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Topic: Storm-Based Warning Fundamentals

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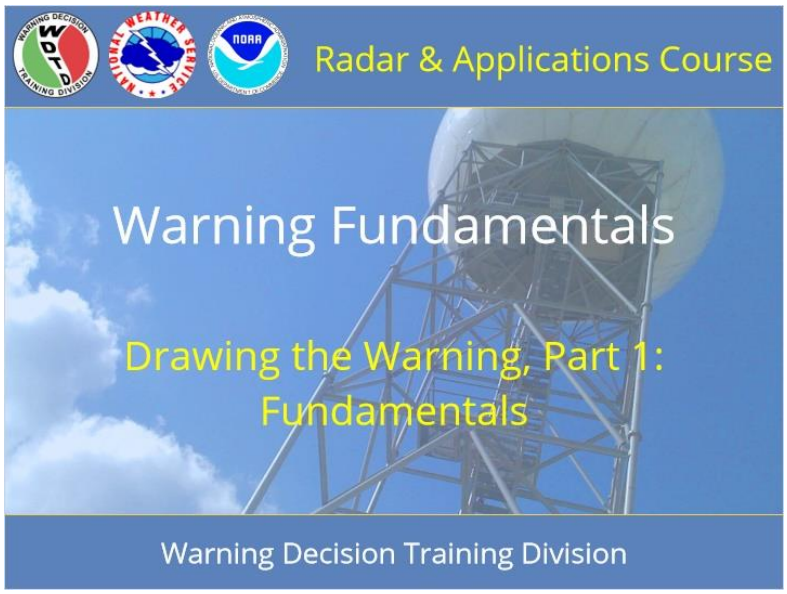
Drawing the Warning, Part 1: Fundamentals

1. Introduction

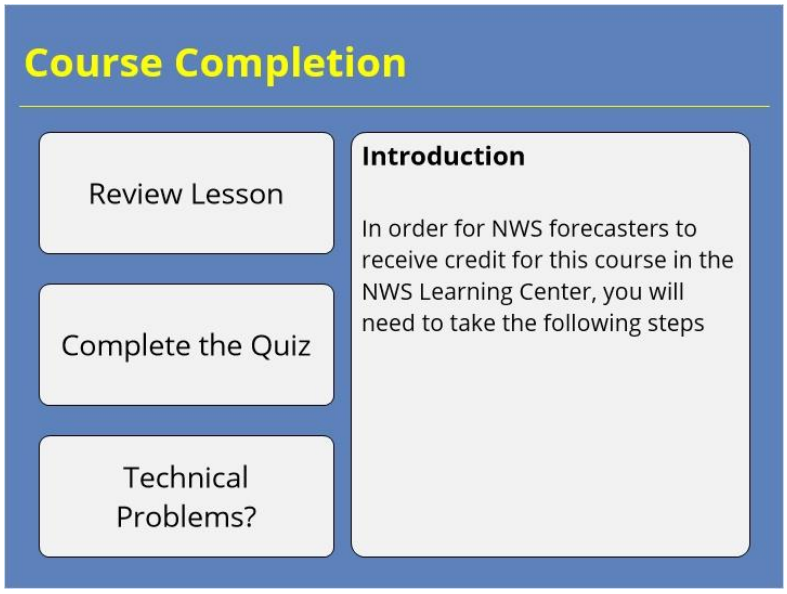
1.1 Title Slide



Notes:

Welcome to RAC Warning Fundamentals. This is Drawing the Warning, Part One, and we will discuss the fundamentals of drawing warning polygons. I am Barb Mayes Boustead.

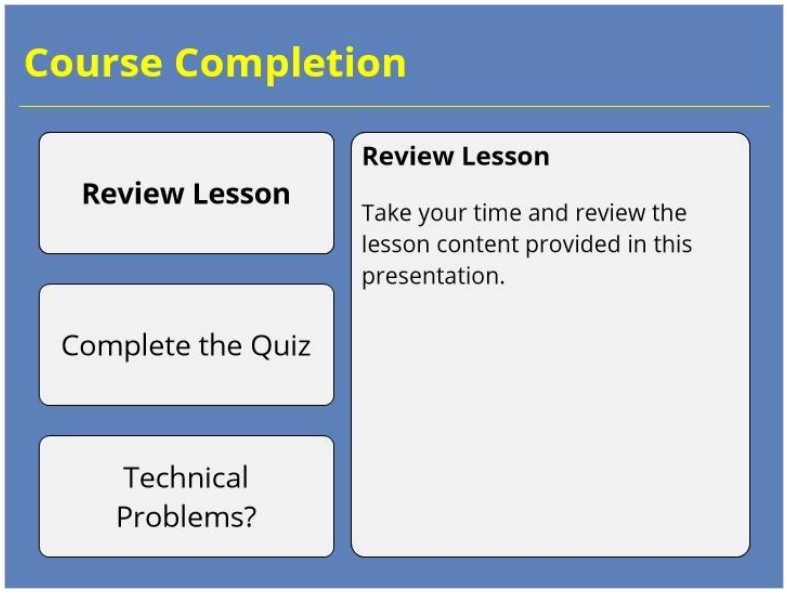
1.2 Course Completion Info



Notes:

If you are completing this course for credit, please review this interaction on how to complete this course within the NWS Learning Center. After viewing all the slides, click "Next" to continue.

Review Lesson (Slide Layer)



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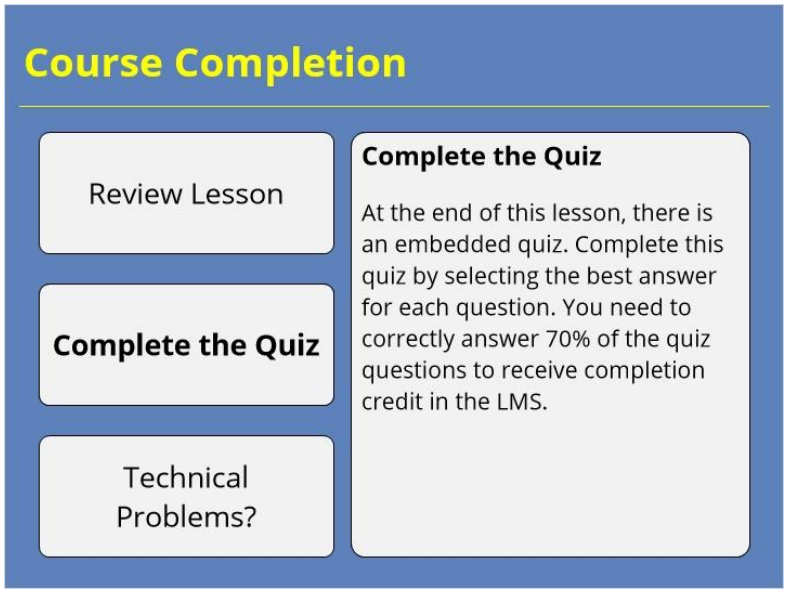
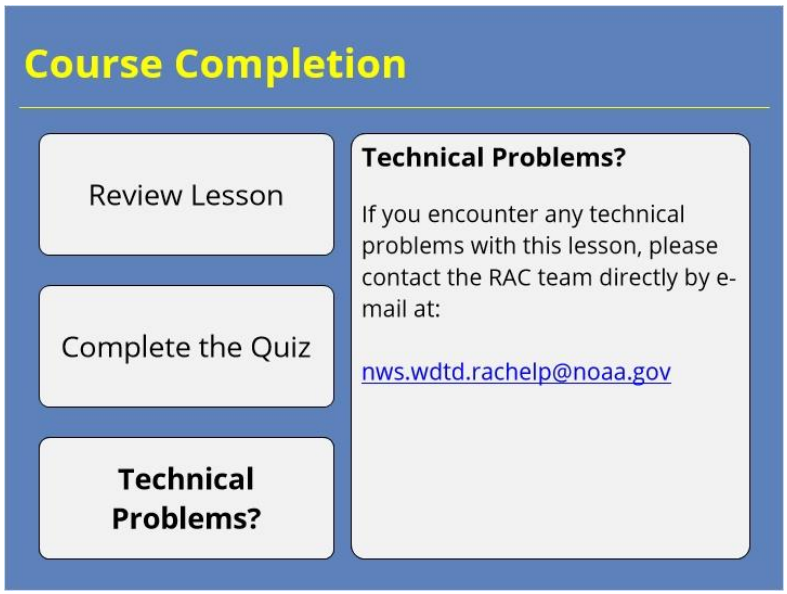
Complete the Quiz (Slide Layer)



Technical Problems (Slide Layer)



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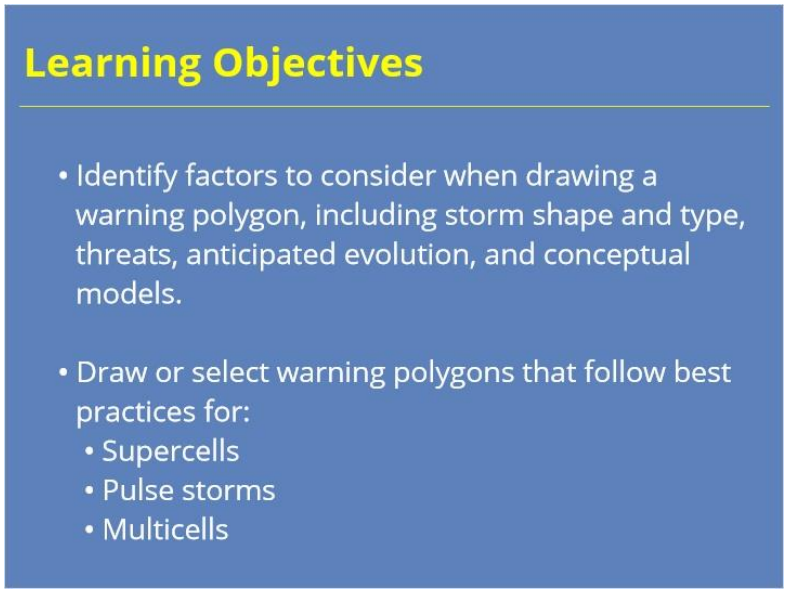
1.3 Learning Objectives



Notes:

The learning objectives for this module are to identify factors to consider when drawing a warning polygon, including storm shape and type, anticipated threats and storm evolution, and conceptual models. Then, draw or select warning polygons that follow best practices for supercells, pulse severe thunderstorms, and multicells (including line segments, bow echoes, and QLCSs).

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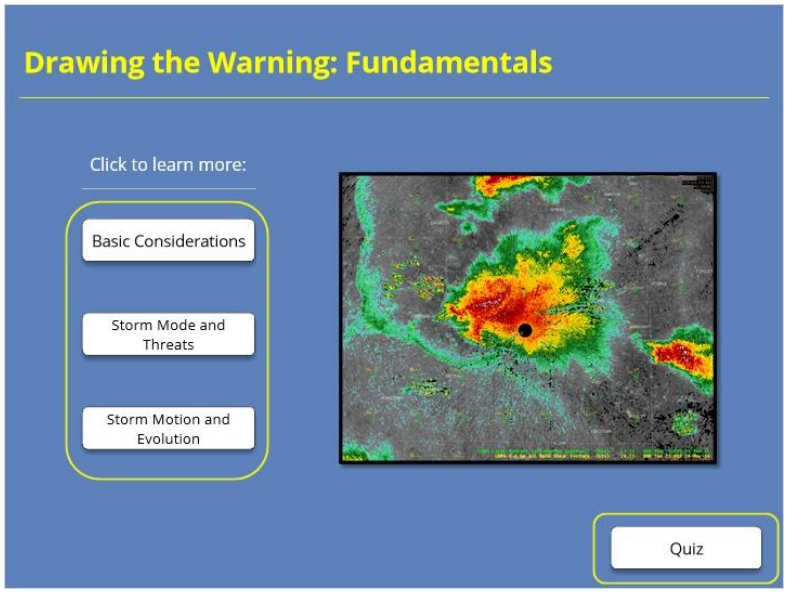
2. Homepage

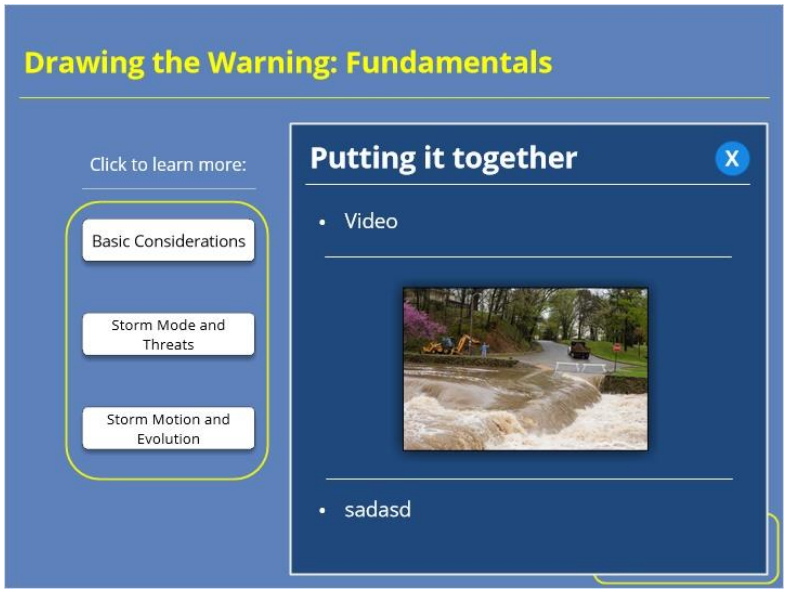
2.1 Homepage: Drawing the Warning: Fundamentals and Phiosophy



Notes:

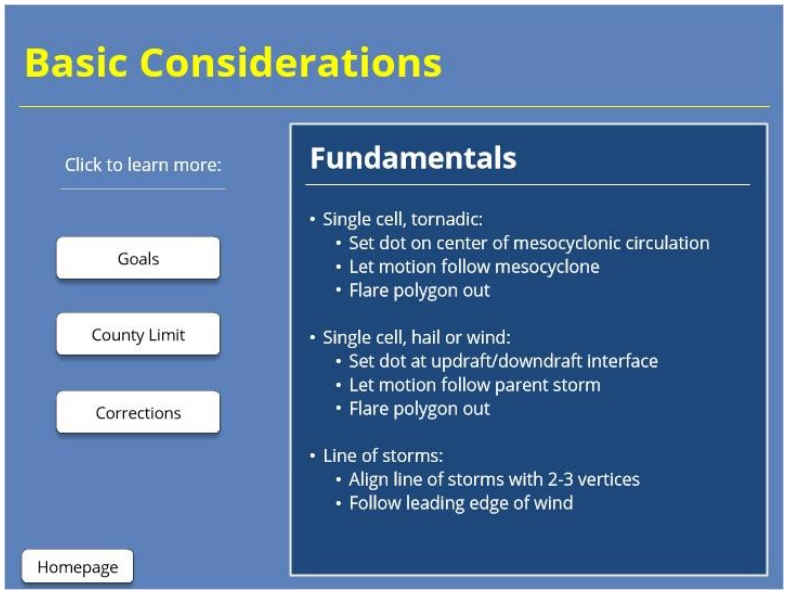
Welcome to the homepage for this first lesson on drawing warning polygons, focusing on the fundamentals. From here, you can click on these three buttons to learn more about the layers of information to consider when drawing a polygon. Then, once you feel comfortable with these materials, take the quiz by clicking the button at the bottom right of the screen

Video example (Slide Layer)



3. Basic Considerations

3.1 Basic Considerations



Notes:

FUNDAMENTALS:

When issuing a warning on a single cell for a tornado, set the “drag me to a storm” dot on the center of the mesocyclonic circulation, and track that circulation for storm motion. Flare the polygon out at the end to cover the inherent increase in uncertainty with time. For a single cell hail or wind threat, set the dot at the updraft-downdraft interface. Let the motion follow the parent storm, and again, flare out the polygon toward its end. With a line of storms, using the line feature, align 2 or 3 vertices with the leading edge of the wind to track the storm.

BASIC GOALS:

I. Would it make sense for the goal of a warning to be to maximize or to minimize lead time?
II. Our goal is to maximize the reasonable lead time in a warning. Would it make sense for the goal a warning to be to maximize or to minimize false alarms?

III. It makes more sense to minimize the false alarm area in our warnings! Put more broadly, our goal is to cover the hazard fully in order to alert the public in a timely fashion about an impending threat.

12 COUNTY LIMIT:

Do you know the maximum number of counties or parishes that can be included in a severe thunderstorm or tornado warning? The answer, provided in the NWS directives, is 12! Be sure that the maximum number of counties in your warnings is 12, at the most.

CAN’T CORRECT SHAPE OF BOX:

Any warning or statement can be corrected for its wording and grammar, format, and dissemination code. Can you correct the shape of the polygon with a correction: The answer is no! It is important to get that right when the warning is first sent.

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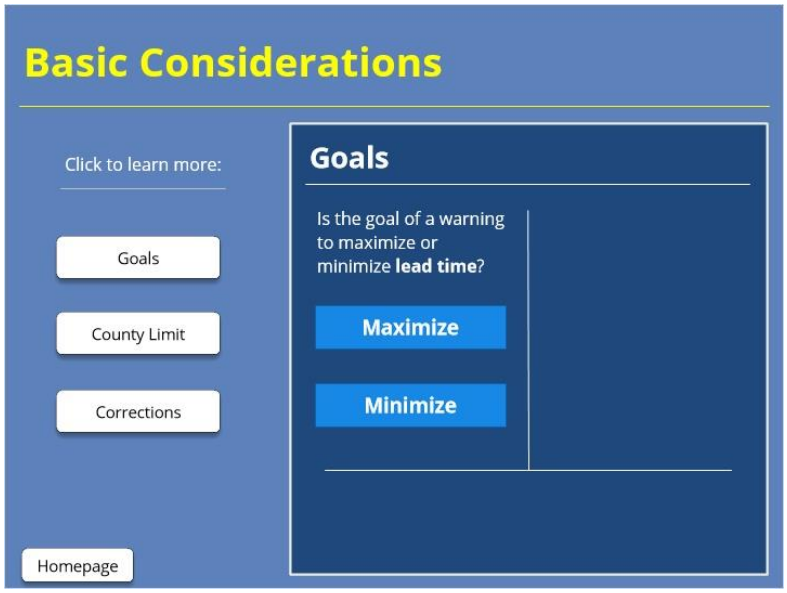
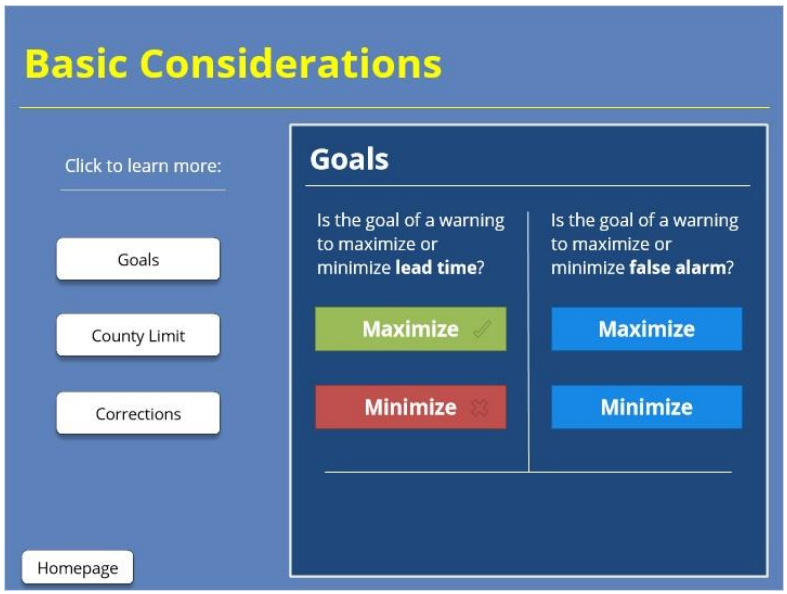
Goals (Slide Layer)



Goals - II (Slide Layer)



