

Storm Prediction Center Lab Exercise

May 24, 2011

Objective:

The Storm Prediction Center (SPC) is one of the most critical information sources to rely on for severe weather forecasts and products. The objective of this lab is to practice using different SPC products and to relate those products to actions you would take as an emergency manager. This lab will walk you through several days worth of SPC products starting several days before an event all the way up to just a few hours before the event begins.

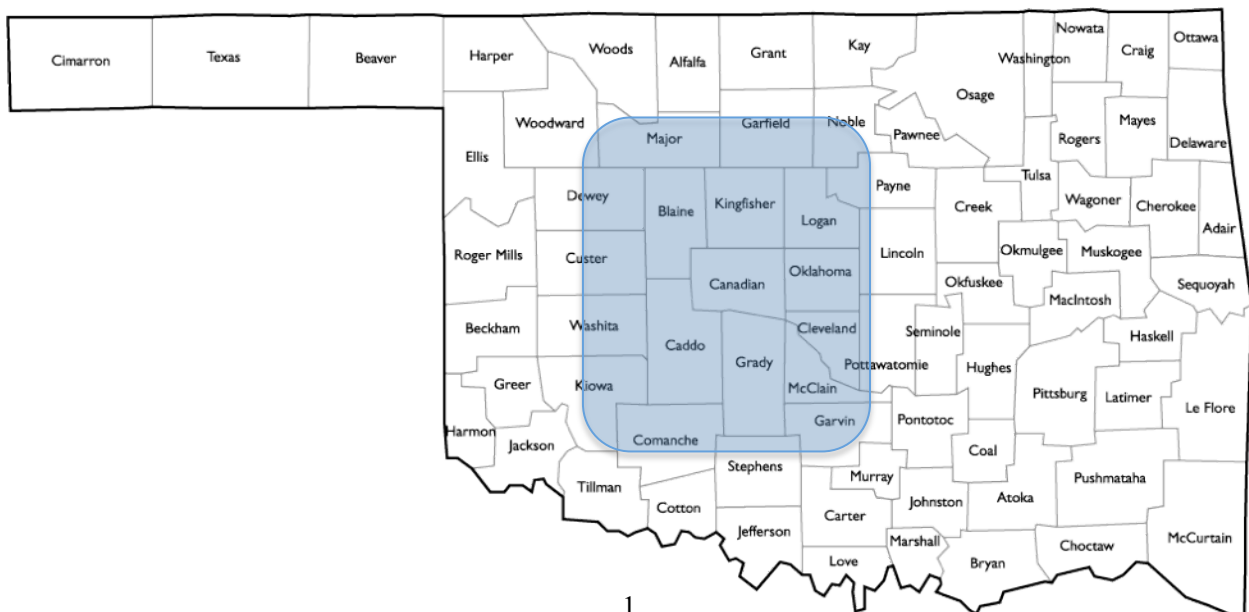
It is important to remember that once tornado or severe thunderstorm watches have been issued by the Storm Prediction Center and an event is imminent, it is then time to transition your focus to information from the local National Weather Service office (warnings, etc.), radar, surface conditions (Oklahoma Mesonet), and other information sources you may use. That will, however, not be the focus of this particular lab.

Instructions:

Please read through the questions contained in this lab exercise and answer them as best you can in the space at the bottom of each page. You are welcome to work in a group of up to 3 or on your own if you'd like. If you work in a group, at least one person must turn in an answer sheet. During your work on this lab you are welcome to use any materials from OK-First class. Once everyone is finished we will walk through the lab questions together and discuss them.

Region of Focus for this Exercise:

For the purposes of this lab, play the role of an emergency manager in the blue shaded area of central Oklahoma. Pick a city or county, write it down below, and assume the role of that emergency manager for the remainder of this lab.



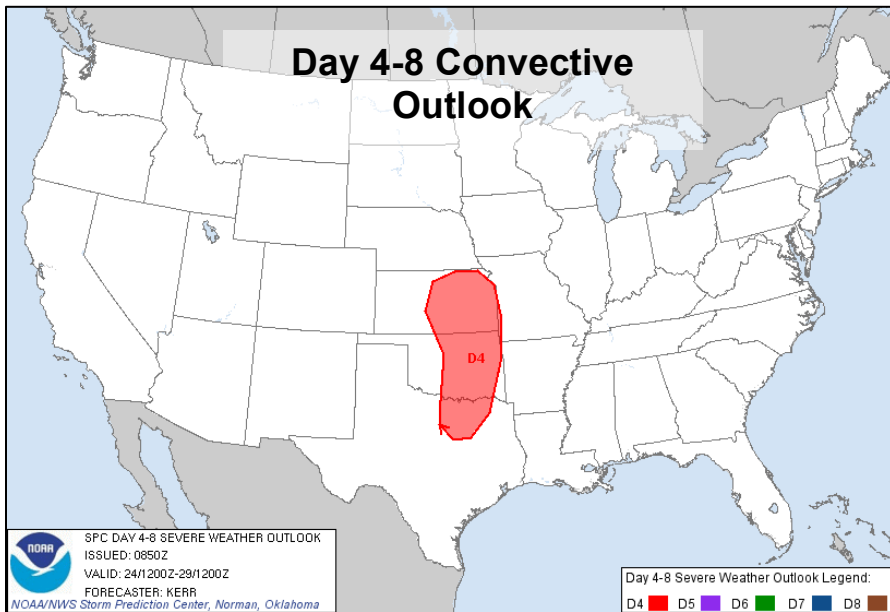
Terminology:

The following are definitions of several meteorological terms you may see during this lab:

