Weather Event Simulator

Simulation Guide: *April 8, 1998 Event*

Presented by the

Warning Decision Training Branch

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Ed Mahoney, Chief

Warning Decision Training Branch
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Document History

This simulation guide was originally completed on February 28, 2002. In order to track updates and changes, the document history is provided here. The version number, seen at the bottom of every page will be updated as each significant change is made to the simulation guide.

Version	Date	Description
1.0	28 Feb 2002	Initial release.
1.1	01 Mar 2002	• Added Document History. • Changed gray scale images in Appendices to color. • Corrected minor typographical errors. • Added blank pages to Virtual Reality Simulation - Self Study to facilitate printing the Trainee Job Sheet. As a result of these edits, page numbers have been shifted in some portions of the document.
1.2	08 Mar 2002	• Added names previously left off of the acknowledgements, with our apologies. • Corrected minor typographical errors. • Highlighted usage note in How to Use This Document chapter. • Added titles to Appendices and updated corresponding cross references. • Added WDTB URL, below.

Note: the date of modification is listed on the cover page.

To provide feedback, comments or ideas related to this document, please visit our web site at: http://wdtb.noaa.gov

Table of Contents

1: How to Use This Document

I. Introduction

Welcome to the ***April 8, 1998*** simulation guide! The purpose of this guide is to provide the trainer at a forecast office with guidance on preparing and delivering effective severe weather simulations using this case. This guide is being released in accordance with the Weather Event Simulator Integration and Operations Plan (WES IOP).

Since this document outlines the "answers" to the challenges of the event, it is specifically meant for the use of the trainer only.

A simulation can be as simple (view data and practice using WarnGen) or as involved (pause simulation to discuss warning decisions and the impacts of all data on these decisions) as needed. ***The simulation length can be modified depending on the time available for training, the needs of the trainee, and the focus of the training.*** The simulation can focus on the technology alone, the science alone, or the interactions between these two and the human decision maker (i.e. simulating an actual event). This guide is the first in a series of training guides, each associated with specific cases identified in the WES IOP. With this guide, the trainer can summarize the key points of a particular case, choose the type of simulation appropriate for the trainee, and then see an example of how to run that simulation type.

See Table 1-1 for a description of the layout of this document.

Table 1-1: Simulation Guide Layout

How to Use This Document	
Introduction	The introduction describes contents of the simulation guide and how to use this document.
Simulation Types	This section provides a brief, generic description of the various types of simulations presented in this document. Read this section to help you decide which type of simulation best fits the needs of the trainee (e.g., one which focuses on interpretation skills, or the use of AWIPS, or timing capabilities, or all the above).

Table 1-1: Simulation Guide Layout

The April 8, 1998 Event	
Overview	The event overview provides a summary of the key components of this event. Read this section to get a brief overview of the type of weather or challenges associated with the case.
Prepared Simulations	
Real Time Simulation, Interval Based Simulation, Situation Awareness Simulation, Virtual Reality Simulation - Guided, Virtual Reality Simulation - Self Study, Case Study Simulation	Prepared simulations are provided in this portion of the simulation guide. Each one contains directions on when to start/stop the simulation, objectives, tasks, expected results, and talking points to help hone in on certain features.
Supporting Data	
Storm Reports	Storm Reports contains a graphical plot of Storm Data and a text list of Storm Data valid for the simulations.
SPC Products	SPC Products contains graphical plots of the watches/outlooks and text discussion SPC products.
Support Materials	Support Materials contains a CWA map and a useful form for documenting issued warnings and advisories.

To prepare to run a simulation, the trainer should read ***How to Use This Document*** as the background necessary to choose and deliver effective simulations. The trainer may wish to modify the provided simulations, or develop their own simulations with specific learning objectives. The prepared simulations are the “scripts” designed for one-on-one training, where ***trainer and trainee participate together for the optimum learning experience***. Training research indicates this is the most effective way to run a simulation. If this collaboration is ***absolutely*** not possible, one simulation example has been included that does not require the trainer to be present (Virtual Reality Simulation - Self Study). Experience gained from running simulations can be used to guide future training activities.

In order to manage a simulation session, the trainer must be able to run a simulation as documented with the WES install and testing instructions included with the WES software. The simulations will be much more relevant if local WarnGen templates and procedures are created on the WES machine or moved over from the local AWIPS prior to running the simulations. For more detailed information on these techniques as they become available, visit http://www.comet.ucar.edu/strc/wes/.

II. Simulation Types

Real-time Simulation

A real-time simulation focuses on mastering warning mechanics and developing routines where the simulation runs from start to finish without interruption. The training objective is to demonstrate effective and timely manipulation of AWIPS data and applications (e.g., WarnGen) for the purpose of developing timely warning products.

Interval-Based Simulation

An interval-based simulation focuses on detailed discussions of critical warning points utilizing pauses in the simulation. The training objectives are to demonstrate methods of data interpretation, effective use of AWIPS data, proper type and content of warnings, and weighing information in the decision making process. In addition, the trainee should demonstrate ways to handle uncertainty in the warning decision making process.

The objectives of the interval-based simulation are achieved by the **trainer and trainee** working together through a simulation that is occasionally paused to invoke the question-and-answer process. Direct observation of actions taken by the trainee during important decision points during the simulation can provide excellent opportunities for the trainer to discuss applications of effective warning decision making.

Situation Awareness Simulation

A situation awareness simulation focuses on evaluating the trainee's ability to perceive and understand warning inputs and project this into expectations and action. For this level of simulation, the trainer will occasionally pause the simulation to query the trainee on interpretation of events. Through this process, the trainer attempts to deduce whether the trainee is maintaining all three levels of situation awareness. The training objective at this level of simulation is to ***demonstrate awareness of the situation***.

During this type of simulation, the pausing or “freezing” of simulated data (at an unannounced time) provides an opportunity for the trainer to assess the level of situation awareness that the trainee has of a given situation by asking three questions:

1. Does the trainee recognize the data? (e.g. are they aware of all potentially severe storms?)

2. Does the trainee understand the meaning of the data? (V_r of 50kts, strong backing low-level winds, etc.)

3. Has the trainee formed an expectation based on these data?

As in the interval-based simulation, monitoring of the trainee’s level of situation awareness and subsequent decision-making process is only achieved via the trainer’s questioning on the methodologies and conceptual models used in the decision-making process.

Virtual Reality Simulation

The virtual reality simulation mode is intended to most closely resemble what can happen in the office for a real event. The training objective of the virtual reality simulation is to effectively manage all aspects of a challenging and distracting warning environment while still producing quality products. For example, the trainer might provide conflicting information (spotter reports without supporting radar data) or interject problems (primary radar data unavailable) that the trainee has to react to and overcome during the simulation. This simulation focuses on the highest level of performance and critical thinking skills that should be present with an expert warning forecaster. Running the expert forecasters on staff first through the virtual reality simulation may be a good place to start using WES to enhance a local training plan. Experiences in this simulation can be used to incorporate local knowledge and expertise into future simulations for others forecasters on staff.

Case Study Review

The case study review is appropriate for simulating analysis and manipulation of data sets, including longer-fused events (such as a developing winter storm). Objectives for this type of training depend on the type of event and the forecast problem (boundary analysis, precipitation type forecasting, model initialization, etc.). Training objectives should be based on demonstration and recognition of the strengths and limitations of the various data sets and procedures which are best used to make the watch or warning decision.

The *April 8, 1998* Event

Overview

On the afternoon and early evening of April 8th, 1998, a significant severe weather outbreak occurred over the southeast US. This was a high risk situation with the potential for widespread severe weather, including significant tornadoes. Despite the tornado outbreak potential, only two storms out of many in the Birmingham CWA produced tornadoes. One storm in north-central AL produced a brief, weak tornado, while the other storm in central AL produced a family of three tornadoes with F3, F5, and F2 damage, respectively. The F5 tornado was a particularly devastating event that struck the metropolitan area of Birmingham, AL. The Birmingham storm caused 34 fatalities, 272 injuries, and $42 million in property damage, with more than 1000 homes being severely damaged or destroyed.

The widespread nature of the severe weather provides for a wide range of simulation types covering different learning objectives. Some of the unique aspects of this event include being able to properly anticipate and effectively warn for widespread severe weather and a devastating tornado event. The low number of tornadic storms also provides a unique opportunity to explore discriminating tornado forecasting in an environment with high expectations and important variations on the mesoscale. In addition to the tornado element of the event, widespread large hail occurred (golf ball and some baseball size), and a few storms produced isolated damaging wind gusts (50 to 60 kts). Flooding was not reported for this event. For a plot of storm data and the report list, see Appendix A.

2: Real Time Simulation

I. Introduction

This real-time simulation example focuses on the area of the CWA that contains hail producing supercells becoming more elevated with time. The simple signatures and manageable workload with these storms allows the trainee time to focus on using WarnGen and developing timing skills. This simulation is appropriate for a novice warning forecaster who has been exposed to using WarnGen and can benefit from focusing primarily on the mechanics of issuing warnings.

Objectives

The training objectives of this real-time simulation are to demonstrate:

- Ability to effectively use WarnGen to create warnings.
- Ability to effectively use WarnGen to issue severe weather statements as a follow up warning product.
- A timely routine for calling up products to evaluate the threat for tornadoes, hail, wind, and flooding.

Responsibilities

Support materials in sections I (Introduction), II (Pre-simulation Briefing), III (Simulation), IV (Post-simulation Briefing), and V (Trainer Evaluation Guide), have been designed for a two person training session with the following responsibilities:

Trainee

Pre-Brief: Obtain a summary shift change briefing by the trainer.

Simulation: Issue warnings and follow up statements for the sector containing all storms south and east of the KBMX radar.

Post-Brief: Discuss with the trainer any lessons learned and how they can be implemented at the local office.

Trainer

Pre-Brief: Set up the simulation and give a shift change briefing summarizing the threat for all severe weather types (tornado, hail, wind, flooding).

Simulation: Manage the simulation, evaluate the performance of the trainee, and interject spotter reports.

Post-Brief: Discuss trainee performance, any lessons learned from the simulation, and how they can be implemented at the local office.

This real-time simulation is designed to take 3.5 hours to complete, with 15 minutes for the pre-simulation briefing, 2.75 hours for the simulation, and 30 minutes for the post-brief. As with all simulation examples, times can be adjusted as needed. The simulation starts at 2200 UTC on April 8^{th}, 1998 and ends at 0045 UTC on April 9^{th}, 1998. The following sections are designed for the ***trainer to use*** to instruct and evaluate the trainee.

II. Pre-simulation Briefing

The objective of the pre-simulation briefing is for the trainer to briefly describe the threat for severe weather (tornado, hail, wind, and flash flooding) to the trainee. The trainer should step through the following tasks to prepare the simulation.

Trainer Tasks

1. Provide a pen and paper for the trainee to keep track of warnings issued and expiration time. (A useful form is provided in Appendix C.)

2. Close down any existing D2D sessions, and start the simulator for the time period 2221 UTC on April 8^{th}, 1998 to 0045 UTC on April 9^{th}, 1998.

3. Stop the simulator immediately to allow the trainer to brief the trainee on the environment up to the start time.

4. Start a D2D session, and if the trainee’s local procedures have not been recreated on the WES, the trainer may wish to give the trainee more time to create procedures, or the trainer may wish to build them for the trainee.

5. Provide a pre-simulation briefing for the trainee. Some elements that may be used include:

- Load a 0.5° Z/SRM from the KBMX radar and overlay the CWA map to familiarize the trainee with the geography, and inform trainee they will be responsible for warning for all storms south through east of the radar.
- Point out on the SPC products provided in Appendix B that the warning sector is in a high risk area, within but close to the edge of a particularly dangerous situation (PDS) tornado watch with threat for damaging tornadoes, hail to 3 inch diameter, and wind gusts to 80 mph.
- Point out the east-west oriented band of convection developing and moving into the warning sector for this simulation.
- Load ETA 4 panel family on regional scale and show the ETA is developing storms over northern AL ahead of the upper forcing and cold front by 00 UTC.
- On a clear state scale load surface obs, then vis satellite, then LAPS CAPE and CIN (four product overlay) to point out storms will be moving into colder more stable air as they cross a significant north-south oriented stability boundary in this warning sector. Storms should be monitored for signs of rapid changes in intensification/rotation, but the tornado threat decreases as the storms move into deeper colder air.
- Load a LAPS 0-6km bulk shear vector horizontal plot using the volume browser (under the “Fields” menu select “Convect” and choose “Shear Fields” to locate the product) on a WFO scale map to point out widespread strong shear (~ 70 kts) supporting supercells over the whole CWA.
- Load a LAPS “Right Moving Supercell” storm motion horizontal plot to point out right moving supercell predicted motion of ~250° at 35 kts.
- Load a LAPS point sounding in Tallapoosa county using the volume browser.
- Point out the significant instability is elevated (surface based ~600 J/kg, elevated parcel ~ 1600 J/kg determined using the interactive skew-T), and that may limit tornado production.
- Point out that the moderate helicity values (200-250 m/s using LAPS estimated storm motion and the hodograph) will likely not be realized with elevated storms, thus decreasing the tornado threat.
- Point out that although wet-bulb zero heights are relatively high (11.7 kft), supercell processes still support large hail growth.
- Point out saturated/stable air and weak winds in lower troposphere may limit damaging wind threat.

- Point out that widespread flooding is not expected with relatively fast storm motions.
- Load an ETA point sounding on CONUS scale for the same point and illustrate the increased threat of severe weather with time as the wind fields are expected to strengthen from 18 to 00 UTC.

6. Inform the trainee that the flash flood guidance for the BMX CWA is approximately 1.5” for one hour, and 2” for three hours.

7. Summarize that the expected storm type is for supercell storms that may become more elevated with time as they move into the colder stable air. Tornado threat will be maximized as storms cross the north-south oriented stability boundary, so storms should be monitored closely for rapid increases in intensity and rotation. The most common threat for storms will be large hail, though very large sizes may be limited by the high wet-bulb zero heights and elevated instability. Damaging wind threat is low initially though the threat increases slightly with time as the models forecast strengthening wind fields. Flash flooding threat is low due to relatively fast storm motions.

III. Simulation

The training objectives of this real-time simulation are to demonstrate:

- Ability to effectively use WarnGen to create warnings.
- Ability to effectively use WarnGen to issue severe weather statements as a follow up warning product.
- A timely routine for calling up products to evaluate the threat for tornadoes, hail, wind, and flooding.

This 2.75 hour simulation starts at 2200 UTC on April 8th, 1998, and ends at 0045 UTC on April 9th, 1998. The trainee will be asked to warn for the sector containing all storms south and east of the radar. The trainer should use the Section V Trainer Evaluation Guide to assist in evaluating trainee performance.

Trainer Tasks

1. Explain the objectives to the trainee (see page 2-1).

2. State to the trainee that:

- There will be no pauses during the simulation.

- The trainer will be forwarding spotter reports to the trainee during the simulation.

3. Close down any existing D2D sessions, and start the simulation for the time period 2200 UTC on April 8th, 1998 to 0045 UTC on April 9th, 1998. Then start new D2D sessions. Note that this start time is earlier than in the pre-simulation briefing to allow the trainer some extra time to show trainee how to issue a warning and severe weather statement, and save the product to a file. If only a single monitor exists, the trainer may wish to load two D2D sessions on one monitor to help mitigate the hardware limitation.

4. Take about 10 minutes to show the trainee how to create a warning, follow-on severe weather statement, and how to save it to a file. To export a warning to a file after the warning has been typed up:

- In the text editor, click under “File”, “Export to File...”.
- Type in the name of the warning at the end of the path in the “filename” box on the bottom of the popup window and click OK.

5. Inform the trainee to take 5-10 minutes to set up their D2D sessions and start warning.

6. During the simulation, provide storm reports as spotter reports. Use the reports listed in the Trainer Evaluation Guide on page 2-6 (consult image in Appendix A for graphical locations).

7. Evaluate the trainee’s ability to issue timely severe weather products and their warning routines using the Trainer Evaluation Guide on page 2-6.

8. At 0045 UTC (the end of the simulation), give the trainee a 5 minute break.

IV. Post-simulation Briefing

The objective of this post simulation briefing is to discuss the trainee’s ability to issue timely severe weather products and their warning routines used in the simulation. The trainee should first be asked to give their perceptions of the simulation, and then should work with the trainer to evaluate performance and issues pertaining to the local warning operations. The trainer should use the evaluation completed during the simulation to focus discussion on relevant issues.

Trainer Tasks

1. Ask the trainee to self evaluate performance on:

- Using WarnGen to create warnings.
- Using WarnGen to issue severe weather statements as a follow-up warning product.
- Demonstrating a routine for evaluating threat for tornadoes, hail, wind, and flooding.

2. Discuss the observations of performance noted during the simulation. Utilize the warning files that were saved in the evaluation process.

V. Trainer Evaluation Guide

The focus of the real-time simulation is not on whether correct warning decisions were made; rather, it is on whether the warnings and severe weather statements were created properly and efficiently, and whether appropriate warning routines were used to evaluate the severe weather potential. Suggestions for issues to evaluate while the trainee is creating products during the simulation are included below, as well as a storm-by-storm breakdown of important features in the data (including spotter reports) for the trainer to use during the simulation:

Warnings

- Is the method of calculating the storm motion with WarnGen adequate? Does the trainee start at the end of a loop of 0.5° reflectivity and step back 3-4 frames before dragging the circle to the feature being tracked? Does the trainee step through the loop to insure the tracking is adequate and correct it if it is not?
- Does the trainee click on the Redo Box button to redraw the box after obtaining an adequate storm motion?
- Does the trainee modify the polygon appropriately next to county boundaries? Are all the counties in the polygon selected correctly before the warning text is created?
- Is the duration of the warning appropriate for the workload?
- Does the trainee utilize the appropriate product type and optional bullets in choosing the text? Is the text modified to discuss only the primary threats specific to the storm being interrogated? Are they over-using call to action statements? Is the magnitude of the threat conveyed clearly in the warning (e.g. quarter size or baseball size hail)? Are spotter observations mentioned in the text?

- Does the trainee appear to read the warning before sending it out? Are there text mistakes in the warnings?
- Are the important cities in the path of the storm identified in the warning?
- If pathcasting is being used, is it overly precise given the uncertainty in the movement of the storm?
- Is the trainee falling behind in monitoring all the storms because of problems using WarnGen?

Severe Weather Statements

- Is the polygon moved and resized reasonably to where the storm is at the latest 0.5° reflectivity image in the loop?
- Is any new pertinent information being included in the statement (storm has intensified, weakened, showing signs of even larger hail)?
- Are the follow-on statements timely given the workload (at least one per warning)?
- Does the content of the statement reflect the locations and general content of the original warning?

Methodology

- Does the trainee evaluate each severe weather threat prior to creating the first warning?
- Are the product choices optimal to evaluating the threat?
- Is the trainee using all tilts Z/SRM to evaluate the latest data and three dimensional storm structure?
- Is the choice of tilts in the 4 panel chosen appropriately to sample the low, middle, and upper levels of the storm to look at temporal changes in the evolution?
- Is SRM being used to evaluate rotation?
- Is the 0.5° base velocity periodically checked for signs of strong ground-relative winds even though the wind threat is not high?
- Are the radar estimated precipitation totals being checked occasionally, particularly for the storms moving over the same area in Tallapoosa and Chambers county?

- Are the reflectivity characteristics in middle and upper levels being evaluated with all tilts Z/SRM (or layer 2 LRM) and VIL for high reflectivity cores aloft for evaluating hail threat?
- Is base data used along with derived products (VIL, CR, radar algorithms)?
- Is satellite data being monitored for cold cloud tops and overshooting tops?
- Is lightning data being used to look for dense clusters of cloud to ground lightning indicating strong updrafts?
- Are changes in objective analysis fields such as LAPS CAPE/CIN, etc. being investigated at some time during the simulation?
- Are raw observations of the environment being investigated (surface obs, KBMX VWP)?
- Are meso-analysis fields reviewed when the new surface observations are in at the top of the hour and when the new objective analysis fields are in at 20 minutes after the hour?
- Is the most recent data always being accessed when evaluating a storm?
- Is the trainee using the overestimates in the hail algorithm maximum estimated hail size in the warning, or are they using the algorithm output as general guidance?
- Is the trainee able to perform tasks and still keep up with new incoming data?

General Issues

Time (UTC)	Description
2356	precipitation accumulations from KBMX are reset to zero (This is an artifact of the process of developing this case.)

Storm Summary

During the simulation there are at least five storms south and east of the radar that require more detailed monitoring. The first storm to monitor moves from Elmore to Tallapoosa to Chambers county and produces hail up to golf ball size. The second storm moves over the same path as the first (Elmore to Tallapoosa to Chambers county #2) and produces hail up to golf ball size. The third through fifth storms to monitor evolve out of a multi-cell complex with right movers and left movers. The left moving storm that moves from Chilton to Coosa to Talladega county produces dime size hail, and the other storms have no severe weather reported with them. Though there is rotation in mid and upper levels, there is no organized low-level rotation with any of the storms. The southeast part of the CWA can be used as a good example of how to safely discriminate between tornadic and non-tornadic storms using radar data and mesoscale analysis. The lack of organized low-level rotation and the elevated instability (and high surface based CIN) combine to suggest the tornado threat, in this situation, was inhibited due to the elevated nature of the storms.

Elmore-Tallapoosa-Chambers County Storm Reports

Time (UTC)	Description
2233 KBMX	broad appendage developing, though low level is not organized
2210	nickel hail in Deatsville (Elmore county)
2228 KBMX	LRM high reflectivity core aloft intensifying on cyclonic member of splitting storm
2238 KBMX	VIL increase to 45 kg/m^2
2249 KBMX	VIL increase to 55 kg/m^2
2250	1" hail 6 S Alexander City (Tallapoosa county)
2300	1" hail 8 N Dadeville (Tallapoosa county)
2314-2325 KBMX	VIL 65 and 70 kg/m^2, HI MEHS suggests golf ball to baseball hail
2325	golf ball hail 3 N Lafayette (Chambers county)
2330	1" hail 8 N-NE Lafayette (Chambers county)
2335	hail 9 NE Lafayette (Chambers county)
	dime size in Fredonia (eastern Chambers county)
	quarter size in Five Points
	golf ball size in Buffalo (central Chambers county)

Autauga-Elmore-Tallapoosa-Chambers County Storm (#2) Reports

Time (UTC)	Description
2330 KBMX	LRM high reflectivity core aloft intensifying and VIL 45 kg/m^2
2335-2345 KBMX	LRM high reflectivity core aloft intensifying more and VIL 50, 55, and 60 kg/m^2, and HI MEHS suggests 1.5-2.0A hail
2350	golf ball hail in Kent (western Elmore county)
0006-0012 KBMX	LRM high reflectivity core aloft intensifying and VIL 50, 55 kg/m^2
0037	hail 12 W Dadeville (Tallapoosa county)
	dime size near Wind Creek State Park
	golf ball in Our Town (western Tallapoosa county)
0028	0.75 A hail 6 SSE Alexander City (Tallapoosa county)
0032 KBMX	LRM high reflectivity core aloft intensifying and VIL 50, 55 kg/m^2
0033	dime hail 5 SE Alexander City (Tallapoosa county)
0037 KBMX	HI MEHS suggests hail to 1.5"

Chilton-Coosa-Talladega County Storm (left mover) Reports

Time (UTC)	Description
2345 KBMX	LRM high reflectivity core aloft intensifying and VIL 40 kg/m^2
2350	dime hail in Pleasant Grove 14 NW Clanton (Chilton county)
0001 KBMX	LRM high reflectivity core aloft intensifying
0012 KBMX	VIL increase to 40 kg/m^2

Dallas-Chilton-Coosa County Storm (right mover) Reports

Time (UTC)	Description
0027 KBMX	reflectivity appendage developing with no organized low-level rotation

3: Interval Based Simulation

I. Introduction

This simulation allows the trainee to develop critical thinking skills. To that end, the trainer and trainee should come to consensus through discussion when arriving at decision points.