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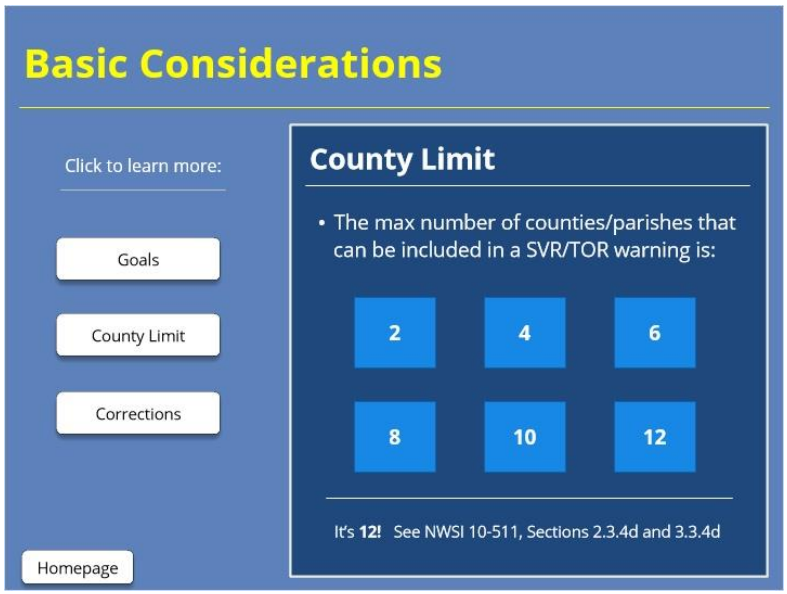
Goals - III (Slide Layer)

12-County Limit (Slide Layer)



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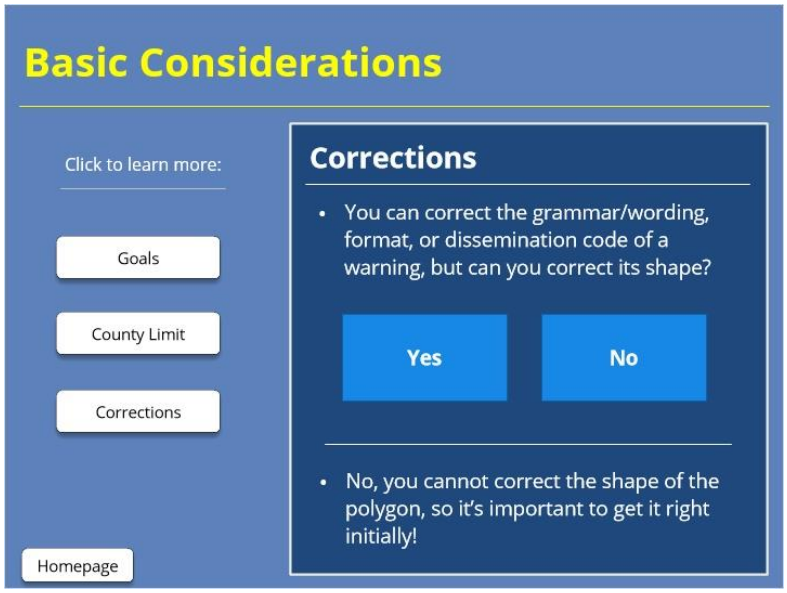
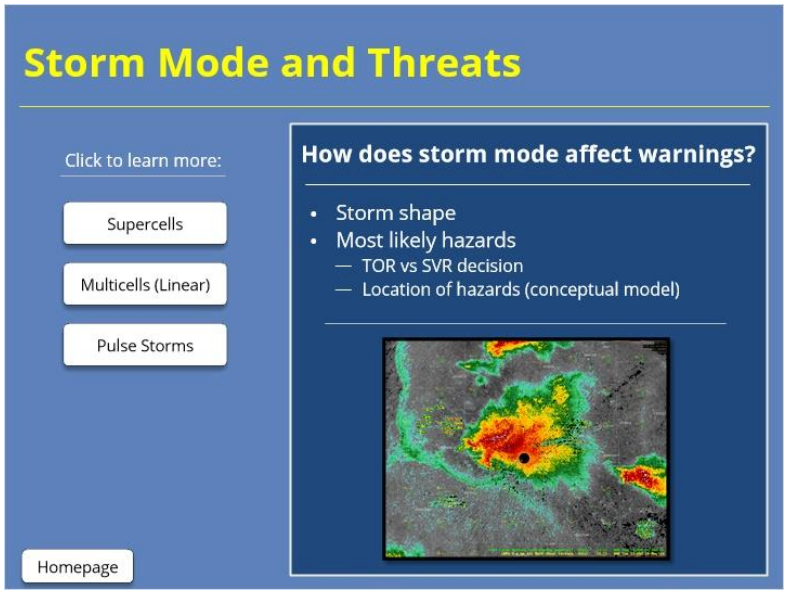
Corrections (Slide Layer)



4. Storm Mode and Threats

4.1 Storm Mode and Threats



Notes:

STORM MODE AND THREATS:

Storm mode plays a role in the current and future shape of a thunderstorm, as well as the most likely hazards. Understanding conceptual models of storm modes can help a warning meteorologist anticipate where in the storm the hazards are likely to occur and, when combined with knowledge about the storm environment, how those hazards may persist, intensify, or decline over the next 30 to 60 minutes. For each storm mode, click on the buttons to view the most likely locations for tornadoes, hail, and damaging winds, along with how those threats would be contained in an example warning polygon.

SUPERCELLS

Supercells can contain all hazards: tornadoes, hail, and winds. For most isolated supercells, if a tornado warning is issued, the threats of damaging winds and hail are in close enough proximity that one warning can cover all of the hazards.

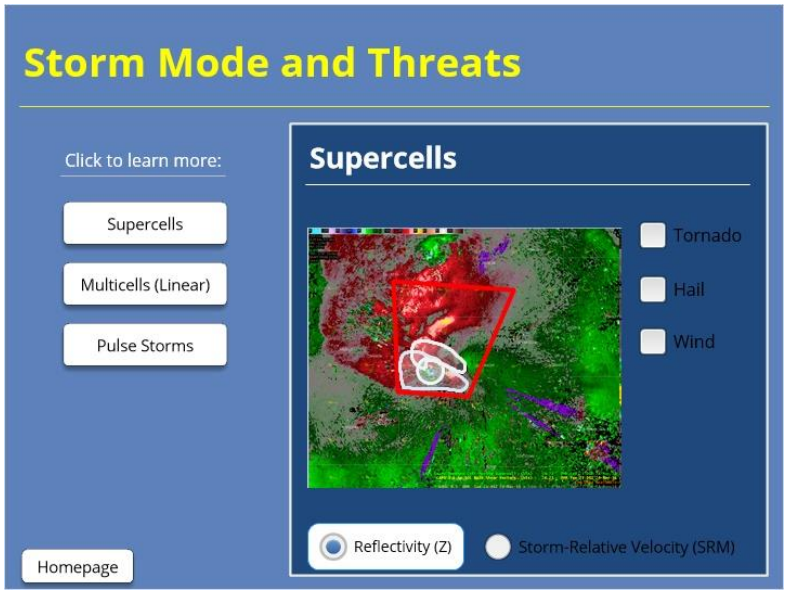
MULTICELLS (LINEAR)

Multicell thunderstorms often are in the shape of a line or line segment. The main risk tends to be damaging winds, with tornadoes as a secondary risk. Though the risk of hail is not zero, it is usually more limited in nature. With a more widespread risk of winds than tornadoes, a larger severe thunderstorm warning would be needed to cover the risk of winds, with smaller embedded tornado warnings when spin-ups are possible. We will get into more details of tornadoes embedded in lines in another module.

PULSE STORMS

Pulse thunderstorms can contain a risk of hail, especially as they reach mature phase, with the threat of wind increasing as storms pass maturity and in the early dissipation phase. Though the risk of tornadoes is not zero, it is rare for tornadoes to occur in pulse convection.

Supercells (Slide Layer)



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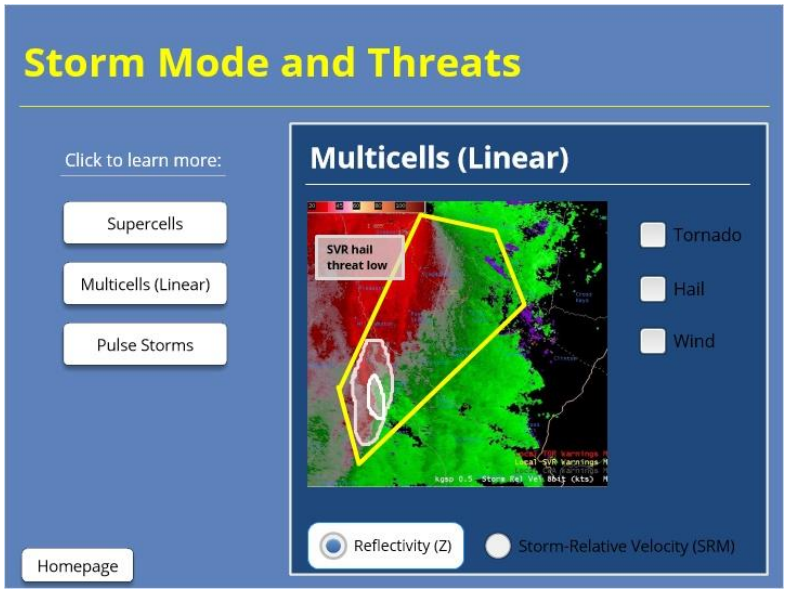
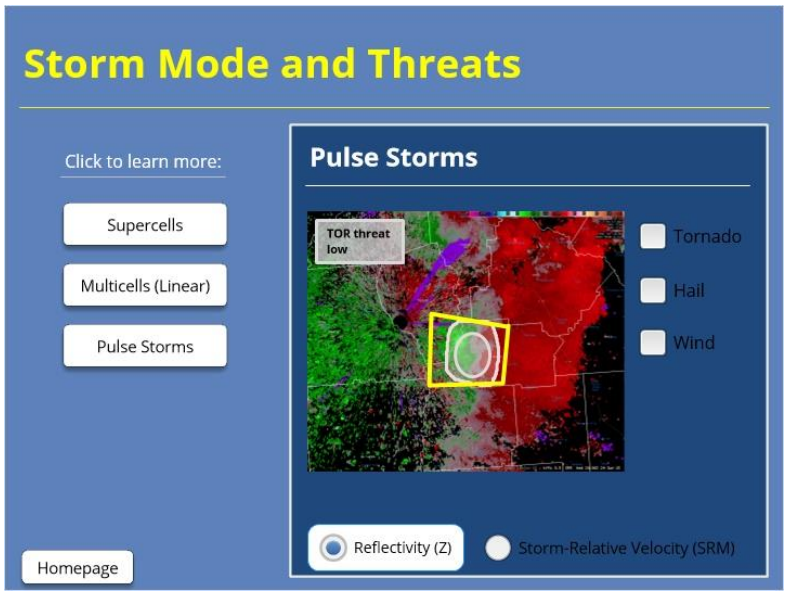
Multicells (Slide Layer)

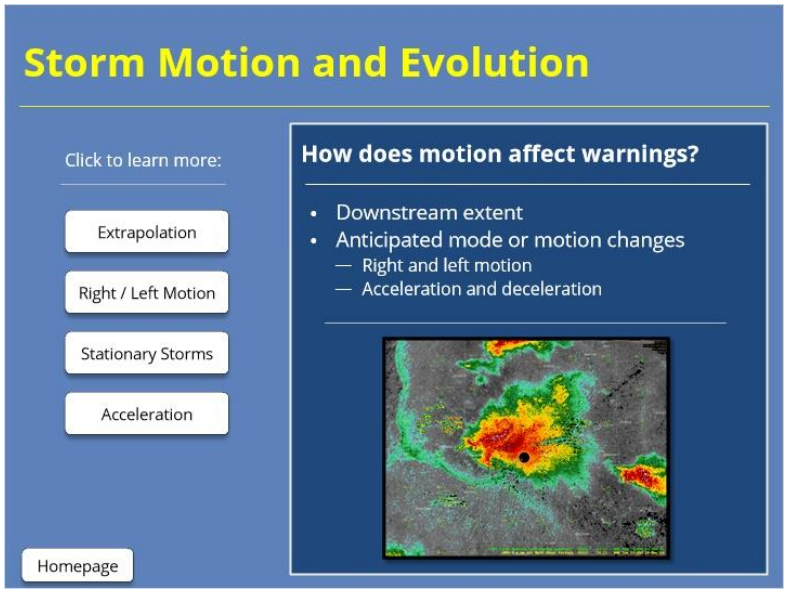


Pulse Storms (Slide Layer)



5. Storm Motion and Evolution

5.1 Storm Motion and Evolution



Notes:

STORM MOTION AND EVOLUTION:

We take the motion and expected evolution of a storm into account when we draw a warning polygon. Doing so will help us better anticipate how far to extend a warning downstream and whether we need to account for deviant motion. Many factors influence a storm's motion, including wind shear profiles, boundary interactions, topography, and storm mergers. The uncertainty of future motion is why polygons are drawn larger at the end than the beginning.

EXTRAPOLATION

Extrapolation is the assumption that the recent motion of a storm will continue into the future. It is how the speed and direction of a storm are anticipated using WarnGen's distance/speed tracking and is a good first guess in anticipating the location of a storm through the duration of a warning.

RIGHT AND LEFT MOTION:

Right/Left I: Supercells can take on motion that is either right or left of the mean wind, as you have learned earlier. A right-moving storm often will slow down in addition to propagating right of the mean wind. You can overlay Bunkers right-moving storm vectors as a first guess to help anticipate and account for the right turn, then stretch your polygon on its right side to account for the area of threat.

Right/Left 2: A left-moving supercell often occurs after a storm has split. Left movers are notorious for their hail threats. Overlay Bunkers left-moving vectors to anticipate the direction of a left-mover, and turn your distance-speed indicator to match it.

STATIONARY STORMS:

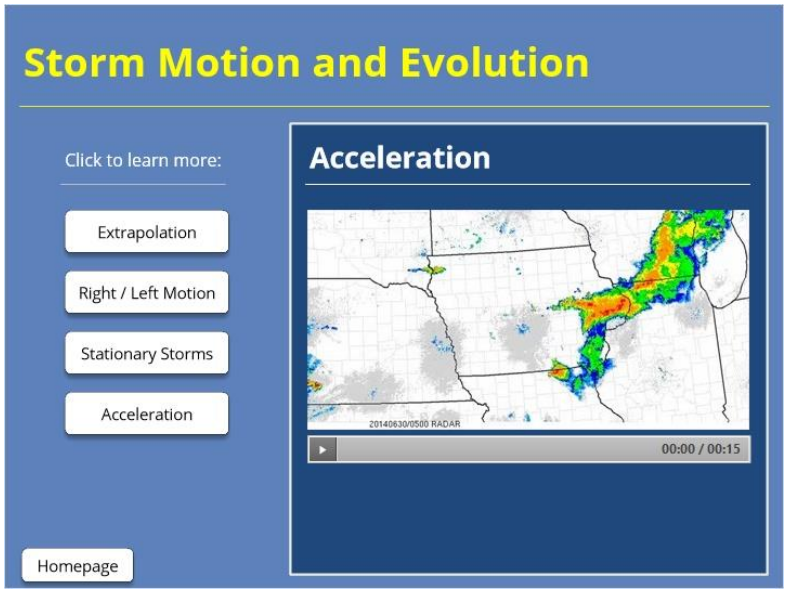
Stationary 1: Stationary storms can occur for a couple of reasons. One common type of stationary storm is a pulse thunderstorm in a low-shear environment, in which the mean steering flow is weak. In the case of a nearly stationary pulse storm, downburst winds can spread in all directions, and the resulting polygon is square or symmetrical to capture the threat.

Stationary 2: Given a certain balance of mean winds and right-moving propagation, supercells also can become stationary, with nearly stationary tornadoes possible. The threat for a tornado in a stationary supercell is often confined to a very small area that, once established, can be warned with a small polygon that still captures the threat fully. Tornadoes can still wobble, retrograde, and anticyclonically wrap around the mesocyclone in an stationary storm, so while the polygon can be drawn tight to the threat, use care to not be overly aggressive in trimming its size.

ACCELERATION:

Especially in the case of multicells, as in linear convection or bowing segments, storms can accelerate with the development of a cold pool. Follow the apex of the bow to anticipate the direction in which storms are accelerating, and be mindful of the mesoscale environment to anticipate cold pool development. In these cases, take care to draw your polygons far enough downstream, and leave yourself enough time to issue the next warning downstream before the wind threat accelerates out of the polygon.

Acceleration (Slide Layer)



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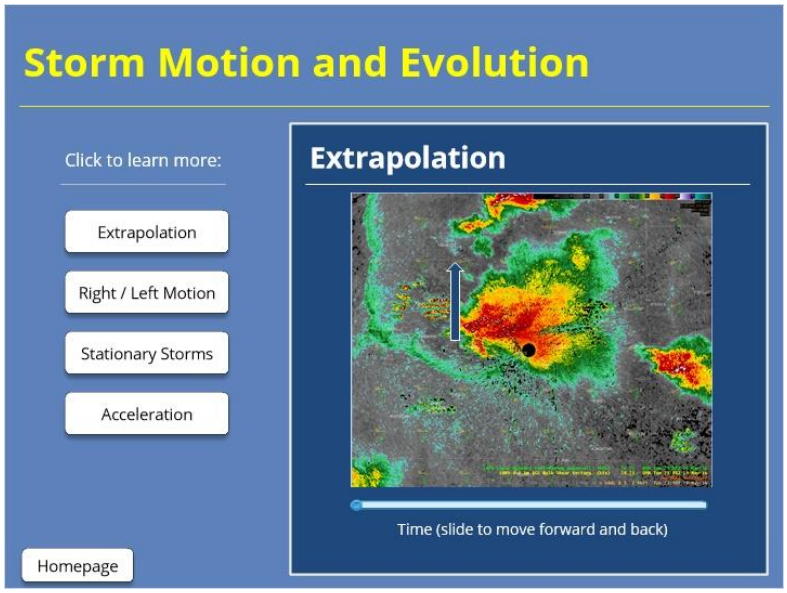
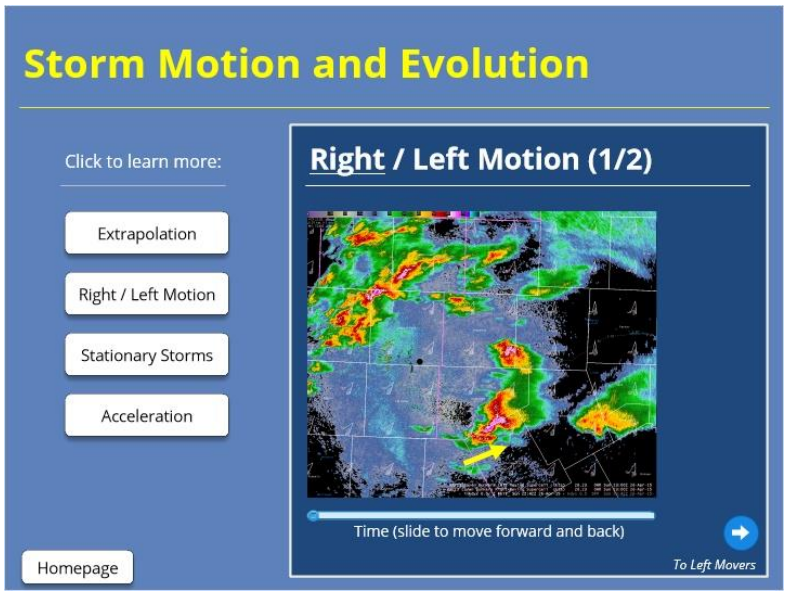
Extrapolation (Slide Layer)



Right / Left Motion (Slide Layer)