- **500 mb Trough** – A region of air at approximately 18,000 feet with lower pressures and colder temperatures. Troughs commonly extend from the pole down to the south and move from west to east. Troughs help increase instability and shear and are a key ingredient for severe weather.
- **Cap** – A layer of air that is warmer than air above and below it. While the cap limits rising motion, it can enhance the severity of some storm events by holding storms until the peak heating of the day. If too strong, however, it can prevent any storms from happening.
- **Convective Available Potential Energy (CAPE)** – A measure of instability in the atmosphere. Severe weather situations typically require CAPE values of 1000 J/kg and greater, though low-end severe weather can occur with less. Outbreaks tend to have CAPE of 2500 J/kg or higher.
- **Convective Outlook** – A forecast detailing the locations and type of expected severe thunderstorm occurrence across the contiguous United States. This product is issued 5 times for today's forecast, 2 times for tomorrow's forecast, and only once a day beyond that.
- **Dew Point Temperature** – The temperature that air must be cooled for water vapor to condense into liquid water. High dew point temperatures of 55 degrees Fahrenheit or greater are necessary for severe weather, though high end days tend to have dewpoints of 65F or greater. High dew points also mean low cloud bases, which are critical for the formation of tornadoes.
- **Diffluent Flow** – Motion in the atmosphere where winds flow away from a particular region. Diffluence in the upper part of the atmosphere can aid thunderstorm development because it tends to help provide lift below it.
- **Helicity** – A measure of the amount of rotation found in a storm's updraft. Values of 300-499 m^2/s^2 are favorable for supercells and strong tornadoes. Values above 450 m^2/s^2 are favorable for violent tornadoes.
- **Mesoscale Discussions** – A short term (0 to 3 hours) and small scale (roughly half the size of Oklahoma) analysis and forecast for active weather. Mesoscale discussions can give advanced notice about an upcoming watch, may provide an update on a watch, or may give an update of an active weather situation.
- **Severe Thunderstorm Watch** – A collection of counties that have favorable atmospheric conditions to produce storms capable of having 1 inch or greater hail and/or 58 mph or greater winds.
- **Tornado Probabilities** – The chance of a tornado occurring within 25 miles of a given location. For example, a 35% probability of tornadoes in a given area means that tornadoes would happen within 25 miles of that location in roughly 1 out of 3 similar forecasts.
- **Tornado Watch** – A collection of counties that have favorable atmospheric conditions for producing tornadic storms.
- **Veering Winds** – Winds that turn in a clockwise manner with height. For instance, winds from the South at the ground and from the West higher up is an example of veering winds.
- **Wind Shear** – Winds that change direction and speed as you go up in the atmosphere. This is one of the most important ingredients for tornadoes and an ingredient that change rapidly in a short period of time.

Lab Exercise:

It's the morning of Saturday, May 21, 2011 you review the convective outlooks from the Storm Prediction Center (SPC) and notice that the SPC has placed central Oklahoma in a slight risk of severe storms today (Saturday, May 21), tomorrow (Sunday, May 22), and the day after (Monday, May 23). You also notice the following Storm Prediction Center Day 4-8 Convective Outlook shown below (graphic and discussion) mentioning something about Tuesday, May 24.



D4	Tue, May 24, 2011 - Wed, May 25, 2011	D7	Fri, May 27, 2011 - Sat, May 28, 2011
D5	Wed, May 25, 2011 - Thu, May 26, 2011	D8	Sat, May 28, 2011 - Sun, May 29, 2011
D6	Thu, May 26, 2011 - Fri, May 27, 2011	(All days are valid from 12 UTC - 12 UTC)	

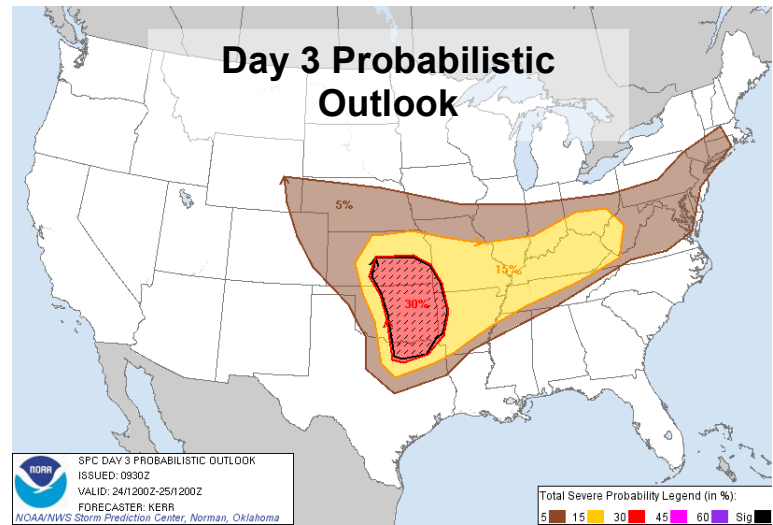
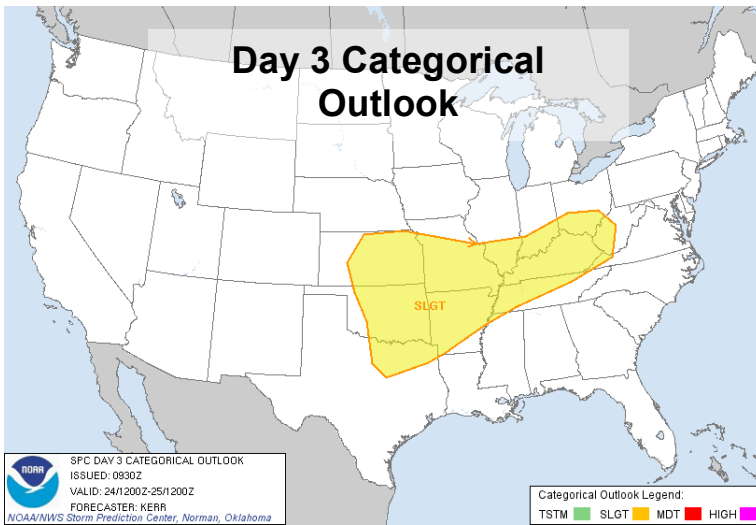
...SEVERE STORMS POSSIBLE ACROSS THE CNTRL/SRN PLAINS TUESDAY...