The simulation focuses on the unique aspects of handling warning responsibility for a warning sector containing a variety of supercells with significantly different signatures that produce large hail, isolated severe winds, and one tornado. Because of the numerous non-tornadic supercells in an environment expected to produce widespread tornadoes, this simulation lends itself to discussing issues relating to the feasibility of discriminating between tornadic versus non-tornadic supercells. At various points in the simulation, the WES trainer will pause the simulation and query the trainee about specific learning points. The trainer and trainee should discuss decisions based on the available information and expected outcomes. This simulation is appropriate for a warning forecaster who is proficient at issuing warnings and can benefit from practicing handling conflicting information and challenging warning workloads.

Objectives

The training objectives of this interval-based simulation are:

- Demonstrate effective methods of data interpretation.
- Demonstrate proper type and content of warnings.
- Demonstrate how to weigh information and handle uncertainty in the warning decision making process.

Responsibilities

Support materials in sections I (Introduction), II (Pre-simulation Briefing), III (Simulation), IV (Post-simulation Briefing), and V (Trainer Evaluation Guide) have been designed for a two person training session with the following responsibilities:

Trainee

Pre-Brief: Analyze the environmental data, issue a briefing detailing the threat for all severe weather types, sectorize the county warning area into three warning sectors.

Simulation: Issue warnings and follow up statements for a sector covering the storms in northwest and north-central part of the CWA.

Post-Brief: Discuss with the trainer any lessons learned and how they can be implemented at the local office.

Trainer

Pre-Brief: Set up the simulation, evaluate and discuss trainee briefing and rationale behind the trainee's sectorizing for this event.

Simulation: Manage the simulation, pause the simulation and discuss important learning issues, and interject spotter reports.

Post-Brief: Discuss trainee performance, any lessons learned from the simulation, and how they can be implemented at the local office.

This interval-based simulation is designed to take 3.25 hours to complete, with 30 minutes for the pre-simulation briefing, 1.75 hours for the simulation, 30 minutes for simulation discussion, and 30 minutes for the post-brief. The simulation starts at 2321 UTC on April 8th, 1998 and ends at 0104 UTC on April 9th, 1998. As with all simulation examples, times can be adjusted as needed. The following sections are designed for the ***trainer to use*** to instruct and evaluate the trainee.

II. Pre-simulation Briefing

The objective of the pre-simulation briefing is for the trainee to assess the level of threat for severe weather (tornado, hail, wind, and flash flooding), formulate expectations of timing and evolution of convection, and sectorize the warning operations accordingly. The trainer should step through the following tasks to prepare the simulation and evaluate/document the trainee performance:

Trainer Tasks

1. Print map with county names and CWA outline from Support Materials (see Figure C-C-2 on page C-3) for drawing warning sectors.

2. Print out the warning log from Support Materials (see page C-1) so the trainee can keep track of the warnings they issue.

3. Close down any existing D2D sessions, and start the simulator for the time period 2321 UTC on April 8th, 1998 to 0104 UTC on April 9th, 1998.

4. Stop the simulator immediately to allow the trainee to investigate the environment up to the start time.

5. Start a D2D session, and inform the trainee they have 30 minutes to analyze the environment of the BMX CWA and give a briefing to the trainer. If the trainee's local procedures have not been re-created on the WES, the trainer may wish to give the trainee more time to create procedures.

6. Instruct the trainee to:

- Identify the level of threat for tornadoes, hail, wind, and flooding throughout the CWA.
- Create three warning sectors to divide up warning responsibility into manageable areas.
- Give a summary of the pre-simulation briefing analysis detailing the rationale behind the severe weather threats and why the sectors were chosen.

7. Briefly evaluate and discuss the reasoning behind the expected threat. In evaluating the trainee's briefing, consider the following:

- Widespread 0-6 km shear supports supercells throughout the CWA.
- Boundary in the eastern part of the CWA enhances threat for tornadoes as they move across the boundary, and less of a tornado threat as they move into more stable air.
- Elevated instability over the boundary in the eastern part of the CWA supports elevated supercells.
- Surface boundary evident in far NW AL (see vis and sfc obs) enhances tornado threat as boundary continues to destabilize and lift northward.
- Instability maximum in central AL enhances all severe weather threat in the 70+ dewpoint air.

- Low temperature-dewpoint spreads over central AL limits cold pool production, thereby decreasing damaging wind threat somewhat and increasing significant tornado potential.
- Weaker lower tropospheric winds decrease threat for damaging winds.
- Widespread risk of large hail with supercell storms despite relatively high wet-bulb zero heights.
- Relatively fast storm speeds do not support widespread threat of flash flooding except where storms train over same area.
- Immediate threat of severe in southeast, southwest, and northwest part of the CWA requires warning sector coverage.

8. Inform the trainee that the flash flood guidance for the BMX CWA is approximately 1.5” for one hour, and 2” for three hours.

9. Point out on the SPC products provided in Appendix B that the CWA is in a high risk area, and that a particularly dangerous situation (PDS) tornado watch has been issued with a threat for damaging tornadoes, hail to 3 inch diameter, and wind gusts to 80 mph.

10. Briefly evaluate and discuss the reasoning behind the sectorizing. Three optimal sectors include:

- the southern and eastern part of the CWA
  - where supercells will move over cooler and more stable surface air
- the line segment in the western and central part of the CWA
  - where storms will move into the instability and low-level shear maximum
- the storms in the northwest and northern part of the CWA
  - where instability is less and storms are more isolated

11. Instruct the trainee to take on responsibility of warning for a sector containing all storms north and northeast of the convective line extending from Pickens to Tuscaloosa county. Also state that during the simulation the trainee should communicate ways to modify the sector to address any potential confusion of responsibilities with storms crossing sectors.

III. Simulation

The training objectives of this interval-based simulation are to demonstrate effective methods of data interpretation, demonstrate proper type and content of warnings, and demonstrate how to weigh information and handle uncertainty in the warning decision making process. This simulation starts at 2321 UTC on April 8th, 1998 and ends at 0104 UTC on April 9th, 1998. At three times during the simulation (0001, 0045, 0104 UTC; unknown to the trainee), the simulation will be paused and the trainer will assess the trainee's warnings and methodology. Discussion is encouraged. For a storm-by-storm breakdown of important features in the data and important evaluation points, consult the Trainer Evaluation Guide on page 3-7.

Trainer Tasks

1. Explain the objectives to the trainee (see page 3-1).

2. State to the trainee that:

- There will be three pauses managed by the trainer, at surprise times, each lasting up to 10 minutes during the two hour simulation, at which times the trainer will query the trainee about their warnings and their methodology.
- The trainee should communicate any problem areas to the trainer when there are potentially severe storms crossing out of or into the warning sector outlined in the pre-simulation briefing.
- The trainer will be forwarding spotter reports to the trainee during the simulation.

3. Close down any existing D2D sessions, and start the simulation for the time period 2321 UTC on April 8th, 1998 to 0104 UTC on April 9th, 1998. Then start new D2D sessions. If only a single monitor exists, the trainer may wish to load two D2D sessions on one monitor to help mitigate the hardware limitation.

4. Show the trainee how to create a warning and save it to a file. To export a warning to a file after the warning has been typed up:

- In the text editor, click under “File”, “Export to File...”.
- Type in the name of the warning at the end of the path in the “filename” box on the bottom of the popup window and click OK.

5. Give the trainee 5-10 minutes to set up their D2D sessions.

6. During the simulation, provide storm reports as spotter reports. Use the reports listed in the Trainer Evaluation Guide (consult Appendix A for graphical locations).

7. At 0001 UTC pause the simulation for up to 10 minutes and ask:

(1) “What are the current warnings out and why?”

(2) “What is the expectation of these storms in the next 30 minutes?”

Get the trainee to focus on the reasoning behind the decisions and what products they are using to base their judgements. Discuss the reasoning with the trainee and try to reach a consensus on the warning decision. Some considerations for discussion points include:

- the level of threat for all severe weather types
- product choice
- warning composition details
- radar sampling issues
- environmental analysis
- uncertainty in the decision making process

8. Resume Simulation.

9. At 0045 UTC pause the simulation for up to 10 minutes and repeat **Step 7**.

10. Resume Simulation.

11. At 0104 UTC pause the simulation for up to 10 minutes and repeat **Step 7**.

12. End the simulation after last pause, and give the trainee a 5 minute break.

IV. Post-simulation Briefing

The objectives of the post simulation briefing are to summarize the successes and failures of the warning process, and evaluate how this information can best be applied to local warning operations. The trainee should first be asked to give their perceptions of the simulation, and then should work with the trainer to evaluate performance and issues pertaining to the local warning operations. The trainer should use the evaluation completed during the pre-simulation briefing and simulation to focus discussion on relevant issues. Evaluation of performance should focus more on the reasoning behind the decision making than on how the warning products relate to the reports in Storm Data.

Some of the key issues to include in the discussion are:

- The feasibility of discriminating between tornadic and non-tornadic storms.

- Warning sector issues (modification and communication).
- The importance of radar base data analysis with environmental assessment (using multiple radars).
- The importance of evaluating data quality of the environment and radar data.

Trainer Tasks

1. Ask the trainee to:
  - Discuss the strengths and weaknesses of the data used in the decision making as well as the approach to analyzing the data.
  - Discuss any problems encountered with determining the type or content of the warnings.
  - Discuss the challenges of synthesizing the warning inputs and the sources of uncertainty.

2. Review the reports and the times to compare to the warnings.

3. Discuss the lessons learned from the event, and how best to implement changes at the local forecast office.

V. Trainer Evaluation Guide

The training objectives of this interval-based simulation are to demonstrate effective methods of data interpretation, demonstrate proper type and content of warnings, and demonstrate how to weigh information and handle uncertainty in the warning decision making process. Part of the evaluation can be done during the query sessions in the simulation, and more evaluation can be done while the trainee is actively involved in the warning operations during the simulation. Suggestions for issues to evaluate while the trainee is creating products during the simulation are included below, as well as a storm-by-storm breakdown of important features in the data (including spotter reports) for the trainer to use during the simulation:

General Issues

Time (UTC)	Description
2356	precipitation accumulations from KBMX are reset to zero (This is an artifact of the process of developing this case.)
0020	LAPS CAPE fields contaminated (too low) by local storms (KMSL at 2336 in Colbert county, KTUP at 2336 in Lee county MS, and KTCL at 2350 in Tuscaloosa county)
0026, 0036-0056	KGWX radar data stops coming in
0100	surface obs beginning to veer in central AL decreasing low-level shear and helicity

Considerations

- Does the trainee anticipate the general threat to increase with time as storms mature and move through the instability maximum?
- Are radar precipitation estimates and base velocity occasionally monitored for flooding threats and wind threats (in addition to the tornado and hail threats) even though they weren't the primary severe weather expectation?
- Does the trainee use the radar algorithms as a safety net or as the primary warning tool? How do you think that affects the ability to detect severe weather threats and generate lead time in the warnings?
- Is the mesoscale environment data monitored at some time during the simulation (surface obs, VWP, and LAPS)?
- Does the trainee recognize the horizontal plot of LAPS helicity values are significantly too low, and they do not represent the actual 0-3 km storm relative helicity?
- Does the trainee recognize the storm contaminated observations incorrectly reducing the instability over a large area at 0000 and 0100 UTC?
- Does the trainee recognize the veering surface winds with time in central AL and the subsequent decrease in low-level shear at 0100 UTC?

Storm Summary

During the simulation there are at least six storms that require more detailed monitoring for severe weather in the warning sector. At the start of the simulation the two storms in Walker and Franklin counties require immediate monitoring. The storm moving from Walker-Cullman-Marshall-DeKalb counties produces hail from dime to baseball in size, 50-60 kt wind gusts, and one tornado with F1 damage. The small left moving storm moving from Franklin-Colbert-Lauderdale counties produces quarter to golf ball size hail. The next two storms requiring monitoring enter the warning sector in Lamar and Franklin counties. The left moving storm moving from Lamar-Fayette-Marion-Winston-Lawrence counties is the left split member of the Birmingham storm, and it produces dime to golf ball size hail (and perhaps baseball size...see questionable report #49 in Appendix A). The storm moving from Lee-Itawamba-Franklin-Colbert-Lawrence counties produces dime to golf ball size hail though it has strong indications of producing a tornado as it approaches the CWA. The fifth and six storms requiring monitoring approach the warning sector from Tishimingo and Monroe and counties. The Tishimingo-Lauderdale County storm produces dime size hail, and the Monroe-Lamar-Marion line segment produces wind damage.

Walker-Cullman-Marshall-DeKalb County Storm

Time (UTC)	Description
2315	dime size hail 8 N Dadeville (NW Walker County)
2330 KBMX	LRM high reflectivity core intensifying aloft
2350 KBMX	LRM high reflectivity core intensifying aloft
2350	5 SE Arley; several trees reported down and porches were blown off a few lake homes in the area along Smith Lake southeast of Arley, gust to 50 kts estimated (SE Winston county)
2356 KBMX	VIL increase to 45 kg/m^2
0001 KBMX	VIL increase to 55 kg/m^2, HI MEHS 2.25"
0005	dime size hail 4 WNW Cullman (Cullman County)
0010	baseball size hail north of Cullman (Cullman County)
0012 KBMX	VIL increase to 60 kg/m^2
0013 KHTX	rotation increases to moderate/strong aloft, 2 cell structure with two mesocyclone centers, 80kt delta-V at 1.5°
0014	quarter size hail in Cullman (Cullman County)
0022 KBMX	bad TVS in de-aliasing failure; many subsequent detections affected by de-aliasing/noisy data in high-shear region

Time (UTC)	Description
0024 KHTX	moderate-strong rotation > 11 Kft, 75 delta-V at 1.5°
0027-0048 KBMX	LRM very large high reflectivity core aloft, VIL 55-70+, HI MEHS 1.75-3.5”
0029 KHTX	rotation strengthens with both mesocyclones, 80-90 kt delta-V aloft, strong low-level reflectivity gradient, low-levels range-folded
0030	hen egg size hail in Joppa (Cullman County)
0035	1” hail in Hulaco (Morgan County)
0037	dime size hail in Arab (Marshall County)
0039 KHTX	appendage developing, BWER, moderate-strong rotation aloft
0042	golf ball size hail in Baileyton (Cullman County)
0045	baseball size hail in Arab (western Marshall County)
0049	half-dollar size hail in Joppa (Cullman County)
0052	baseball size hail in Arab (western Marshall County)
0054 KHTX	significant de-aliasing failures in high shear area aloft
0058-0103 KBMX	strong rotation > 7Kft (V_r 50 kt), strong TVS (95 kt delta-V)
0059	baseball size hail in Arab (western Marshall County)
0059	golf ball size hail in downtown Guntersville (central Marshall County)
0059 KHTX	moderate-strong rotation aloft and moderate convergent rotation extending to low levels
0104 KHTX	strong rotation increasing > 8Kft, hook echo, BWER
0111	nickel size hail 4 SE Albertville (eastern Marshall County)
0114	up to golf ball size hail northeast of Albertville (eastern Marshall County)
0117	baseball size hail in Geraldine (Dekalb County)
0118	trees, signs, and power lines down along SR 168 and SR 68, 5 WSW Crossville, estimated gusts to 60 kts (Dekalb County)
0120 KHTX	well-defined 0.5° low-level divergence in core over Geraldine with low-level circulation to the south

Time (UTC)	Description
0123-0128	small tornado destroyed a few barns near Geraldine, and numerous trees were also snapped or uprooted; 2 NNE to 3.8 NNE Geraldine (Dekalb County) (Note: the location does not match the radar signature.)
0148	1” hail in Fort Payne (Dekalb County)
0150	quarter size hail in Fort Payne (Dekalb County)
0150	1" hail just N of Fort Payne (Dekalb County)

Considerations

- Is the KHTX radar being used to interrogate the velocity signatures, particularly when de-aliasing problems exist or when the storm gets closer to the KHTX radar?
- Is the trainee detecting the high reflectivity cores aloft before the high reflectivities reach low levels for diagnosing the large hail threat?
- Does the trainee recognize the early development of significant rotation at 0013 from the KHTX radar?
- Does the trainee recognize the Cullman County storm contains two updraft cores in close proximity to each other, and that each is associated with separate mesocyclones?
- Does the trainee recognize that cell to cell interactions are a reason to monitor a storm more closely due to increased uncertainty?
- Does the trainee recognize 0022 KBMX TVS detection was corrupted by a de-aliasing failure at 1.5°, and that many of the TVS detections from KBMX are affected by bad data in high shear regions?
- Does the trainee recognize the change in character of the storms from ~0015-0030 with stronger rotation and an very large area of high reflectivities aloft.
- Knowing the environment's potential, the persistent moderate to strong rotation aloft and rotation extending to low-levels from 0015-0025, and the reports of baseball size hail, would a tornado warning be prudent?
- Does the trainee use severe weather statements to include the latest relevant information (e.g. reports of very large hail, intensifying circulations, etc.)?

- Does the trainee recognize the transition from two cells to one cell with classic supercell characteristics by 0104?
- Does the trainee recognize the storm is moving into a less favorable environment for tornadoes with time as CAPE is decreasing and CIN is increasing?
- Does the trainee recognize that there is some uncertainty in the LAPS instability and CAPE fields due to the KGAD observation consistently reading a little low on the dewpoint relative to surrounding sites (see 12-18 UTC and 01 UTC)?

Franklin-Colbert-Lauderdale County Storm

Time (UTC)	Description
2314 KBMX	LRM high reflectivity core aloft intensifying
2317-2336 KGWX	4-panel Z/SRM decent of 60dBZ core from 18Kft-5Kft
2325 KBMX	VIL increasing to 45 kg/m^2
2330 KBMX	60 dBZ at 0.5°, HI MEHS 1.75"
2336 KGWX	three-body scatter spike at 1.5° indicating large hail
2345	quarter size hail 2 E Muscle Shoals (Colbert County)
2350	quarter size hail in Florence (Lauderdale County)
2350	quarter size hail 2 N Muscle Shoals (Colbert County)
0004	golf ball size hail 2 S Lexington (Lauderdale County)

Considerations

- Does the trainee recognize the leftward deviate motion (~ 230 at 45-50 kts) suggests this is an anticyclonic mini supercell with minimal tornado threat, but an increased threat for strong winds given the rapid motion?
- Does the trainee utilize the KGWX radar (closest) to investigate rotation potential and reflectivity structure with this storm?
- Are hail sizes and wind speeds included in the warning?
- Does the trainee recognize that there is some uncertainty about the environment in NW AL due to the scarcity of surface observations (e.g. how far north is the instability maximum given the 70 dewpoints at KTCL and

KBHM, and how far east is the high temperature-dewpoint spreads from KTUP)?

- Does the trainee recognize the significant cooling at the KMSL surface observation when the storm passes overhead, and that the localized storm observation is corrupting the LAPS analysis away from the observation?

Lamar-Fayette-Marion-Winston-Lawrence County Storm

Time (UTC)	Description
2345 KBMX	VIL increasing to 45 kg/m^2, first of many mis-diagnosed TVS detections around the strong anticyclonic rotation of anticyclonic supercell
2350 KBMX	LRM high reflectivity core aloft intensifying, beginning of de-aliasing failures at 1.5°
2356 KBMX	HI MEHS 1.75"
0001 KBMX	VIL increasing to 60 kg/m^2
0006-0042 KBMX	4-panel Z/SRM Three-body scatter spike descending with time indicating decent of large hail
0001-0042 KBMX	HI MEHS 2.25”-3.5”
0017 KBMX	poorly defined TVS, beginning of de-aliasing failures (1.5°) and noisy data aloft
0032 KBMX	poorly defined TVS
0037 KBMX	70 dBZ reflectivities 0.5 and 1.5°, 2 poorly defined TVS detections
0022	golf ball size hail in Winfield (Marion County)
0030	golf ball size hail in Brilliant (Marion County)
0044-0053	golf ball size hail 3 S Haleyville (Winston County)
0112	nickel size hail in Moulton (Lawrence County)
0113	questionable time/location(?)...baseball size hail 6 S Hackleburg, numerous cars damaged west of Bear Creek (Marion County)

Considerations

- Does the trainee recognize the Lamar County storm is moving into the warning sector around 2345, and does the trainee coordinate the sectorizing issue with the trainer?
- Does the trainee recognize this storm is the left split anticyclonic supercell from the large storm in Pickens County, and therefor poses less of a threat for tornadoes, and an increased threat for strong winds with the fast motion (~ 225° at 50-55 kts)?
- Does the trainee utilize the KGWX radar (closest) to evaluate low-level features (rotation, storm structure) until the radar data becomes unavailable?
- Does the trainee recognize the significance of the three-body scatter spike as a direct measurement of large hail?
- Does the trainee recognize the large hail signatures aloft preceding the large hail reports, and would a severe thunderstorm warning be prudent by 0006?
- Are hail sizes and wind estimates included in the warning?
- Does the trainee recognize the de-aliasing failures/noisy data and its potential impact on the TVS algorithm?
- Does the trainee correctly discount the TVS signatures as being tornadic given they are poorly defined, in an area of poor data quality, and that they are associated with an anticyclonic supercell (TVS algorithm only detects cyclonic shears).
- Does the trainee recognize that there is some uncertainty about the environment in NW AL due to the scarcity of surface observations (e.g. how far north is the instability maximum given the 70 dewpoints at KTCL and KBHM, and how far east is the high temperature-dewpoint spreads (enhancing high wind threat) from KTUP)?
- Does the trainee recognize the LAPS instability analysis is being corrupted at 00 and 01 UTC (see KTUP and KMSL) by storms passing over the surface observations, and that these local effects do not likely extend far out ahead of the storms?