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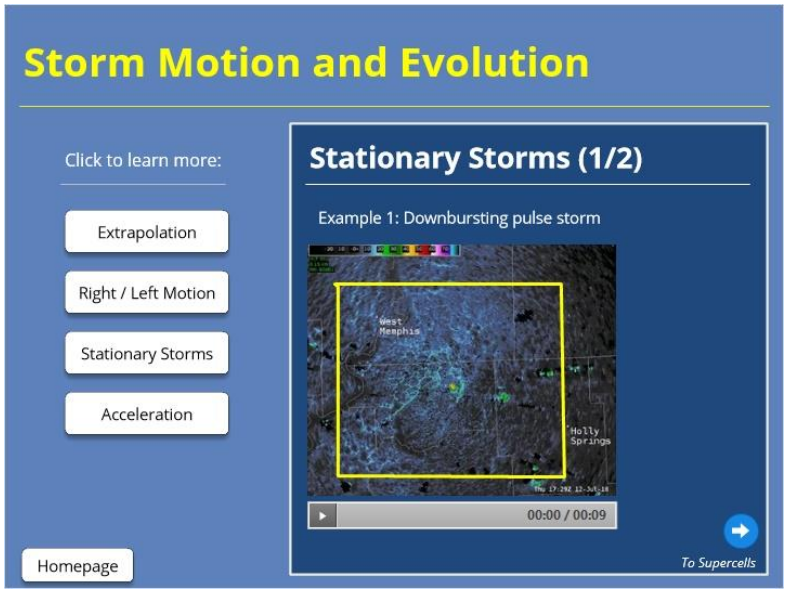
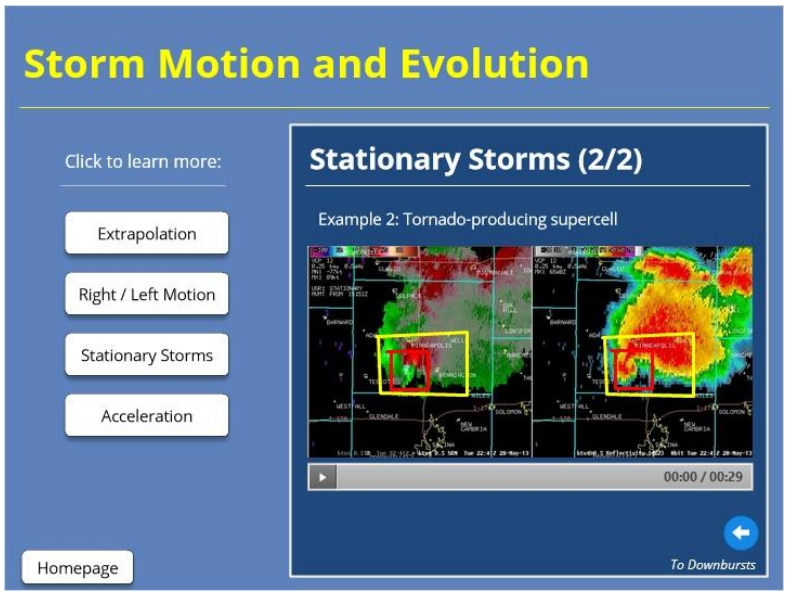
Stationary Storms (Slide Layer)



Stationary Storms 2 (Slide Layer)



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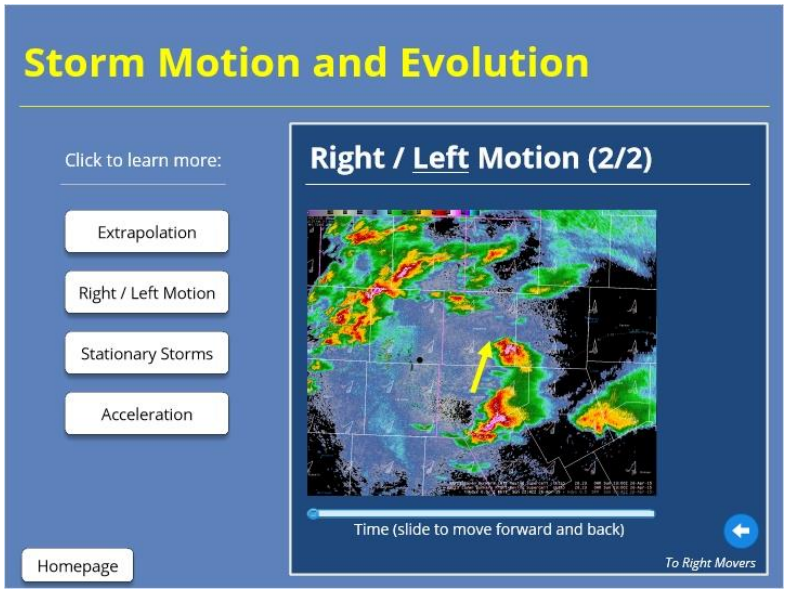
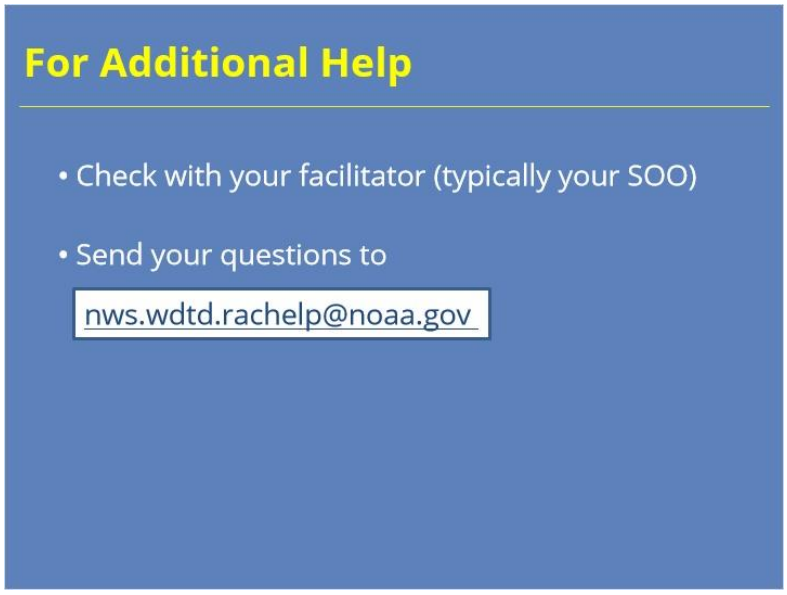
Right / Left Motion 2 (Slide Layer)



7. For Help

7.1 For Additional Help



Notes:

For additional help, check with your facilitator (typically your SOO) or send your questions to the listserv e-mail address here.

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Welcome to this RAC Warning Fundamentals lesson, the second of three parts on drawing the warning. In this section, we will discuss additional considerations to the shape of your warnings.

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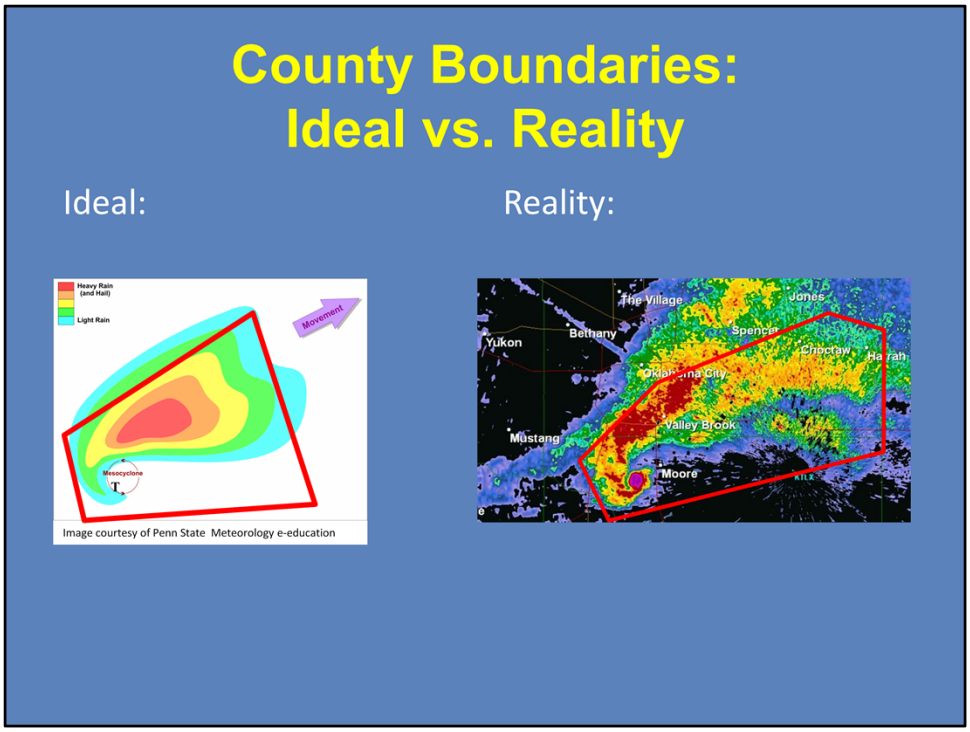
Learning Objective

- Identify warning polygons that follow NWSI 10-511 and best practices while incorporating additional factors such as:
  - County boundaries and other geographical entities
  - Overlapping warnings
  - Large areal coverage

The learning objective for this lesson is to select warning polygons while considering additional factors such as county boundaries and other geographical entities, overlapping warnings, and large areal coverage.



In an idealized world, we would draw purely storm-based warning polygons as a practice. In reality, we realize that we don't operate in a bubble, and neither do our warnings. Many of our interactions are with officials at the county and city levels, and these boundaries are important for both our partners and the public. We also may be weighing decisions of whether or not to include decision support points, bodies of water, or other point locations of interest in a warning that we are drawing. Our warnings are more of a hybrid of considerations that range from meteorological to geopolitical and societal. As we balance these considerations, it is important to be aware of the impact of our warnings and make intentional decisions about what to include and what to leave out.

Image link: https://www.e-education.psu.edu/meteo3/sites/www.e-education.psu.edu.meteo3/files/images/lesson8/idealizedreflectivity_supercell.PNG

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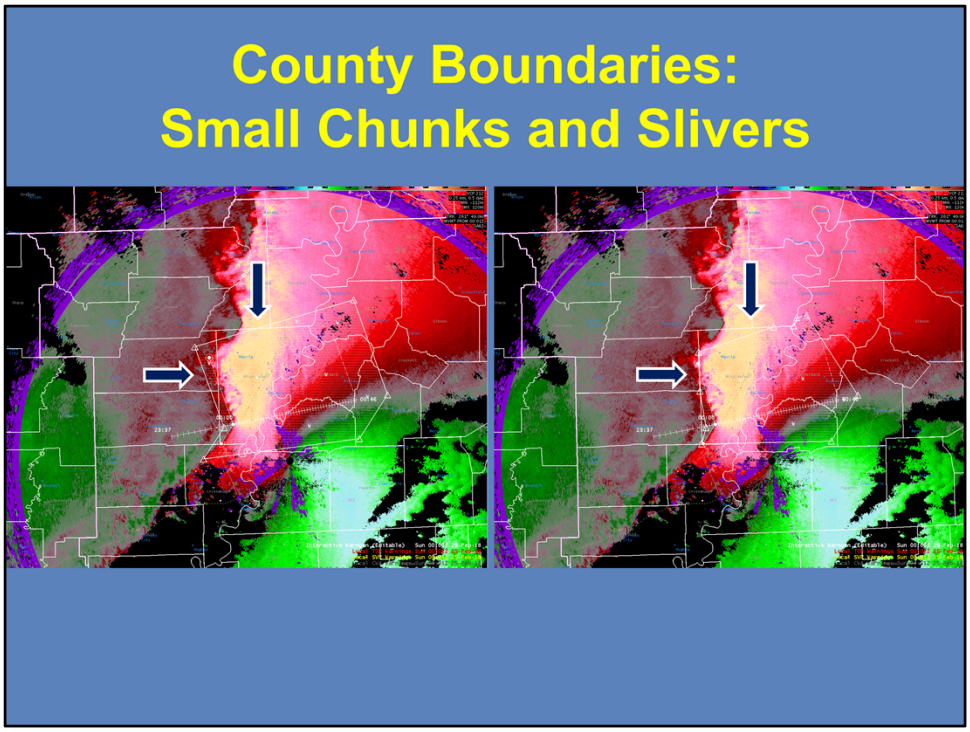

As you draw your warning to be initially storm-based, you may find that the polygon just barely clips the edges of counties into the warning. Be cognizant of those edge pieces, and be sure that the decision of whether that segment is in or out of the warning is intentional. If that sliver will be threatened by severe hail, damaging winds, or a tornado, it should be included. If the sliver is far enough removed from the core of the storm, you can leave it out. A quick time-saving tip is to right-click on a county as you are drawing the warning to leave it out. When you hit the button to redraw based on warned/hatched area, the vectors will adjust to keep that county out. Also, keep in mind that a designated percentage of a county must be included in the polygon, by default, in order for that county to be included in the warning. That percentage is set locally via the Localization perspective. If you are intentionally drawing a small area of a county into the warning and WarnGen snaps it back out again, redraw your line to include a slightly larger portion of the county.

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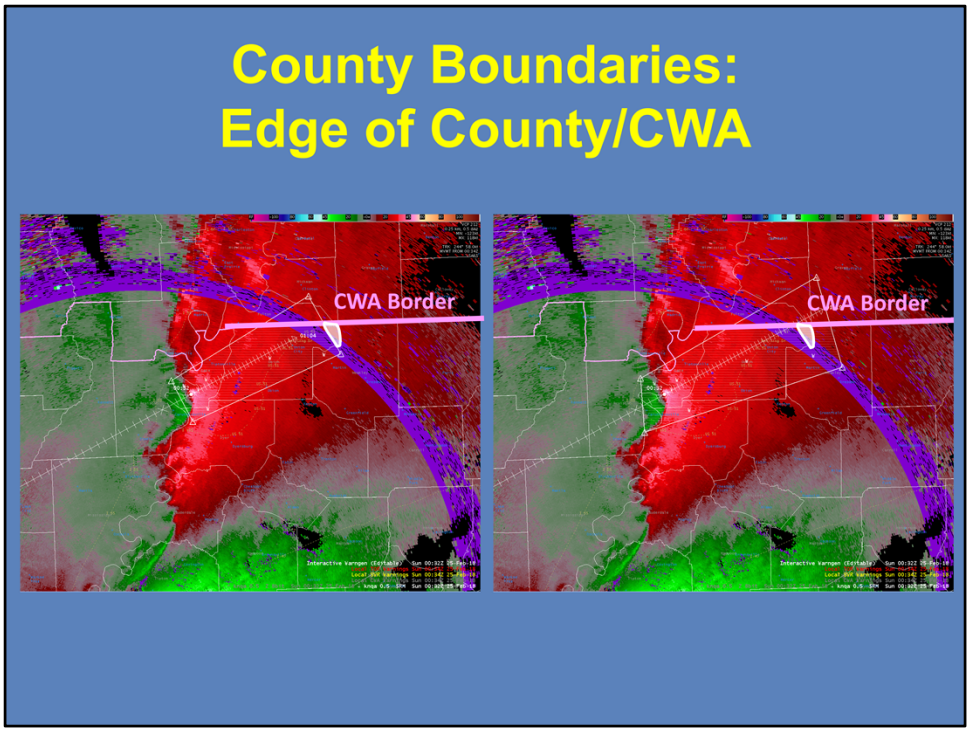

When a warning polygon is close to the edge of a county, a city, or a decision support point, but not quite all the way there, you may want to pull the warning to the edge of the county or to include that point. This is especially true at the edge of a county warning area, where the next office downstream may wish to draw a polygon without leaving a gap between the warnings. In this example, a small sliver of a county, shown in white, was left out of the default polygon near the edge of the county warning area border, in pink. To extend the polygon in this case, I extended the length of the warning from 30 to 45 minutes, though I could have simply drawn the polygon out farther, as well.

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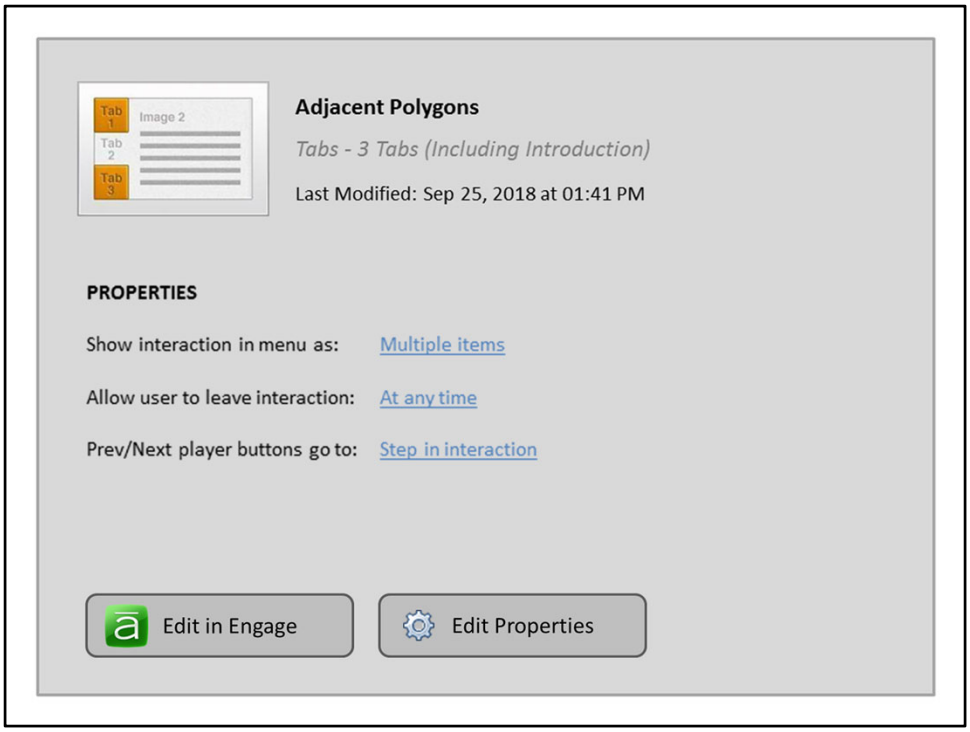

Warning polygons for storms close together should have enough overlap, but not too much. With adjacent polygons, small overlap is good, especially if the storm prompting the warnings is continuous. If the storms are both isolated and not merging, and the threat areas are far enough apart, there may not be a need to overlap at all.

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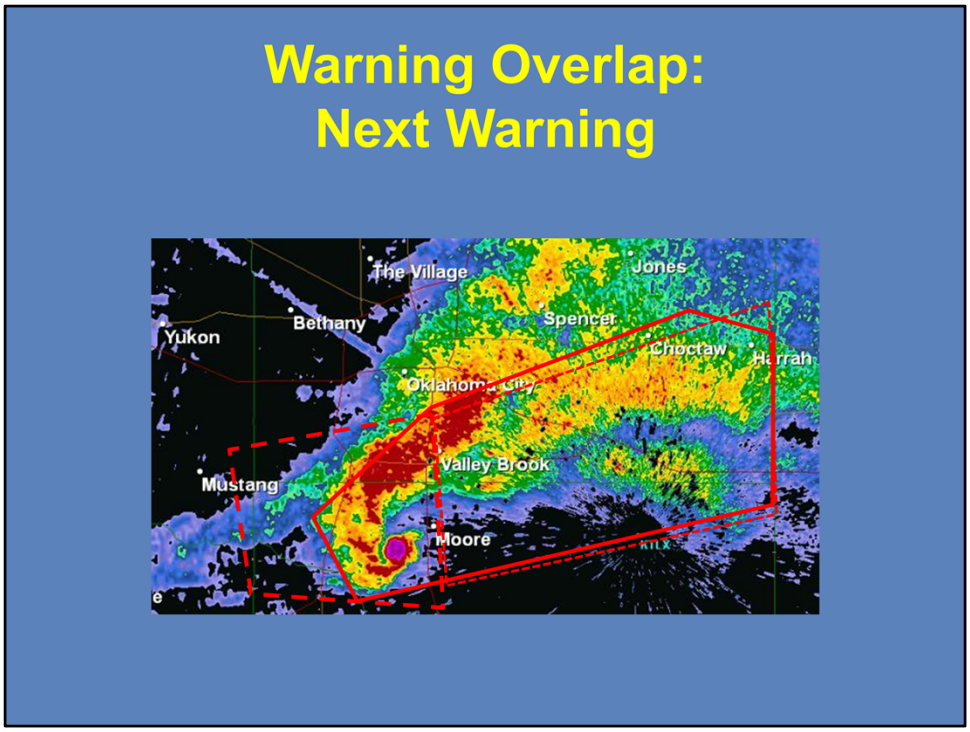

Some overlap is desired as an active storm exits its previous warning and enters the new polygon. You do not want to match the edge of the old polygon to the edge of the new polygon. First, the odds of the storm crossing the line between polygons at exactly the time when the first warning expires and the second takes effect are very low. Second, storms cover an area even if the center of it did land perfectly on that line at expiration time. Keep a reasonable overlap to cover the time that both warnings are in effect, and concentrate on issuing the new warning for where the storm is now and will be for the duration of the warning. Keep in mind that faster-moving storms probably will need a little less overlap than slower storms, and also be sure to adjust your polygons if you find that your warnings have a large area left at the end of the valid warning time as you work through the event.