VARIABILITY AMONG THE MEDIUM RANGE MODELS AND ENSEMBLES BECOMES QUITE LARGE DURING THE MIDDLE AND LATTER PART OF THE PERIOD CONCERNING THE UPPER FLOW EVOLUTION...BOTH ON THE SMALLER AND LARGER SCALES. HOWEVER...GUIDANCE REMAINS SUGGESTIVE THAT THE MOST SIGNIFICANT SHORT WAVE IMPULSE...EMERGING FROM A LARGER-SCALE TROUGH EVOLVING OVER THE WESTERN STATES THIS WEEKEND...WILL ACCELERATE EAST OF THE ROCKIES BY EARLY TUESDAY. IT SEEMS PROBABLE THAT THIS WILL BE ACCOMPANIED BY A DEEPENING CYCLONE OVER THE SOUTH CENTRAL PLAINS...WHERE A PREVAILING MOIST AND UNSTABLE ENVIRONMENT SHOULD BE SUPPORTIVE OF CONSIDERABLE STRONG/SEVERE STORM DEVELOPMENT. THE GREATEST SEVERE RISK FOR SEVERE STORMS... INCLUDING POTENTIALLY TORNADIC SUPERCELLS...APPEARS TO EXIST LATE TUESDAY AFTERNOON AND EVENING ACROSS PARTS OF NORTH CENTRAL TEXAS AND CENTRAL/EASTERN OKLAHOMA AND KANSAS.

..KERR.. 05/21/2011

Question 1. Given the situation, what are your priorities on that Saturday morning for the next few days? Does May 24 play into your plans at this time? Explain why or why not. Provide your answer below.

Let's move forward in time one day to Sunday, May 22, 2011. That morning you check out the Day 3 Convective Outlook to see what it now shows for the forecast on Tuesday, May 24th. You see the following categorical outlook (left), probabilistic outlook (right), and discussion (bottom).



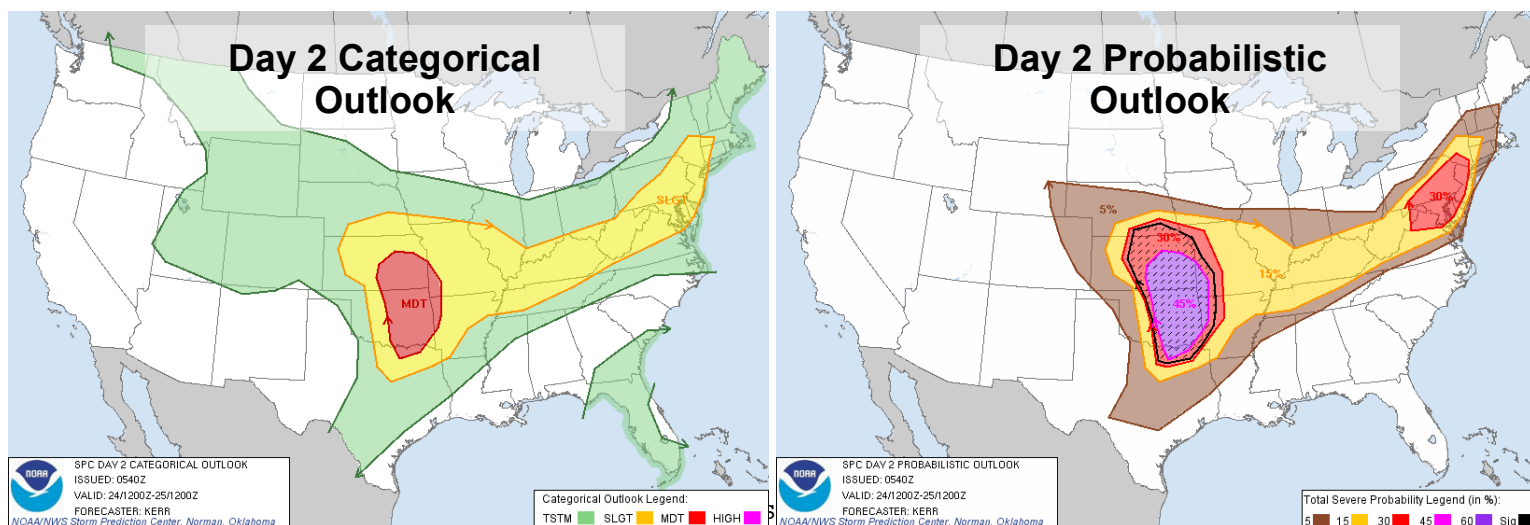
...CENTRAL/SOUTHERN PLAINS...

VARIABILITY AMONG THE MODELS AND MODEL ENSEMBLES PERSISTS...AND IS TOO SIGNIFICANT AT THE PRESENT TIME TO CONFIDENTLY DELINEATE GREATER THAN SLIGHT RISK SEVERE PROBABILITIES. TIMING OF STRONGER MID/UPPER FORCING SPREADING ACROSS THE WARM SECTOR IS ONE ISSUE... AND THIS MAY NOT OCCUR UNTIL NEAR OR SHORTLY AFTER DARK ACROSS PARTS OF CENTRAL/EASTERN KANSAS AND OKLAHOMA SOUTHWARD INTO NORTH CENTRAL TEXAS. REGARDLESS...BOUNDARY LAYER CAPE ON THE ORDER OF 3000+ J/KG...IN THE PRESENCE OF STEEPENING LAPSE RATES...APPEARS PROBABLE NEAR THE DEEPENING CYCLONE AND AN EASTWARD SURGING DRY LINE...AS A 60-80 KT WESTERLY 500 MB JET NOSES ACROSS THE SOUTHERN PLAINS RED RIVER VALLEY REGION. THE UPPER JET...COUPLED WITH STRENGTHENING OF A SOUTHERLY LOW-LEVEL JET TO AROUND 50 KT...WILL CONTRIBUTE TO LARGE CLOCKWISE CURVED LOW-LEVEL HODOGRAPHS AND STRONG DEEP LAYER SHEAR SUPPORTIVE OF LONG LIVED SUPERCELLS CAPABLE OF PRODUCING STRONG TORNADOES AND VERY LARGE HAIL. THE SEVERE THREAT MAY CONTINUE INTO THE OVERNIGHT HOURS...BEFORE DIMINISHING AS BOUNDARY LAYER INSTABILITY FINALLY WANES.