Lee-Itawamba-Franklin-Colbert-Lawrence County Storm

Time (UTC)	Description
2350 KBMX	LRM indicating large area of high reflectivity core aloft, VIL 55 kg/m^2, 0.5 SRM shows strong mid-level rotation, and storm moving toward CWA
2351 KGWX	4 panel Z/SRM shows moderate rotation aloft (V_r 40 kts), low-level convergent rotation, BWER, hook echo, 70 dBZ up to 9Kft, expansive gust front south of the storm at 0.5° indicating significant cold pool
2356 KGWX	4 panel Z/SRM shows low-level rotation and convergence increasing to moderate strength, BWER collapsing
0007 KGWX	moderate strength gate-gate shear (delta-V 60 kts)
0018	nickel hail 19 W Russellville (Franklin County)
0026 KGWX	radar data unavailable
0041-0056 KGWX	radar data unavailable
0042 KBMX	strong mid-level rotation at 0.5°
0040	golf ball hail 5 S Tuscumbia in Colbert Heights (Colbert County)
0100	dime size hail 9 NW Moulton in Hatton (Lawrence County)

Considerations

- Does the trainee recognize the storm in Itawamba County storm approaching the warning sector around 2345?
- Does the trainee utilize the KGWX radar (closest) to evaluate low-level features (rotation, storm structure) until the radar data becomes unavailable?
- Does the trainee recognize the environment and the radar data both support a tornado threat before it crosses into the CWA?
- Does the warning reference threats for tornado, large hail, and damaging winds?.
- Does the trainee recognize the fast storm motion (~ 250 at 50 kts) and high temperature-dewpoint spreads over NE MS increase the potential for strong winds?

- Does the trainee recognize the KGWX radar data temporarily stops coming in at 0026 and from 0041-0056?
- Does the trainee recognize that there is some uncertainty about the environment in NW AL due to the scarcity of surface observations (e.g. how far north is the instability maximum given the 70 dewpoints at KTCL and KBHM, and how far east is the high temperature-dewpoint spreads from KTUP)?
- Does the trainee recognize the LAPS instability analysis is being corrupted at 00 and 01 UTC (see KTUP and KMSL) by storms passing over the surface observations, and that these local effects do not likely extend far out ahead of the storms causing the contamination?
- Does the trainee recognize the storm eventually crosses over the cold stable boundary laid out by the Franklin-Colbert-Lauderdale County anticyclonic mini supercell?

Monroe-Lamar-Marion County Line Segment

Time (UTC)	Description
0036 KGWX	0.5° Z/V shows slightly bowing line segment though low-level winds 30-40 kts
0056 KGWX	0.5° Z/V winds approaching 50 kts
0130	15 NE Hamilton, wind damage along 2R 241 in the eastern part of the county (Marion County)

Considerations

- Does the trainee recognize the storms in Monroe and Itawamba Counties (and the storm southwest in Clay County) approaching the CWA from the west (~ 0050)?
- Does the trainee recognize the fast storm motion (~ 260 at 45 kts) increases the likelihood for strong winds?

Tishimingho-Lauderdale County Storm

Time (UTC)	Description
0123	dime size hail in Waterloo (western Lauderdale County)

Considerations

- Does the trainee recognize the storm rapidly approaching the northwestern part of the CWA around 0100 UTC?
- Does the trainee recognize the fast storm motion (~ 230° at 65-75 kts) increases the likelihood for strong winds?

4: Situation Awareness Simulation

I. Introduction

This simulation focuses on the unique aspects of handling warning responsibility for a warning sector containing a storm that produces a violent tornado in a major metropolitan area. This simulation is appropriate for a warning forecaster with intermediate level of expertise who is proficient with the mechanics of issuing warnings. At three times, unknown to the trainee, the simulation will be paused for the trainer to evaluate the trainee's situation awareness.

Objective

The training objective of this situation awareness simulation is:

- Demonstrate the three levels of situation awareness (perceive, comprehend, project) during a challenging warning situation.

Responsibilities

Support materials in sections I (Introduction), II (Pre-simulation Briefing), III (Simulation), IV (Post-simulation Briefing), and V (Trainer Evaluation Guide) have been designed for a two person training session with the following responsibilities:

Trainee

Pre-Brief: Analyze the environmental data, issue a briefing detailing the threat for all severe weather types, sectorize the county warning area into three warning sectors.

Simulation: Issue warnings and follow up statements for the sector containing the storm that produces the F5 tornado.

Post-Brief: Discuss with the trainer any lessons learned and how they can be implemented at the local office.

Trainer

Pre-Brief: Set up the simulation, evaluate and document trainee briefing and rationale behind the trainee's sectorizing for this event.

Simulation: Manage the simulation, pause the simulation to query the trainee's level of situation awareness, evaluate the performance of the trainee, and interject spotter reports.

Post-Brief: Discuss trainee performance and any lessons learned from the simulation and how they can be implemented at the local office.

This situation awareness simulation is designed to take 3.5 hours to complete, with 30 minutes for the pre-simulation briefing, 2 hours for the simulation, 30 minutes for querying, and 30 minutes for the post-brief. The simulation starts at 2302 UTC on April 8th, 1998 and ends at 0100 UTC on April 9th, 1998. As with all simulation examples, times can be adjusted as needed. The following sections are designed for the ***trainer to use*** to instruct and evaluate the trainee.

II. Pre-simulation Briefing

The objective of the pre-simulation briefing is for the trainee to assess the level of threat for severe weather (tornado, hail, wind, and flash flooding), formulate expectations of timing and evolution of convection, and sectorize the warning operations accordingly. The trainer should step through the following tasks to prepare the simulation and evaluate/document the trainee performance.

Trainer Tasks

1. Print map with county names and CWA outline from Support Materials (see Figure C-C-2 on page C-3) for drawing warning sectors.

2. Print out the warning log from Support Materials (see page C-1) so the trainee can keep track of the warnings they issue.

3. Close down any existing D2D sessions, and start the simulator for the time period 2302 UTC on April 8th, 1998 to 0100 UTC on April 9th, 1998.

4. Stop the simulator immediately to allow the trainee to investigate the environment up to the start time.

5. Start a D2D session, and inform the trainee they have 30 minutes to analyze the environment of the BMX CWA and give a briefing to the trainer summarizing the severe weather threat. If the trainee's local procedures have not been re-created on the WES, the trainer may wish to give the trainee more time to create procedures.
6. Instruct the trainee to:
   - Identify the level of threat for tornadoes, hail, wind, and flooding throughout the CWA.
   - Create three warning sectors to divide up warning responsibility into manageable areas.
   - Give a summary of the pre-simulation briefing analysis detailing the rationale behind the severe weather threats and why the sectors were chosen.
7. Take notes on the rationale behind the decisions. Document where the reasoning or methods can be improved and any unique approaches that may be useful to pass on to other staff to include in future simulations. In evaluating the trainee's briefing, consider the following:
   - Widespread 0-6 km shear supports supercells throughout the CWA.
   - The boundary in the eastern part of the CWA enhances threat for tornadoes as they move across the boundary, and less of a tornado threat as they move into more stable air.
   - Elevated instability over the boundary in the eastern part of the CWA supports elevated supercells.
   - The surface boundary evident in far NW AL (see vis and sfc obs) enhances tornado threat as boundary continues to destabilize and lift northward.
   - The instability maximum in central AL enhances all severe weather threat in the 70°+ dewpoint air.
   - Low temperature-dewpoint spreads over central AL limit cold pool production, thereby decreasing damaging wind threat somewhat and increasing significant tornado potential
   - Weaker lower tropospheric winds decrease threat for damaging winds.
   - Supercell storms support a widespread risk of large hail though wet-bulb zero heights are relatively high.
   - Storm speeds do not support a widespread threat of flash flooding except where storms train over same area.

- There is an impending threat of severe weather in southeast, southwest, and northwest part of the CWA requiring warning sector coverage.

8. Inform the trainee that the flash flood guidance for the BMX CWA is approximately 1.5” for one hour, and 2” for three hours.

9. Point out on the SPC products provided in Appendix B that the CWA is in a high risk area, and that a particularly dangerous situation (PDS) tornado watch has been issued with a threat for damaging tornadoes, hail to 3 inch diameter, and wind gusts to 80 mph.

10. Briefly evaluate and discuss the reasoning behind the sectorizing. Three optimal sectors include:

- the southern and eastern part of the CWA
  - where supercells will move over cooler and more stable surface air
- the line segment in the western and central part of the CWA
  - where storms will move into the instability and low-level shear maximum
- the storms in the northwest and northern part of the CWA
  - where instability is less and storms are more isolated

11. Instruct the trainee to take on responsibility of warning for the sector containing Pickens county. Also state that during the simulation the trainee should communicate ways to modify the sector to address any potential confusion of responsibilities with storms crossing sectors.

III. Simulation

The training objective of this situation awareness simulation is to demonstrate three levels of situation awareness during a challenging warning situation. This 2 hour simulation starts at 2302 UTC on April 8th, 1998, and ends at 0100 UTC on April 9th, 1998. The trainee will be asked to warn for the sector they created in the pre-simulation briefing that includes the storm entering Pickens County (eventually moves into Birmingham). At three times during the simulation (2339, 0002, 0027 UTC; unknown to the trainee), the simulation will be paused and the trainer will assess the trainee’s situation awareness by evaluating:

- Has the trainee perceived data relevant to all the severe weather threats (spotter reports, expiration times of current warnings, etc.)?

- Does the trainee understand the meaning of the data? (What warnings are needed?)
- Has the trainee formed an expectation based on these data? (Will the threat change over time?)

For a storm-by-storm breakdown of important features in the data and important evaluation points, consult the Trainer Evaluation Guide on page 8.

Trainer Tasks

1. State to the trainee that:

- The objectives of the simulation are to demonstrate the ability to perceive warning related inputs, understand the meaning of the assessment and project this into expectations and actions.
- There will be three pauses managed by the trainer, at surprise times, each lasting up to 10 minutes during the 2 hour simulation. At which times the trainer will ask.
    (1) “What is the current state of the severe potential and why?”
    (2) “What is the expectation of these storms in the next 30 minutes?”
    (3) “When will the current warnings expire?”
- The trainee should communicate any problem areas to the trainer when there are potentially severe storms crossing warning sectors selected in the pre-simulation briefing.
- The trainer will be forwarding spotter reports to the trainee during the simulation.

2. Close down any existing D2D sessions, and start the simulation for the time period 2302 UTC on April 8^{th}, 1998 to 0100 UTC on April 9^{th}, 1998. Then start new D2D sessions. If only a single monitor exists, the trainer may wish to load two D2D sessions on one monitor to help mitigate the hardware limitation.

3. Show the trainee how to create a warning and save it to a file. To export a warning to a file after the warning has been typed up:

- In the text editor, click under “File”, “Export to File...”.
- Type in the name of the warning at the end of the path in the “filename” box on the bottom of the popup window and click OK.

4. Give the trainee 5-10 minutes to set up their D2D sessions.

5. During the simulation, provide storm reports as spotter reports. Use the reports listed in the Trainer Evaluation Guide on page 4-8 (consult image in Appendix A for graphical locations).

6. At 2333 UTC consider giving a leading report. Pass on that "the local TV station is reporting NEXRAD radar indicated tornado over northern Tuscaloosa county". This can happen if the TV station utilizes the TVS information in the Combined Attribute Table shipped with the Composite Reflectivity product with the NIDS data.

7. At 2339 UTC pause the simulation for up to 10 minutes and ask:

(1) "What is the current state of the severe potential and why?"

(2) "What is the expectation of these storms in the next 30 minutes?"

(3) "When will the current warnings expire?"

- Try to get the trainee to focus on the reasoning behind the decisions and what products they are using to base their judgements. Document the reasoning, and take note of any significant severe weather cues not recognized. Pay particularly close attention to whether the trainee has identified the large hail threat for the storm in northern Tuscaloosa county and the tornado threat with marginal severe hail for the large storm in Pickens county.
- If the trainee is "lost" or behind, document the reason. If corrective measures are needed to "reengage" them, make adjustments before resuming.

8. Resume the simulation.

9. At 0002 pause the simulation and ask:

(1) "What is the current state of the severe potential and why?"

(2) "What is the expectation of these storms in the next 30 minutes?"

(3) "When will the current warnings expire?"

- Try to get the trainee to focus on the reasoning behind the decisions and what products they are using to base their judgements. Document the reasoning, and take note of any significant severe weather cues not recognized. Pay particularly close attention to whether the trainee has identified the large hail threat for the storm in Walker county, the imminent tornado threat with marginal severe hail threat for the large storm in Pickens county, and the marginal tornado threat for the mini supercell in central Pickens county.

- If the trainee is “lost” or behind, document the reason. If corrective measures are needed to “reengage” them, make adjustments before resuming.

10. Resume the simulation.

11. At 0027 pause the simulation and ask:

    (1) “What is the current state of the severe potential and why?”
    (2) “What is the expectation of these storms in the next 30 minutes?”
    (3) “When will the current warnings expire?”

- Try to get the trainee to focus on the reasoning behind the decisions and what products they are using to base their judgements. Document the reasoning, and take note of any significant severe weather cues not recognized. Pay particularly close attention to whether the trainee has identified the imminent significant tornado threat with large hail for the large storm in Tuscaloosa county and the marginal tornado/severe hail threat for the mini supercell in Pickens/Tuscaloosa county and for the two storms entering the CWA in Pickens and Sumter counties.
- If the trainee is “lost” or behind, document the reason. If corrective measures are needed to “reengage” them, make adjustments before resuming.

12. At 0100 UTC (the end of the simulation), give the trainee a 5 minute break.

IV. Post-simulation Briefing

The objective of the post simulation briefing is to summarize the successes and failures of the warning process and evaluate how this information can best be applied to local warning operations. The trainee should first be asked to give their perceptions of the simulation, and then should work with the trainer to evaluate performance and issues pertaining to the local warning operations. The trainer should use the evaluation done during the pre-simulation briefing and simulation to focus discussion on relevant issues. Evaluation of performance should focus more on the reasoning behind the decision making than on how the warning products relate to the reports in Storm Data.

Some of the key issues to include in the discussion are:

- Isolating the large hail threat for the lead storm in N Tuscaloosa into Walker counties.

- Using the closest radar (KGWX) to catch the supercell intensification characteristics prior to the tornado developing.
- Issuing effective follow-on severe weather statements on the most dangerous storms while balancing the need to spend more time evaluating the severe potential of other weaker storms at longer ranges from the KBMX radar.
- Maintaining the big picture issues while periodically focussing on the details.

Trainer Tasks

1. Ask the trainee to:
- Discuss problems encountered with perceiving warning related inputs.
- Discuss any warning related inputs that were particularly challenging to understand.
- Discuss problems encountered with formulating expectations and actions.

2. Review the reports and the times to compare to the warnings.

3. Discuss the key issues of the event and any lessons learned, and how best to implement changes at the local forecast office.

V. Trainer Evaluation Guide

The training objective of this situation awareness simulation is for the trainee to demonstrate three levels of situation awareness during a challenging warning situation. Part of the evaluation can be done during the query sessions, and more evaluation can be done while the trainee is actively involved in the warning operations. Suggestions for issues to evaluate while the trainee is creating products during the simulation are included below, as well as a storm-by-storm breakdown of important features in the data (including spotter reports) for the trainer to use during the simulation:

General Issues

Time (UTC)	Description
0026, 0036-0056	KGWX radar data stops coming in
2356	precipitation accumulations from KBMX are reset to zero (This is an artifact of the process of developing this case.)
0020	LAPS CAPE fields contaminated (too low) by local storms (KMSL at 2336 in Colbert county, KTUP at 2336 in Lee county MS, and KTCL at 2350 in Tuscaloosa county)
0100	surface obs beginning to veer in central AL decreasing low-level shear and helicity

Considerations:

- Does the trainee expect the general threat to increase with time as the storms mature and continue moving through the instability maximum?
- Are radar precipitation estimates and base velocity occasionally monitored for flooding threats and wind threats (in addition to the tornado and hail threats) even though they were not the primary severe weather expectation?
- Does the trainee use the radar algorithms as a safety net or as the primary warning tool? How do you think that affects the ability to detect severe weather threats and generate lead time in the warnings?
- Is the Lamar County left split coordinated with the trainer if it crossed or came near a new warning sector?
- Is the mesoscale environment data monitored at some time during the simulation (surface obs, VWP, and LAPS)?
- Does the trainee recognize the horizontal plot of LAPS helicity values are significantly too low, and they do not represent the actual 0-3 km storm relative helicity?
- Does the trainee recognize the storm contaminated observations incorrectly reducing the instability over a large area?
- Does the trainee recognize the veering surface winds with time in central AL and the subsequent decrease in low-level shear/helicity at 0100 UTC?

Storm Summary

During the simulation there are at least five storms that require more detailed monitoring for severe weather in the warning sector that includes the Birmingham storm. The lead storm in the line over western Alabama produces dime and golf ball sized hail in Tuscaloosa and Walker Counties though there is no well defined and deep cyclonic rotation. The Birmingham storm produces tornadoes and dime sized hail from Pickens to Tuscaloosa to Jefferson Counties. The remaining three storms do not have severe weather reported with them, though they contain signatures worth monitoring. A miniature supercell forms just to the west of the Birmingham storm, and it develops an appendage in reflectivity, a brief low-level circulation that weakens with time, and moderate TVS values at long range. Two other mature storms also with marginal supercell characteristics and moderate TVS signatures move from Noxubee and Kemper Counties in Mississippi into Pickens and Sumter Counties.

Tuscaloosa-Walker County Storm (lead storm in the line)

Time (UTC)	Description
2304-2309 KBMX	mid-upper level rotation in SRM, LRM high reflectivity core aloft intensifying, VIL increase from 50 to 60 kg/m^2
2314-2335	Hail algorithm MEHS 1.5 to 2.25"
2320	dime size hail in Samantha (northern Tuscaloosa County)
2320-2325 KBMX	significant precip core descent to low levels
2325 KBMX	65 dBZ reflectivities at 0.5°, and TVS algorithm trips on high shear in weak reflectivities (non-tornadic)
2335 KBMX	VIL increases to 65 kg/m^2
2350 KBMX	golf ball hail in Goodsprings (southern Walker County)
0012 KBMX	LRM high reflectivity core aloft intensifying, VIL increase to 45 kg/m^2
0032 KBMX	LRM and VIL weakens significantly, storm decays

Considerations:

- Is the KBMX radar being used as the primary radar to monitor the depth of the storm (more upper tilts available)?

- Is the trainee recognizing the lack of well-organized low and mid-level cyclonic rotation throughout the storms life?
- Is the trainee detecting the high reflectivity cores aloft before the high reflectivities reach low levels for the hail in northern Tuscaloosa county?
- Does the trainee consider holding off on a tornado warning due to the lack of organized persistent rotation?
- Does the trainee consider rejecting the 2325 TVS algorithm detection as being tornadic due to the poorly organized rotation and its location relative to reflectivity features?
- Does the trainee continue a threat for large hail into Walker county despite low-level reflectivities weakening after the time of the dime size hail report at 2320?
- Does the trainee draw the sector to leave the Fayette-Walker-Winston storm in the northwest sector? If not, would that have allowed more time for better warnings and follow-on statements?

Pickens-Tuscaloosa-Jefferson County Storm (Birmingham storm)

Time (UTC)	Description
2314 KBMX	LRM high reflectivity core aloft, VIL 55 kg/m^2
2317 KGWX	organized and deep rotation (strong above 12Kft; V_r 45+ kts) in northeast Noxubee county
2336 KGWX	maturing supercell characteristics including increasing low-level rotation (moderate; V_r 35kt), strong rotation above 12Kft, increasing low-level convergence, BWER, and low-level appendage
2340 KBMX	weak TVS detections begin, LRM high reflectivity core aloft intensifying, VIL increase to 45 kg/m^2
2351 KGWX	moderate to strong (80 kt) gate-to-gate delta-V in 0.5° SRM
2356 KGWX	low-mid level mesocyclone growing in scale with very strong convergent rotation signature in 0.5° SRM
0001 KBMX	LRM high reflectivity core aloft intensifying, VIL only 30 kg/m^2
0005-0029	first tornado begins in eastern Pickens County and ends in Tuscaloosa County
0010	dime size hail in Echola (western Tuscaloosa County)
0012 KBMX	VIL increase to 55 kg/m^2

Time (UTC)	Description
0018	dime size hail at Lake Tuscaloosa (western Tuscaloosa County)
0022-0103 KBMX	HI MEHS 2” to 2.5"
0026, 0036-0056 KGWX	radar data stops coming in
0032-0103 KBMX	VIL 65 and 70+ kg/m^2
0052-0128	second tornado begins in eastern Tuscaloosa county and ends in Jefferson county (downtown Birmingham)
0103	dime size hail in Concord (western Jefferson County)
0113 KBMX	OHP estimates > 2 inches of rain in one hour in western Jefferson county with more storms headed for the same area

Considerations:

- Is KGWX the primary radar being used for low and mid level velocity interrogation due to the better low-level sampling?
- Is a tornado warning considered for Pickens County by 2340? If not, is it because of not recognizing the three dimensional structure of the supercell from KGWX and the environment?
- Is the severe hail threat included in the warning as well as expected size?
- Does the trainee understand the significance of the intensifying low-level convergent rotation being a precursor to low-level mesocyclogenesis?
- Is the location of the circulation mentioned in the tornado warnings or the precipitation core?
- Is the trainee aware of the east-west oriented fine line in reflectivity (and other bands of showers around the storm) approaching the storm from the south from 2300-0027?
- Is the trainee aware that the KBMX radar shows no significant velocity structure in the 0.5° base velocity product across the fine line as it passes over the radar?
- Are Birmingham suburbs and interstates appropriately mentioned in the tornado warning and severe weather statements?
- What wording is used to separate this warning from a general tornado warning?

- Are locations in the path overly specific?
- Are spotter reports used to motivate people to take shelter?
- Is the heavy rainfall in Jefferson county recognized even though there are no reports of flooding?

Pickens-Tuscaloosa-Jefferson County Storm (mini supercell)

Time (UTC)	Description
2356 KGWX	rapidly intensifying low-level rotation in miniature cell in SW Pickens county though supercell reflectivity signatures not well defined
0001-0012 KBMX	LRM high reflectivity core aloft, VIL increases from 30-45 kg/m^2
0006-0012 KBMX	moderate TVS signatures
0007 KGWX	hook echo developing with mid-level rotation and weak low-level convergence
0022-0027 KBMX	LRM high reflectivity core aloft increases, VIL 45 kg/m^2

Considerations:

- Is the trainee aware of the storms signatures from the KGWX radar?
- Although no severe weather is reported with this storm, is the storm receiving consideration?

Noxubee-Pickens County Storm

Time (UTC)	Description
0017 KBMX	LRM high reflectivity core aloft, VIL increases to 45 kg/m^2
0021 KGWX	appendage developing with weak circulation
0027 KBMX	moderate TVS
0031 KGWX	echo growing in size, BWER, appendage, weak low-level convergent rotation
0042 KBMX	moderate TVS

Considerations:

- Is the trainee aware of the storms signatures from the KGWX radar?
- Although no severe weather is reported with this storm, is the storm receiving consideration?