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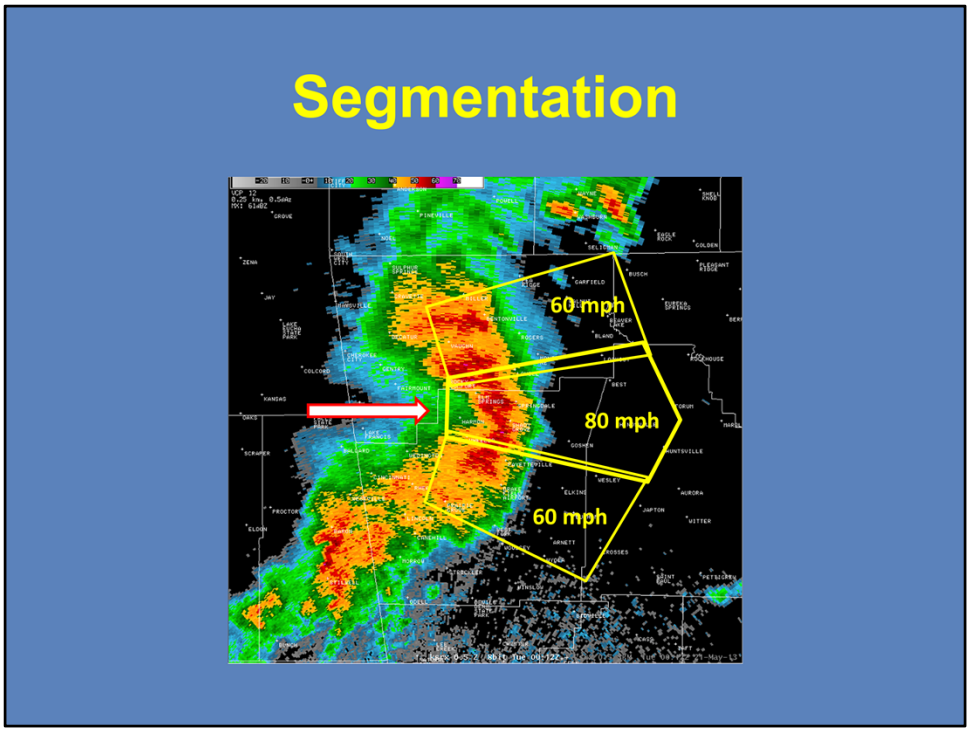

When the threat is a multicell line, particularly a long linear storm, you may want to break the line into segments for warnings, balancing workload with manageable warning sizes. Keep in mind that 12-county limit to warning size, and also keep in mind grouping like threats together. For example, if this was a line that spanned the length of numerous counties and its center is capable of producing 80-mph winds, while the threat of 60-mph winds extends up and down the line, you might want to issue a warning for the higher-end threat in the bowing segment, with two additional warnings on either side of it to capture the lower-end severe threat. Note the slight overlap in these polygons, as well. You can keep the workload manageable by keeping like threats grouped together, staggering end times, and limiting to a few warnings per line – in other words, by not going to an extreme of segmenting, such as issuing single-county warnings.

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In summary, our warning polygons include meteorological, geographical, and even societal factors in their shapes. Be intentional about the decision to include or not include small fragments of counties, cities, decision support points, bodies of water, or other geographical entities in the warning. Maintain a small amount of overlap between polygons on continuous storms and between an old warning and its replacement. For more isolated convection, the decision to overlap or not depends on the size and proximity of those thunderstorms. For long lines of convection, consider breaking them into segments. Keep like threats grouped, and use some segments but not so many that your workload becomes unmanageable.

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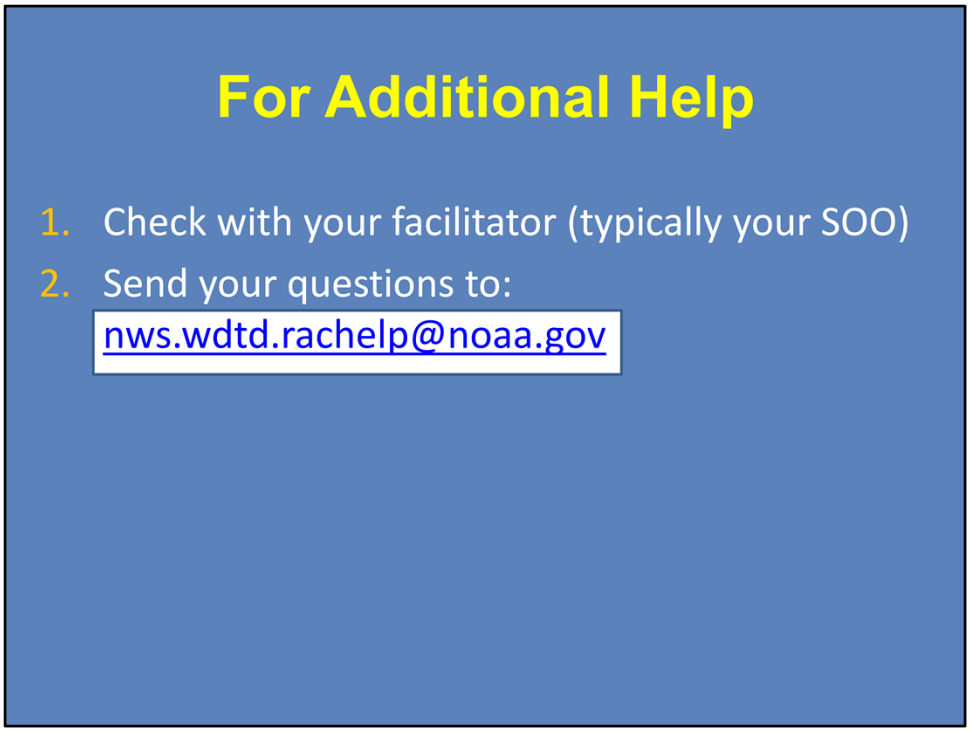
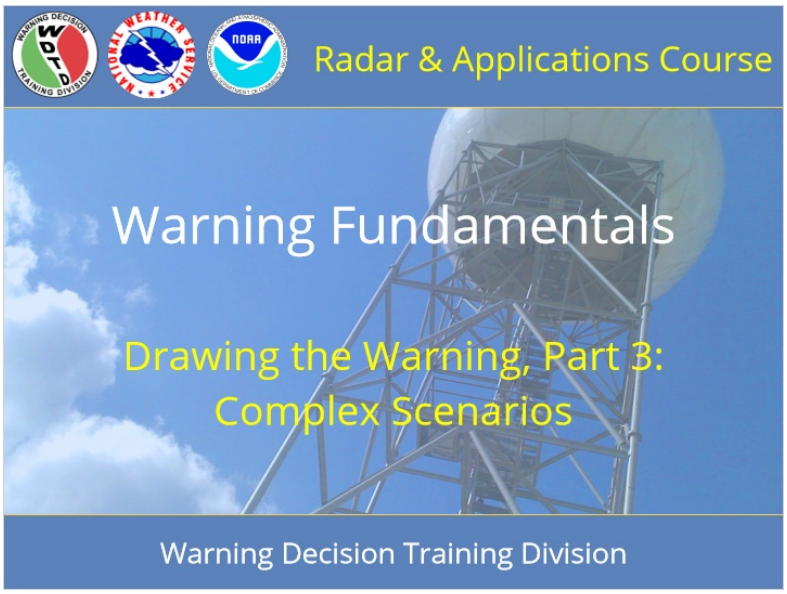


For additional help, check with your facilitator (typically your SOO) or send your questions to the listserv e-mail address here.

Drawing the Warning, Part 3: Complex Scenarios

1. Introduction

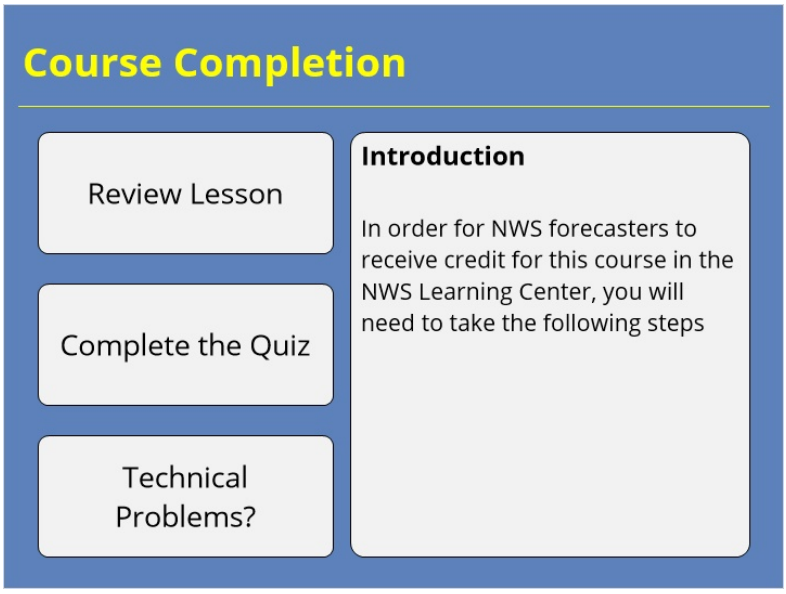
1.1 Title Slide



Notes:

Welcome to RAC Warning Fundamentals. This is Drawing the Warning, Part Three, and we will go over some of the more complex scenarios you may see when drawing warnings polygons.

1.2 Course Completion Info



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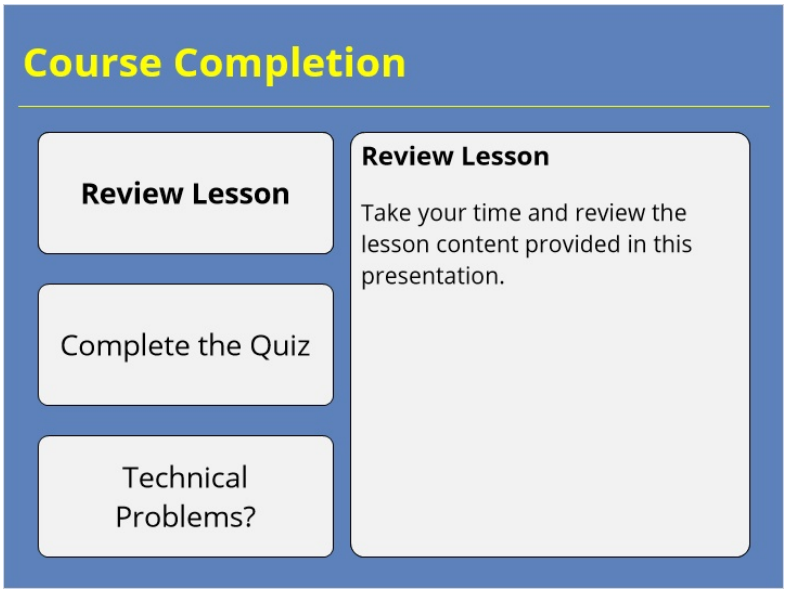
Review Lesson (Slide Layer)



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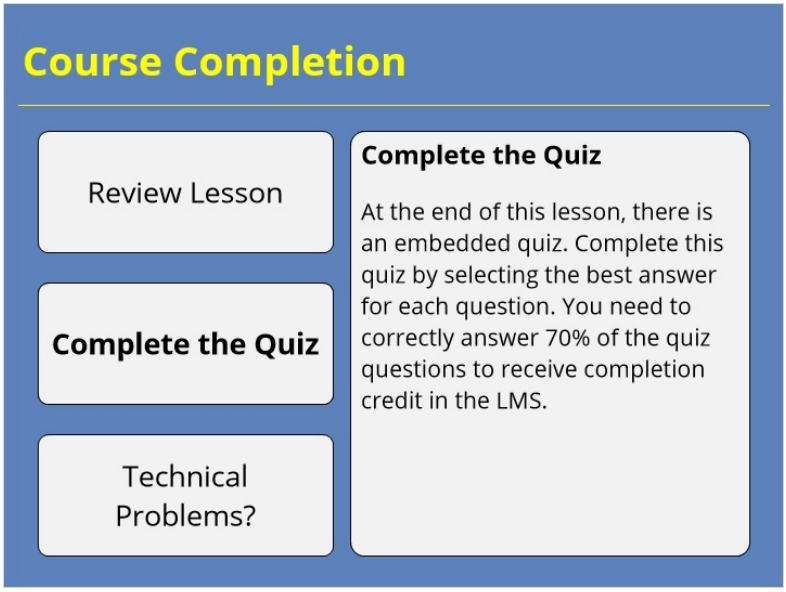
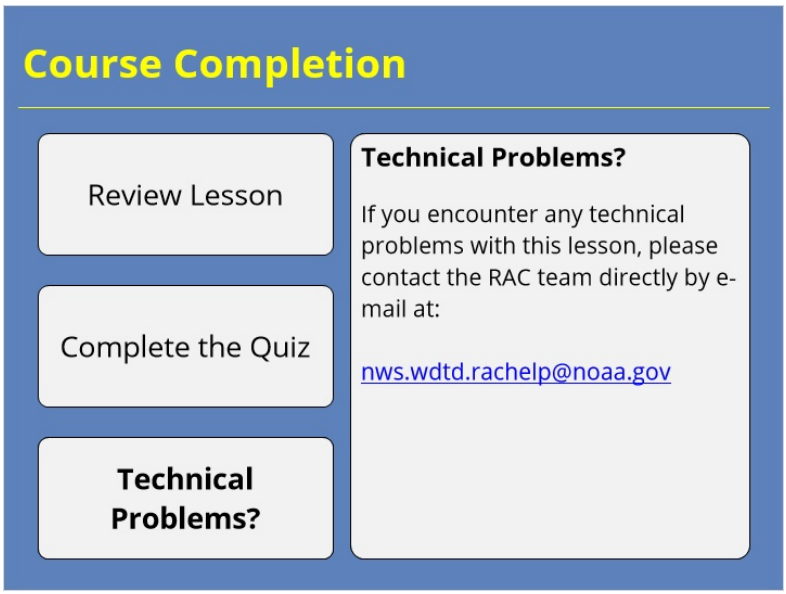
Complete the Quiz (Slide Layer)



Technical Problems (Slide Layer)



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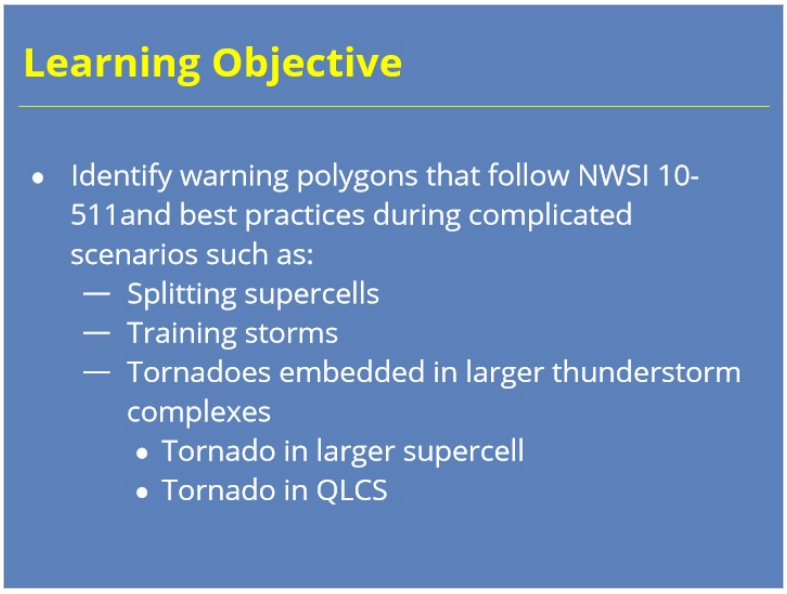
1.3 Learning Objectives

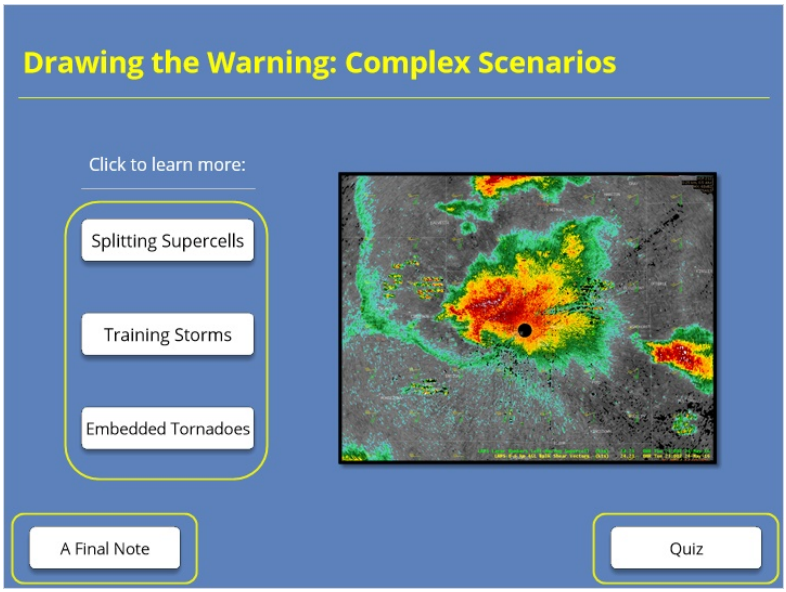


Notes:

The learning objective for this module is to be able to identify warning polygons for complex scenarios such as splitting supercells, training storms, and tornadoes embedded in larger thunderstorm complexes.