..KERR.. 05/22/2011

Question 2. What is the probability value of severe weather occurring in central Oklahoma on May 24? Please describe what that value means. Also, what do the hatched (dashed) lines in the probability outlook on the right mean? Write your answers below. Finally, circle the different terms in the above discussion that represent our different MILS (Moisture, Instability, Lift, and Shear) ingredients and label them as M, I, L, or S.

It's now the morning of Monday, May 23, 2011. Storms thankfully did not affect your area over the weekend even with several slight risks. You view the SPC convective outlooks. Today's forecast is a moderate risk for severe weather (not shown) and includes a hail threat (45% probability; with a hatched area) as well as some threat for tornadoes (10% probability; no hatched area). You also check the Day 2 outlook for tomorrow (May 24, 2011) and see the following categorical outlook (left), probabilistic outlook (right), and discussion (bottom).



...CENTRAL/SOUTHERN PLAINS...

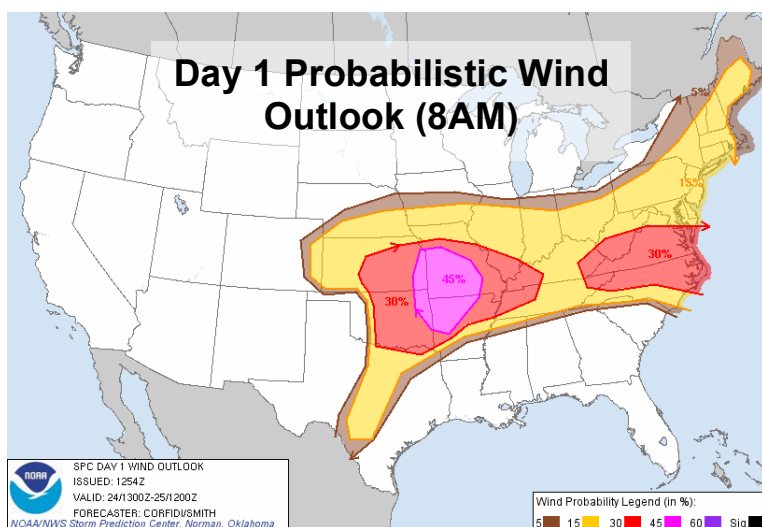
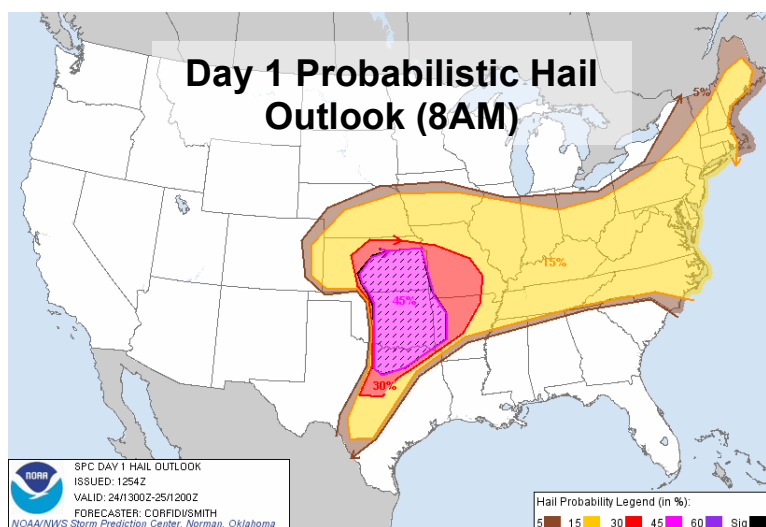
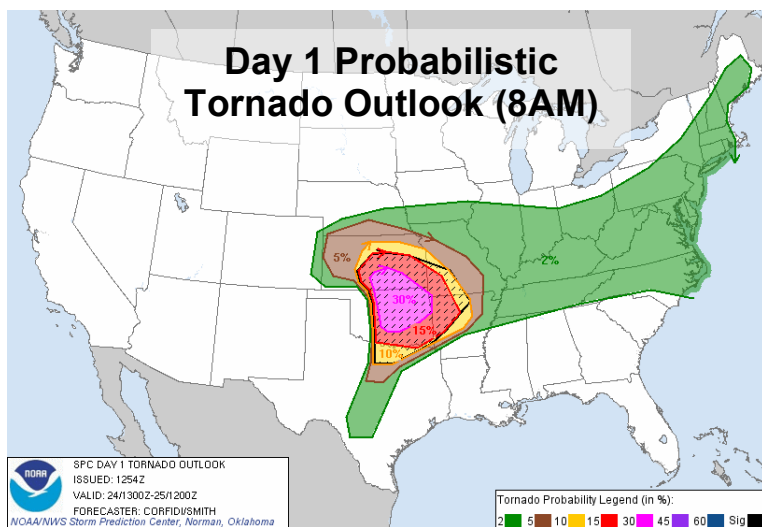
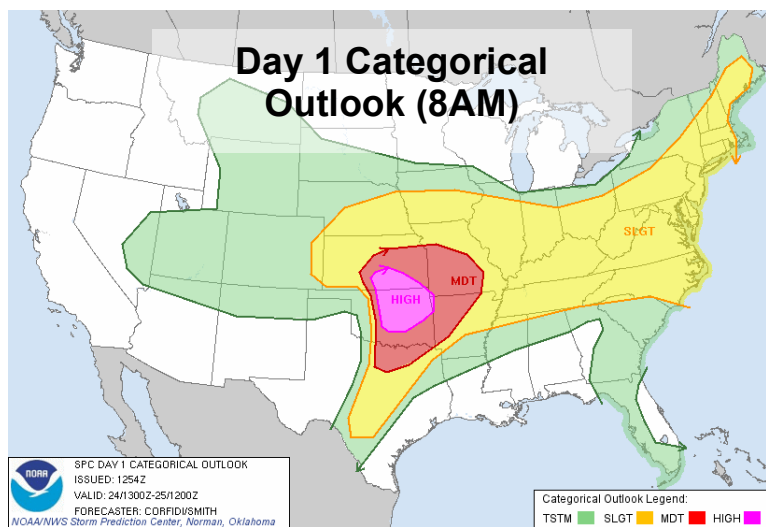
LINGERING VARIABILITY AMONG THE MODELS AND ENSEMBLES CONCERNING THE TIMING AND TRACK OF THE TROUGH MERGING FROM THE SOUTHWEST CONTINUES TO COMPLICATE THE FORECAST. BUT IT APPEARS THAT THIS WILL ONLY IMPACT THE EXACT PLACEMENT OF THE HIGHEST SEVERE PROBABILITIES...AS THE EVOLVING LARGE-SCALE PATTERN SEEMS SUPPORTIVE OF A FAIRLY CLASSIC SEVERE WEATHER OUTBREAK. AND ENOUGH COMMON GROUND APPEARS TO EXIST TO JUSTIFY AN UPGRADE TO MODERATE RISK SEVERE PROBABILITIES ACROSS MUCH OF CENTRAL/EASTERN KANSAS AND OKLAHOMA...PORTIONS OF NORTH CENTRAL TEXAS...NORTHWEST ARKANSAS AND SOUTHWEST MISSOURI.