Kemper-Sumter-Greene County Storm

Time (UTC)	Description
0022 KBMX	LRM high reflectivity core aloft, VIL increases to 65 kg/m^2
0028 KBMX	HI MEHS 1.5"
0036 KGWX	appendage developing
0048 KBMX	LRM high reflectivity core aloft, VIL increases to 45 kg/m^2

Considerations:

- Is the trainee aware of the storms signatures from the KGWX radar?
- Although no severe weather is reported with this storm, is the storm receiving consideration?

5: Virtual Reality Simulation - Guided

I. Introduction

This simulation focuses on the unique aspects of handling warning responsibility for a warning sector containing a storm that produces a violent tornado in a major metropolitan area. This simulation is appropriate for an experienced warning forecaster who is proficient with the mechanics of issuing warnings and can benefit from practicing warning workload management.

Objective

The training objective of this virtual reality simulation is to effectively manage all aspects of a challenging and distracting warning environment while still producing quality products.

Responsibilities

Support materials in sections I (Introduction), II (Pre-simulation Briefing), III (Simulation), IV (Trainer Evaluation Guide), and V (Post-simulation Briefing) have been designed for a two person training session with the following responsibilities:

Trainee

Pre-Brief: Analyze the environmental data, issue a briefing detailing the threat for all severe weather types, sectorize the county warning area into three warning sectors.

Simulation: Issue warnings and follow up statements for the sector containing the storm that produces the F5 tornado.

Post-Brief: Discuss with the trainer any lessons learned and how they can be implemented at the local office.

Trainer

Pre-Brief: Set up the simulation, evaluate and document trainee briefing and rationale behind the trainee's sectorizing for this event.

Simulation: Manage the simulation, evaluate the performance of the trainee, and interject information such as spotter reports, special forecast requests, and any type of challenges that can happen in a real event (be creative!).

Post-Brief: Discuss trainee performance and any lessons learned from the simulation and how they can be implemented at the local office.

This virtual reality simulation is designed to take 3.5 hours to complete, with 30 minutes for the pre-simulation briefing, 2.5 hours for the simulation, and 30 minutes for the post-brief. The simulation starts at 2302 UTC on April 8th, 1998 and ends at 0130 UTC on April 9th, 1998. As with all simulation examples, times can be adjusted as needed. The following sections are designed for the ***trainer to use*** to instruct and evaluate the trainee.

II. Pre-simulation Briefing

The objective of the pre-simulation briefing is for the trainee to assess the level of threat for severe weather (tornado, hail, wind, and flash flooding), formulate expectations of timing and evolution of convection, and sectorize the warning operations accordingly. The trainer should step through the following tasks to prepare the simulation and evaluate/document the trainee performance.

Trainer Tasks

1. Print map with county names and CWA outline from Support Materials (see Figure C-C-2 on page C-3) for drawing warning sectors.
2. Print out the warning log from Support Materials (see page C-1) so the trainee can keep track of the warnings they issue.
3. Close down any existing D2D sessions, and start the simulator for the time period 2302 UTC on April 8th, 1998 to 0100 UTC on April 9th, 1998.
4. Stop the simulator immediately to allow the trainee to investigate the environment up to the start time.

5. Start a D2D session, and inform the trainee they have 30 minutes to analyze the environment of the BMX CWA and give a briefing to the trainer summarizing the severe weather threat. If the trainee's local procedures have not been re-created on the WES, the trainer may wish to give the trainee more time to create procedures.

6. Instruct the trainee to:

- Identify the level of threat for tornadoes, hail, wind, and flooding throughout the CWA.
- Create three warning sectors to divide up warning responsibility into manageable areas.
- Give a summary of the pre-simulation briefing analysis detailing the rationale behind the severe weather threats and why the sectors were chosen.

7. Take notes on the rationale behind the decisions. Document where the reasoning or methods can be improved and any unique approaches that may be useful to pass on to other staff to include in future simulations. In evaluating the trainee's briefing, consider the following:

- Widespread 0-6 km shear supports supercells throughout the CWA.
- The boundary in the eastern part of the CWA enhances threat for tornadoes as they move across the boundary, and less of a tornado threat as they move into more stable air.
- Elevated instability over the boundary in the eastern part of the CWA supports elevated supercells.
- The surface boundary evident in far NW AL (see vis and sfc obs) enhances tornado threat as boundary continues to destabilize and lift northward.
- The instability maximum in central AL enhances all severe weather threat in the 70°+ dewpoint air.
- Low temperature-dewpoint spreads over central AL limit cold pool production, thereby decreasing damaging wind threat somewhat and increasing significant tornado potential
- Weaker lower tropospheric winds decrease threat for damaging winds.
- Supercell storms support a widespread risk of large hail though wet-bulb zero heights are relatively high.
- Storm speeds do not support a widespread threat of flash flooding except where storms train over same area.

- There is an impending threat of severe weather in southeast, southwest, and northwest part of the CWA requiring warning sector coverage.

8. Inform the trainee that the flash flood guidance for the BMX CWA is approximately 1.5” for one hour, and 2” for three hours.

9. Point out on the SPC products provided in Appendix B that the CWA is in a high risk area, and that a particularly dangerous situation (PDS) tornado watch has been issued with a threat for damaging tornadoes, hail to 3” diameter, and wind gusts to 80 mph.

10. Briefly evaluate and discuss the reasoning behind the sectorizing. Three optimal sectors include:

- the southern and eastern part of the CWA
  - where supercells will move over cooler and more stable surface air
- the line segment in the western and central part of the CWA
  - where storms will move into the instability and low-level shear maximum
- the storms in the northwest and northern part of the CWA
  - where instability is less and storms are more isolated

11. Instruct the trainee to take on responsibility of warning for the sector containing Pickens county. Also state that during the simulation the trainee should communicate ways to modify the sector to address any potential confusion of responsibilities with storms crossing sectors.

III. Simulation

The training objective of this virtual reality simulation is to effectively manage all aspects of a challenging and distracting warning environment while still producing quality products. This 2.5 hour simulation starts at 2302 UTC on April 8th, 1998, and ends at 0130 UTC on April 9th, 1998. The trainee will be asked to warn for the sector they created in the pre-simulation briefing that includes the storm entering Pickens County (eventually moves into Birmingham). At 0042 UTC, when the significant tornado threat to the western suburbs of Birmingham is imminent, the trainee will be asked to focus attention solely on the Birmingham storm to provide for the best warnings, severe weather statements, and supplemental information possible. For a storm-by-storm breakdown of important features in the data and important evaluation points, consult the Section V Trainer Evaluation Guide.

Trainer Tasks

1. State to the trainee:

- The training objective of this virtual reality simulation is to effectively manage all aspects of a challenging and distracting warning environment while still producing quality products.
- There will be no pauses during the 2.5 hour simulation (plan accordingly).
- The trainee should communicate any problem areas to the trainer when there are potentially severe storms crossing the warning sector selected in the pre-simulation briefing.
- The trainer will be forwarding spotter reports to the trainee during the simulation.

2. Close down any existing D2D sessions, and start the simulation for the time period 2302 UTC on April 8th, 1998 to 0130 UTC on April 9th, 1998. Then start new D2D sessions. If only a single monitor exists, the trainer may wish to load two D2D sessions on one monitor to help mitigate the hardware limitation.

3. Show the trainee how to create a warning and save it to a file. To export a warning to a file after the warning has been typed up:

- In the text editor, click under “File”, “Export to File...”.
- Type in the name of the warning at the end of the path in the “filename” box on the bottom of the popup window and click OK.

4. Give the trainee 5-10 minutes to set up their D2D sessions.

5. During the simulation, provide storm reports as spotter reports. Use the reports listed in the Trainer Evaluation Guide on page 5-8 (consult image in Appendix A for graphical locations), and make up conflicting spotter reports during the simulation to determine if the trainee is evaluating the reports well. Any other incoming calls or distractions should be interjected as to simulate a real environment. This could include briefings to EMS, toxic spills, failure for a warning to transmit, etc.

6. At 2333 UTC consider giving a distracting request if no tornado warning has been issued for Tuscaloosa County. The local TV station has called, wanting to know why there is no tornado warning. They are showing a NEXRAD Tornado Vortex Signature in northern Tuscaloosa County from their NIDS feed. Evaluate the trainee’s ability to effectively answer the request in a timely manner.

7. At 2350 UTC, consider giving a distracting request. The person writing the short term forecasts would like the trainee's input on the expected severe weather threat over central AL in the next 1-2 hours. Evaluate the trainee's ability to effectively answer the request in a timely manner.

8. At 0012 UTC consider disrupting the warning operations. Simulate a D2D crash or spontaneous logout. ***Do not stop the simulator.*** Either have the trainee exit and restart D2D, or have the trainee stop using D2D temporarily and explain how they would recover. Evaluate the trainee's ability to recover from the disruption.

9. At 0030 UTC consider disrupting the warning operations. Inform the trainee that the last warning issued did not transmit properly. Evaluate the trainee's ability to recover from the disruption.

10. At 0042 UTC ask trainee to focus solely on the tornadic storm heading towards Birmingham. Note that the western suburbs start in the cities of Sylvan Springs and Hueytown. Ask trainee to issue products to best convey the magnitude of the threat and location of the relevant features in a timely fashion.

11. At 0103 UTC consider giving a distracting request. The Highway Patrol is considering limiting access to the interstate highways around Birmingham because of the tornado threat. They would like the trainee to provide any information on the track of the tornado relative to the major interstate highways (I-20, I-65, I-459, I-59). Evaluate the trainee's ability to answer the request in a timely manner.

12. At 0115 UTC consider giving a distracting request. A major outdoor sports activity is occurring in the Birmingham suburb of Homewood in south-central Jefferson County. Lightning in the area has caused them to halt the game temporarily while they assess the lightning threat. They would like the trainee to give them an estimate of when the storm will pass so they can resume play. Evaluate the trainee's ability to answer the request in a timely manner.

13. At 0130 UTC (the end of the simulation), give the trainee a 5 minute break.

IV. Post-simulation Briefing

The objective of the post simulation briefing is to summarize the successes and failures of the warning process and evaluate how this information can best be applied to local warning operations. The trainee should first be asked to give their perceptions of the simulation, and then should work with the trainer to evaluate performance and issues pertaining to the local warning operations. The trainer should use the evaluation done during the pre-simulation briefing and simulation to focus discussion on relevant issues. Evaluation of performance should focus more on the reasoning behind the decision making than on how the warning products relate to the reports in Storm Data.

Some of the key issues to include in the discussion are:

- Isolating the large hail threat for the lead storm in N Tuscaloosa into Walker counties.
- Using the closest radar (KGWX) to catch the supercell intensification characteristics prior to the tornado developing.
- Issuing effective follow-on severe weather statements on the most dangerous storms while balancing the need to spend more time evaluating the severe potential of other weaker storms at longer ranges from the KBMX radar.
- Maintaining the big picture issues while periodically focussing on the details.
- Using mesoscale analysis to help anticipate the areas of greatest risk for severe weather.
- Handling stress and workload so as to keep the effective flow of information going.
- Off-loading tasks as necessary.
- Maintaining a high level of situation awareness throughout.

Trainer Tasks

1. Ask the trainee to:
   - Discuss challenges in managing the warning workload for the sector.
   - Discuss any problems encountered with responding to the disruptions in the warning environment.

2. Review the reports and the times to compare to the warnings.

3. Discuss the lessons learned from the event, and how best to implement changes at the local forecast office.

V. Trainer Evaluation Guide

The training objective of this virtual reality simulation is to effectively manage all aspects of a challenging and distracting warning environment while still producing quality products. The evaluation of the trainee by the trainer is to be done while the trainee is actively involved in the warning operations. Suggestions for issues to evaluate while the trainee is creating products during the simulation are included below, as well as a storm-by-storm breakdown of important features in the data (including spotter reports) for the trainer to use during the simulation:

General Issues

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0100	surface obs beginning to veer in central AL decreasing low-level shear and helicity

Considerations:

- Does the trainee expect the general threat to increase with time as the storms mature and continue moving through the instability maximum?
- Are radar precipitation estimates and base velocity occasionally monitored for flooding threats and wind threats (in addition to the tornado and hail threats) even though they were not the primary severe weather expectation?
- Does the trainee use the radar algorithms as a safety net or as the primary warning tool? How do you think that affects the ability to detect severe weather threats and generate lead time in the warnings?
- Is the Lamar County left split coordinated with the trainer if it crossed or came near a new warning sector?

- Is the mesoscale environment data monitored at some time during the simulation (surface obs, VWP, and LAPS)?
- Does the trainee recognize the horizontal plot of LAPS helicity values are significantly too low, and they do not represent the actual 0-3 km storm relative helicity?
- Does the trainee recognize the storm contaminated observations incorrectly reducing the instability over a large area?
- Does the trainee recognize the veering surface winds with time in central AL and the subsequent decrease in low-level shear/helicity at 0100 UTC?

Storm Summary

During the simulation there are at least five storms that require more detailed monitoring for severe weather in the warning sector that includes the Birmingham storm. The lead storm in the line over western Alabama produces dime and golf ball sized hail in Tuscaloosa and Walker Counties though there is no well defined and deep cyclonic rotation. The Birmingham storm produces tornadoes and dime sized hail from Pickens to Tuscaloosa to Jefferson Counties. The remaining three storms do not have severe weather reported with them, though they contain signatures worth monitoring. A miniature supercell forms just to the west of the Birmingham storm, and it develops an appendage in reflectivity, a brief low-level circulation that weakens with time, and moderate TVS values at long range. Two other mature storms also with marginal supercell characteristics and moderate TVS signatures move from Noxubee and Kemper Counties in Mississippi into Pickens and Sumter Counties.

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2320-2325 KBMX	significant precip core descent to low levels
2325 KBMX	65 dBZ reflectivities at 0.5°, and TVS algorithm trips on high shear in weak reflectivities (non-tornadic)

Time (UTC)	Description
2335 KBMX	VIL increases to 65 kg/m^2
2350 KBMX	golf ball hail in Goodsprings (southern Walker County)
0012 KBMX	LRM high reflectivity core aloft intensifying, VIL increase to 45 kg/m^2
0032 KBMX	LRM and VIL weakens significantly, storm decays

Considerations:

- Is the KBMX radar being used as the primary radar to monitor the depth of the storm (more upper tilts available)?
- Is the trainee recognizing the lack of well-organized low and mid-level cyclonic rotation throughout the storms life?
- Is the trainee detecting the high reflectivity cores aloft before the high reflectivities reach low levels for the hail in northern Tuscaloosa county?
- Does the trainee consider holding off on a tornado warning due to the lack of organized persistent rotation?
- Does the trainee consider rejecting the 2325 TVS algorithm detection as being tornadic due to the poorly organized rotation and its location relative to reflectivity features?
- Does the trainee continue a threat for large hail into Walker county despite low-level reflectivities weakening after the time of the dime size hail report at 2320?
- Does the trainee draw the sector to leave the Fayette-Walker-Winston storm in the northwest sector? If not, would that have allowed more time for better warnings and follow-on statements?

Pickens-Tuscaloosa-Jefferson County Storm (Birmingham storm)

Time (UTC)	Description
2314 KBMX	LRM high reflectivity core aloft, VIL 55 kg/m^2
2317 KGWX	organized and deep rotation (strong above 12Kft; V_r 45+ kts) in northeast Noxubee county

Time (UTC)	Description
2336 KGWX	maturing supercell characteristics including increasing low-level rotation (moderate; V_r 35kt), strong rotation above 12Kft, increasing low-level convergence, BWER, and low-level appendage
2340 KBMX	weak TVS detections begin, LRM high reflectivity core aloft intensifying, VIL increase to 45 kg/m^2
2351 KGWX	moderate to strong (80 kt) gate-to-gate delta-V in 0.5° SRM
2356 KGWX	low-mid level mesocyclone growing in scale with very strong convergent rotation signature in 0.5° SRM
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0005-0029	first tornado begins in eastern Pickens County and ends in Tuscaloosa County
0010	dime size hail in Echola (western Tuscaloosa County)
0012 KBMX	VIL increase to 55 kg/m^2
0018	dime size hail at Lake Tuscaloosa (western Tuscaloosa County)
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0026, 0036-0056 KGWX	radar data stops coming in
0032-0103 KBMX	VIL 65 and 70+ kg/m^2
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0103	dime size hail in Concord (western Jefferson County)
0113 KBMX	OHP estimates > 2 inches of rain in one hour in western Jefferson county with more storms headed for the same area

Considerations:

- Is KGWX the primary radar being used for low and mid level velocity interrogation due to the better low-level sampling?
- Is a tornado warning considered for Pickens County by 2340? If not, is it because of not recognizing the three dimensional structure of the supercell from KGWX and the environment?
- Is the severe hail threat included in the warning as well as expected size?

- Does the trainee understand the significance of the intensifying low-level convergent rotation being a precursor to low-level mesocyclogenesis?
- Is the location of the circulation mentioned in the tornado warnings or the precipitation core?
- Is the trainee aware of the east-west oriented fine line in reflectivity (and other bands of showers around the storm) approaching the storm from the south from 2300-0027?
- Is the trainee aware that the KBMX radar shows no significant velocity structure in the 0.5° base velocity product across the fine line as it passes over the radar?
- Are Birmingham suburbs and interstates appropriately mentioned in the tornado warning and severe weather statements?
- What wording is used to separate this warning from a general tornado warning?
- Are locations in the path overly specific?
- Are spotter reports used to motivate people to take shelter?
- Is the heavy rainfall in Jefferson county recognized even though there are no reports of flooding?

Pickens-Tuscaloosa-Jefferson County Storm (mini supercell)

Time (UTC)	Description
2356 KGWX	rapidly intensifying low-level rotation in miniature cell in SW Pickens county though supercell reflectivity signatures not well defined
0001-0012 KBMX	LRM high reflectivity core aloft, VIL increases from 30-45 kg/m^2
0006-0012 KBMX	moderate TVS signatures
0007 KGWX	hook echo developing with mid-level rotation and weak low-level convergence
0022-0027 KBMX	LRM high reflectivity core aloft increases, VIL 45 kg/m^2

Considerations:

- Is the trainee aware of the storms signatures from the KGWX radar?

- Although no severe weather is reported with this storm, is the storm receiving consideration?

Noxubee-Pickens County Storm

Time (UTC)	Description
0017 KBMX	LRM high reflectivity core aloft, VIL increases to 45 kg/m^2
0021 KGWX	appendage developing with weak circulation
0027 KBMX	moderate TVS
0031 KGWX	echo growing in size, BWER, appendage, weak low-level convergent rotation
0042 KBMX	moderate TVS

Considerations:

- Is the trainee aware of the storms signatures from the KGWX radar?
- Although no severe weather is reported with this storm, is the storm receiving consideration?

Kemper-Sumter-Greene County Storm

Time (UTC)	Description
0022 KBMX	LRM high reflectivity core aloft, VIL increases to 65 kg/m^2
0028 KBMX	HI MEHS 1.5"
0036 KGWX	appendage developing
0048 KBMX	LRM high reflectivity core aloft, VIL increases to 45 kg/m^2

Considerations:

- Is the trainee aware of the storms signatures from the KGWX radar?
- Although no severe weather is reported with this storm, is the storm receiving consideration?

6: Virtual Reality Simulation - Self Study

I. Introduction

Objectives

The training objective of this virtual reality simulation is for the trainee to practice their warning methodology for a sector of a CWA containing a storm that produces a violent tornado in a major metropolitan area.

Without a trainer present during the simulation to provide spotter reports, conflicting information, and real-time evaluation, the success of the simulation will rest on the trainee's ability to self critique their methodology following the event. This simulation is appropriate for an experienced warning forecaster who is proficient with the mechanics of issuing warnings and can benefit from practicing warning workload management.

Responsibilities

Support materials in sections I (Introduction), II (Pre-simulation Briefing), III (Simulation), IV (Post-simulation Briefing), V (Trainer Evaluation Guide), and the Trainee Job Sheet have been designed for a two person training session with the following responsibilities:

Trainee

Pre-Brief: Analyze the environmental data, issue a written briefing detailing the threat for all severe weather types, and sectorize the county warning area into three warning sectors.

Simulation: Start the simulation, and issue warnings and follow up statements for the sector containing the storm that produces the F5 tornado.

Post-Brief: Discuss with the trainer any lessons learned and how they can be implemented at the local office.

Trainer

Pre-Brief: Set up the simulation for the trainee, provide trainee work-sheets before the simulation session.

Simulation: No attendance.

Post-Brief: Discuss trainee's perceptions of performance and any lessons learned from the simulation and how they can be implemented at the local office.

This virtual reality simulation is designed to take 3.5 hours to complete, with 30 minutes for the pre-simulation briefing, 2.5 hours for the simulation, and 30 minutes for the post-brief. The simulation starts at 2302 UTC on April 8^{th}, 1998 and ends at 0130 UTC on April 9^{th}, 1998. The following sections are designed for the ***trainer to use*** to instruct and evaluate the trainee.

II. Pre-simulation Briefing

The objective of the pre-simulation briefing is for the trainee to assess the level of threat for severe weather (tornado, hail, wind, and flash flooding), formulate expectations of timing and evolution of convection, and sectorize the warning operations accordingly. The trainee should step through the pre-simulation briefing job sheets to prepare the simulation and document expectations of severe weather threat.

III. Simulation

The training objective of this self-guided virtual reality simulation is for the trainee to practice their warning methodology for a sector of a CWA containing a storm that produces a violent tornado in a major metropolitan area. This 2.5 hour simulation starts at 2302 UTC on April 8^{th}, 1998, and ends at 0130 UTC on April 9^{th}, 1998. In the Section 5.5 Trainee Job Sheet, provided to the trainee by the trainer, the trainee will be asked to warn for the sector they created in the pre-simulation briefing that includes the storm entering Pickens County (eventually moves into Birmingham).

IV. Post-simulation Briefing

The objective of the post simulation briefing is to summarize the successes and failures of the warning process and evaluate how this information can best be applied to local warning operations. At the end of the Trainee Job Sheet (see page 6-11), the trainee is to work with the trainer to discuss issues found in the briefing that pertain to improving local warning operations.

V. Trainer Evaluation Guide

The training objective of this self-guided virtual reality simulation is for the trainee to practice their warning methodology on a warning sector containing the Birmingham storm. Evaluation of the trainee is to be done by the trainee after the simulation using the Trainee Job Sheet on page 11. As part of the evaluation process, the trainee is to review this Trainer Evaluation Guide to understand the key features in the data and general issued for this simulation.