2. Homepage

2.1 Homepage

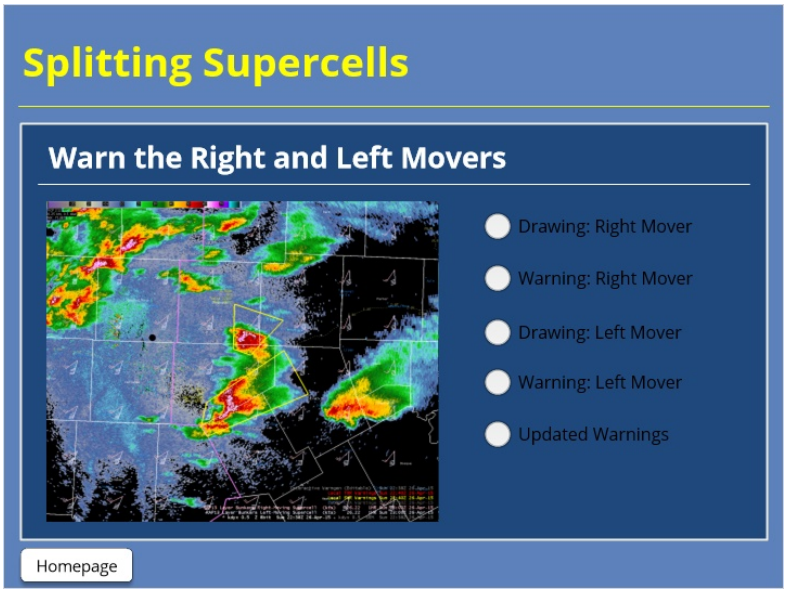


Notes:

Welcome to the homepage for this third lesson on drawing warning polygons, focusing on additional layers of complexity from storm structures and evolutions. From here, you can click on these three buttons to learn more about some of these complex scenarios. At the lower left, we'll leave you with one last thought about drawing warning polygons. Then, once you feel comfortable with these materials, take the quiz by clicking the button at the bottom right of the screen

3. Splitting Supercells

3.1 Splitting Supercells

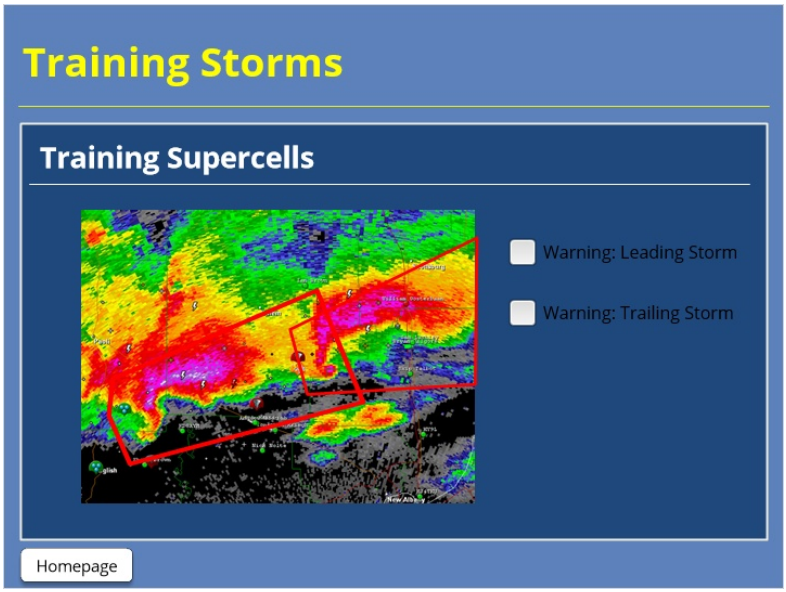


Notes:

As discussed in previous lessons, supercells can and do split into right- and left-movers. Keep in mind that you can diagnose left and right movement using near-storm environmental analysis and with overlays of motion barbs from numerical model output. A single warning doesn't typically split with them, of course, so what is the best strategy when you find yourself warning on a storm that you know is beginning the process of splitting? In most cases, you'll warn the right- and left-movers separately. The starting edges of your polygons are likely to overlap, but that overlap will decrease as the storms move apart. As you click through the steps, note the different speeds and directions of motion of each component of the split. As the warnings are updated to remove the back edges from the threat, the polygons separate.

4. Training Storms

4.1 Training Storms

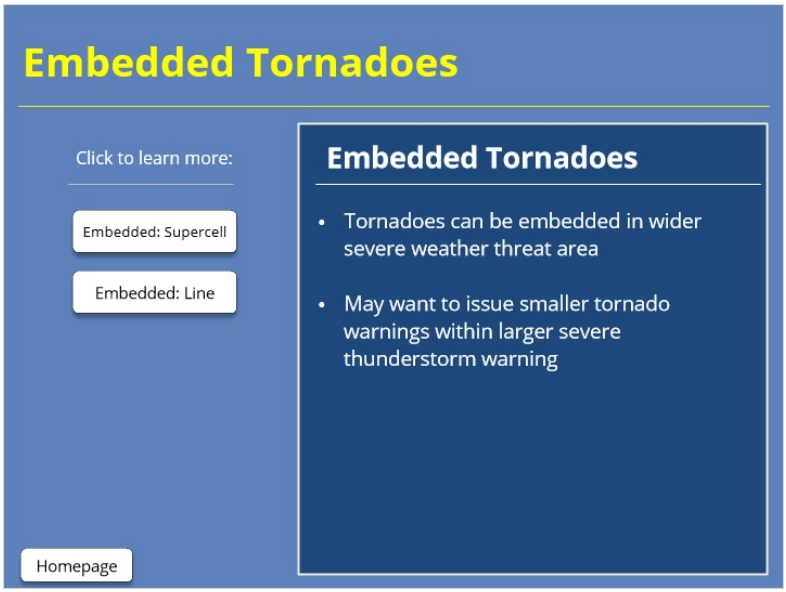


Notes:

Warning polygons get a little more complicated for training storms. In an example of training supercells, warn on each storm individually. Initially, the polygons will have a little overlap. Be sensitive about erasing the back edge of the polygon on the leading storm. If the second storm is going to move into that location, let that warning stay in place to prevent the mixed message of being in a warning, then out, then in again. You can trim the back edge of the second storm, though, as well as any part of the polygon for the leading storm that the second storm is not expected to move into.

5. Embedded Tornadoes

5.1 Embedded Tornadoes



Notes:

Tornadoes can be embedded in areas of more widespread severe weather threat. In those cases, it can make sense to issue severe thunderstorm warnings for the larger threat, with smaller tornado warnings for those more limited areas of tornado threat.

EMBEDDED TORNADOES: SUPERCELL

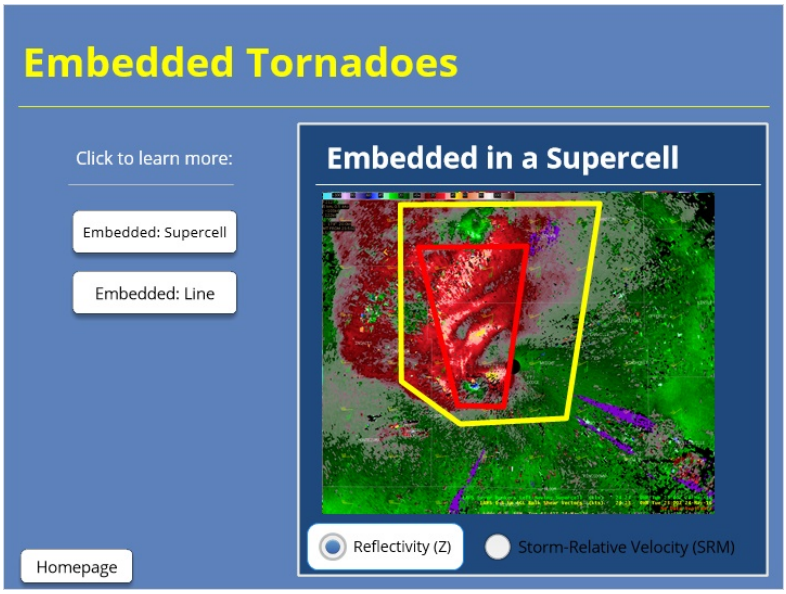
In a few cases, the area of threat from a tornado is small relative to the threat of hail and damaging winds from the entire supercell. In that case, you might want to issue a severe thunderstorm warning for the supercell to cover the broader hail and wind threats, with a smaller tornado warning in place to cover the more compact tornado threat. If you choose to go this route, here is an example of how to address it. Let's envision a scenario where you issue a severe thunderstorm warning first, perhaps even with a tornado-possible tag. (We'll discuss those tags in a later lesson.) The severe thunderstorm warning should encompass the hail and wind threats of the supercell, as we learned in a previous lesson. When you draw the tornado warning, the threat is much smaller, and the warning may be entirely embedded within the severe thunderstorm warning. The tornado warning also will be a shorter duration, typically.

EMBEDDED TORNADOES: LINE

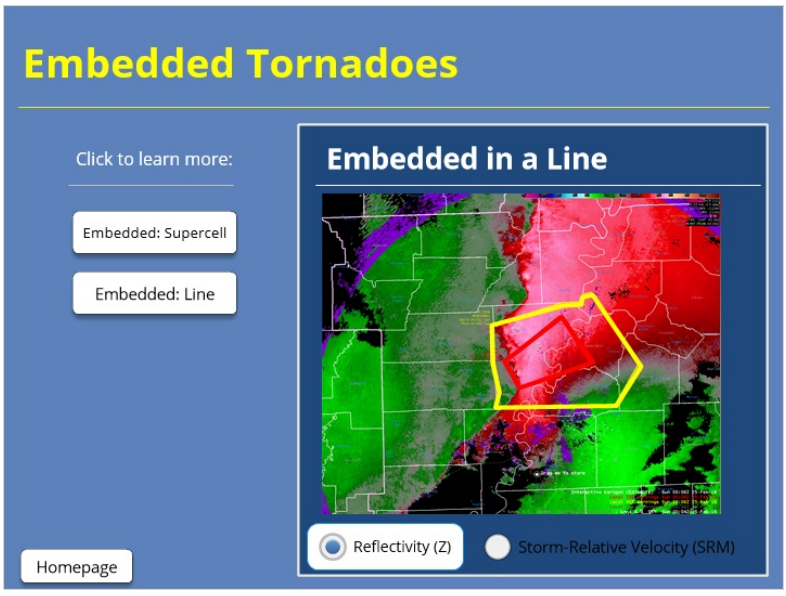
Identifying and warning for QLCS tornadoes is a complicated and tricky issue that is tackled more in-depth in the WOC Severe training series, as well as in a set of modules produced by NWS Central Region and available in the learning center. We will just touch on one warning polygon possibility here, noting that you will want to complete further training to round out your competence with QLCS tornadoes. When a tornado is embedded in a line of convection, there often is a broader severe thunderstorm warning in effect - likely before the tornado threat materializes. One or more tornado warnings can be embedded in that severe thunderstorm warning to highlight

the small areas of threat for a tornado.

Embedded Supercell (Slide Layer)

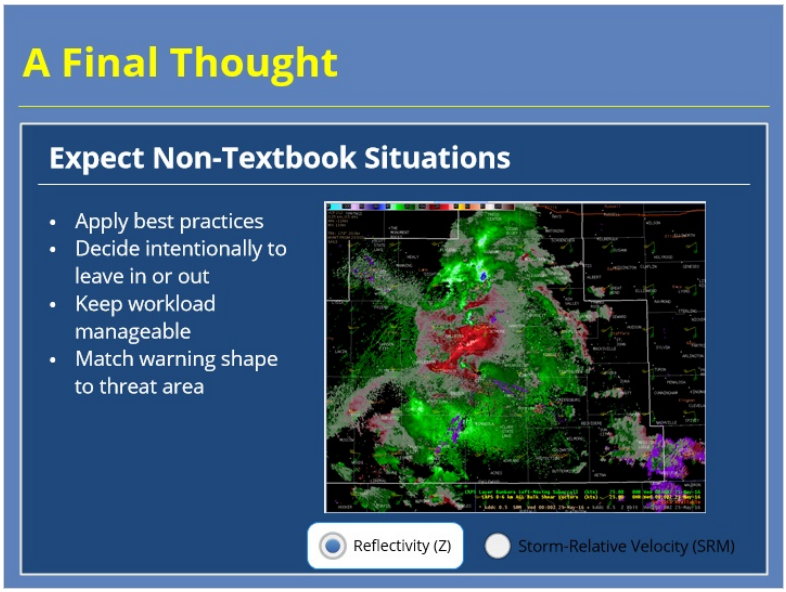


Embedded Line (Slide Layer)



7. A Final Note

7.1 Put It Together



Notes:

You'll see things in your career that are not textbook storms. In fact, that will be the case more often than not. Use best practices to make the best warning polygons and construct the best messages for whatever scenario you encounter. The foundations will remain the same: Be intentional about what areas are and are not included in the warning. Keep your workload manageable. Match the warning shape to areas at risk of hail, damaging winds, or tornadoes.

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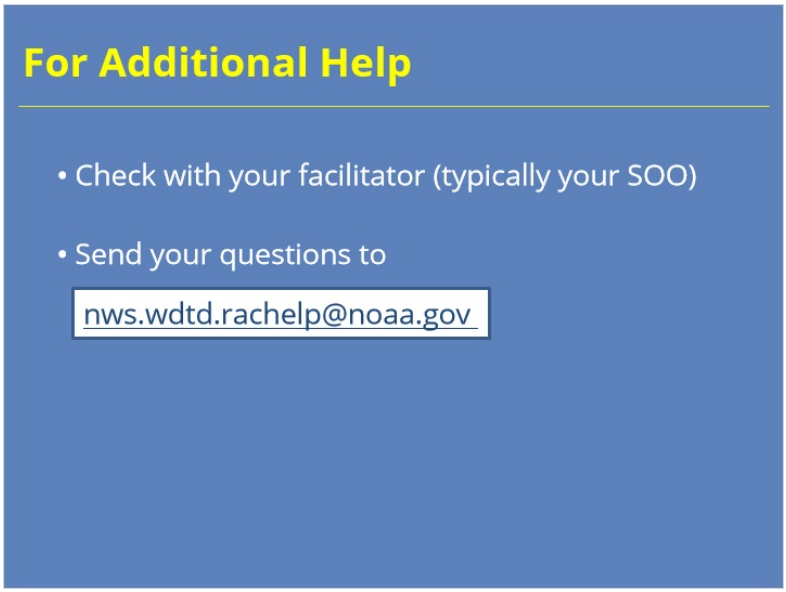
8. For Help

8.1 For Additional Help



Notes:

For additional help, check with your facilitator (typically your SOO) or send your questions to the listserv e-mail address here.

Welcome to the RAC Warning Fundamentals lesson on Warning Content: Impact-Based Warnings.

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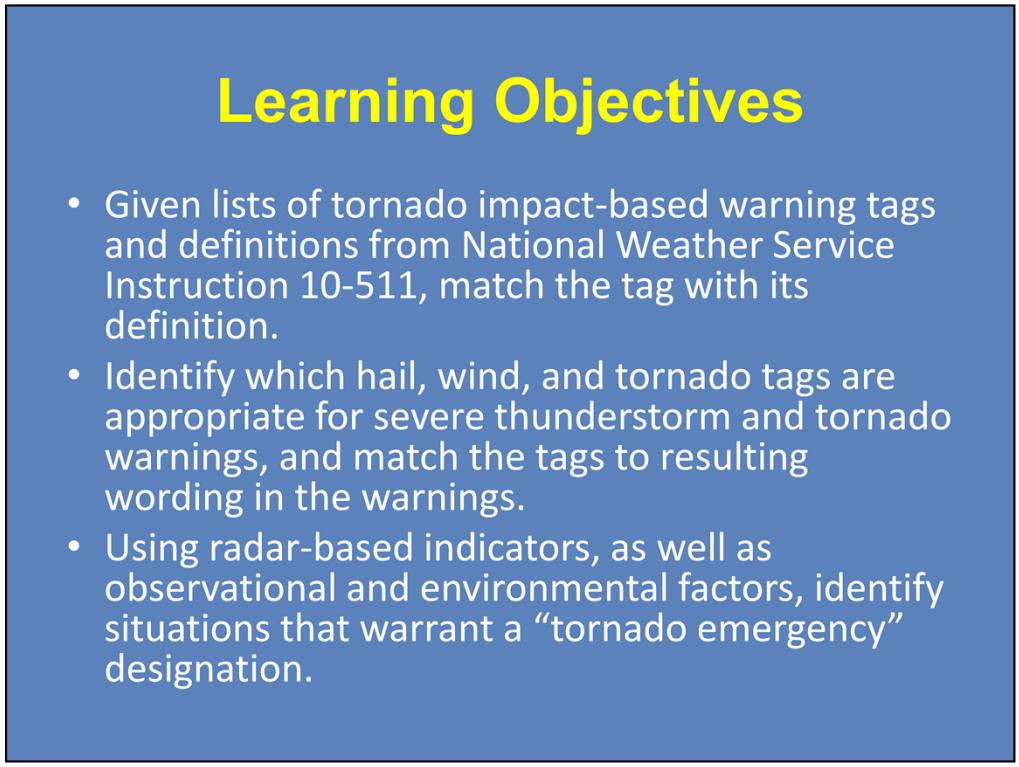
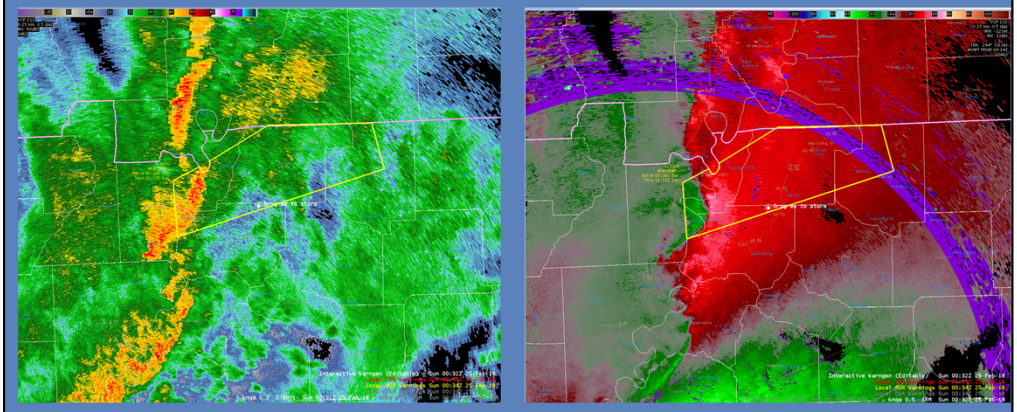


The learning objectives for this lesson are to match hail, wind, and tornado tags with their definitions and resulting wording in both severe thunderstorm and tornado warnings. We also will learn how to identify those rare “tornado emergency” situations.

Severe Thunderstorm Warnings (SVRs)



First, let's address the many impact statements available for severe thunderstorm warnings.

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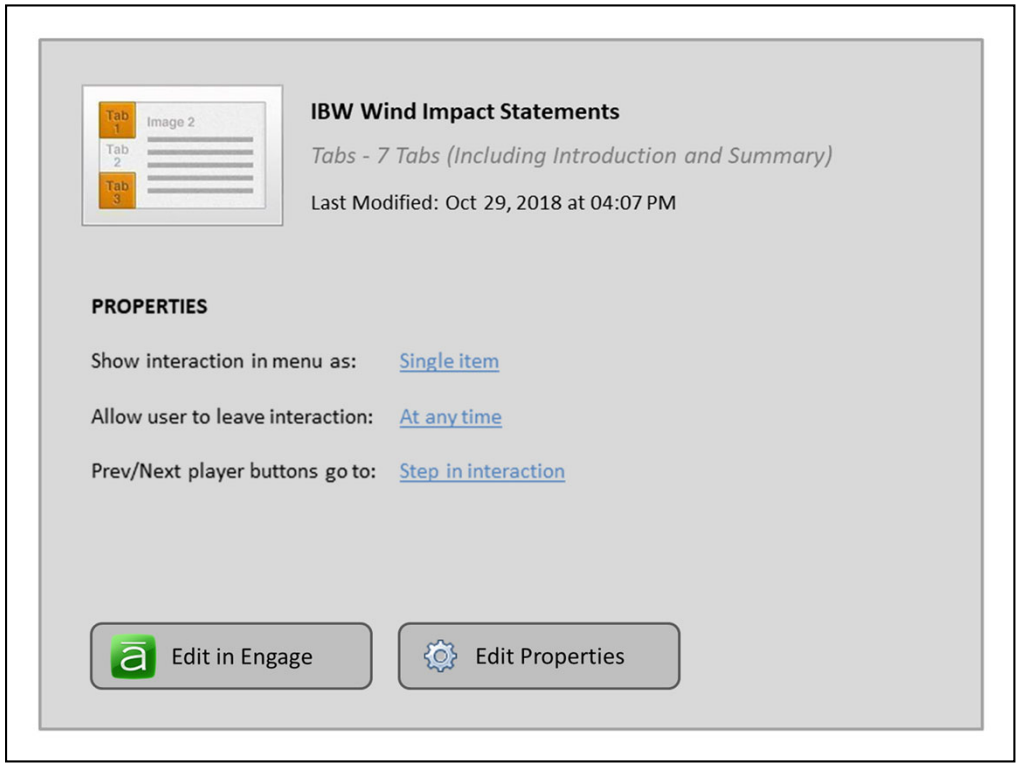

These are the wind impact statements and tags for Severe Thunderstorm Warnings (SVRs) and Severe Weather Statements (SVSs), as delineated in NWSI 10-511. Click through each option to read more.

There are five wind-only impact tag categories that provide quick information to partners and the public on the type of potential wind damage and magnitude.