SURFACE DEW POINTS AROUND 70F ARE PROGGED IN THE WARM SECTOR OF THE DEEPENING CYCLONE...ALONG AND EAST OF A SHARPENING DRY LINE DURING THE LATE AFTERNOON HOURS...WHEN PEAK AFTERNOON HEATING AND STEEPENING LAPSE RATES ASSOCIATED WITH MID-LEVEL COOLING PROBABLY WILL CONTRIBUTE TO MIXED LAYER CAPE OF 2000-4000 J/KG. AS THE MID-LEVEL JET NOSES INTO THE RED RIVER VALLEY...THE DRY LINE IS EXPECTED TO BECOME THE FOCUS FOR THE PRIMARY STORM DEVELOPMENT AS IT SURGES NORTHEASTWARD OUT OF SOUTH CENTRAL KANSAS...AND EASTWARD OUT OF CENTRAL OKLAHOMA...THROUGH MUCH OF EASTERN KANSAS AND OKLAHOMA BY LATE EVENING. GIVEN THE ANTICIPATED WIND PROFILES...EXHIBITING STRONG DEEP LAYER SHEAR AND LARGE CLOCKWISE CURVED LOW-LEVEL HODOGRAPHS...THE ENVIRONMENT IS EXPECTED TO BECOME CONDUCTIVE TO LONG-LIVED SUPERCELLS CAPABLE OF PRODUCING VERY LARGE HAIL AND STRONG TORNADOES. THIS THREAT MAY CONTINUE THROUGH MUCH OF THE EVENING...PERHAPS INTO THE 06-09Z TIME FRAME...GRADUALLY SPREADING TOWARD THE LOWER MISSOURI VALLEY AND OZARKS...BEFORE DIMINISHING IN THE PRESENCE OF A MORE STABLE OR STABILIZING BOUNDARY LAYER.

..KERR.. 05/23/2011

Question 3. What actions are you planning on taking for the next 2 days? Discuss what you would be doing at your EOC. Provide your answers in the space below. Also, please circle the different terms in the above discussion that represent our different MILS (Moisture, Instability, Lift, and Shear) ingredients and label them as M, I, L, or S.

It's now the morning of Tuesday, May 24, 2011. Being the day of the event, you now have much more information available to you as shown below in the 8AM outlook. This includes the overall categorical risk for the day (top left) as well as probabilities for tornadoes (top right), hail (bottom left), and wind (bottom right), plus the discussion (bottom).