General Issues

Time (UTC)	Description
0026, 0036-0056	KGWX radar data stops coming in
2356	precipitation accumulations from KBMX are reset to zero (This is an artifact of the process of developing this case.)
0020	LAPS CAPE fields contaminated (too low) by local storms (KMSL at 2336 in Colbert county, KTUP at 2336 in Lee county MS, and KTCL at 2350 in Tuscaloosa county)
0100	surface obs beginning to veer in central AL decreasing low-level shear and helicity

Considerations:

- Does the trainee expect the general threat to increase with time as the storms mature and continue moving through the instability maximum?
- Are radar precipitation estimates and base velocity occasionally monitored for flooding threats and wind threats (in addition to the tornado and hail threats) even though they were not the primary severe weather expectation?
- Does the trainee use the radar algorithms as a safety net or as the primary warning tool? How do you think that affects the ability to detect severe weather threats and generate lead time in the warnings?
- Is the Lamar County left split coordinated with the trainer if it crossed or came near a new warning sector?
- Is the mesoscale environment data monitored at some time during the simulation (surface obs, VWP, and LAPS)?

- Does the trainee recognize the horizontal plot of LAPS helicity values are significantly too low, and they do not represent the actual 0-3 km storm relative helicity?
- Does the trainee recognize the storm contaminated observations incorrectly reducing the instability over a large area?
- Does the trainee recognize the veering surface winds with time in central AL and the subsequent decrease in low-level shear/helicity at 0100 UTC?

Storm Summary

During the simulation there are at least five storms that require more detailed monitoring for severe weather in the warning sector that includes the Birmingham storm. The lead storm in the line over western Alabama produces dime and golf ball sized hail in Tuscaloosa and Walker Counties though there is no well defined and deep cyclonic rotation. The Birmingham storm produces tornadoes and dime sized hail from Pickens to Tuscaloosa to Jefferson Counties. The remaining three storms do not have severe weather reported with them, though they contain signatures worth monitoring. A miniature supercell forms just to the west of the Birmingham storm, and it develops an appendage in reflectivity, a brief low-level circulation that weakens with time, and moderate TVS values at long range. Two other mature storms also with marginal supercell characteristics and moderate TVS signatures move from Noxubee and Kemper Counties in Mississippi into Pickens and Sumter Counties.

Tuscaloosa-Walker County Storm (lead storm in the line)

Time (UTC)	Description
2304-2309 KBMX	mid-upper level rotation in SRM, LRM high reflectivity core aloft intensifying, VIL increase from 50 to 60 kg/m^2
2314-2335	Hail algorithm MEHS 1.5 to 2.25"
2320	dime size hail in Samantha (northern Tuscaloosa County)
2320-2325 KBMX	significant precip core descent to low levels
2325 KBMX	65 dBZ reflectivities at 0.5°, and TVS algorithm trips on high shear in weak reflectivities (non-tornadic)
2335 KBMX	VIL increases to 65 kg/m^2

Time (UTC)	Description
2350 KBMX	golf ball hail in Goodsprings (southern Walker County)
0012 KBMX	LRM high reflectivity core aloft intensifying, VIL increase to 45 kg/m^2
0032 KBMX	LRM and VIL weakens significantly, storm decays

Considerations:

- Is the KBMX radar being used as the primary radar to monitor the depth of the storm (more upper tilts available)?
- Is the trainee recognizing the lack of well-organized low and mid-level cyclonic rotation throughout the storms life?
- Is the trainee detecting the high reflectivity cores aloft before the high reflectivities reach low levels for the hail in northern Tuscaloosa county?
- Does the trainee consider holding off on a tornado warning due to the lack of organized persistent rotation?
- Does the trainee consider rejecting the 2325 TVS algorithm detection as being tornadic due to the poorly organized rotation and its location relative to reflectivity features?
- Does the trainee continue a threat for large hail into Walker county despite low-level reflectivities weakening after the time of the dime size hail report at 2320?
- Does the trainee draw the sector to leave the Fayette-Walker-Winston storm in the northwest sector? If not, would that have allowed more time for better warnings and follow-on statements?

Pickens-Tuscaloosa-Jefferson County Storm (Birmingham storm)

Time (UTC)	Description
2314 KBMX	LRM high reflectivity core aloft, VIL 55 kg/m^2
2317 KGWX	organized and deep rotation (strong above 12Kft; V_r 45+ kts) in northeast Noxubee county
2336 KGWX	maturing supercell characteristics including increasing low-level rotation (moderate; V_r 35kt), strong rotation above 12Kft, increasing low-level convergence, BWER, and low-level appendage

Time (UTC)	Description
2340 KBMX	weak TVS detections begin, LRM high reflectivity core aloft intensifying, VIL increase to 45 kg/m^2
2351 KGWX	moderate to strong (80 kt) gate-to-gate delta-V in 0.5° SRM
2356 KGWX	low-mid level mesocyclone growing in scale with very strong convergent rotation signature in 0.5° SRM
0001 KBMX	LRM high reflectivity core aloft intensifying, VIL only 30 kg/m^2
0005-0029	first tornado begins in eastern Pickens County and ends in Tuscaloosa County
0010	dime size hail in Echola (western Tuscaloosa County)
0012 KBMX	VIL increase to 55 kg/m^2
0018	dime size hail at Lake Tuscaloosa (western Tuscaloosa County)
0022-0103 KBMX	HI MEHS 2” to 2.5"
0026, 0036-0056 KGWX	radar data stops coming in
0032-0103 KBMX	VIL 65 and 70+ kg/m^2
0052-0128	second tornado begins in eastern Tuscaloosa county and ends in Jefferson county (downtown Birmingham)
0103	dime size hail in Concord (western Jefferson County)
0113 KBMX	OHP estimates > 2 inches of rain in one hour in western Jefferson county with more storms headed for the same area

Considerations:

- Is KGWX the primary radar being used for low and mid level velocity interrogation due to the better low-level sampling?
- Is a tornado warning considered for Pickens County by 2340? If not, is it because of not recognizing the three dimensional structure of the supercell from KGWX and the environment?
- Is the severe hail threat included in the warning as well as expected size?
- Does the trainee understand the significance of the intensifying low-level convergent rotation being a precursor to low-level mesocyclogenesis?

- Is the location of the circulation mentioned in the tornado warnings or the precipitation core?
- Is the trainee aware of the east-west oriented fine line in reflectivity (and other bands of showers around the storm) approaching the storm from the south from 2300-0027?
- Is the trainee aware that the KBMX radar shows no significant velocity structure in the 0.5° base velocity product across the fine line as it passes over the radar?
- Are Birmingham suburbs and interstates appropriately mentioned in the tornado warning and severe weather statements?
- What wording is used to separate this warning from a general tornado warning?
- Are locations in the path overly specific?
- Are spotter reports used to motivate people to take shelter?
- Is the heavy rainfall in Jefferson county recognized even though there are no reports of flooding?

Pickens-Tuscaloosa-Jefferson County Storm (mini supercell)

Time (UTC)	Description
2356 KGWX	rapidly intensifying low-level rotation in miniature cell in SW Pickens county though supercell reflectivity signatures not well defined
0001-0012 KBMX	LRM high reflectivity core aloft, VIL increases from 30-45 kg/m^2
0006-0012 KBMX	moderate TVS signatures
0007 KGWX	hook echo developing with mid-level rotation and weak low-level convergence
0022-0027 KBMX	LRM high reflectivity core aloft increases, VIL 45 kg/m^2

Considerations:

- Is the trainee aware of the storms signatures from the KGWX radar?
- Although no severe weather is reported with this storm, is the storm receiving consideration?

Noxubee-Pickens County Storm

Time (UTC)	Description
0017 KBMX	LRM high reflectivity core aloft, VIL increases to 45 kg/m^2
0021 KGWX	appendage developing with weak circulation
0027 KBMX	moderate TVS
0031 KGWX	echo growing in size, BWER, appendage, weak low-level convergent rotation
0042 KBMX	moderate TVS

Considerations:

- Is the trainee aware of the storms signatures from the KGWX radar?
- Although no severe weather is reported with this storm, is the storm receiving consideration?

Kemper-Sumter-Greene County Storm

Time (UTC)	Description
0022 KBMX	LRM high reflectivity core aloft, VIL increases to 65 kg/m^2
0028 KBMX	HI MEHS 1.5"
0036 KGWX	appendage developing
0048 KBMX	LRM high reflectivity core aloft, VIL increases to 45 kg/m^2

Considerations:

- Is the trainee aware of the storms signatures from the KGWX radar?
- Although no severe weather is reported with this storm, is the storm receiving consideration?

Trainee Job Sheet

I. Introduction

This job sheet is to be used by the trainee to practice warning operations using a simulation in the BMX CWA.

Objective

The training objective of this “virtual reality” simulation is for the trainee to practice their warning methodology and investigate ways to improve local warning operations from the lessons learned in the simulation.

Without a trainer present during the simulation to provide spotter reports, conflicting information, and real-time evaluation, the success of the simulation will rest on the trainee’s ability to self evaluate their methodology during and following the event. This simulation is appropriate for an experienced warning forecaster who is proficient with the mechanics of issuing warnings and can benefit from practicing warning workload management.

Responsibilities

The simulation has been designed for a two person training session with the following responsibilities:

Trainee

Pre-Brief: Analyze the environmental data, issue a written briefing detailing the threat for all severe weather types, and sectorize the county warning area into three warning sectors.

Simulation: Start the simulation, and issue warnings and follow up statements for the sector containing Pickens county.

Post-Brief: Answer questions in the job sheet, discuss with the trainer any lessons learned and how they can be implemented at the local office.

Trainer

Pre-Brief: Set up the simulation for the trainee, provide trainee worksheets before the simulation session, show trainee how to save a warning to a file.

Simulation: No attendance.

Post-Brief: Discuss trainee's perceptions of performance and any lessons learned from the simulation and how they can be implemented at the local office.

This virtual reality simulation is designed to take 3.5 hours to complete, with 30 minutes for the pre-simulation briefing, 2.5 hours for the simulation, and 30 minutes for the post-brief. The simulation starts at 2302 UTC on April 8th, 1998 and ends at 0130 UTC on April 9th, 1998. As with all simulation examples, times can be adjusted as needed.

II. Pre-simulation Briefing

The objective of the pre-simulation briefing is for the trainee to assess the level of threat for severe weather (tornado, hail, wind, and flash flooding), formulate expectations of timing and evolution of convection, and sectorize the warning operations accordingly.

Trainer Tasks

1. Show trainee how to stop and start the simulator.

2. Show the trainee how to create a warning and save it to a file. To export a warning to a file after the warning has been typed up:

- In the text editor, click under “File”, “Export to File...”.
- Type in the name of the warning at the end of the path in the “filename” box on the bottom of the popup window and click OK.

3. Print map with county names and CWA outline from Support Materials (see Figure C-C-2 on page C-3) for drawing warning sectors.

4. Print out the warning log from Support Materials (see page C-1) so the trainee can keep track of the warnings they issue.

5. Close down any existing D2D sessions, and start the simulator for the time period 2302 UTC on April 8th, 1998 to 0130 UTC on April 9th, 1998.

6. Stop the simulator immediately to allow the trainee to investigate the environment up to the start time

7. Inform the trainee that the flash flood guidance for the BMX CWA is approximately 1.5" for one hour, and 2" for three hours.

8. Point out on the SPC products provided in Appendix B that the CWA is in a high risk area, and that a particularly dangerous situation (PDS) tornado watch has been issued with a threat for damaging tornadoes, hail to 3 inch diameter, and wind gusts to 80 mph.

Trainee tasks:

1. Start a D2D session, and take 30 minutes (or longer, given the background in section I) to analyze the environment of the BMX CWA and document the threat for all severe weather types across the CWA. If the trainee's local procedures have not been re-created on the WES, the trainee should do so now.

a. Identify the level of threat for tornadoes, hail, wind, and flooding throughout the CWA.

b. Identify the reasoning behind each level of threat.

2. Create three warning sectors to divide up warning responsibility into manageable areas based on the data. Annotate these on the map printed out during the pre-simulation briefing. Document the reasoning in the space provided below:

a. What is your rationale for choosing the three sectors?

III. Simulation:

The training objective of this self-guided virtual reality simulation is for the trainee to practice their warning methodology and investigate ways to improve local warning operations from the lessons learned in the simulation. The trainee will be expected to issue warnings, severe weather statements, and issue any products deemed appropriate during the simulation. There will be no pauses during the 2.5 hour simulation.

Trainee tasks:

1. Close down any existing D2D sessions, and start the simulation for the time period 2302 UTC on April 8th, 1998 to 0130 UTC on April 9th, 1998. Then start new D2D sessions. If only a single monitor exists, the trainee may wish to load two D2D sessions on one monitor to help mitigate the hardware limitation. Warn for the warning sector containing Pickens County. Allow 5-10 minutes to set up D2D sessions, and begin warning operations!

2. At 0130 UTC (the end of the simulation), take a 5 minute break.

IV. Post-simulation Briefing

The objective of the post-simulation briefing is to identify strength and weaknesses of the pre-simulation briefing and warning methodology used in the simulation, and develop ways to improve local warning performance. The trainee will be asked to answer questions about their performance and review the storm information given in the Trainer Evaluation Guide on page 6-4. The effectiveness of the post-brief lies on the ability of the trainee to be self critical. Following review of the storm summaries, the trainee should meet with the trainer to discuss any lessons learned and how to improve local operations based on the experience of the simulation.

1. Pre-simulation Briefing Review

a. Review the pre-simulation briefing notes taken earlier. Did your assessment of the threats materialize as you had anticipated? If not, why not?

b. Were the following elements recognized in the pre-simulation briefing?:

- Widespread 0-6 km shear supports supercells throughout the CWA.
- The boundary in the eastern part of the CWA enhances threat for tornadoes as they move across the boundary, and less of a tornado threat as they move into more stable air.
- Elevated instability over the boundary in the eastern part of the CWA supports elevated supercells.

- The surface boundary evident in far NW AL (see vis and sfc obs) enhances tornado threat as boundary continues to destabilize and lift northward.
- The instability maximum in central AL enhances all severe weather threat in the 70°+ dewpoint air.
- Low temperature-dewpoint spreads over central AL limit cold pool production, thereby decreasing damaging wind threat somewhat and increasing significant tornado potential
- Weaker lower tropospheric winds decrease threat for damaging winds.
- Supercell storms support a widespread risk of large hail though wet-bulb zero heights are relatively high.
- Storm speeds do not support a widespread threat of flash flooding except where storms train over same area.
- There is an impending threat of severe weather in southeast, southwest, and northwest part of the CWA requiring warning sector coverage.

If not, why not?

2. Simulation Review

Request and then review the Trainer Evaluation Guide from the trainer. Make notes of any significant features missed in the data, problems you encountered during the simulation, and the methodology you used in the warning process.

3. Trainer/Trainee Discussion

After conducting the self critique of the warning operations, meet with the trainer to summarize perceptions of the simulation and how local warning operations can be improved based on the lessons learned from the simulation.

Trainer Tasks

3a. Some considerations for discussion points include:

- Discuss strengths and weaknesses of the pre-simulation briefing analysis including data sets used.
- Discuss the creation of warning sectors and any problems encountered.
- Discuss the challenges of warning for all the storms in the sector.
- Discuss the challenges of issuing effective warning products for the Birmingham storm.

3b. Review the reports and the times to compare to the warnings.

3c. Discuss the lessons learned from the event, and how best to implement changes at the local forecast office.

7: Case Study Simulation

I. Introduction

In this exercise, D2D will be used to review data which covers a ten hour period from 1200 UTC to 2221 UTC on April 8th, 1998. Climatology, synoptic-scale processes, then mesoscale processes will be considered sequentially to provide a multi-scale analysis related to the warning process. Following this analysis, the trainee may wish to proceed on to any of the warning simulation examples included with the Simulation Guide. This exercise is appropriate for a forecaster who can benefit from multi-scale analysis.

Objectives

The training objectives of this case study simulation are to:

- Analyze a severe weather outbreak environment using the forecast funnel approach.
- Synthesize the analysis into an afternoon area forecast discussion focusing on the afternoon and evening severe weather threat for the BMX CWA.

The local training officer may wish to run through the case study in its current form, or use this example to create their own case study with different learning objectives.

Responsibilities

Support materials in sections I (Introduction), II (Environment Analysis), and III (Summary) have been designed for a two person training session with the following responsibilities:

Trainee

- Analyze the environment leading up to the start of the severe weather outbreak.

Trainer

- Prepare the data set for review.
- Guide the trainee through the forecast funnel process.
- Evaluate the trainee's analysis.

This case study simulation is designed to take 3.5 hours to complete. As with all simulation examples, times can be adjusted as needed. The following sections are designed for the ***trainer to use*** to instruct and evaluate the trainee.

II. Environmental Analysis

Climatology

The suggested completion time for the Climatology section is 20 minutes.

The objective of the climatology analysis is to become familiar with the relative frequency of severe weather on April 8th for the BMX CWA. NSSL's online severe weather climatology module will be used as the analysis tool to evaluate severe weather climatology. This module uses the Storm Data database and the Tom Grazulis Tornado Project database to create heavily smoothed time and space plots of severe weather frequency in the continental US. Details of the analysis techniques are included with the online module that is loaded in this section. The trainee and trainer will need to use a PC connected to the internet to work through the exercise. This web-based climatology analysis can be easily applied to other CWA's, and it can be incorporated into any existing local climatology.

Trainer Tasks

1. On a PC connected to the internet, have the trainee load the following page:

http://www.nssl.noaa.gov/hazard/hazardmap.html

2. Ask the trainee to analyze how the calendar date April 8th relates to the average severe weather season for tornadoes, hail, and wind. To do this task, have the trainee generate a time series for each severe event type for the BMX CWA by selecting the appropriate event type and clicking on north-central Alabama.

3. Evaluate whether the trainee determined the following climatological information for April 8th:

- this day of the year is relatively close to the peak season for tornadoes, significant tornadoes, violent tornadoes, and hail.
- this day is in the early part of the severe wind season.

4. Ask the trainee to click on the “animations” button on the top of the page to begin to analyze the magnitude of the severe weather probabilities relative to surrounding areas. State that the goal of the next exercise is for the trainee to determine:

- whether the probabilities are a local maximum/minimum in the region.
- how the probability relates to the peak probabilities nationally.

5. Under the “All Severe Weather” table have the trainee analyze the three animations (tornado, severe hail, and severe wind) for the 1980-1999 time period. After the loop has loaded, instruct the trainee to stop the loop and page through to find the 800408/0000 image.

6. Under the “High End Severe Weather” table have the trainee analyze the four animations (F2+ 1921-1995, F4+ 1921-1995, 2"+ hail, and 65+ kt wind). After the loop has loaded, instruct the trainee to stop the image and page through the loop to find the...0408/0000 image.

7. Ask the trainee to summarize the analysis of how the local probabilities relate regionally and nationally.

8. Evaluate whether the trainee determined the following:

- probabilities for tornadoes are a local maximum in northern AL, but they are not as high as in later parts of the year in the central US.
- probabilities for severe hail are a local maximum in northern AL, but they are not as high as in later parts of the year in the central US.
- probabilities for severe wind are part of a broad maximum from eastern OK/TX to GA, but they are not as high as in later parts of the year in the central and eastern US.
- probabilities for significant tornadoes are a local maximum in central and northern AL, and the regional maximum is significant relative to maxima nationwide later in the year.
- probabilities for violent tornadoes are a local maximum in central and northern AL, and the regional maximum is significant relative to maxima nationwide later in the year.

- probabilities for 2+ inch hail are relatively low throughout the year though there is a broad and weak maximum in the region this time of year that includes northern AL.
- probabilities for 65+ kt winds are low throughout the year though there is a weak maximum in eastern AL this time of year.

9. Discuss the role of climatology in the warning process with the trainee and the limitations of climatological databases. Recognition of severe weather threats relative to climatology can be used to attain better situation awareness if used appropriately. Be sure to point out that:

- Some of the most significant events can be anomalous events that do not follow climatology.
- Just because climatology suggests a higher or lower probability for a particular severe weather type doesn't mean that it will or won't occur on any given day.
- The databases contain many errors and limitations given the relatively short time period and reporting issues.

Synoptic Assessment

The suggested completion time for the Synoptic Assessment section is 1 hour and 40 minutes.

The objectives of the synoptic assessment are:

- To identify synoptic-scale features in the morning and afternoon observations.
- Evaluate model forecasts of synoptic-scale features for the period up to 0600 UTC April 9th.
- Relate the evaluation to severe weather threat.

To assess the synoptic situation, the trainee will be asked to evaluate the morning upper air and surface data, the 1200 UTC ETA model run, and the 1800 UTC special soundings using D2D. The analysis techniques provided should be modified to include local preferences for synoptic analysis (i.e. different parameter fields, hand analysis). To begin analyzing data in D2D, the trainer will need to prepare the case for review.

Trainer Tasks - Set Up

1. Close down any existing D2D sessions, and start the simulator for the time period 2221 UTC on April 8th, 1998 to 0230 UTC on April 9th, 1998. Doing so will prevent any of the data after the analysis period from being visible.
2. Stop the simulator immediately to allow the trainee to investigate the environment up to the start time
3. Set the start time on the D2D display to 1500 UTC April 8th, 1998. To do this:
   - Click with the left mouse on the “Time:” display on the bottom right-hand part of the D2D window.
   - Enter the year, date, and time after clicking on “Set Time”.
   - Click “OK”.
4. Copy any procedures from the real-time AWIPS over to the WES machine, or re-create the procedures on the local machine.
5. Load a state-scale map and overlay the CWA boundary to familiarize the trainee with the local geography.

1500 UTC Surface

Suggested completion time for tasks 1 through 3: ***5 minutes***

1. Ask the trainee to analyze the latest surface map to locate important synoptic-scale features. Have the trainee load a 1500 UTC surface map overlaid with visible satellite.
2. Ask the trainee to summarize the analysis when completed.
3. Discuss the summary with the trainee, including:
   - cold front from TX to IL
   - warm front in the Great Lakes
   - surface boundary from AL-GA-SC
   - upper 60° and low 70° dewpoints entering southern AL from the west and southwest

1200 UTC Upper Air

Suggested completion time for tasks 1 through 3: ***15 minutes***

1. Ask the trainee to load upper air plots to analyze synoptic scale features relevant to the weather over the BMX CWA. At a minimum, suggest loading the 1200 UTC 250mb, 500mb, 700mb, and 850mb upper-air plots. Make sure to set the density to “Max” to be able to see all the observations.
2. Ask the trainee to summarize the analysis when completed.
3. Discuss the summary with the trainee. Features to note in the data are:
   - 250mb jet max from TX to GA is strong (140 kts at KLZK)
   - 500mb shortwave over OK contains strong flow (85-95 kts from TX to AR)
   - 700mb jet max is in central US (MO-TN-OH); flow is moderate strength (30-35 kts) over the southern US; cap approaching AL from the southwest
   - 850mb jet max in central US; flow is weak-moderate (20-25 kts) over southern US; high dewpoints at 850mb over AL, southeast LA, FL panhandle indicate deep moisture to continue advecting into AL; drier air to the west

Suggested completion time for tasks 4 through 5: ***5 minutes***

4. Ask the trainee to load the KBMX, KJAN, KTLH, and KLIX 1200 UTC soundings to analyze important wind, temperature, and moisture variability over the region.
5. Discuss the summary with the trainee. Features to note in the data are:
   - significant cap approaching from KJAN and KLIX
   - deep low-level moisture profiles over KBMX, KLIX, and KTLH with dry air aloft
   - drier air approaching from the west (KJAN)

Suggested completion time for tasks 6 through 9: ***15 minutes***

6. Clear the display, and ask the trainee to analyze the 1200 UTC BMX sounding to begin evaluating the morning severe weather threat. Have the trainee load the BMX 1200 UTC sounding using the interactive skew-T. To load the interactive skew-T:
   - Load the KBMX sounding.
   - Right click on the black background, and select “KBMX” under the “Interactive Skew-T” drop down menu.
   - Right click on the “Interactive Skew-T” text, and select “Editable”.

