit of the number of this watch is 3 (e.g., SEL3), and the whole watch number is given several lines later. A typical watch duration is 6 to 7 hours, but it may be canceled, replaced, or reissued as required. A watch is not a warning, and should not be interpreted as a guarantee that there will be severe weather! When the SPC feels confident about the possibility of severe weather in a specific area, the watch is usually issued at least 1 hour prior the onset of severe weather.

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## Watch Description

The watch describes in plain language the state(s) affected, valid times, severe weather potential, meaning of the watch, replacements (if any), a short weather discussion, and aviation information for pilots.

In the AVIATION section, the storm top numbers are in hundreds of feet; so "500" is 50,000 feet. MEAN STORM MOTION VECTOR is the average expected motion of all the storms in the watch: The first 3 digits are direction the storms will move from on a 360-degree compass; and the last two digits are the storm's expected forward (ground) speed in knots. So in the watch example above, storms are forecast to move from the southeast (from 160 degrees) at 35 knots.

When weather conditions are favorable for a potential tornado outbreak with extreme tornadoes, the SPC will often highlight a tornado watch with the following "enhanced" wording:

...THIS IS A PARTICULARLY DANGEROUS SITUATION...

Also, similar wording will be used in severe thunderstorm watches when extremely destructive and widespread thunderstorm wind events are anticipated.

Unfortunately, not all severe weather situations are clear cut. For example, severe weather may be expected IF thunderstorms form, but there may be doubt about whether storms will develop. In such cases, SPC may wait until storms actually develop before they issue a watch. Sometimes warnings may precede a watch, especially when weaker severe storms develop before the greater severe threat has developed. If severe weather develops unexpectedly, but is expected to be short lived (last less than a couple of hours) or is only very isolated, a watch probably will not be issued. Instead, the storms would be handled with warnings issued by your local NWS office.

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### Watch Probabilities

Not all watches are created equal, so to provide a better perspective of what is expected severe weather-wise, a set of watch probabilities is included with each watch issuance. Two probabilities for each severe hazard (tornadoes, damaging winds and hail) are included along with the probability of 6 or more severe events. A table illustrating these probabilities is included below.

#### Tornadoes

|   |           |
|---|-----------|
| Probability of 2 or more tornadoes                | Mod (40%) |
| Probability of 1 or more strong (F2-F5) tornadoes | Low (20%) |

#### Wind

|   |           |
|---|-----------|
| Probability of 10 or more severe wind events    | Low (20%) |
| Probability of 1 or more wind events > 65 knots | Low (10%) |

#### Hail

|  |           |
|--|-----------|
| Probability of 10 or more severe hail events   | Low (<5%) |
| Probability of 1 or more hailstones > 2 inches | Low (<5%) |

#### Combined Severe Hail/Wind

|   |           |
|---|-----------|
| Probability of 6 or more combined severe hail/wind events | Mod (50%) |
|---|-----------|

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### Watch Status Messages

Watch Status Messages will be issued at the bottom of each hour (between 20 and 40 minutes after), during the lifetime of each severe thunderstorm and/or tornado watch. The first status message usually will not be issued until the watch has been in effect at least 30 minutes. Each watch status message uses the distance in statute miles relative to anchor points and **to the right of a line** for delineating where the severe weather threat continues. The watch status lines are drawn from one edge of the watch parallelogram to the other edge. The watch status process also includes deselecting those counties where the severe weather threat, to the left of the status line, appears to be over.

The watch status messages rarely include a discussion of the meteorology affecting the watch area, as this information will be contained in a mesoscale discussion (MD). The exception may be with the final watch status message, where a brief sentence sometimes will be included explaining why the watch will be re-issued or allowed to expire.