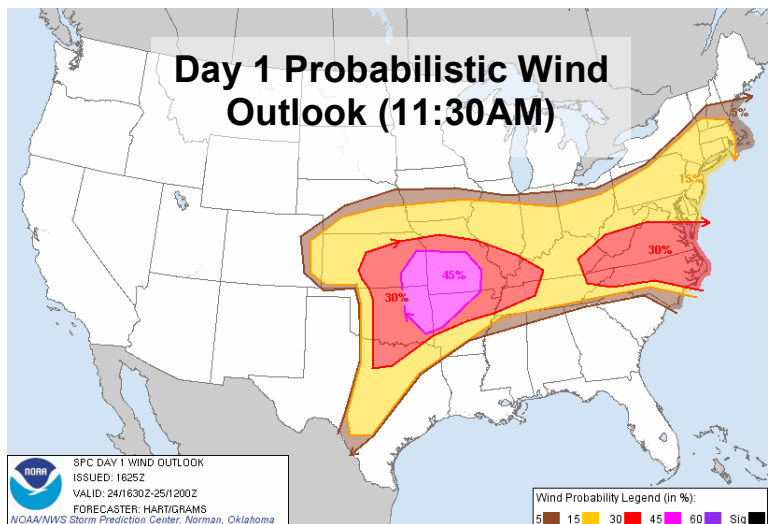
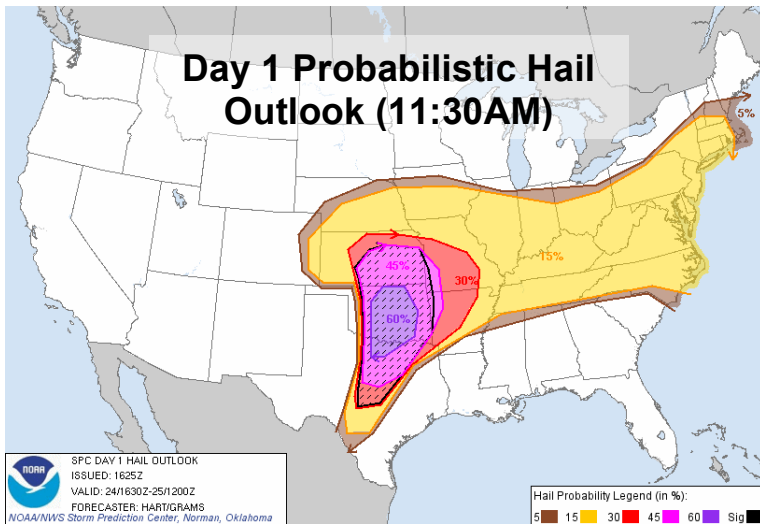
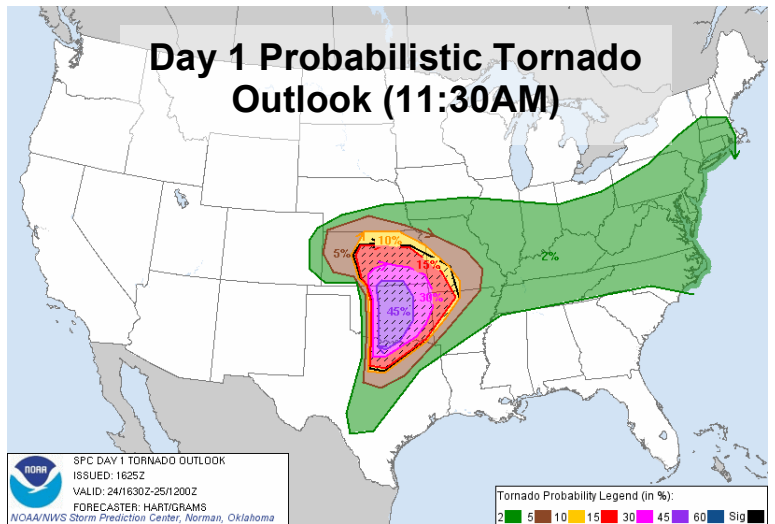
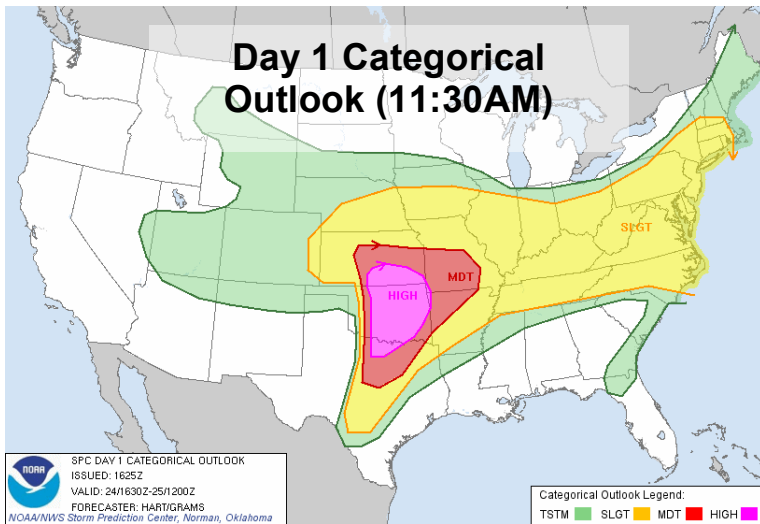
...TORNADO OUTBREAK EXPECTED OVER PARTS OF THE SRN AND CNTRL PLNS AND OZARKS LATER TODAY INTO TONIGHT...

ALTHOUGH SOME POTENTIAL WILL EXIST FOR POSSIBLE STORM INTERFERENCE...ESPECIALLY WITH NWD EXTENT IN HIGH/MDT RISK AREA...SETUP STILL APPEARS FAVORABLE FOR AT LEAST FEW LONG-LIVED DISCRETE/SEMI-DISCRETE STORMS. GIVEN STRENGTH OF WIND FIELD AND STRONG LWR TROPOSPHERIC VEERING DUE TO WWD POSITION OF SFC LOW AND SLIGHT NEG TILT OF UPR VORT...POTENTIAL ALSO WILL EXIST FOR LONG-LIVED STRONG TORNADOES... ESPECIALLY IN CNTRL/ERN/NRN OK. WEAK W-E BOUNDARY NOW INVOLVING THE RED RVR SHOULD MOVE/REDEVELOP NEWD LATER TODAY. THIS FEATURE MAY SERVE AS A SECONDARY FOCUS FOR STORM DEVELOPMENT...AND/OR ENHANCE LOW LVL HELICITY...OVER PARTS OF CNTRL/ER OK LATER TODAY.

...CORFIDI/SMITH.. 05/24/2011

Question 4. What message regarding today's weather situation will you convey to your jurisdiction (county commissioner, mayor, or other)? Write that below.