- Modify the surface temperature and dewpoint with the 1200 UTC surface observations (65/65)

7. On the “Skew-T Controls” popup window lift a surface parcel:

- set the “Lifting Method” to be “Surface”,
- de-select the “Use Fcst Max Temp” box if it is highlighted yellow, and
- click on the “Lift Parcel” button.

8. Ask the trainee to evaluate and summarize the severe weather potential (tornado, hail, wind, and flooding) of the sounding using the skew-T, hodograph, and the “Skew-T Parameters” popup window.

9. Discuss the summary with the trainee including:

- instability is supportive of severe storms; surface-based CAPE is low (~ 850 J/Kg), but instability increases through elevated lifting (850mb parcel ~ 1350 J/Kg) or with daytime heating (“Fcst Max Temp” parcel ~1300 J/Kg and latest 69/68 surface obs suggests 2100J/Kg)
- strong 0-6 km shear supports supercells (estimated 60+ kts)
- SRH low 100-150 m^2/s^2 marginally supports tornadoes
- straight-line hodograph supports splitting storms
- wet-bulb zero heights optimal for large hail
- moist lower troposphere and low wind speeds limit threat for widespread damaging winds
- relatively strong flow doesn't support widespread flooding except where storms train over the same area

1200 UTC ETA Initialization

Suggested completion time: ***5 minutes***

1. Ask the trainee to evaluate and summarize whether the ETA was initialized properly. Have the trainee load a CONUS water vapor loop, then overlay ETA 500mb heights and vorticity using the volume browser.

2. Evaluate the summary, including:

- shortwave well initialized as indicated by the shape of the vorticity plot matching the pattern in the water vapor imagery in TX, OK, and MO

4-Panel Family

Suggested completion time: ***5 minutes***

1. Ask the trainee to analyze the evolution of the basic synoptic-scale features that pertain to triggering and supporting convection over the BMX CWA through 0600 UTC on April 9th, 1998. Have the trainee load a 4-panel ETA family on the regional scale and summarize the evolution.

2. Discuss the summary with the trainee, including:

- small 500mb vorticity maximum moving through northern AL/TN from 1800-0000 UTC may support development of isolated convection early in the afternoon
- warm advection throughout the day may trigger convection
- low CIN over much of the CWA and lack of well-defined trigger mechanism early in the day may complicate anticipating early convective initiation
- surface pressure trough/boundary extending from surface low in eastern MS to northern AL at 0000 UTC may trigger convection later in the afternoon (increase density of the contours to see)
- 500mb CVA with the main wave entering the CWA around 0600 UTC may support ongoing convection later this evening
- widespread 700mb vertical motion by 0000 UTC may support development of widespread convection or may be a sign of convective feedback in the model
- precipitation forecasted over TN and southeast AL by 1800 UTC
- widespread precipitation forecasted over TN, northern AL/MS from 0000-0600 UTC

Volume Browser Horizontal Plots

Suggested completion time: ***25 minutes***

1. Ask the trainee to analyze the ETA forecasts of environmental parameters relevant to supporting severe convection (wind, temperature, moisture, instability, shear, etc.) through 0600 UTC on April 9th, 1998. Have the trainee load the following ETA products using the volume browser on regional scale:

- surface (T, Td, wind, 6hr pressure falls), 850mb (T, wind), 700mb (T, wind), 500mb (T, wind), 250mb (wind)

2. Ask the trainee to summarize the evolution.

3. Discuss the summary, including:

- strong 250mb winds do not change much during the day over AL
- 500mb winds over AL significantly increase by 1800 UTC (75 kts)
- 700mb winds over AL significantly increase from 1800 UTC to 0000 UTC (60 kts)
- strong 700mb and 850mb warm advection over AL throughout the day
- 850mb winds over central and eastern AL strengthen dramatically from 1800 UTC to 0000 UTC (50 kts)
- deep tropospheric warming (500mb, 700mb, and 850mb) slightly increasing cap by 0000 UTC that cools by 0600 UTC
- surface temperatures warm into the 80s F by 1800 UTC over western AL, then cool to the 70s F by 0000 UTC
- upper 60° F surface dewpoints in central AL by 1800 UTC and drying from 0000-0600 UTC
- surface winds veer over northern AL by 0000 UTC as surface pressure fall maximum shifts northeastward

4. Ask the trainee to load the following ETA products using the volume browser on regional scale in a separate pane:

- CAPE, CIN, helicity, 0-6km bulk shear vectors, 0-3km shear, Right Moving Supercell motion, Corfidi Vectors

5. Ask the trainee to summarize the evolution:

- instability (2500 J/kg CAPE) develops early (1800 UTC) over MS and northern AL and weakens some in the evening
- low CIN over AL in the afternoon, but increasing CIN over parts of AL and MS by 0000 UTC
- strong deep shear already in place and strengthening by 1800 UTC (65 kts)
- significant increase in helicity due to the low-level jet between 1800 and 0000 UTC that shifts eastward by 0600 UTC
- gradual increase in 0-3km shear from 1200 - 0000 UTC

- right moving supercell motions of ~ 250° at 30 kts (1800 UTC) to 45 kts (0000 UTC)
- Corfidi Vectors suggest multicell propagation high, leading to low threat of stationary organized multicell complexes with flooding

Volume Browser Sounding

Suggested completion time: ***10 minutes***

1. Ask the trainee to analyze and summarize the significant qualitative changes in ETA forecast profiles over the central part of the CWA (Jefferson County) from 1200-0600 UTC April 9th, 1998 using the volume browser. To load an ETA volume browser sounding:

- under “Tools” select “Points”, and move point A to the central part of the CWA
- set the scale to CONUS, then select “ETA” under “Source”, sounding as the coordinate, “Sounding” under “Thermo”, and “Sounding A” under “Points”
- click the “Load” button

2. Discuss the summary and include:

- rapid destabilization by 1800 UTC due to heating and increase in low-level moisture
- significant increase deep-layer shear by 1800 UTC and low-level shear by 0000 UTC
- straight-line hodograph becoming more curved in low levels by 0000 UTC with much higher storm-relative helicity
- deep tropospheric warming below 300mb and cap increasing by 0000UTC

1915 UTC Analysis

Suggested completion time: ***15 minutes***

1. Change the time to 1915 UTC on April 8^{th} by left-clicking on the time in the D2D display on the lower right portion of the window and entering the appropriate date and time.

2. Ask the trainee to analyze the evolution of potential trigger mechanisms that could be important over the next few hours. Have the trainee load a regional scale surface plot with visible satellite overlaid, then summarize the evolution.

3. Discuss the summary and include:
- convective complex over TN has laid out a surface boundary over northern MS/AL
- surface winds have veered over MS setting up weak convergence in western AL and eastern MS
- elevated convection over southern AL continues lifting north

4. Ask the trainee to analyze and summarize the changes in soundings for KBMX and KJAN from 1200-1800 UTC.

5. Discuss the summary and include:
- mid-level winds have increased at KBMX
- KBMX sounding has warmed below 300mb
- significant destabilization has occurred with CAPE ~ 2600 J/Kg (note sounding needs to be modified with the 1800 UTC observations: 72/70)
- hodograph is still straight
- KJAN cap has raised from 850mb to 800mb suggesting low-level lifting occurred

6. Read the 1500 UTC SPC Convective Outlook and the SPC Public Severe Weather Outlook included in SPC Products, and discuss similarities and differences in reasoning.

Mesoscale Assessment

Suggested completion time: ***60 minutes***

The objectives of the mesoscale assessment are:
- Identify important variations of the environment across the CWA.
- Relate the environment to the threat of severe weather.

To assess the mesoscale situation, the trainee will be asked to evaluate surface observations, satellite, VWPs, LAPS, and radar data at 2221 UTC using D2D. The analysis techniques provided should be modified to include local preferences (i.e. different parameter fields, hand analysis).

2221 UTC Mesoscale Analysis

Suggested completion time for tasks 1 through 3: ***5 minutes***

1. Change the time to 2221 UTC on April 8th by left-clicking on the time in the D2D display on the lower right portion of the window and entering the date and time.

2. Ask the trainee to analyze and summarize the past few hours of evolution of potential convective triggers. Have the trainee load a 32-frame state-scale visible satellite loop, then overlay surface observations.

3. Discuss with the trainee and include:

- storms have formed in eastern MS/western AL in area of weak surface convergence and potential gravity wave oriented WSW to ENE.
- another round of elevated convection has formed over southern and southeastern AL above more stable surface air
- outflow boundary in northern AL has modified, and is starting to lift northward
- storms have formed on the western edge of the low-level cumulus field in northern MS

Suggested completion time for tasks 4 through 5: ***15 minutes***

4. Ask the trainee to analyze and summarize the evolution of the mesoscale environment over the last few hours relative to the analysis of the 1200 UTC ETA forecast completed earlier. Have the trainee load surface observations on state scale, and use the volume browser to overlay surface observations and LAPS CAPE, CIN, helicity, 0-6km bulk shear vectors, and 0-3 km shear, and the right moving supercell storm motion (suggested completion time: 15 minutes).

5. Discuss with the trainee the summary and include:

- instability axis doesn't extend into northeast AL as forecast, but is similar in magnitude to what was earlier forecasted
- CIN is larger than forecast over the eastern part of the CWA
- 0-6 km shear and 0-3 km shear are as strong as forecasted
- helicity values do not represent appropriate storm-relative values due to LAPS helicity calculation technique, but the axis may be in the right spot
- right-moving supercell storm motions estimated to be ~ 260° at 35 kts

Suggested completion time for tasks 6 through 7: ***5 minutes***

6. Ask the trainee to analyze and determine which VWP has the strongest low-level shear using VWPs for each of the three radars.

7. Discuss the trainee summary and include:

- all three radars show the wind 1 Kft above the surface is around 15 kts with KHTX slightly more backed
- differences in shear are related to the winds 7-8 Kft above sea level
- KBMX low-level shear is the strongest with 55 kts at 7-8 Kft ASL
- KGWX shows 30-45 kts at 7-8 Kft ASL
- KHTX shows 30 kts at 7-8 Kft ASL
- all three radars suggest tornadoes still a threat over the CWA

Suggested completion time for tasks 8 through 9: ***5 minutes***

8. Ask the trainee to identify significant differences in the mesoscale environment over the CWA (suggested completion time: 5 minutes).

9. Discuss the trainee summary and include:

- stability maximum over the southeast part of the CWA
- instability maximum over the central part of the CWA
- less instability farther north where surface temperatures are warm and dewpoints are lower
- surface boundaries over the east part of the CWA and northwest part of the CWA
- low-level shear is strongest in the central part of the CWA

Suggested completion time for tasks 10 through 11: ***30 minutes***

10. Ask the trainee to analyze and summarize the environment using LAPS over the three areas of mesoscale variability of instability discussed in 9. Have the trainee load LAPS soundings using WFO scale and the volume browser for: the CIN maximum (western Chambers County), the CAPE maximum (Jefferson County), and in the northwest (Colbert County) where temperatures are warmer and dewpoints are lower.

11. Discuss with the trainee the summary and include:

a. Chambers County Sounding:

- elevated CAPE significant (~ 1850 J/Kg) supporting elevated supercells
- surface CAPE low (~300 J/Kg) and CIN high (~170 J/Kg) decreasing threat of tornadoes in the colder air
- strong 0-6km shear (estimated 70 kts) supports supercells and large hail
- 0-3km SRH ~ 250-300 m^2/s^2 (using hodograph with storm motion of 260° at 35 kts) will not be fully realized if storms are elevated
- wet-bulb zero heights 11.8 Kft is high, limiting hail sizes except with supercell storms
- relatively fast storm motions (35 kts) doesn't support widespread flooding except where storms train over the same area

b. Jefferson County Sounding:

- surface CAPE moderate (2850 J/Kg) and CIN low (1 J/Kg) increasing threat of all severe weather
- strong 0-6km shear (estimated 70 kts) supports supercells and large hail
- 0-3km SRH ~ 250-300 m^2/s^2 using hodograph with storm motion of 260 at 35 kts supports tornadoes
- wet-bulb zero heights 10.7 Kft is high, limiting hail sizes except with supercell storms
- T/Td spreads are low (7 F) decreasing threat for strong cold-pool production and increasing risk for tornadoes
- low LFC and the associated presence of low-level CAPE increases threat for tornadoes
- low-level shear is stronger than LAPS suggests based on the KBMX VWP (VWP 7-8 Kft wind is 55 kts and LAPS is 35 kts)
- relatively fast storm motions (35 kts) doesn't support widespread flooding except where storms train over the same area

c. Colbert County Sounding:

- surface CAPE low-moderate (~ 1600 J/Kg) and CIN low (~ 14 J/Kg) increasing threat of all severe weather
- strong 0-6km shear (estimated 75 kts) supports supercells and large hail
- 0-3km SRH 200-250 using hodograph with storm motion of 260 at 35 kts supports tornadoes
- wet-bulb zero heights 10.0 Kft is moderate-high, limiting hail sizes except with supercell storms
- relatively fast storm motions (35 kts) doesn't support wide-spread flooding except where storms train over the same area
- T/Td spreads are higher (14° F and higher (17-20° F) in the surrounding area) increasing threat for stronger cold-pool production and slightly decreasing risk for tornadoes

12. Read the latest tornado watch from SPC in Appendix B, and point out the particularly dangerous situation.

III. Summary

The objective of the summary is to synthesize the morning analysis and create an area forecast discussion with special emphasis on the short term evolution (2200-0600 UTC). After creating the area forecast discussion the trainee may wish to run through a simulation. Before ending the exercise the trainee and trainer should discuss lessons learned from the analysis and how to apply these to local operations.

Suggested completion time for tasks 1 through 2: ***20 minutes***

1. Ask the trainee to create an area forecast discussion that summarizes the 1200-2221 UTC analysis for the CWA, including:

- the level of threat for each severe weather type over areas of mesoscale variability in the CWA
- the expected evolution over the next 3-8 hours
- any potential limiting factors

2. Discuss the rationale behind the information conveyed. Some of the key points to include:

- potential exists for a significant severe weather outbreak this afternoon throughout the CWA with significant tornadoes, large hail, and isolated damaging winds possible
- supercells expected with widespread strong deep shear over the whole CWA
- significant variations of instability and low-level shear/helicity over eastern, central, and northwestern AL
- tornado threat maximized in central AL where instability and low-level shear/helicity are greatest and low-level T/Td spreads are lowest
- tornado threat not as high in northwest AL where instability is less, T/Td spreads are higher, and low-level shear/helicity is not as strong
- tornado threat significantly lower in eastern AL as supercells become elevated and move over stable surface air
- large hail (up to baseball sized) expected CWA-wide with supercells
- damaging wind also possible and threat increases as lower-tropospheric windspeeds increase in the early evening
- damaging wind threat less in eastern AL with saturated and stable surface
- widespread flooding not anticipated with fast storm motions
- some uncertainty in anticipating how far north the high dewpoints will extend
- some uncertainty whether the retreating outflow boundary over KMSL in northwest AL will slow down and interact with storms
- some uncertainty with the evolution of the elevated convection in south-central and southwest AL moving northward
- severe threat continues into the evening as upper forcing and cold front enter the CWA later tonight

Suggested completion time for tasks 3 through 4: ***15 minutes***

3. Ask the trainee to summarize lessons learned from the exercise and how to apply these to local operations.

4. Discuss strengths and limitations of the forecast funnel approach for this event based on the analysis experience. Some elements to discuss include:

- the use of climatology to raise situation awareness of the range of threats for tornadoes, hail, and wind

- the benefit of analyzing large scale motions first, followed by smaller scale analysis
- the importance of using raw observations in combination with numerical model forecasts to best estimate the environment and anticipate severe weather evolution
- the importance of recognizing variations in the environment over the CWA and their implications for input into the warning process

Appendix A: Storm Reports

Storm reports are provided on subsequent pages in this Appendix as a reference to assist during simulation operations.

Rpt#	Location	Time (UTC)	Storm Characteristic
1	**Cherokee County**		
	Spring Garden	2130	**Hail (0.75)**

Dime-size hail was reported in Spring Garden in the southern part of the county.

Rpt#	Location	Time (UTC)	Storm Characteristic
2	**Elmore County**		
	Deatsville	2210	**Hail (0.88)**

Hail the size of nickels was reported by a storm spotter in Deatsville.

Rpt#	Location	Time (UTC)	Storm Characteristic
3	**Tallapoosa County**		
	6 S Alexander City	2250	**Hail (1.00)**
4	**Tallapoosa County**		
	8 N Dadeville	2300	**Hail (0.75)**

Dime-size hail was reported in Eagle Creek.

Rpt#	Location	Time (UTC)	Storm Characteristic
5	**Walker County**		
	Eldridge	2315	**Hail (0.75)**

Three-quarter inch hail was reported in Eldridge. The hail report came from the Carbon Hill PD.

Rpt#	Location	Time (UTC)	Storm Characteristic
6	**Tuscaloosa County**		
	Samantha	2320	**Hail (0.75)**

Dime-size hail was reported in Samantha.

Rpt#	Location	Time (UTC)	Storm Characteristic
7	**Chambers County**		
	3 N Lafayette	2325	**Hail (0.75)**
8	**Chambers County**		
	8 NNE Lafayette	2330	**Hail (0.75)**
9	**Chambers County**		
	9 NE Lafayette	2335	**Hail (0.75)**

Golf-ball-size hail was reported in Buffalo, in the central part of the county. Hail the size of quarters was reported in Five Points. Dime-size hail was reported in Fredonia in the eastern part of the county.

Rpt#	Location	Time (UTC)	Storm Characteristic
10	**Colbert County**		
	2 E Muscle Shoals	2345	**Hail (1.00)**

Quarter-size hail was reported just east of Muscle Shoals.

Rpt#	Location	Time (UTC)	Storm Characteristic
11	**Elmore County**		
	Kent	2350	**Hail (1.75)**

Golf-ball-size hail was reported in the eastern part of the county.

Rpt#	Location	Time (UTC)	Storm Characteristic
12	**Lauderdale County**		
	Florence	2350	**Hail (1.00)**

Quarter-size hail was reported in Florence.

Rpt#	Location	Time (UTC)	Storm Characteristic
13	**Colbert County**		
	2 N Muscle Shoals	2350	**Hail (1.00)**

Quarter-size hail was reported just inside Colbert County near the county line.

14 **Walker County**
Goodsprings 2350 **Hail (1.75)**
Golf-ball-size hail was reported in Goodsprings, in the southern part of the county.

15 **Chilton County**
14 NW Clanton 2350 **Hail (0.75)**
Dime-size hail was reported in Union Grove.

16 **Winston County**
5.2 SE Arley 2350 **Thunderstorm Wind (G50)**
There were several trees reported down and porches were blown off a few lake homes in the area along Simth Lake southeast of Arley.

17 **Pickens County**
2 S Gordo to 0001 **Tornado (F3)**
4.1 SE Gordo 0005

18 **Tuscaloosa County**
1.4 NW Holman to 0005 **Tornado (F3)**
7.6 N Northport

This was the first of three tornadoes produced by one supercell thunderstorm moving across central Alabama. The tornado began at 7:01 pm CDT just south of Gordo in extreme eastern Pickens County and traveled east-northeast moving into Tuscaloosa County around 7:05 pm CDT. The tornado stayed mostly in rural areas crossing the swampy area of the Sipsey River and a number of small roads before crossing SR 21. It remained in rural areas crossing SR 171 and US 43. the tornado dissipated at Lake Tuscaloosa just south of where SR 69 crosses the lake.

Emergency management reported that five single-family dwellings were destroyed along with major damage reported to one house and minor damage to 23 others. Eleven mobile homes were destroyed and three mobile homes were damaged. A couple from North Carolina camping at Lake Lurleen lost everything.

19 **Lauderdale County**
2 S Lexington 0004 **Hail (1.75)**
Golf-ball-size hail was reported just south of Lexington.

20 **Cullman County**
4 WNW Cullman 0005 **Hail (0.75)**
Dime-size hail was reported in Baldwin.

21 **Tuscaloosa County**
15 NW Northport 0010 **Hail (0.75)**
Dime-size hail was reported in Echola, in the western part of the county.

22 **Cullman County**
4 N Cullman 0010 **Hail (2.75)**
Baseball-size hail was reported north of Cullman. Some siding was damaged on homes.

23 **Cullman County**
Cullman 0014 **Hail (1.00)**
Quarter-size hail was reported in Cullman.

24	**Tuscaloosa County**		
	5 NE Northport	0018	**Hail (0.75)**

Dime-size hail was reported at Lake Tuscaloosa.

25	**Franklin County**		
	19 W Russellville	0018	**Hail (0.88)**

Nickel-size hail was reported.

26	**Marion County**		
	Winfield	0022	**Hail (1.75)**

Golf-ball-size hail was reported in Winfield.

27	**Tallapoosa County**		
	6 SSE Alexander City	0028	**Hail (0.75)**

Dime-size hail was reported near Wind Creek State Park.

28	**Cullman County**		
	Joppa	0030	**Hail (2.75)**

Hen-egg-size hail was reported in Joppa, taking some shingles off roofs.

29	**Marion County**		
	Brilliant	0030	**Hail (1.75)**

Golf-ball-size hail was reported in Brilliant.

30	**Tallapoosa County**		
	5 SE Alexander City	0033	**Hail (0.75)**

Dime-size hail was reported at US 280 river bridge.

31	**Morgan County**		
	Hulaco	0035	**Hail (1.00)**

32	**Tallapoosa County**		
	12 W Dadeville	0037	**Hail (1.75)**

Golf-ball-size hail was reported in Our Town, in the western part of the county.

33	**Marshall County**		
	Arab	0037	**Hail (0.75)**

Dime-size hail was reported in Arab.

34	**Colbert County**		
	5 S Tuscumbia	0040	**Hail (1.75)**

Golf-ball-size hail was reported in Colbert Heights.

35	**Tuscaloosa County**		
	10 NNW Brookwood to	0042	**Tornado (F5)**
	11.8 NNE Brookwood	0052	
36	**Jefferson County**		
	6.9 SW Oak Grove to	0052	**Tornado (F5)**
	Pratt City	0128	

A tornado, the second spawned from the same supercell, began in rural sections of eastern Tuscaloosa County 1.5 miles east of the Warrior River. The tornado moved through primarily rural and unpopulated areas of eastern Tuscaloosa County before crossing into extreme southwestern Jefferson County. The tornado remained in primarily unpopulated area until just before reaching Oak Grove community where three deaths occurred in a mobile home. The tornado destroyed the Oak Grove School and a number of other buildings including a fire department as it crossed CR 23/54.