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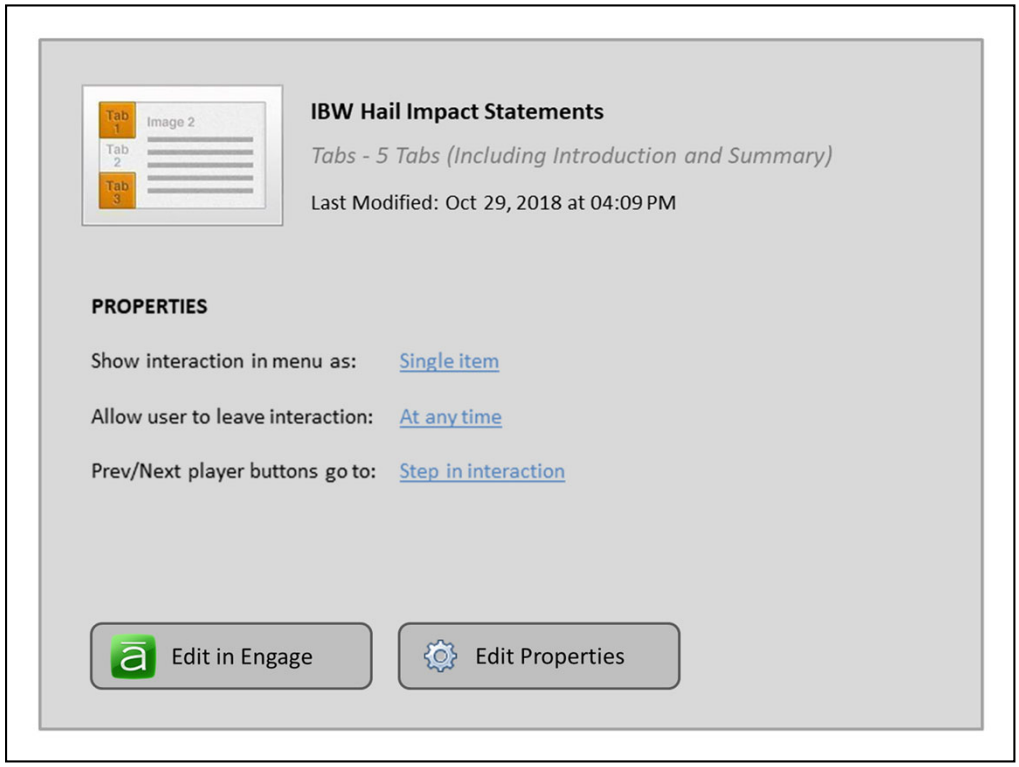

These are the hail impact statements and tags for Severe Thunderstorm Warnings (SVRs) and Severe Weather Statements (SVSs), as delineated in NWSI 10-511. Click through each option to read more.

There are three hail-only impact tag categories that provide quick information to partners and the public on the type of potential hail damage and magnitude.

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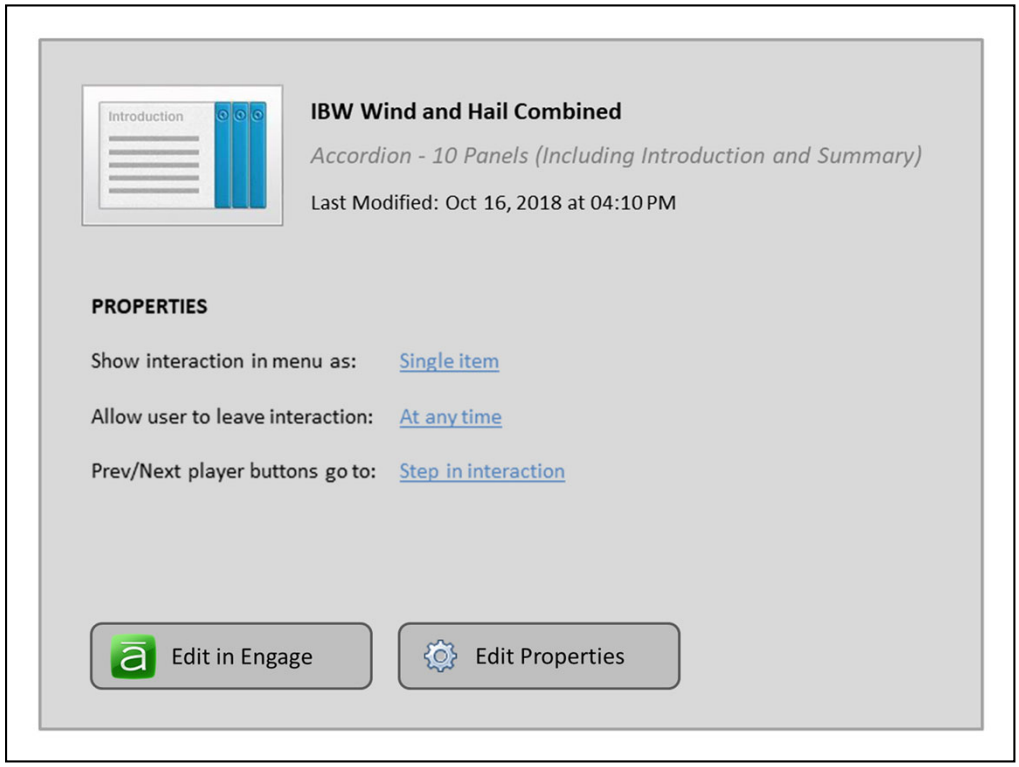

These are the impact statements and tags for Severe Thunderstorm Warnings (SVRs) and Severe Weather Statements (SVSs) with combined hail and wind threats, as delineated in NWSI 10-511. Click through each option to read more.

Generally, these impacts statements are concatenated unless significant wind (≥ 80 mph) and/or significant hail (≥ 2.75”) are forecast. If one hazard is deemed ‘significant’ and not the other, the impact statement will be shortened to reflect only the hazard that is significant.

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SVR: Tornado Possible Tag

...
THE NATIONAL WEATHER SERVICE IN NEW ORLEANS HAS ISSUED A

* SEVERE THUNDERSTORM WARNING FOR...
EASTERN WASHINGTON PARISH IN SOUTHEASTERN LOUISIANA...
NORTHWESTERN ST. TAMMANY PARISH IN SOUTHEASTERN LOUISIANA...
PEARL RIVER COUNTY IN SOUTHERN MISSISSIPPI...

* UNTIL 415 PM CST

* AT 341 PM CST...SEVERE THUNDERSTORMS WERE LOCATED ALONG A LINE EXTENDING FROM NEAR SANDY HOOK TO NEAR CROSSROADS TO BUSH TO NEAR COVINGTON...MOVING NORTHEAST AT 50 MPH.

HAZARD...70 MPH WIND GUSTS.

SOURCE...RADAR INDICATED.

IMPACT...EXPECT CONSIDERABLE TREE DAMAGE. DAMAGE IS LIKELY TO MOBILE HOMES...ROOFS AND OUTBUILDINGS.

* LOCATIONS IMPACTED INCLUDE...
BOGALUSA...COVINGTON...POPLARVILLE...ABITA SPRINGS...VARNADO...
MADISONVILLE...SUN...CROSSROADS...BUSH...MCNEIL AND ANGIE.

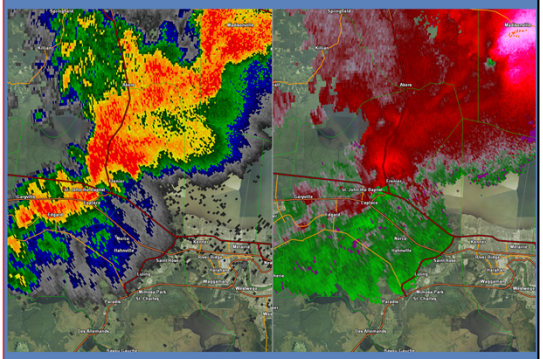
PRECAUTIONARY/PREPAREDNESS ACTIONS...

REMAIN ALERT FOR A POSSIBLE TORNADO! TORNADOES CAN DEVELOP QUICKLY FROM SEVERE THUNDERSTORMS. IF YOU SPOT A TORNADO GO AT ONCE INTO THE BASEMENT OR SMALL CENTRAL ROOM IN A STURDY STRUCTURE.

FOR YOUR PROTECTION MOVE TO AN INTERIOR ROOM ON THE LOWEST FLOOR OF A BUILDING.

A TORNADO WATCH REMAINS IN EFFECT UNTIL 1000 PM CST FOR SOUTHEASTERN LOUISIANA AND SOUTHERN MISSISSIPPI.

TORNADO...POSSIBLE
HAIL...<.75IN
WIND...70MPH



0.5 deg Z and SRM from KLIX
2215 UTC 23 Feb 2016

The “tornado possible” tag is used in severe thunderstorm warnings for situations in which a severe thunderstorm has some potential for producing a brief, small tornado, but forecaster confidence is not high enough to issue a tornado warning. Some situations where this may apply could include landspout tornadoes and QLCS events. You also could apply this tag with severe thunderstorms in an environment that you believe will be conducive to tornado development, such as initial supercell development within tornado watches before storms mature enough to produce tornadoes. When a “tornado possible” tag is applied, a call-to-action statement that mentions tornadoes developing quickly should be highlighted, and a “TORNADO…POSSIBLE” statement will be appended at the end of the warning.

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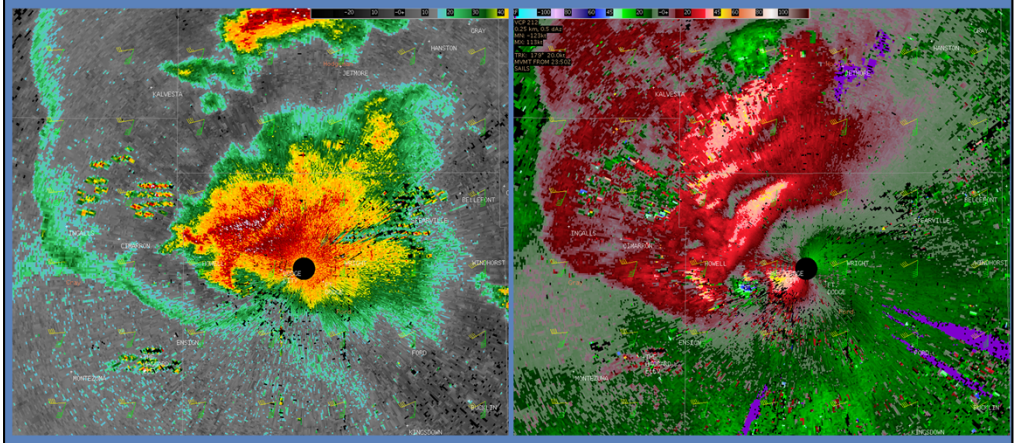
Tornado Warnings (TORs)



Let’s move on to the tags that can be applied to tornado warnings.

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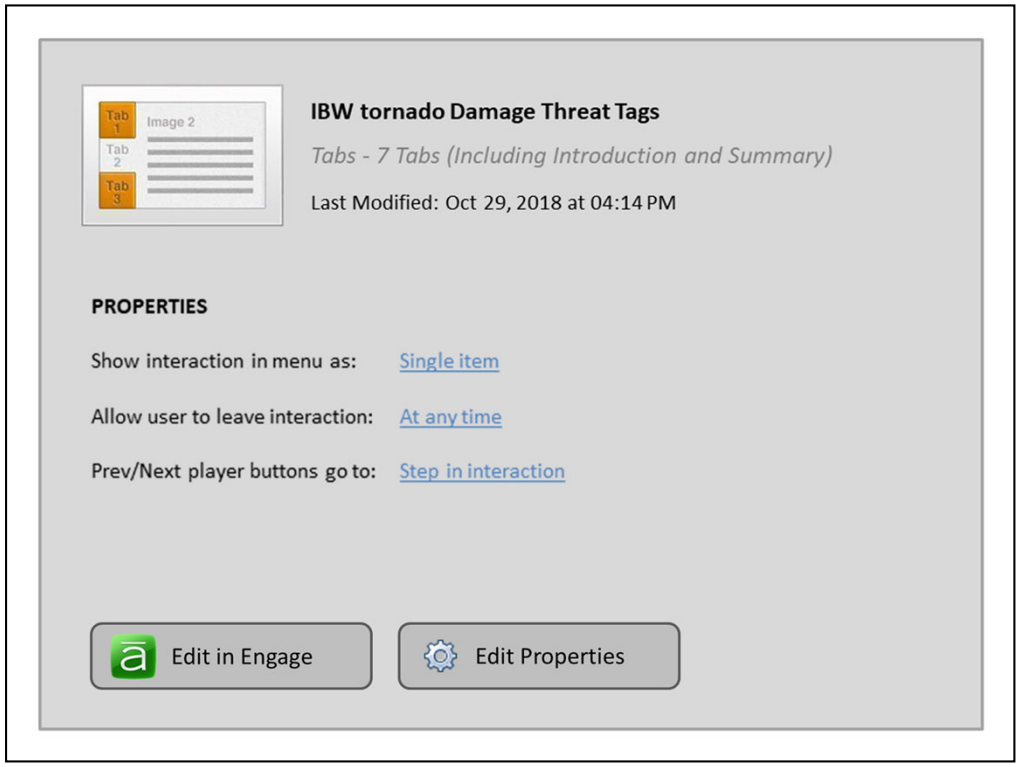

These are the tornado impact statements and tags for Tornado Warnings (TORs) and Severe Weather Statements (SVSs), as delineated in NWSI 10-511. Click through each option to read more.

There are four accepted tornado damage threat tag categories that provide quick information to partners and the public on the type of potential tornado damage and magnitude.

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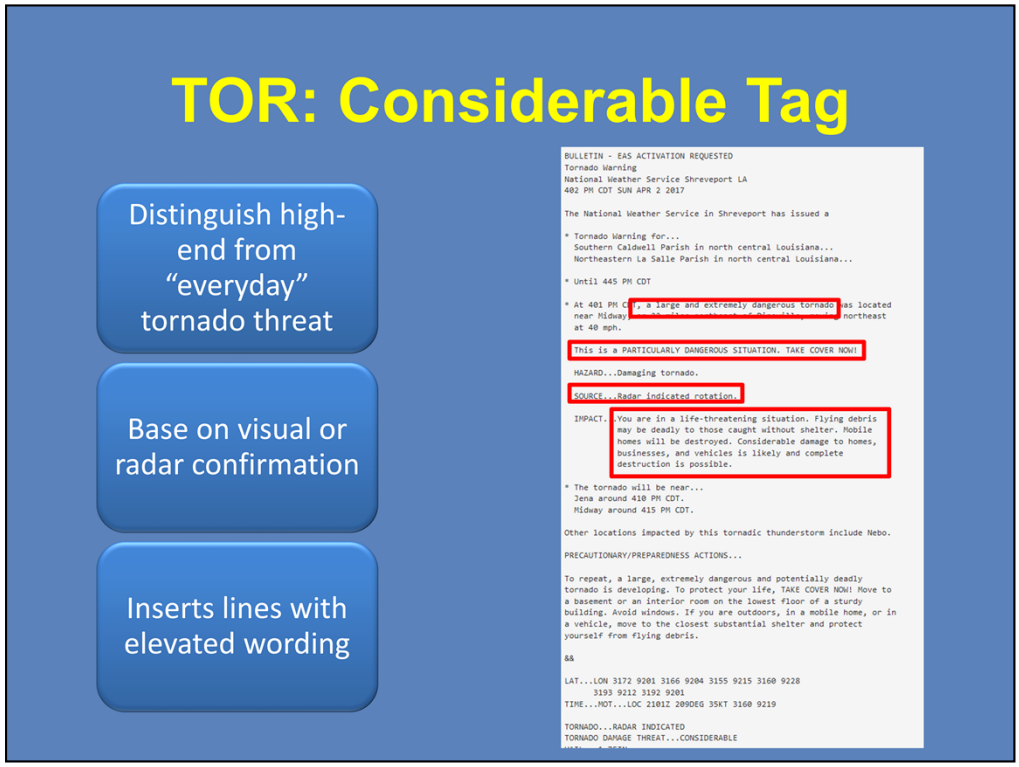

Let's talk more about those high-end tornado warning tags. The intent of impact-based warning tags is to give forecasters a way to distinguish the potential for a high-impact event in warnings and follow-up statements. The target range for the "Considerable" tag is strong to violent tornadoes, but don't try to pinpoint or forecast EF-scale ratings. Lines with elevated wording, along with enhanced impact statements, provide high-intensity cues for partners and the public. There should be confirmation that the tornado is on the ground. That confirmation can be visual, such as a report from reliable sources like trained spotters, trusted storm chasers, or live cameras. It also can be radar-based, with the presence of a tornado debris signature and higher rotational velocities that support the existence of a damaging tornado. The considerable tag should be selected only rarely and for those tornado warnings where the storm signatures and reports suggest the possibility of a strong or violent tornado.

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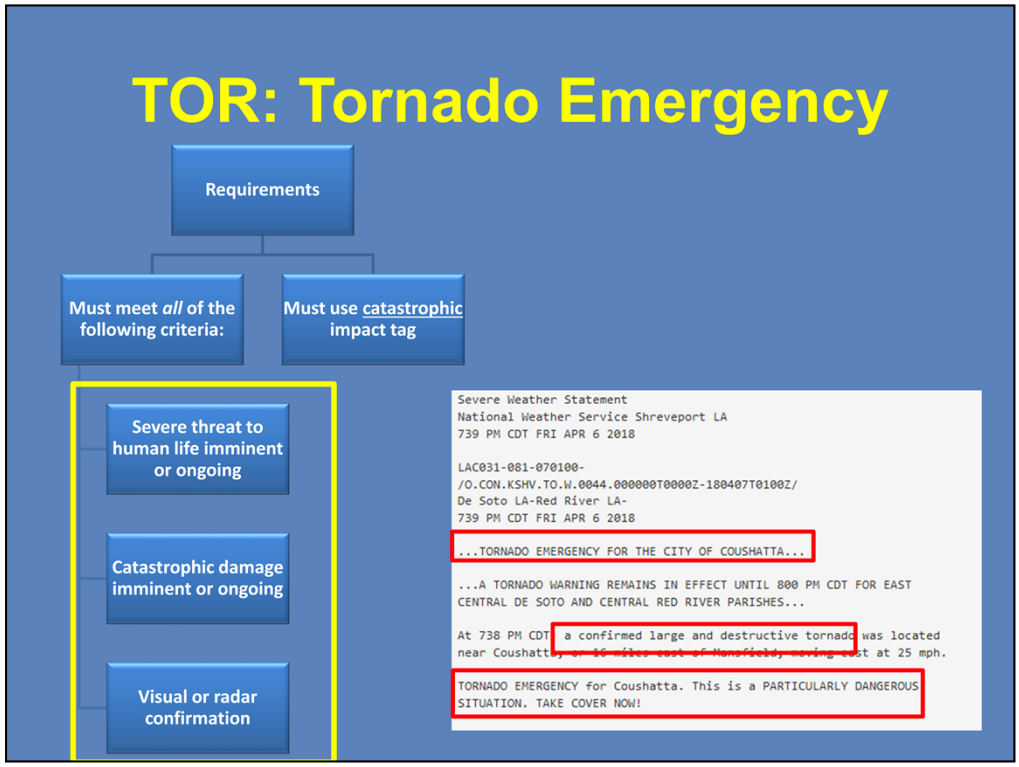

In exceptional circumstances, the conditions might warrant issuing a tornado emergency. The label should be reserved for the most extreme of circumstances, the kind that rarely, if ever, happen in any one meteorologist's career. Before issuing a tornado emergency, all of the following criteria must be met . First, there must be an imminent or ongoing severe threat to human life. That is, the tornado is approaching a population center. Second, catastrophic damage must be imminent or ongoing. Third, there must be confirmation of a tornado on the ground. As with a considerable tag, that confirmation can be either visual or radar-based. Essentially, you would issue a tornado emergency with high confidence of a strong or violent tornado approaching a populated area, in an environment that supports its persistence. With a tornado emergency, you will use the catastrophic damage tag in addition to selecting tornado emergency from the options within the WarnGen interface. It is important to include both steps if you are issuing a tornado emergency. The wording within the warning elevates another step, with a headline at the top of the warning and a separate line both indicating a tornado emergency.