It's now 11:30AM on Tuesday, May 24, 2011. An updated forecast has just come out – check it out below.



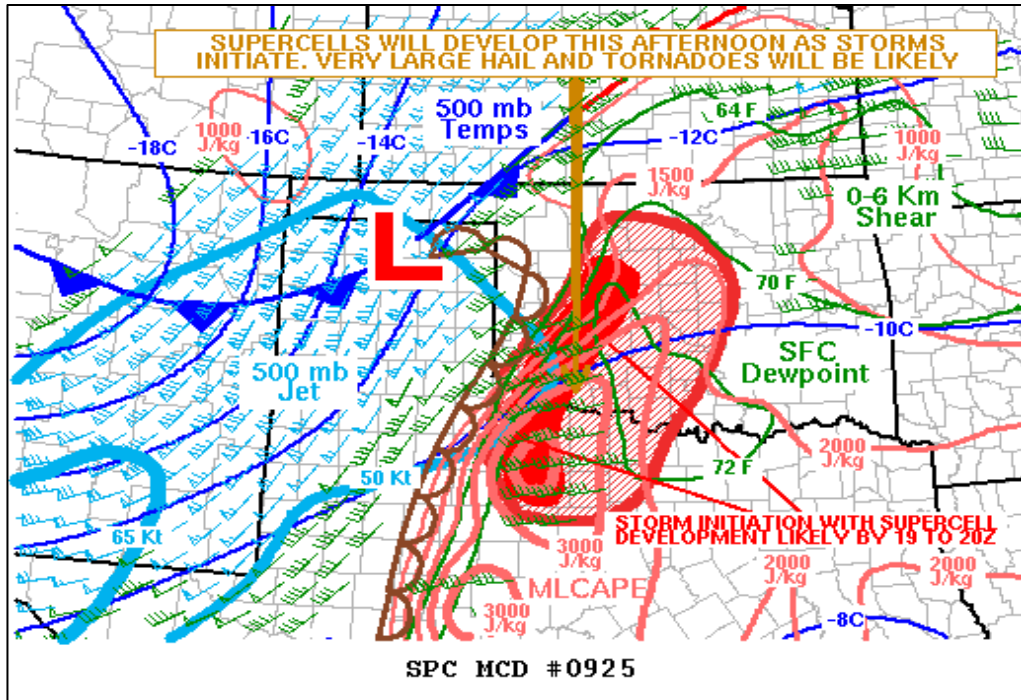
...AN INTENSE OUTBREAK OF TORNADOES AND WIDESPREAD SEVERE THUNDERSTORMS IS EXPECTED LATER TODAY OVER PORTIONS OF KS/OK/TX...

AS THE AFTERNOON PROGRESSES...CONTINUED HEATING AND LARGE SCALE LIFT DUE TO APPROACHING UPPER TROUGH MAY LEAD TO MULTIPLE ROUNDS OF CONVECTIVE DEVELOPMENT ALONG THE DRYLINE. THESE STORMS WILL ALSO TRACK ACROSS THE HIGH RISK AREA DURING THE EVENING. LOW LEVEL WINDS WILL BE STRENGTHENING...WITH ALL CONDITIONS FAVORING THE POTENTIAL FOR LONG-TRACKED STRONG/VIOLENT TORNADOES AND VERY LARGE HAIL OVER PORTIONS OF NORTH TX...CENTRAL OK...AND CENTRAL KS.

..HART/GRAMS.. 05/24/2011

Question 5. You need to provide a situation update on today's forecast to your jurisdiction's leadership (county commissioner, mayor, or other). In the space below write down the update you would provide them based on how the forecast has evolved since the morning.

The beginning of the storm event appears to be only a couple hours away now. To keep ahead of the situation, you continue monitoring products from the SPC. One of the products you view is a Mesoscale Discussion issued at 12:18PM, which is shown below.