The tornado moved into unpopulated area for a short while before crossing CR 54 (Lock 17 Road/Warrior River Road) where numerous houses and other structures were damaged and destroyed including another volunteer fire department building. Eleven deaths were reported in this area.

The tornado crossed Rock Creek just west of Rock Creek Road, a steep, hilly, unpopulated area. The tornado path then moved into a fairly densely populated area all the way until it dissipated in Pratt City. Areas affected included Pinedale Estates, McGregor Estates, Rockwood, Sylvan Springs, Wylam Heights, Edgewater, McDonald Chapel, Minor, West Ensley, and Pratt City. Pratt City is also within the city limits of Birmingham. Four deaths occurred Sylvan Springs, two in Wylam Heights, nine in Edgewater, two in McDonald Chapel, and one in West Ensley.

According to American Red Cross surveys, 608 homes were destroyed, 556 sustained major damage, and another 810 had minor damage. There were 1,164 families with homes that were unlivable.

Forest service officials estimated 4,000 acres of timber was destroyed in Jefferson County and 1,000 acres in Tuscaloosa County.

37 **Cullman County**
Baileyton 0042 **Hail (1.75)**
Golf-ball-size hail was reported in Baileyton.

38 **Winston County**
3 S Haleyville 0044-0053 **Hail (1.75)**
Golf-ball-size hail was reported in and south of Haleyville.

39 **Marshall County**
Arab 0045 **Hail (2.75)**
Baseball-size hail was reported in Arab.

40 **Cullman County**
Joppa 0049 **Hail (1.25)**
Half-dollar-size hail was reported in Joppa.

41 **Marshall County**
Arab 0052 **Hail (2.75)**
42 **Marshall County**
Guntersville 0059 **Hail (1.75)**
Baseball-size hail was reported in downtown Arab and golf-ball-size hail was reported in downtown Guntersville.

43 **Blount County**
Oneonta 0058 **Hail (0.75)**
Dime-size hail was reported in Oneonta.

44	**Lawrence County**		
	9 NW Moulton	0100	**Hail (0.75)**

Dime-size hail was reported in Hatton.

45	**Jefferson County**		
	Concord	0103	**Hail (0.75)**

Dime-size hail was reported in Concord.

46	**Marshall County**		
	4 SE Albertville	0111	**Hail (0.88)**

Nickel-size hail was reported southeast of Albertville.

47	**Randolph County**		
	Roanoke	0112	**Hail (1.25)**

Larger than quarter-size hail was reported in Roanoke.

48	**Lawrence County**		
	Moulton	0112	**Hail (0.88)**

Nickel-size hail was reported in Moulton.

49	**Marion County**		
	6 E Hackleburg	0113	**Hail (2.75)**

Baseball-size hail was reported west of Bear Creek. Numerous cars were damaged.

50	**Marshall County**		
	2 NE Albertville	0114	**Hail (1.75)**

Up to golf-ball-size hail was reported northeast of Albertville by amateur radio storm spotters.

51	**Dekalb County**		
	Geraldine	0117	**Hail (2.75)**

Baseball-size hail was reported in Geraldine.

52	**Dekalb County**		
	5 WSW Crossville	0118	**Thunderstorm Wind (G60)**

Trees, signs, and power lines were down along SR 168 and SR 68, west of Crossville.

53	**Jefferson County**		
	Fultondale	0121	**Hail (0.75)**
54	**Jefferson County**		
	Forestdale	0122	**Hail (1.00)**

Dime-size hail was reported in Fultondale along Interstate 65. Quarter-size hail was reported in Forestdale.

55	**Lauderdale County**		
	Waterloo	0123	**Hail (0.75)**

Dime-size hail was reported in Waterloo by amateur radio storm spotters.

56	**Dekalb County**		
	2 NNE Geraldine to	0123	**Tornado (F1)**
	3.8 NNE Geraldine	0128	

A small tornado destroyed a few barns near Geraldine. Numerous trees were also snapped or uprooted.

57 **Limestone County**
Athens 0125 **Hail (0.75)**
Dime-size hail was reported in Athens.

58 **Marion County**
15 NE Hamilton 0130 **Thunderstorm Wind (G50)**
Wind damage was reported along 2R 241, in the eastern part of the county.

59 **Dekalb County**
Fort Payne 0148 **Hail (1.00)**
60 **Dekalb County**
2 N Fort Payne 0150 **Hail (1.00)**
Quarter-size hail was reported in Fort Payne. One inch hail was reported just north of Fort Payne.

61 **Jefferson County**
Pinson 0155 **Hail (0.75)**
Dime-size hail was reported in Pinson by storm spotters.

62 **St. Clair County**
2.3 NNE Moody to 0156 **Tornado (F2)**
3.2 SE Wattsville 0215
The tornado began 2.3 miles north-northeast of Moody and just west of US 411. The tornado crossed US 411 where a large church and associated buildings, some recently constructed were destroyed. The tornado traveled on an east-northeast track moving through relatively rural areas. It affected a portion of CR 174 and then crossed US 231 just south of Wattsville. The tornado damaged a number of buildings in the Coal City area including a mobile home where two people were killed and three children were injured. The tornado ended in an open area just including a mobile home where two people were killed and three children were injured. The tornado ended in an open area just east of Coal City. Emergency Management for St. Clair County reported that 26 homes were destroyed, 30 homes suffered major damage, and 59 sustained minor damage. This included 42 mobile homes.

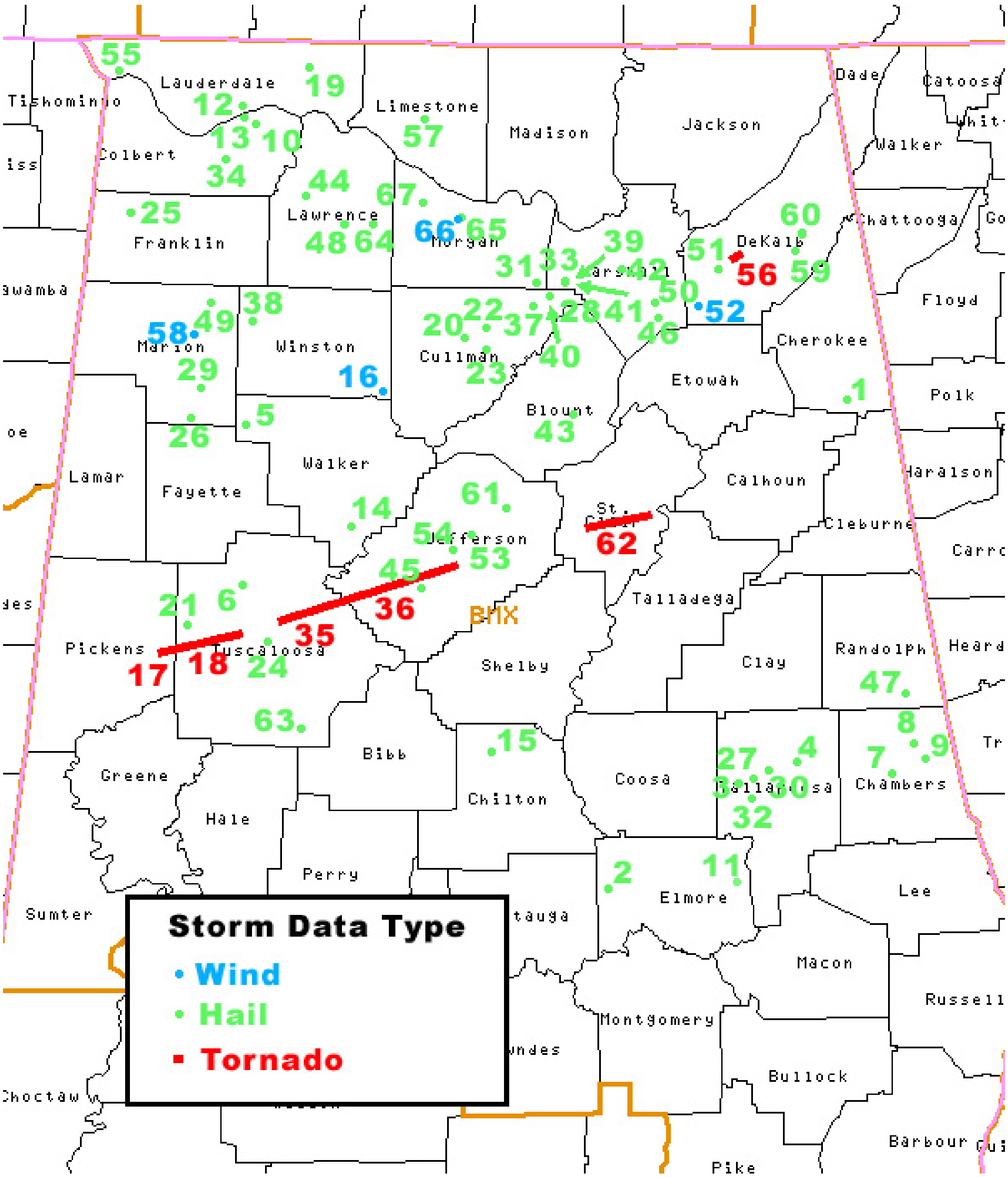
63 **Tuscaloosa County**
11 SSW Vance 0205 **Hail (0.88)**
Nickel-size hail was reported in Hagler, in the southeast part of the county.

64 **Lawrence County**
10 E Moulton 0212 **Hail (1.00)**
Quarter-size hail was reported east of Moulton.

65 **Morgan County**
9 SE Decatur 0220 **Hail (1.00)**
66 **Morgan County**
9 SE Decatur 0220 **Thunderstorm Wind (G55)**
Quarter-size hail was reported and numerous trees and billboards were downed in Priceville, in the central part of the county.

67 **Morgan County**
3 S Decatur 0222 **Hail (0.75)**
Dime-size hail was reported south of Decatur.

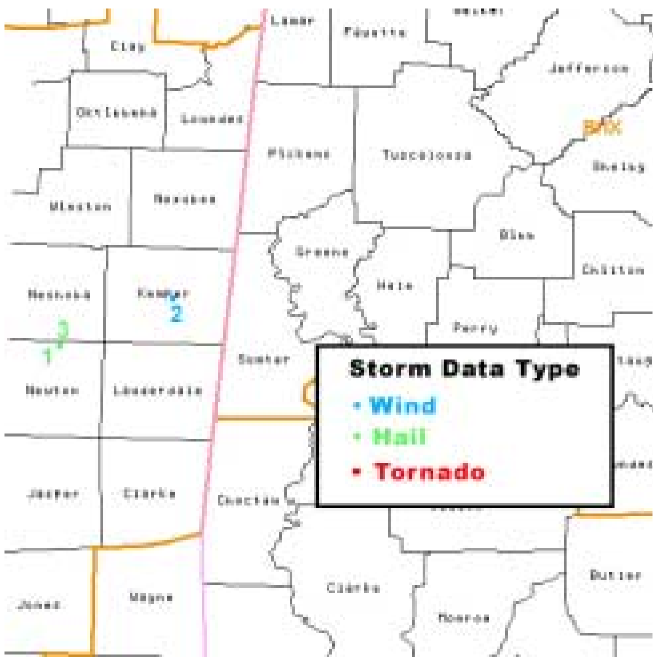
Storm Data from 2100 UTC on 4/8/98 through 0230 UTC on 4/9/98



Rpt#	Location	Time (UTC)	Storm Characteristic
1	**Newton County**		
	Union	0000	**Hail (0.75)**
2	**Kemper County**		
	De Kalb	0010	**Thunderstorm Wind**

Three roofs of houses were damaged and one roof was blown off. Several trees and power lines were blown down.

Rpt#	Location	Time (UTC)	Storm Characteristic
3	**Newton County**		
	Union	0215	**Hail (0.75)**



Rpt#	Location	Time (UTC)	Storm Characteristic
1	**Alcorn County**		
	Collinstown	2212 2220	**Hail (1.75)**
2	**Alcorn County**		
	Collinstown	2212 2220	**Thunderstorm Wind**

Several trees were knocked down.

3	**Pontotoc County**		
	Ecru	2312 2325	**Hail (1.75)**

Hail ranging from quarter- to golf-ball-size fell on Ecru.

4	**Union County**		
	Ingomar to Sherman	2315 2330	**Thunderstorm Wind**

Two mobile homes were lifted off their foundations. The framework of a new house was knocked down. An awning over a front porch to a mobile home was ripped off. A tractor shed was demolished. A few other mobile homes were damaged. Several trees were knocked down.

5	**Pontotoc County**		
	Sherman to Thaxton	2325 2330	**Hail (1.75)**

Quarter-size hail fell in the Sherman area while golf-ball-size hail fell in Thaxton.

6	**Pontotoc County**		
	4 W Thaxton to 1 E Thaxton	2325 2330	**Thunderstorm Wind**

One person was killed when his mobile home was demolished. One house had its windows blown out of it. A shed lost its roof. Two mobile homes and one house were damaged. A horse was killed in the storm. Numerous trees were blown down.

7	**Union County**		
	Sherman	2340 2345	**Hail (1.00)**
8	**Lee County**		
	Guntown	2350 2355	**Thunderstorm Wind**

A few trees were knocked down.

9	**Lee County**		
	Saltillo	2350 2355	**Hail (1.75)**

Several cars were damaged at the Birmingham Ridge Baptist Church by the hail including broken windows.

10	**Pontotoc County**		
	Friendship	2350 2355	**Thunderstorm Wind (G55)**

Several trees were knocked down.

11	**Tishomingo County**		
	Golden	0005 0010	**Hail (0.75)**
12	**Tishomingo County**		
	Belmont	0010	**Thunderstorm Wind**

0025

A lumber truck was overturned. Several homes and businesses suffered roof damage and had windows blown out of them. Numerous power lines, telephone lines and trees were blown down with some of the trees landing on houses.

13 **Itawamba County**

Ratliff 0015 **Hail (1.75)**

0020

14 **Chickasaw County**

Houston 0020 **Thunderstorm Wind**

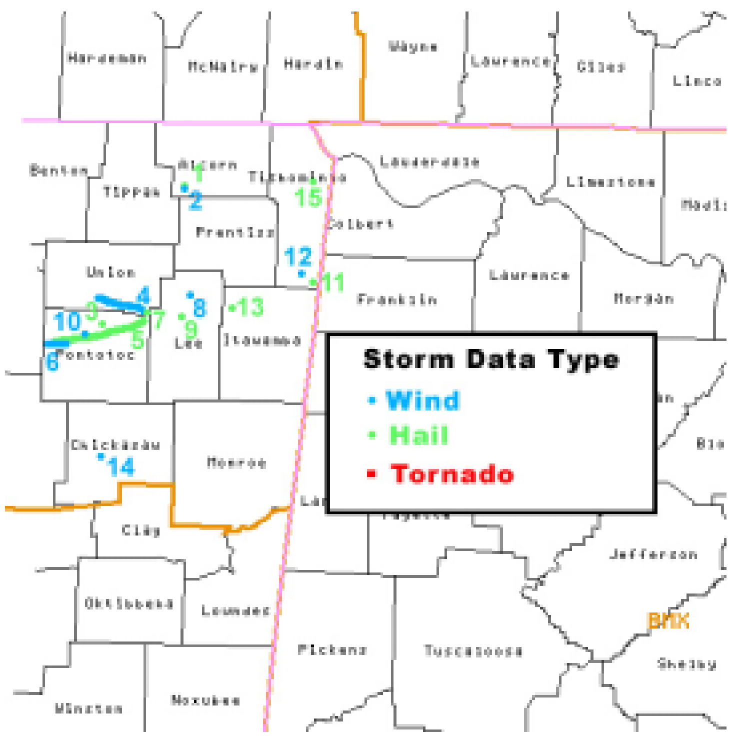
0025

A few trees and some power lines were blown down.

15 **Tishomingo County**

Iuka 0115 **Hail (0.75)**

0120



Appendix B: SPC Products

SPC products are provided on subsequent pages in this Appendix as a reference to assist during simulation operations.

CONVECTIVE OUTLOOK...REF AFOS NMCGPH94O.

VALID 081500Z - 091200Z

REF WW NUMBER 0183...VALID TIL 1900Z

THERE IS A HIGH RISK OF SVR TSTMS THIS AFTERNOON AND EARLY TONIGHT ACROSS PARTS OF NRN MS...NRN/CNTRL AL...NRN GA AND SRN TN. THIS AREA IS TO THE RIGHT OF A LINE FROM 35 SSE MKL 40 WSW CSV 35 WSW TYS 35 SSW TYS 50 NW AND 20 S AND 30 E LGC 20 W AUO 35 SW CKL 45 ESE GWO 30 SE UOX 35 SSE MKL.

THERE IS A MDT RISK OF SVR TSTMS THIS AFTERNOON AND TONIGHT ACROSS MUCH OF MS..SRN AL...CENTRAL GA...CENTRAL AND WRN NC AND SC...MUCH OF CENTRAL AND ERN TN N OF HIGH RISK AREA. THIS AREA IS TO THE RIGHT OF A LINE FROM 35 N MCB 30 SW GWO 15 ESE MEM MKL BNA 20 ENE HSS 30 NNW GSO 10 NNW RDU 15 E FAY FLO 35 ENE DHN 35 NNE MOB 35 ESE MCB 35 N MCB.

THERE IS A SLGT RISK OF SVR TSTMS TO THE RIGHT OF A LINE FROM 15 ESE BPT 20 NW LFK 20 NE PBF 25 WSW EVV 15 W FDY 35 NNW CLE 20 ENE FKL 15 WSW MRB DCA 20 E SBY ...CONT... 15 E JAX 50 N PIE.

GEN TSTMS ARE FCST TO THE RIGHT OF A LINE FROM 15 SSW PSX HDO 30 W TXK 25 NNE SLO MKE 55 NNE MTC BUF ISP.

...SIGNIFICANT SEVERE WEATHER OUTBREAK EXPECTED TODAY OVER MUCH OF THE SOUTHEASTERN U.S. A PUBLIC SEVERE WEATHER OUTLOOK WILL BE ISSUED AROUND 16Z.

...SEVERE THUNDERSTORM FORECAST DISCUSSION...

POTENT SEVERE THUNDERSTORM PATTERN HAS EVOLVED OVER THE SERN U.S. WITH MARKED INCREASE IN INSTABILITY OVERNIGHT INTO THE AREA AHEAD OF STRONG UPPER S/WV TROF AND ASSOCIATED MID/UPPER JET. SITUATION COMPLEX WITH SEVERE THUNDERSTORMS UNDERWAY WITH IMPRESSIVE BOW ECHO CURRENTLY MOVING INTO NRN MS AND ISOLATED SEVERE STORMS ALONG GULF COAST.

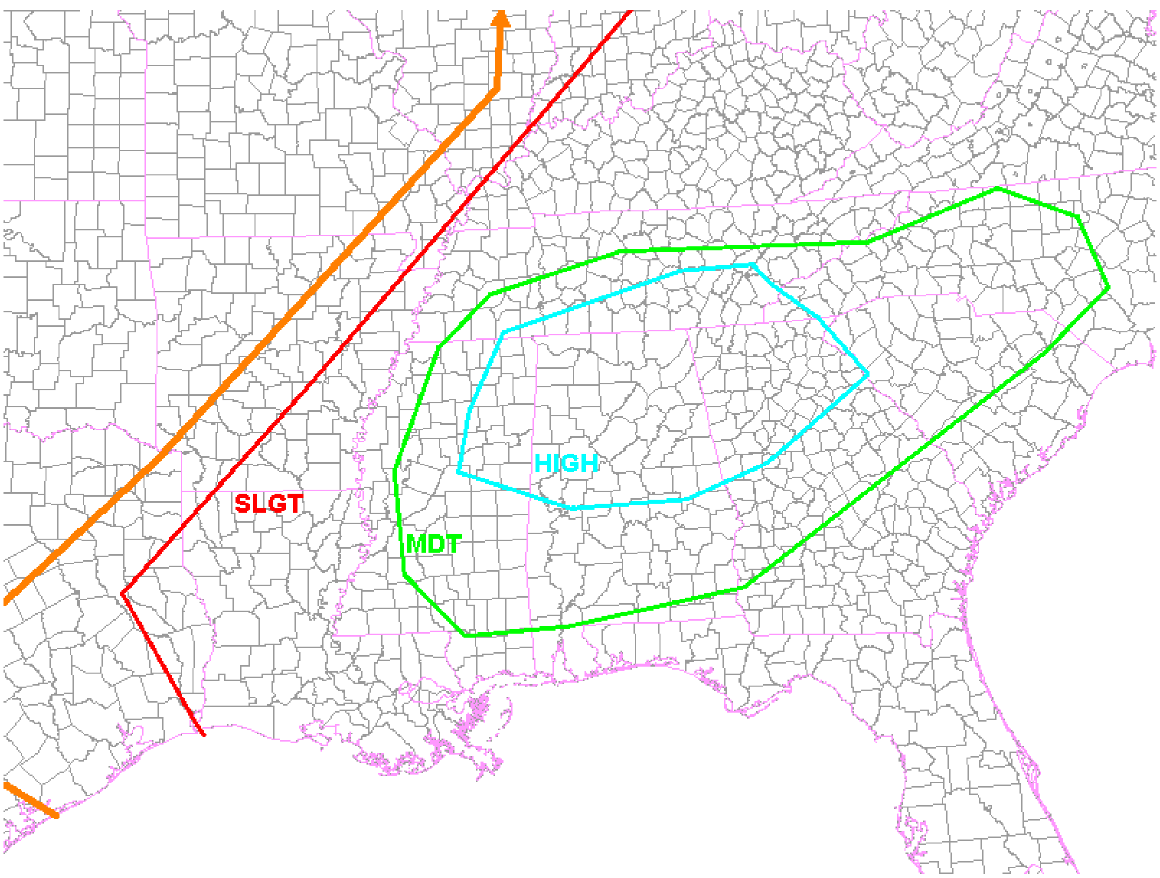
MODELS AGREE SOMEWHAT THAT A MORE ORGANIZED SURFACE LOW WILL DEVELOP THIS AFTERNOON VICINITY TN/AL BORDER AND DEEPEN NEWD TONIGHT. WITH WIDESPREAD MODERATE INSTABILITY AND STRONG MID/UPPER WINDS CONDITIONS WILL DEVELOP BY MID AFTERNOON FOR SUPERCELLS AND TORNADOES ALONG AND AHEAD OF THE RAPIDLY MOVING LINE OF STORMS NOW MOVING INTO NRN MS. THIS

IS REFLECTED IN THE HIGH RISK WHICH WAS SHIFTED EWD INTO GA AND NWD INTO SRN TN FOR THIS AFTERNOON AND EVENING.