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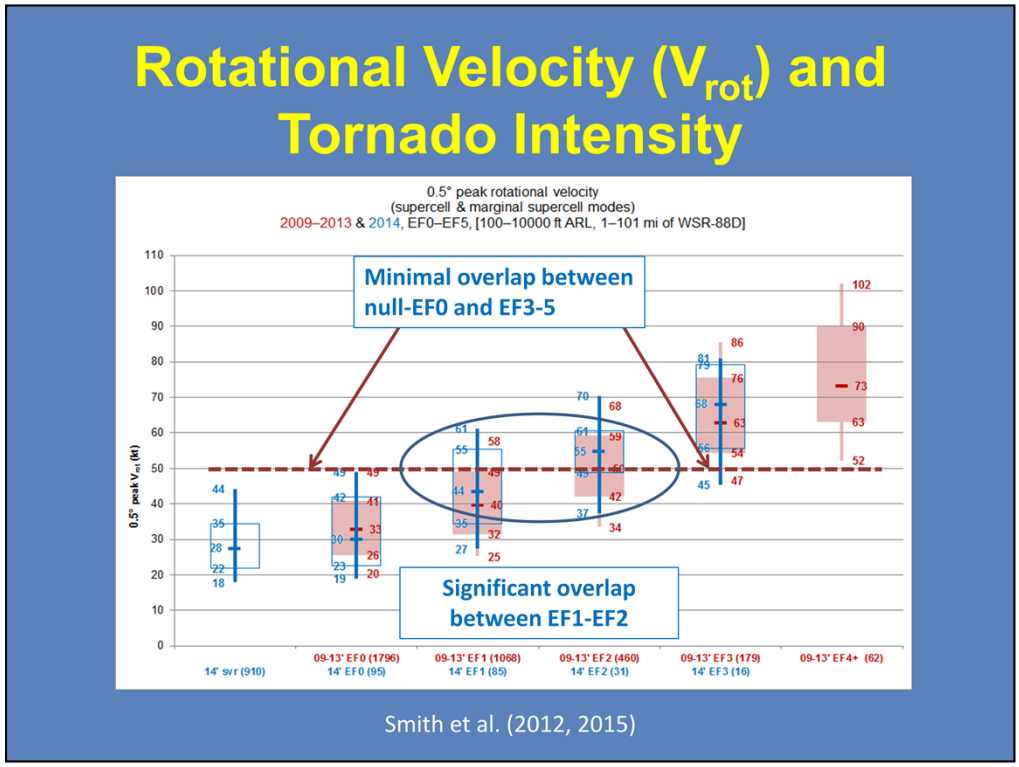


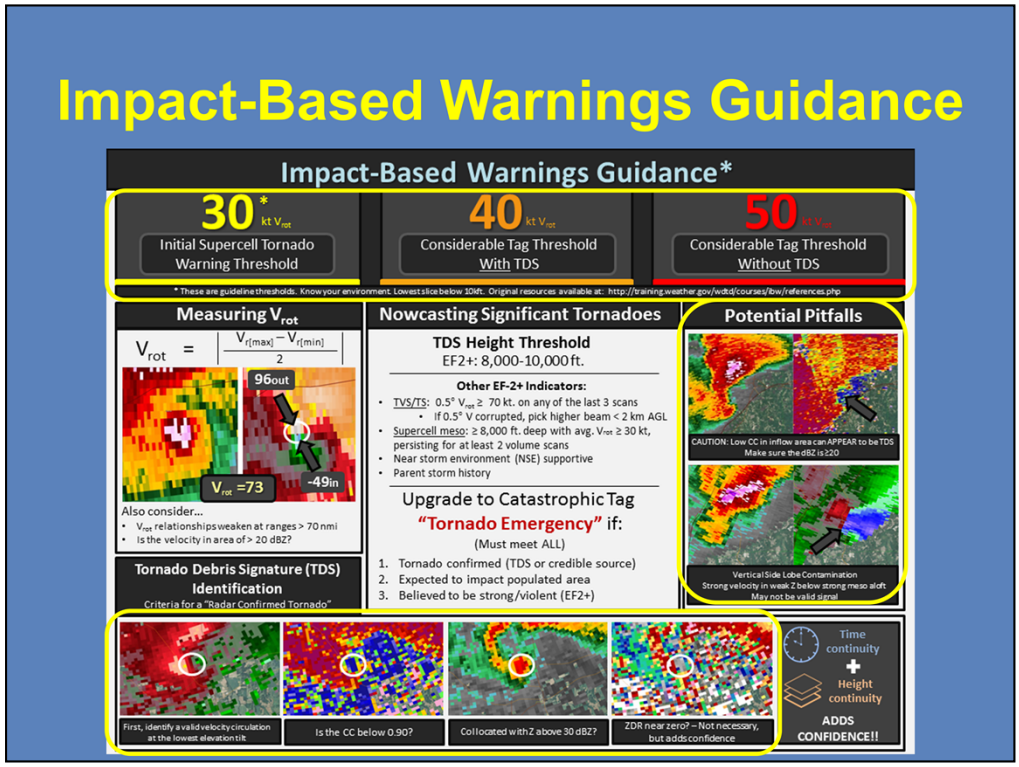
We have talked about what the tags are and how to use them, so now let's talk about the "why" and the background a bit more.

This SPC relational climatology by Smith et al. in 2012 and 2015 shows a relationship between increasing maximum 0.5 degree rotational velocity and increasing maximum EF scale of occurring tornadoes. The box and whiskers chart shown is for maximum low-level rotational velocity below 10,000 feet, looking at supercell and marginal supercell convective modes. The light red shaded boxes are data from 2009-2013, while the blue outlines are data from 2014 and include rotational velocities from non-tornadic severe supercells – in other words, null events. The box and whiskers have standard configurations, with the box encompassing the 2nd and 3rd quartiles and the tips of the whiskers representing the 10th and 90th percentiles. The dash in the middle of each box is the median, or the top of the 2nd quartile. For each event in the study, the authors recorded rotational velocities from the scan prior to tornado touchdown until the scan prior to tornado dissipation.

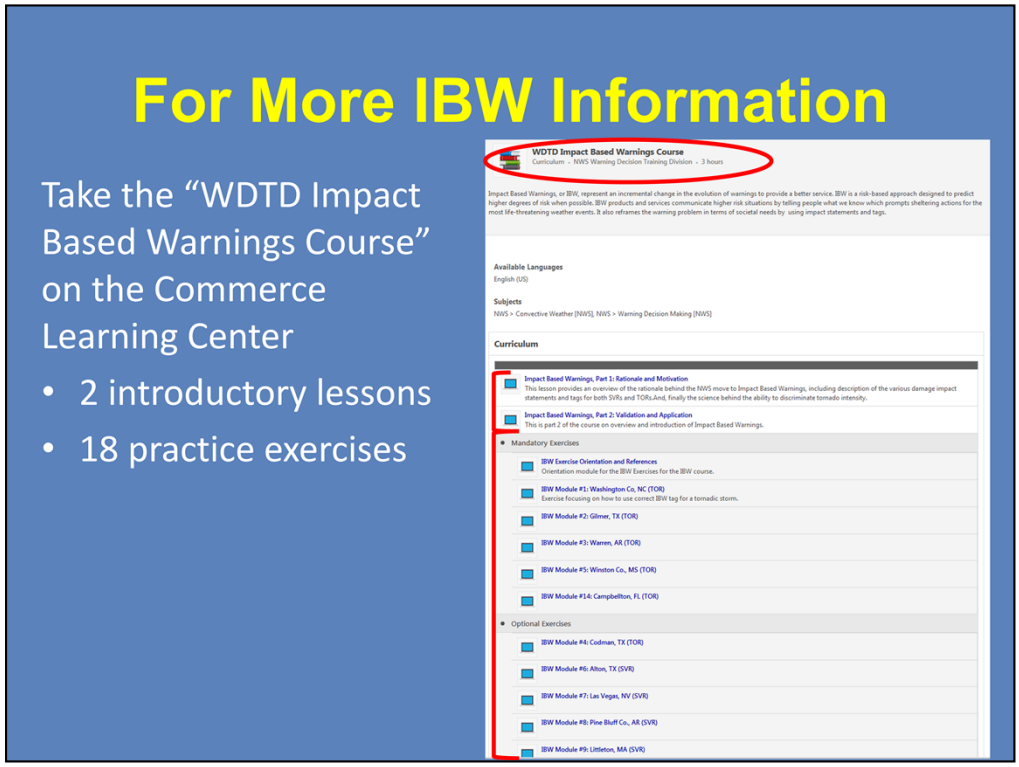
Again, we are not trying to pinpoint tornado intensity by EF scale. We are just trying to "ring the bell" a little louder for higher-impact tornado events. This chart shows why. You'll notice that there is plenty of overlap in maximum low-level rotational

velocity associated with EF1 and EF2 tornadoes – but you can also see there is little overlap between null events or EF0s and EF3s to EF5s. The graphic hints at some capacity for distinguishing between weak and strong tornadoes and provides guidance for rotational velocities that are more likely to be associated with strong or violent tornadoes than with weak or no tornadoes.

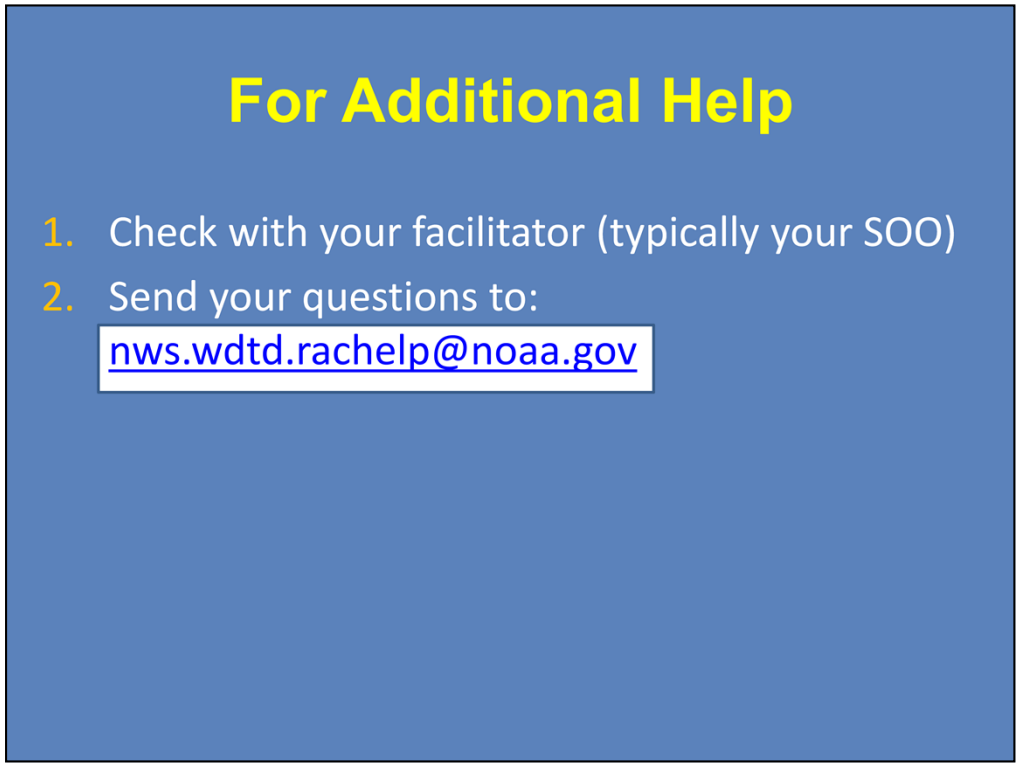
There is no cookbook answer to the question of when to use a “considerable” tag, but that is rarely the case for anything in operational meteorology. Keep in mind that the value of your role in the warning decision process is in staying situationally aware and considering a wide variety of factors to stay one step ahead of the tornado threat.



A copy of this handy one-pager of guidance is available in the “Resources” tab and also will be handed out during the RAC workshop. Keep in mind that the thresholds have fuzzy boundaries. Persistence of the features matters, as do storm history and the near-storm environment. Beware of pitfalls and lookalike signatures, including side lobe contamination and low-CC signatures in the inflow notch. True tornado debris signature components include a velocity couplet, low CC (usually embedded within higher values), and near-zero ZDR in the presence of reflectivity above 30 dBZ. Check the height of the tornado debris signature as a proxy for intensity, and also keep in mind that a TDS may not be evident in places where a relative lack of trees or structures means that little debris is being lofted by the tornado.



What we have included in this module is a brief introduction to impact-based warnings. For more in-depth background and information, there is a short course available on the Commerce Learning Center. You'll find a curriculum titled "WDTD Impact-Based Warnings Course" there, which includes a two-part, more in-depth discussion of the background and justification for using impact-based warnings, and 18 practice exercises.



For additional help, check with your facilitator (typically your SOO) or send your questions to the listserv e-mail address here.

Welcome to this RAC Warning Fundamentals lesson on what to do after the warning is issued. We will go through the many ways to use severe weather statements, or SVSs, to follow up initial warning issuance. I am Barb Mayes Boustead.

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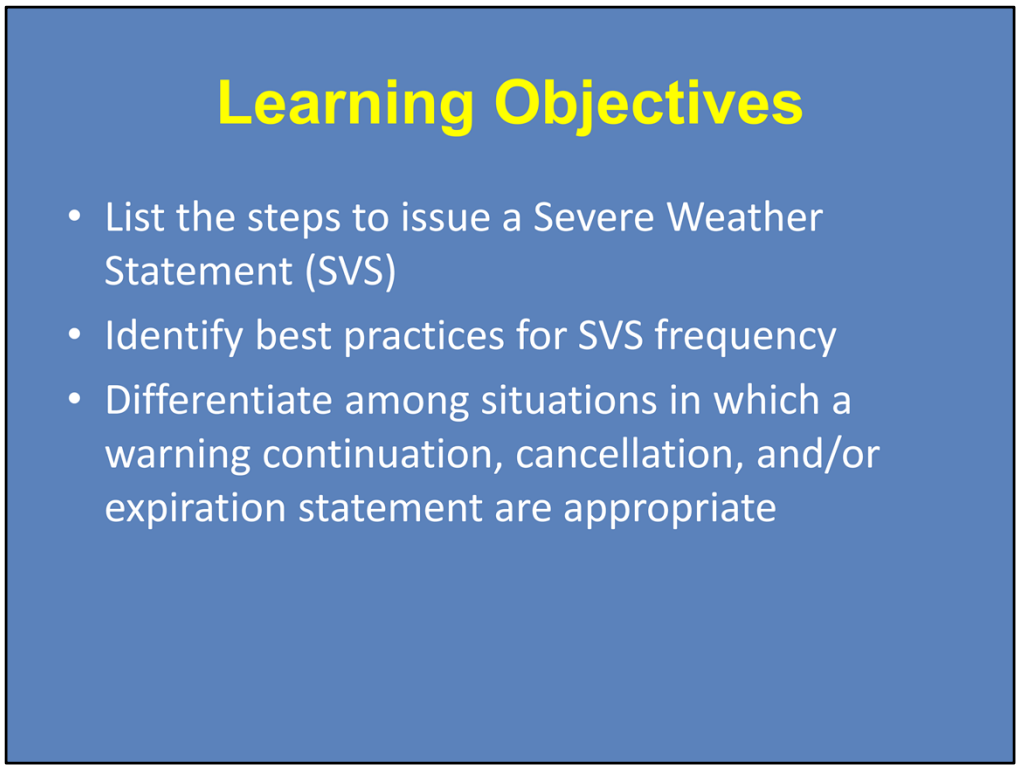

The learning objectives for this lesson are to be able to list the steps to issue a Severe Weather Statement (or SVS), to identify best practices for frequency of issuing SVSs, and to differentiate among situations that would require an SVS to continue, cancel, or expire the warning.

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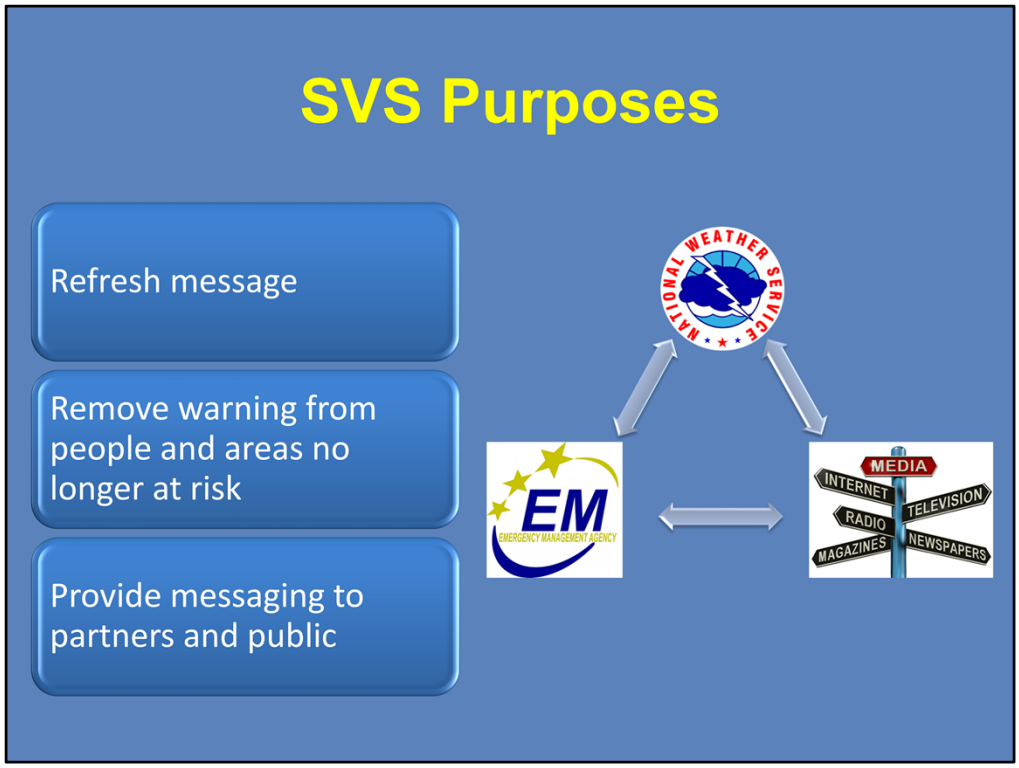

SVSs are an integral part of the communication chain to our partners and the public. An SVS refreshes the message about the severe thunderstorm or tornado, which allows the media to update their messaging. Emergency managers and first responders can shift from shelter to response more quickly with updated messaging from their local NWS office. SVSs also refresh the message of the warning on NOAA weather radio and on our webpages, as well as to private sector vendors who are relaying the warnings. Additionally, issuing an SVS allows the office to remove areas no longer at risk from the warning, by taking areas out of the polygon where the threat has passed. SVSs should be viewed as a decision support and communication tool, allowing the warning meteorologist to reach partners and the public directly and communicate clearly the changes in threat during a severe thunderstorm or tornado warning.