MESOSCALE DISCUSSION 0925
NWS STORM PREDICTION CENTER NORMAN OK
1218 PM CDT TUE MAY 24 2011

AREAS AFFECTED...NW TX...WRN AND CNTRL OK

CONCERNING...SEVERE POTENTIAL...TORNADO WATCH LIKELY

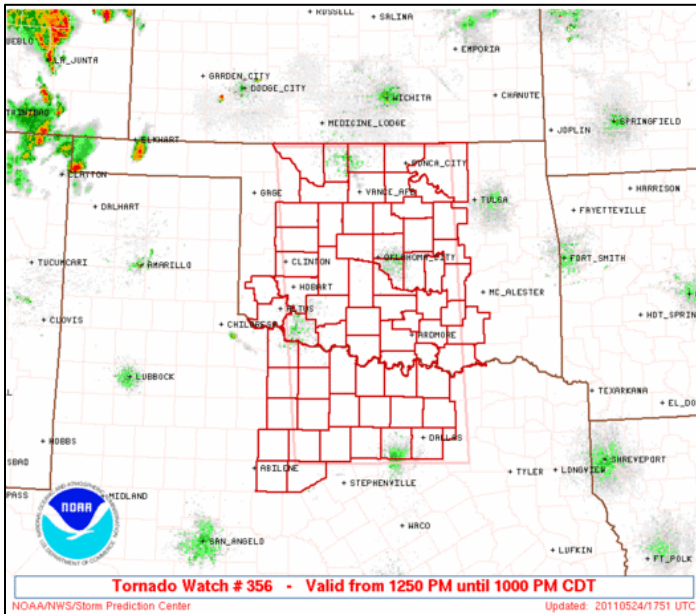
VALID 241718Z - 241845Z

STORM INITIATION IS EXPECTED ACROSS WRN OK AND NW TX OVER THE NEXT HOUR. SUPERCELLS SHOULD RAPIDLY DEVELOP WITH A THREAT FOR LARGE HAIL AND TORNADOES. A TORNADO WATCH WILL LIKELY NEED TO BE ISSUED BY 18Z. SFC ANALYSIS SHOWS A 997 MB LOW IN THE NRN TX PANHANDLE WITH A DRYLINE EXTENDING SWD FROM THE LOW ACROSS FAR WRN OK INTO WEST TX. THE DRYLINE IS STARTING TO ADVANCE EWD WITH VISIBLE SATELLITE IMAGERY SHOWING AN EXPANDING FIELD OF CUMULUS FROM I-40 IN WRN OK SWD TO NEAR SAN ANGELO IN WCNTRL TX. AS FURTHER DESTABILIZATION OCCURS THIS AFTERNOON AND THE CAP WEAKENS...RAPID CELL INITIATION IS EXPECTED TO OCCUR ALONG THIS CORRIDOR. AS THIS OCCURS...A 50 TO 65 KT MID-LEVEL JET EJECTING NEWD TOWARD THE SRN PLAINS WILL CREATE STRONG DEEP LAYER SHEAR PROFILES VERY FAVORABLE FOR SUPERCELLS. AS STORMS INTENSIFY...VERY LARGE HAIL GREATER THAN 2 INCHES IN DIAMETER WILL BECOME LIKELY. IN ADDITION...A 30 TO 40 KT LOW-LEVEL JET IS IN PLACE ACROSS NW TX AND WRN OK. AS THIS FEATURE STRENGTHENS...LOW-LEVEL SHEAR WILL BECOME VERY FAVORABLE FOR TORNADOES. WITH 0-3 KM STORM RELATIVE HELICITIES INCREASING INTO THE 450 TO 600 M2/S2 RANGE...LONG-TRACK STRONG TORNADOES ARE EXPECTED TO OCCUR LATE THIS AFTERNOON INTO EARLY THIS EVENING.

..BROYLES.. 05/24/2011

Question 6. What information do you take away from this forecast and what actions (if any) would you take as a result? Write your answer below.

At 12:50PM a PDS tornado watch is issued. The watch graphic, discussion, and hazard probabilities assigned to the watch are all shown below.



Tornadoes

Probability of 2 or more tornadoes	High (90%)
Probability of 1 or more strong (F2-F5) tornadoes	High (70%)

Wind

Probability of 10 or more severe wind events	Mod (50%)
Probability of 1 or more wind events > 65 knots	Mod (60%)

Hail

Probability of 10 or more severe hail events	High (90%)
Probability of 1 or more hailstones > 2 inches	High (80%)

Combined Severe Hail/Wind

Probability of 6 or more combined severe hail/wind events	High (>95%)
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URGENT - IMMEDIATE BROADCAST REQUESTED
 TORNADO WATCH NUMBER 356
 NWS STORM PREDICTION CENTER NORMAN OK

1250 PM CDT TUE MAY 24 2011

THE NWS STORM PREDICTION CENTER HAS ISSUED A TORNADO WATCH FOR PORTIONS OF

WESTERN AND CENTRAL OKLAHOMA
 NORTHWEST AND NORTH-CENTRAL TEXAS

EFFECTIVE THIS TUESDAY AFTERNOON AND EVENING FROM 1250 PM UNTIL 1000 PM CDT.

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

DESTRUCTIVE TORNADOES...LARGE HAIL TO 3 INCHES IN DIAMETER...THUNDERSTORM WIND GUSTS TO 70 MPH...AND DANGEROUS LIGHTNING ARE POSSIBLE IN THESE AREASDISCUSSION...TSTM INITIATION IS ANTICIPATED WITHIN THE NEXT HOUR OR TWO ALONG THE DRYLINE FROM WRN OK INTO W-CNTRL TX. STRONG HEIGHT FALLS/DYNAMIC FORCING FOR ASCENT ASSOCIATED WITH NEGATIVELY TILTED MIDLEVEL TROUGH EMERGING INTO THE PLAINS SHOULD SUPPORT A RAPID INCREASE IN STORM COVERAGE THROUGH THE AFTERNOON. WARM SECTOR AIR MASS IS CHARACTERIZED BY A VERY MOIST BOUNDARY LAYER WITH DEWPOINTS IN THE UPPER 60S TO LOWER 70S. WHEN COUPLED WITH STEEP MIDLEVEL LAPSE RATES...ENVIRONMENT IS MODERATELY TO STRONGLY UNSTABLE WITH MLCAPE VALUES OF 2500-4000 J/KG. DEEP-LAYER SHEAR STRENGTHENING TO 40-50 KT WILL PROMOTE RAPID SUPERCELL DEVELOPMENT WITH THE INITIAL HAZARD BEING VERY LARGE HAIL. INITIAL VEER-BACK WIND PROFILE OBSERVED IN CURRENT VADS/PROFILERS IS EXPECTED TO TRANSITION TO LARGE CLOCKWISE CURVED HODOGRAPHS BY 00Z WHERE 0-1 KM SRH WILL APPROACH 400-500 M2/S2. AS SUCH...EXPECT A RAPID INCREASE IN THE THREAT FOR TORNADOES THIS AFTERNOON INTO EVENING...SOME OF WHICH COULD BE LONG-TRACKED AND STRONG TO VIOLENT.

...MEAD

Question 7. How would you make use of this information to continue your emergency operations as well as inform the necessary individuals in your jurisdiction? Write down what you would do with this information below. Also, please circle the different terms in the above discussion that represent our different MILS (Moisture, Instability, Lift, and Shear) ingredients and label them as M, I, L, or S.

Question 8 (final question!). Consider the preparations you made for this event as an emergency manager in Central Oklahoma. Was the information you viewed here sufficient enough and with enough lead-time to adequately prepare your jurisdiction for this day? Briefly explain. If the information wasn't sufficient, explain what other information or additional sources you would have needed. Write your answers below.