OTHER AREAS OF SEVERE THUNDERSTORMS WILL DEVELOP AHEAD OF COLD FRONT NWD INTO ERN OH VALLEY AND EWD INTO CAROLINAS. HAVE MOVED MDT RISK INTO CAROLINAS AS WIND PROFILES BECOME INCREASINGLY FAVORABLE FOR SUPERCELLS AND WIND DAMAGE DURING AFTERNOON WHERE CONSIDERABLE HEATING WILL TAKE PLACE UNDER CURRENT MOSTLY CLEAR SKIES. ORGANIZED SQUALL LINE...POSSIBLY THE CURRENT BOW MOVING ACROSS NRN MS WILL MOVE RAPIDLY ACROSS CAROLINAS EARLY TONIGHT WITH WIND DAMAGE AND POSSIBLE TORNADOES.

SHIFTED THE SLIGHT RISK NWD INTO VA WHERE WARM FRONT WILL FOCUS STG/SVR THUNDERSTORMS THIS AFTERNOON AND INCREASINGLY UNSTABLE AIR MASS.

Convective Outlook for 1500 UTC on 04/08/98



BULLETIN - IMMEDIATE BROADCAST REQUESTED
TORNADO WATCH NUMBER 188
STORM PREDICTION CENTER NORMAN OK
135 PM CDT WED APR 8 1998

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

NORTHERN AND CENTRAL ALABAMA
NORTHERN AND CENTRAL MISSISSIPPI

EFFECTIVE THIS WEDNESDAY AFTERNOON AND EVENING FROM 200 PM UNTIL 800 PM CDT.

THIS IS A PARTICULARLY DANGEROUS SITUATION WITH THE POSSIBILITY OF VERY DAMAGING TORNADOES. ALSO...LARGE HAIL TO 3 INCHES IN DIAMETER...THUNDERSTORM WIND GUSTS TO 80 MPH...AND DANGEROUS LIGHTNING ARE POSSIBLE IN THESE AREAS.

THE TORNADO WATCH AREA IS ALONG AND 80 STATUTE MILES NORTH AND SOUTH OF A LINE FROM 45 MILES WEST SOUTHWEST OF GREENWOOD MISSISSIPPI TO 30 MILES EAST NORTHEAST OF ANNISTON ALABAMA.

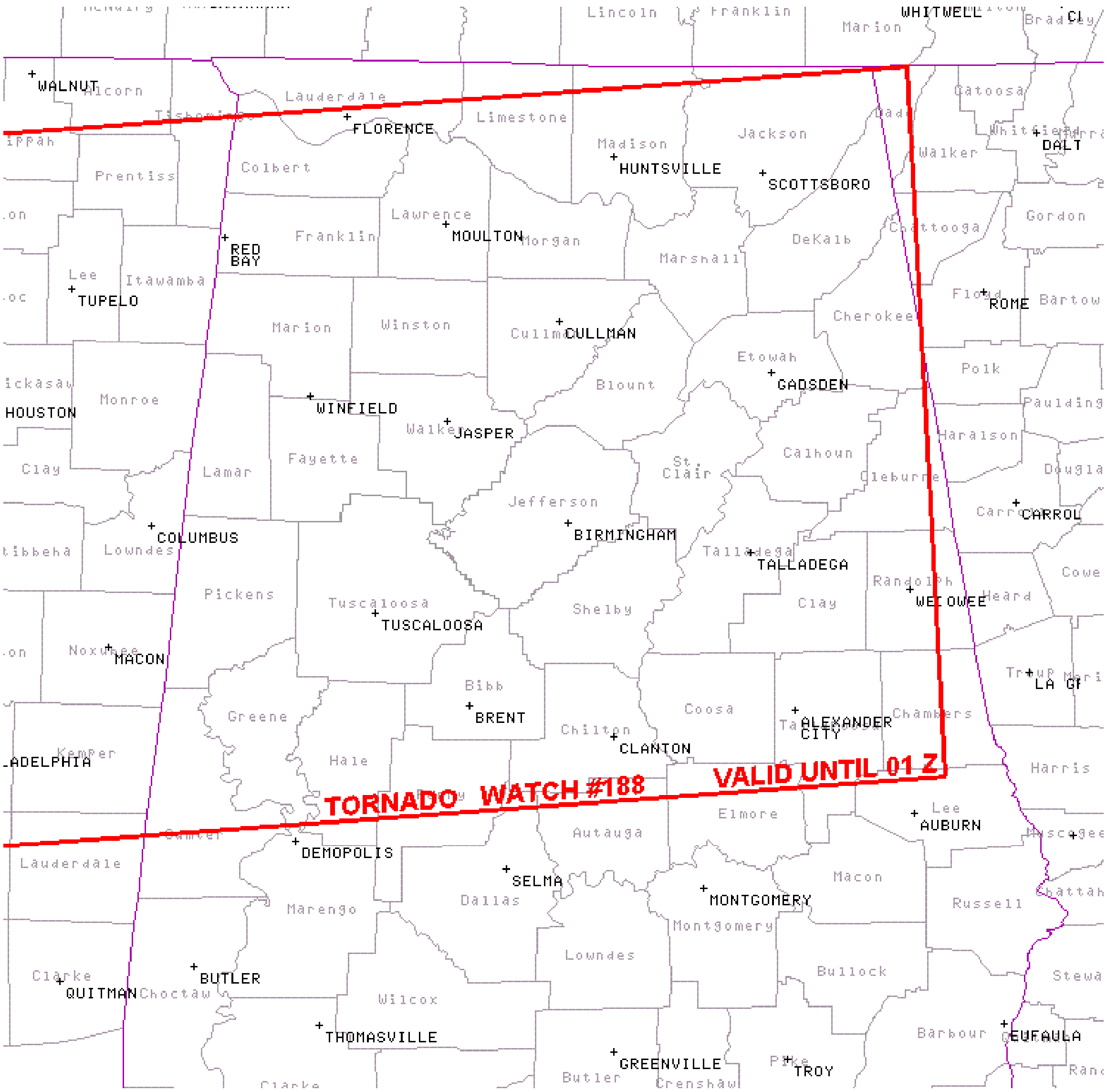
REMEMBER...A TORNADO WATCH MEANS CONDITIONS ARE FAVORABLE FOR TORNADOES AND SEVERE THUNDERSTORMS IN AND CLOSE TO THE WATCH AREA. PERSONS IN THESE AREAS SHOULD BE ON THE LOOKOUT FOR THREATENING WEATHER CONDITIONS AND LISTEN FOR LATER STATEMENTS AND POSSIBLE WARNINGS.

DISCUSSION...STORMS EXPECTED TO DEVELOP RAPIDLY OUR OF AR INTO MS AS STRONG S/WV APPROACHES FROM TX WITH ASSOCIATED POTENT WIND PROFILES. AIRMASS NOW VERY UNSTABLE WITH CAPES AOA 2500 J/KG MS INTO WRN AL. CONDITIONS FAVORABLE FOR SUPER CELLS AND TORNADOES.

AVIATION...TORNADOES AND A FEW SEVERE THUNDERSTORMS WITH HAIL SURFACE AND ALOFT TO 3 INCHES. EXTREME TURBULENCE AND SURFACE WIND GUSTS TO 70 KNOTS. A FEW CUMULONIMBI WITH MAXIMUM TOPS TO 520. MEAN STORM MOTION VECTOR 24040.

;342,0904 344,0852 323,0852 320,0904;

Graphic for Tornado Watch #188



BULLETIN - IMMEDIATE BROADCAST REQUESTED
TORNADO WATCH NUMBER 194
STORM PREDICTION CENTER NORMAN OK
653 PM CDT WED APR 8 1998

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

NORTHERN AND CENTRAL MISSISSIPPI
NORTHERN AND CENTRAL ALABAMA

EFFECTIVE THIS WEDNESDAY NIGHT AND THURSDAY MORNING FROM 730 PM UNTIL 200 AM CDT.

THIS IS A PARTICULARLY DANGEROUS SITUATION WITH THE POSSIBILITY OF VERY DAMAGING TORNADOES. ALSO...LARGE HAIL TO 2 INCHES IN DIAMETER...THUNDERSTORM WIND GUSTS TO 80 MPH...AND DANGEROUS LIGHTNING ARE POSSIBLE IN THESE AREAS.

THE TORNADO WATCH AREA IS ALONG AND 95 STATUTE MILES EITHER SIDE OF A LINE FROM 20 MILES WEST NORTHWEST OF GREENWOOD MISSISSIPPI TO 35 MILES EAST NORTHEAST OF ANNISTON ALABAMA.

REMEMBER...A TORNADO WATCH MEANS CONDITIONS ARE FAVORABLE FOR TORNADOES AND SEVERE THUNDERSTORMS IN AND CLOSE TO THE WATCH AREA. PERSONS IN THESE AREAS SHOULD BE ON THE LOOKOUT FOR THREATENING WEATHER CONDITIONS AND LISTEN FOR LATER STATEMENTS AND POSSIBLE WARNINGS.

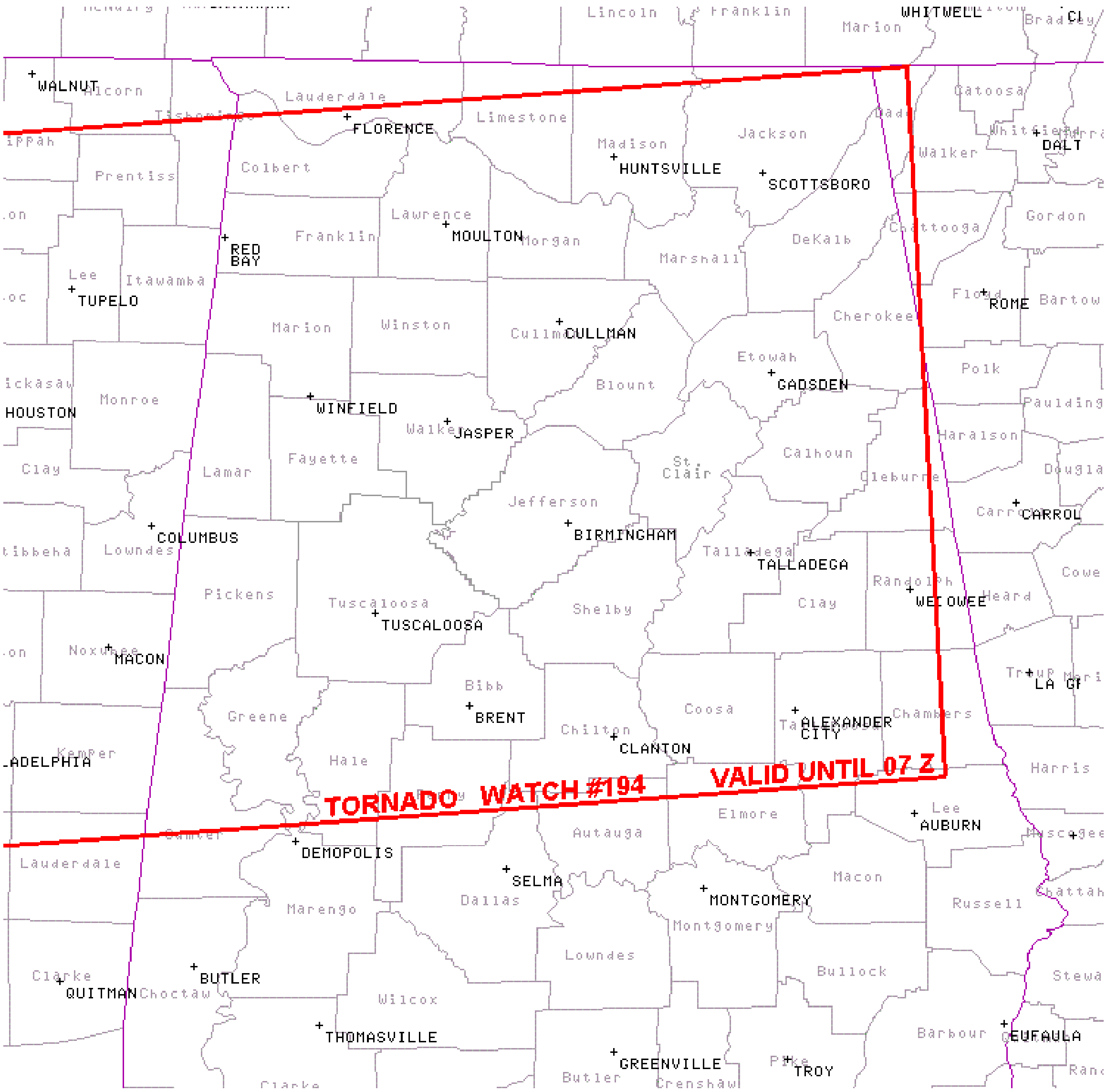
OTHER WATCH INFORMATION...THIS TORNADO WATCH REPLACES TORNADO WATCH NUMBER 188. WATCH NUMBER 188 WILL NOT BE IN EFFECT AFTER 730 PM CDT.

DISCUSSION...THUNDERSTORM CLUSTER WITH A HISTORY OF TORNADOES AND SEVERE WEATHER WILL CONTINUE OVER WATCH AREA AS AIR MASS VERY UNSTABLE WITH CAPES ABOVE 3000 J/KG. 90 KT MID LEVEL SPEED MAX WILL MOVE ACROSS REGION AHEAD OF SURFACE FRONT AND VIGOROUS UPPER TROUGH THUS MAINTAINING POTENTIAL OF TORNADIC SUPERCELLS.

AVIATION...TORNADOES AND A FEW SEVERE THUNDERSTORMS WITH HAIL SURFACE AND ALOFT TO 2 INCHES. EXTREME TURBULENCE AND SURFACE WIND GUSTS TO 70 KNOTS. A FEW CUMULONIMBI WITH MAXIMUM TOPS TO 500. MEAN STORM MOTION VECTOR 24040.

;345,0902 350,0851 321,0851 321,0902;

Graphic for Tornado Watch #194



MKCPWOMKC
TTAA00 KMKC 081520
PUBLIC SEVERE WEATHER OUTLOOK
NATIONAL WEATHER SERVICE KANSAS CITY MO
1100 AM CDT WEDNESDAY 8 APRIL 1998

OUTBREAK OF SEVERE THUNDERSTORMS WITH TORNADOES...LARGE HAIL AND DAMAGING WINDS IS EXPECTED ACROSS PARTS OF THE TENNESSEE VALLEY AND THE NORTHERN GULF COAST STATES INTO AREAS OF NORTHERN GEORGIA...

THE STORM PREDICTION CENTER IN NORMAN OKLAHOMA IS FORECASTING AN OUTBREAK OF SEVERE THUNDERSTORMS WITH TORNADOES...LARGE HAIL AND DAMAGING WINDS TODAY AND TONIGHT ACROSS PARTS OF THE TENNESSEE VALLEY AND GULF COAST STATES. THE MAIN AREA THAT WILL EXPERIENCE THIS SEVERE ACTIVITY INCLUDE:

> PARTS OF NORTHEAST AND EAST CENTRAL MISSISSIPPI...EASTWARD ACROSS PARTS OF SOUTHERN TENNESSEE...NORTHERN AND CENTRAL ALABAMA INTO MUCH OF NORTHERN AND CENTRAL GEORGIA.

A WARM...HUMID AND UNSTABLE AIR MASS IS LOCATED ACROSS MUCH OF THE SOUTHEASTERN STATES THIS MORNING. SEVERE THUNDERSTORMS OVER PARTS OF THE LOWER MISSISSIPPI VALLEY WILL MOVE EAST AND NORTHEAST TODAY MOVING ACROSS SOUTHERN TENNESSEE AND NORTHERN MISSISSIPPI AND NORTHERN ALABAMA EARLY THIS AFTERNOON. ADDITIONAL SEVERE THUNDERSTORMS ARE MOVING NORTHEASTWARD ACROSS SOUTHERN ALABAMA AND CENTRAL GEORGIA THIS AFTERNOON AS THE COLD FRONT MOVES EASTWARD ACROSS MISSISSIPPI THIS AFTERNOON...MORE SEVERE THUNDERSTORMS ARE EXPECTED TO DEVELOP ACROSS ALABAMA INTO GEORGIA AND THE WESTERN CAROLINAS BY TONIGHT.

A STRONG COLD FRONT EXTENDS FROM INDIANA SOUTHWARD INTO LOUISIANA AND WILL CONTINUE TO MOVE EASTWARD ACROSS OHIO AND THROUGH MISSISSIPPI AND ALABAMA TONIGHT. STRONG MIDDLE AND UPPER LEVEL WINDS EXTEND FROM TEXAS EASTWARD AND NORTHEASTWARD ACROSS THE TENNESSEE VALLEY AND THE GULF COAST STATES TODAY REACHING ACROSS THE SOUTHERN CAROLINAS TONIGHT. SOUTHERLY LOW LEVEL WINDS WILL EXTEND FROM LOUISIANA NORTH AND NORTHEASTWARD INTO NORTHERN GEORGIA BRINGING WITH IT MOISTURE FROM THE GULF OF MEXICO THROUGH THIS EVENTING.

THIS IS A POTENTIALLY DANGEROUS WEATHER SITUATION. THOSE IN THE THREATENED AREAS ARE URGED TO REVIEW SEVERE WEATHER SAFETY RULES AND MONITOR RADIO...TV...OR NOAA WEATHER RADIO FOR UP TO DATE WATCHES...WARNINGS AND STATEMENTS.

...JACK HALES/DAN MCCARTHY...
STORM PREDICTION CENTER
NNNN

Appendix C: Support Materials

This Appendix includes:

A sample warning log provided for use in the simulations (see page C-2).

A map of the Birmingham CWA (see Figure C-C-2 on page C-3).

Warning Decision Training Branch

Team Members: **Warning Log** **Today's Date**

__________/__________ Simulation Location/Date ______________ Page #__________

Warning Type
Tornado - T
Svr Tstm - S
Flash Flood - F
Svr Wx Statement - SVS
Nowcast - NOW

List Basis for Warnings (In order of importance):
1 - Reflectivity; 2 - SRM; 3- Base Velocity;
4 - MESO; 5- TVS; 6 - VIL; 7- Precip; 8 - Other Alg
9 - Loop; 10 - Report; 11 - Other (explain)

#	Type	Issued (UTC)	Expires (UTC)	Counties or portions of counties warned	init	ver
	Basis:	Location and type of wx expected:				

#	Type	Issued (UTC)	Expires (UTC)	Counties or portions of counties warned	init	ver
	Basis:	Location and type of wx expected:				

#	Type	Issued (UTC)	Expires (UTC)	Counties or portions of counties warned	init	ver
	Basis:	Location and type of wx expected:				

#	Type	Issued (UTC)	Expires (UTC)	Counties or portions of counties warned	init	ver
	Basis:	Location and type of wx expected:				

#	Type	Issued (UTC)	Expires (UTC)	Counties or portions of counties warned	init	ver
	Basis:	Location and type of wx expected:				

#	Type	Issued (UTC)	Expires (UTC)	Counties or portions of counties warned	init	ver
	Basis:	Location and type of wx expected:				

#	Type	Issued (UTC)	Expires (UTC)	Counties or portions of counties warned	init	ver
	Basis:	Location and type of wx expected:				

Figure C-1. Warning Log Form.

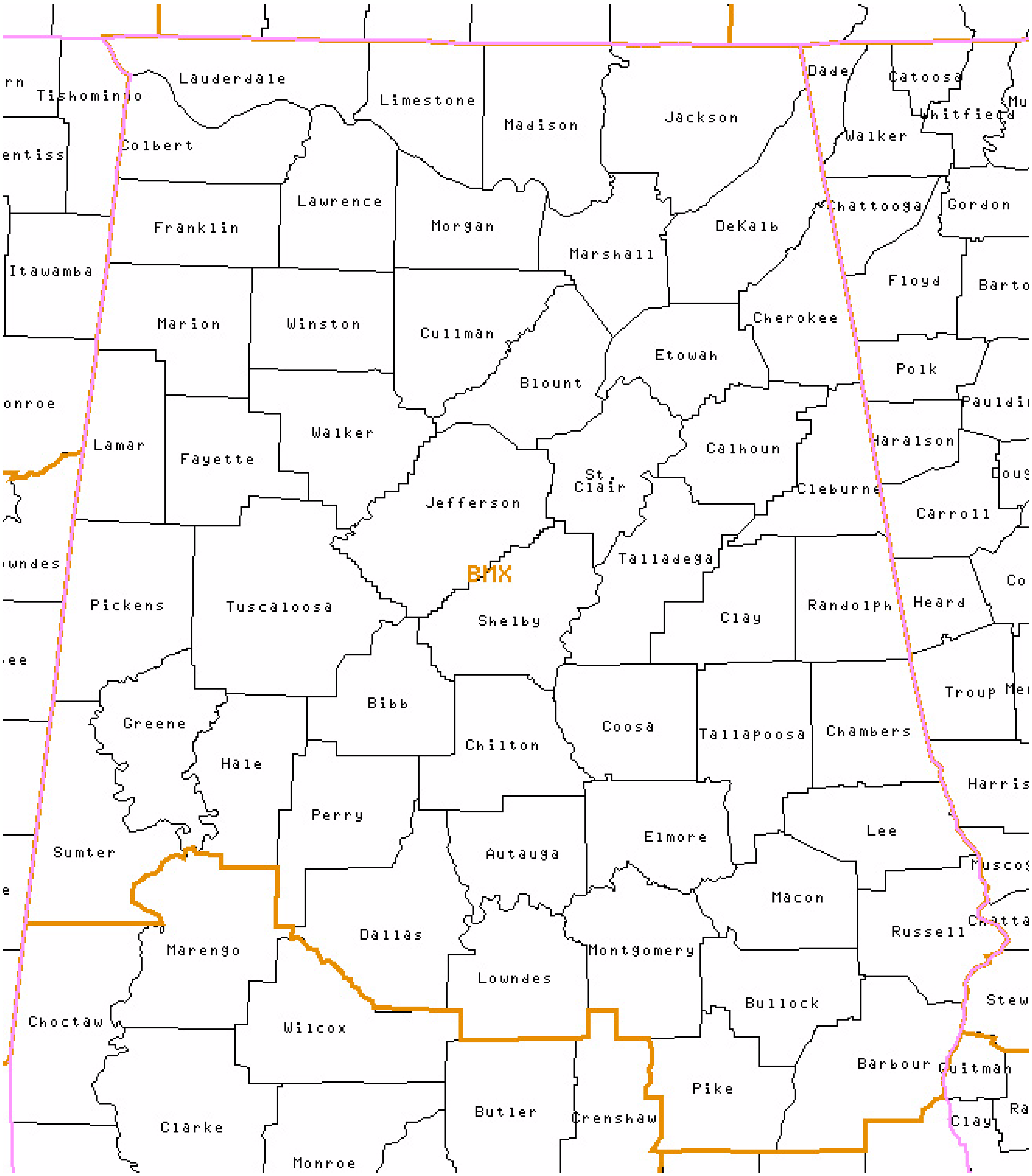


Figure C-2. Map of the BMX CWA.