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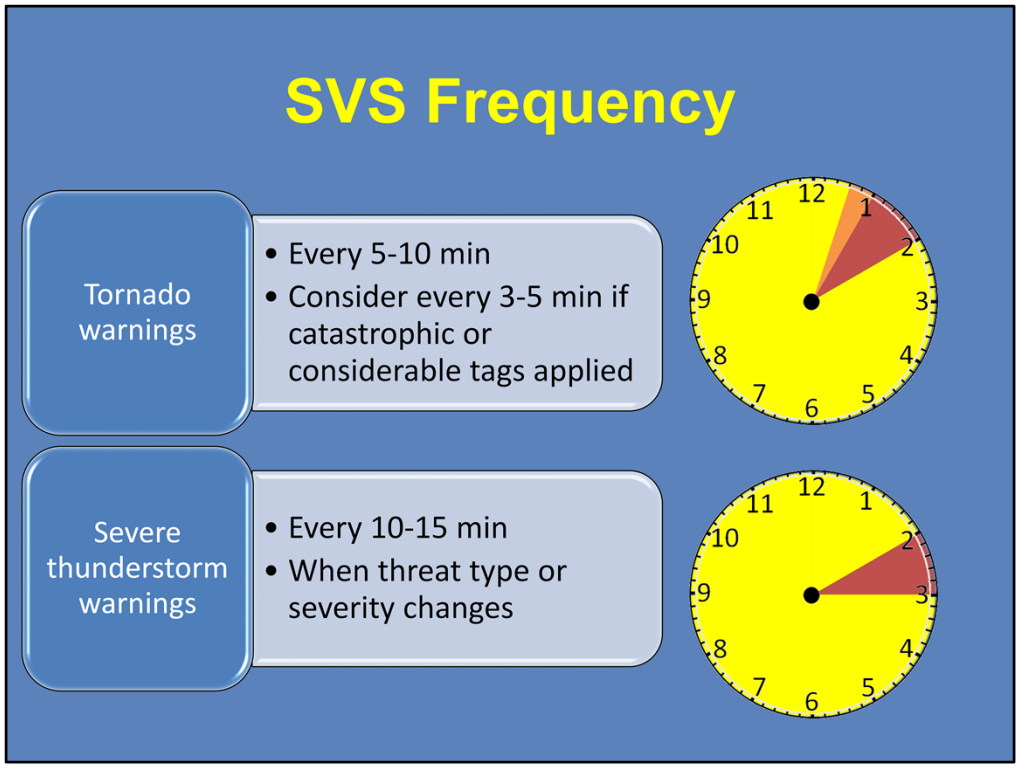

Directives provide a lower limit on the number of SVSs required during a warning, but there are some best practices to ensure the flow of information to our partners and public. NWS Instruction 10-511 stipulates that WFOs should issue an SVS at least once during a warning, with more frequent updates to help keep the public informed. For tornado warnings, a good rule of thumb is to issue an SVS every 5 to 10 minutes during the warning. Consider more frequent updates, as much as every 3 to 5 minutes, in high-impact situations, such as when a considerable or catastrophic tag is applied. For severe thunderstorm warnings, aim for issuing an SVS at least every 10 to 15 minutes. Reports of severe weather often can trigger an SVS, and SVSs should include recent reports in their text. It's also important to issue an SVS when the threat type or intensity changes, such as when radar signatures or reports indicate a bigger hail size than the initial warning or when a tornado goes from being radar-indicated to reported.

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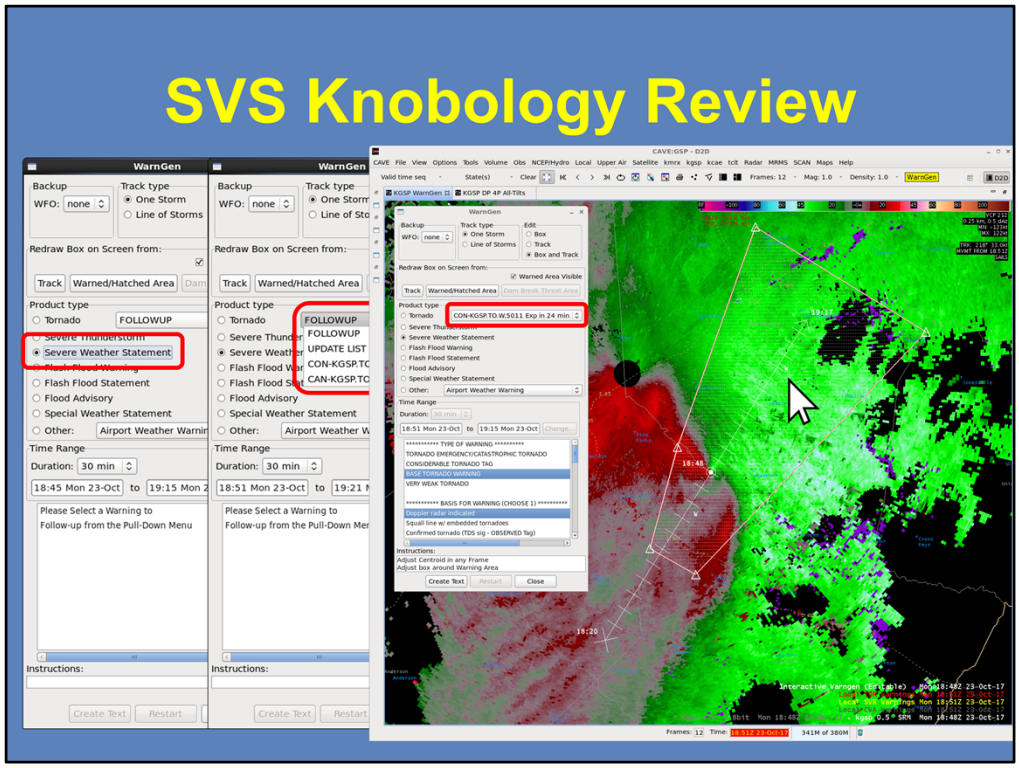
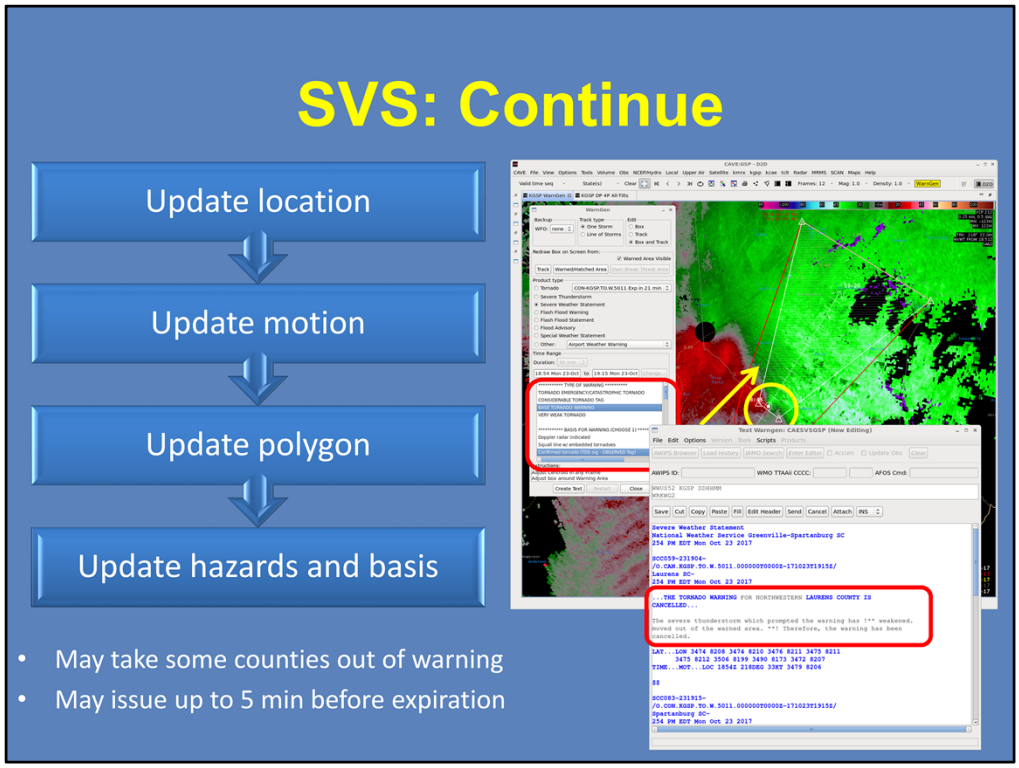
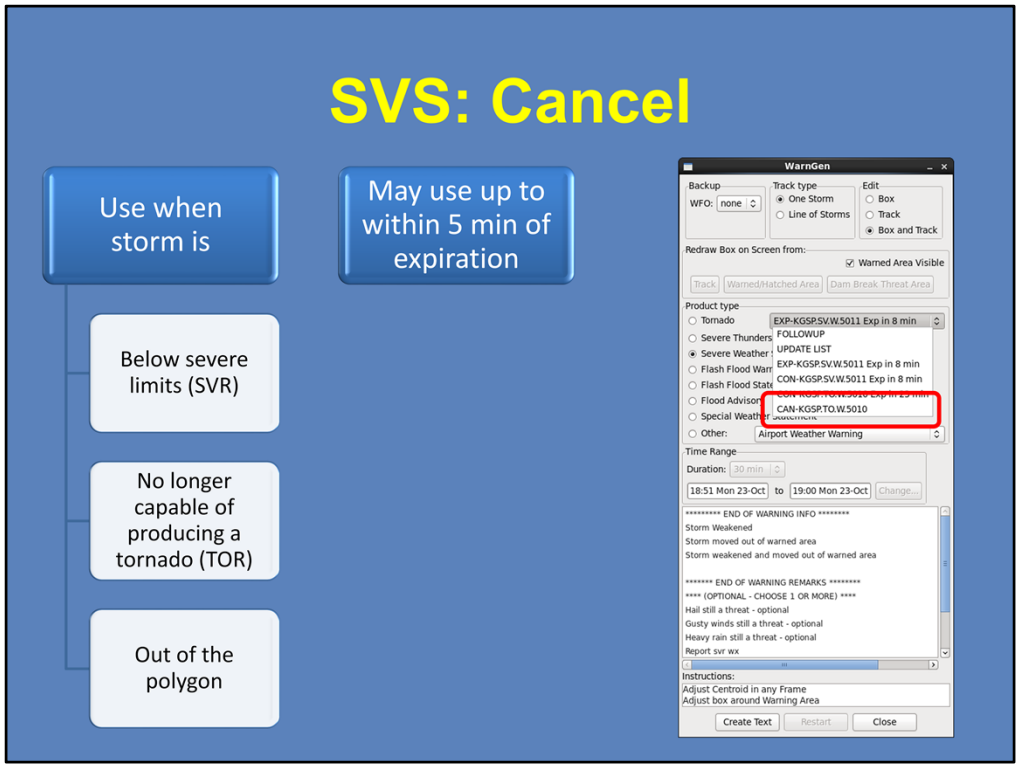


When you are ready to issue an SVS, select “Severe Weather Statement” in the WarnGen product list. There are two ways you can select which warning you are SVSing. The first way is to use the drop-down menu and select using the warning number. The second way, which has the benefits of being faster and removing a possible source of human error, is to right-click in the polygon of the warning you wish to update. The correct warning will be selected automatically in the list in the WarnGen window. From there, possible options will include continuing the warning, canceling it, or expiring it, depending on how much time is left until the warning expires.



Issue an SVS to continue a warning anytime from as soon as it is issued through up to 5 minutes before expiration. In the process of issuing the continuation, remember to update four components: the location and motion of the storm, the shape of the polygon, and the hazards and basis in the text. It typically makes the most sense for your workflow to progress in that order: use the distance/speed indicator to be sure the point is aligned to the threat area, check the motion to ensure it is still representative, tighten the polygon and remove areas no longer in a threat, and then update the hazards for which you are warning, as well as the basis of the warning if that has changed. As you update the warning, the change in polygon shape may remove some counties from the threat; these will appear in the text of the SVS as a cancellation for just those counties, with a continuation for the remaining counties in the polygon.



You should proactively cancel a warning when it no longer poses the risk indicated in the warning. For a severe thunderstorm warning, use an SVS to cancel when the storm has weakened below severe limits, such as a pulse storm that has dropped its core already. Cancel a tornado warning when a storm is no longer capable of producing a tornado, such as when a storm is overtaken by a line and rapidly loses its rotation in the low and mid levels. Finally, cancel a warning if the storm that prompted it has moved fully out of the polygon. You can issue a cancellation up to 5 minutes before the expiration time of the warning, using the option labeled “CAN” in the drop-down menu.

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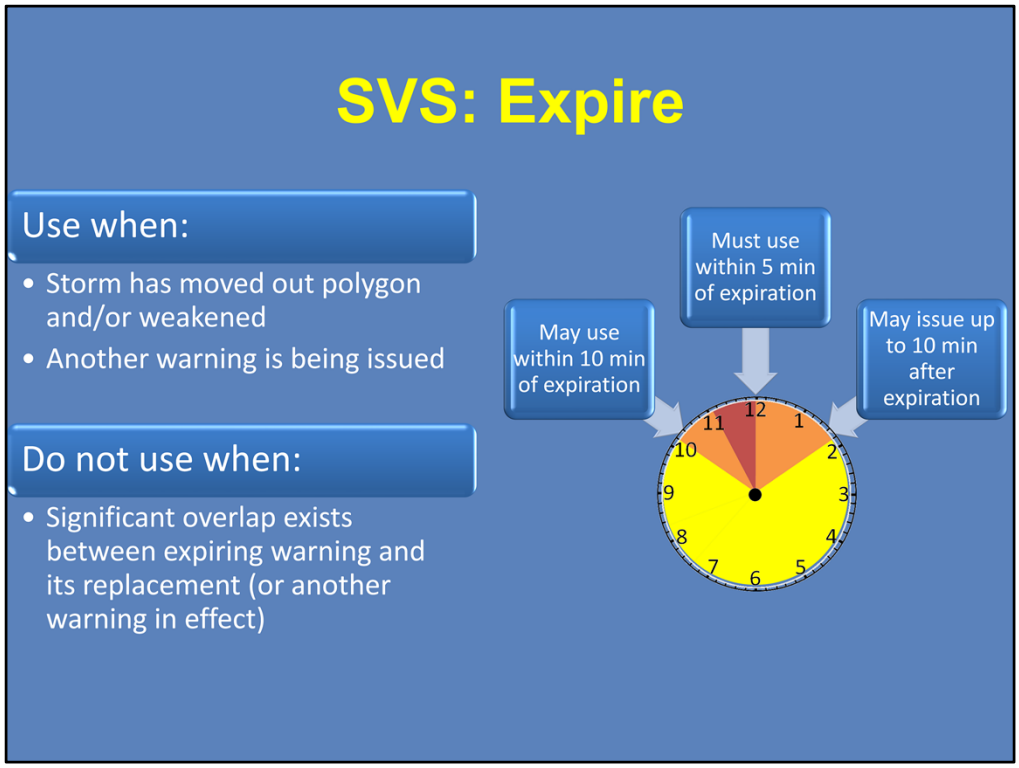

Expiration statements are issued near the end time of a warning. They may be issued within 10 minutes of expiration, and they *must* be used within 5 minutes of expiration. They also can be issued up to 10 minutes after expiration. Expirations should be used when a storm has moved out of a polygon or has weakened. They may be used even when another warning is being issued, and the templates allow for text input that a warning remains in effect for an area that you can describe by county portions. It's not recommended to use an expiration if the overlap between the expiring warning and its replacement, or a different warning in effect, is significant. This is to avoid confusing the message to partners and the public about whether or not a warning is in effect.

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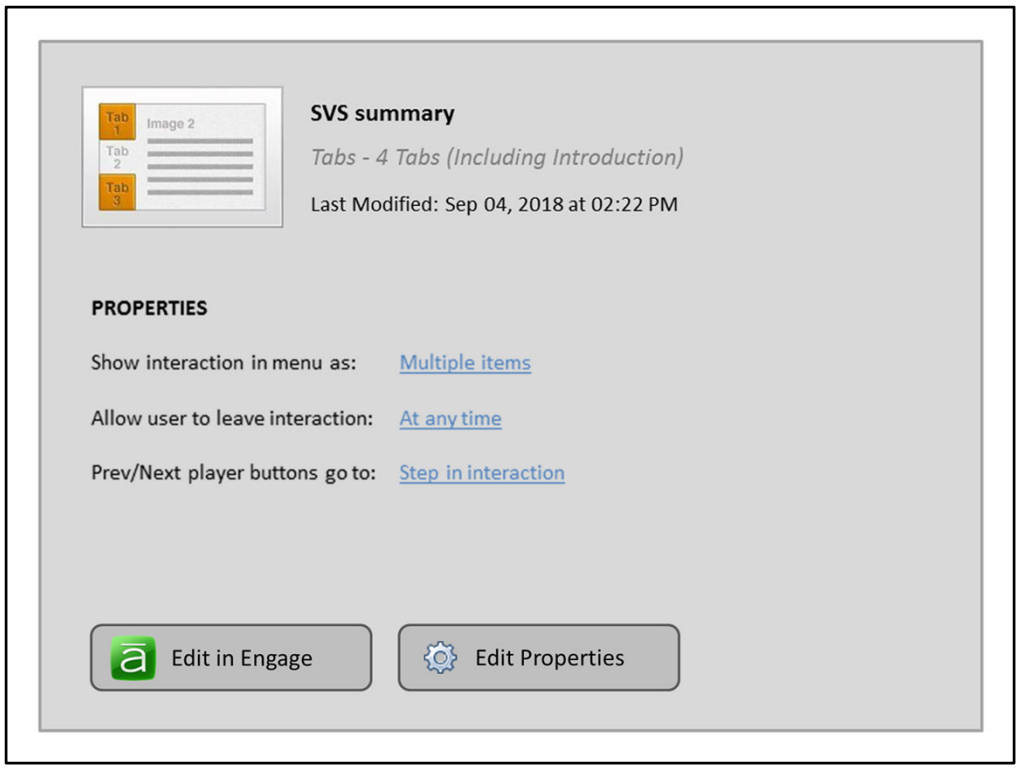

In summary, SVSs are an important part of the information flow from the warning decision-maker to our full suite of partners and the public, allowing the media to adjust their messaging and responders a chance to issue “all clear” messages and begin their response efforts. The workflow of issuing an SVS includes updating the location of the storm and its track, then updating the polygon to remove areas that are no longer in the threat, and finally, updating the severity information and basis of the warning in the text. We issue SVSs to continue the warning, with updated messaging; to cancel a warning before its expiration time window; and to expire a warning at its scheduled time.

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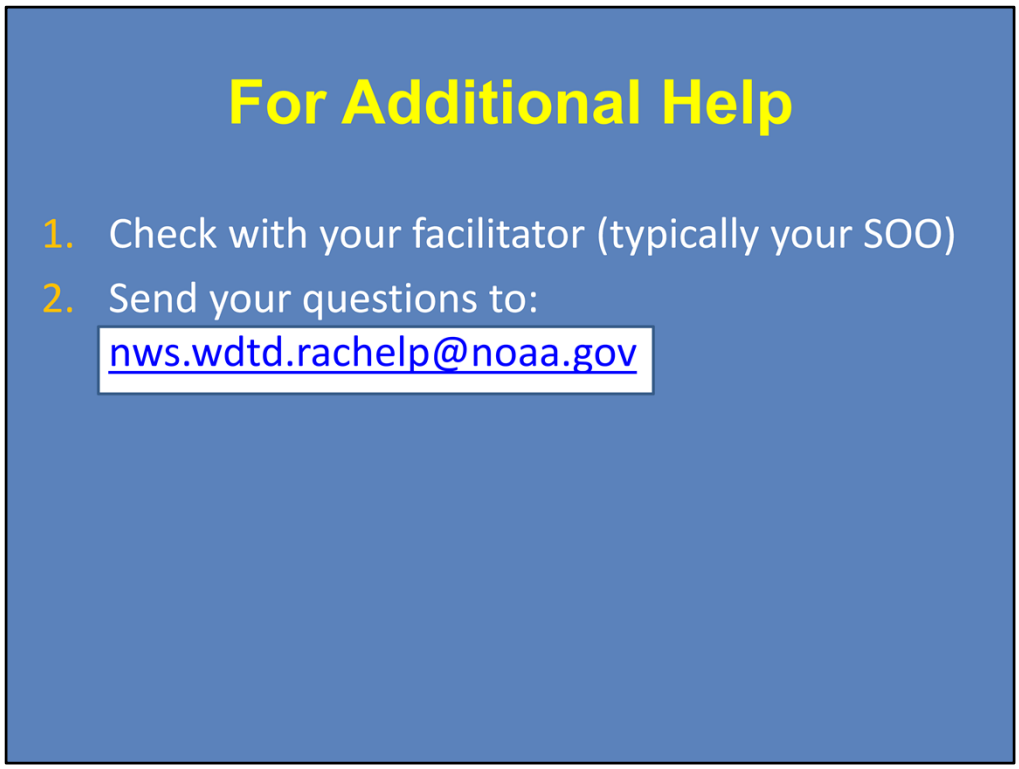

For additional help, check with your facilitator (typically your SOO) or send your questions to the listserv e-mail address here.