

**AWOC Winter Weather Track
Instructional Goals**

September 15, 2009

IC# title: Lessons Learning Objectives Performance Objectives

<p>IC 1: Orientation to AWOC Winter Wx Track (only 1 lesson delivered via live Gotomeeting)</p>	<p>L1.1. Students, facilitators and management should be able to identify the objectives and timelines for the course.</p> <p>L1.2. Students, facilitators, and management should be able to identify their roles and responsibilities for the course.</p>	<p>P1.1 (For facilitators) Register all your forecasters in the LMS for the course.</p> <p>P1.2 (For students) Complete pre-course survey.</p> <p>P1.3 (for MICs) Discuss performance expectations of the forecasters from the course.</p>
<p>IC 2: Winter Wx Products and Services</p> <ul style="list-style-type: none"> • Lesson 1: Products and Policy 	<p>L2.1 Based on NWSI 10-513, 10-514, and 10-515, identify why certain winter weather products are issued.</p>	
<ul style="list-style-type: none"> • Lesson 2: Forecast and Product Collaboration 	<p>L2.2 Identify the key elements of collaboration in the winter weather forecasting process.</p> <p>L2.3 Review effective collaboration techniques for consistency and accuracy in winter products and services</p>	<p>P2.1 Execute an effective collaboration process within the forecast process.</p> <p>P2.2 Identify and demonstrate effective and appropriate use of collaboration tools.</p> <p>P2.3 Demonstrate knowledge of collaboration triggers.</p> <p>P2.4 Effectively integrate opportunities for collaboration as part of HPC's Winter Weather Desk and SPC's Winter Mesoscale Discussions</p>

IC 3: User Needs to Mitigate Societal Impacts of Winter Weather: Road Weather		
<ul style="list-style-type: none"> Lesson 1: Significant Impacts to Users 	<p>L3.1 Understand the NWS policy on DOT support and be able to differentiate between appropriate and inappropriate NWS support of DOT operations during hazardous weather.</p>	
<ul style="list-style-type: none"> Lesson 2: Road Weather Impacts & Surface Transportation Management Strategies 	<p>L3.2 Identify the impacts adverse weather has on surface transportation and the strategies used by DOTs to mitigate these impacts, including the general and strategy specific goals of the mitigation techniques.</p> <p>L3.3 Explain the significance of the strategic and tactical planning timeframes for DOT mitigation activities.</p> <p>L3.4 Indicate which parameters most often indicate event severity for significant warning-criteria and sub-advisory winter weather events.</p> <p>L3.5 Explain the meteorological and human factors relationship that play key roles in the severity of sub-advisory winter weather events, including the range of values when key parameters are significant for NWS support of DOT operations.</p>	
<ul style="list-style-type: none"> IC3.3: Tools for Monitoring Road Weather 	<p>L3.6 Explain the benefits of RWIS and other local mesonet data available to NWS</p>	<p>P3.1 After completing this lesson, you should be able to access local mesonet data</p>

	<p>forecasters in real-time via MADIS and other sources.</p> <p>L3.7 Identify the two different kinds of RWIS sites and what factors may impact the usefulness of these data.</p> <p>L3.8 Explain the most common issues NWS forecasters may encounter with quality controlling and using local mesonet data in an operational environment.</p>	<p>in AWIPS, view the quality control test results for those data, and be able to perform a basic diagnosis of the errors caught by these test results.</p>
<ul style="list-style-type: none"> • IC3.4, The NWS-Ground Transportation Partnership 	<p>L3.11 Identify the topics discussed that may help NWS forecasters and DOTs better meet their respective missions.</p> <p>L3.12 Characterize the discussion of each topic presented in this lesson, including how the topic impacts the NWS-DOT partnership.</p>	
<ul style="list-style-type: none"> • IC 3.5, Comparing Timelines of NWS Products & Ground Transportation Mitigation Strategy Implementation 	<p>L3.13 Identify how weather information and surface transportation management strategies fit into the basic DOT concept of operations presented.</p> <p>L3.14 Describe, in general terms, how NWS products and services may fit into an event timeline for various types of weather events.</p>	
<p>IC 4: Climatology of Winter Storms</p>	<p>L4.1 Understand the spatial and temporal aspects of slowly evolving systems that affect winter weather</p>	<p>P4.1 Demonstrate the ability to recognize patterns that enhance/suppress winter storms.</p>

<ul style="list-style-type: none"> • Lesson 1: Using CPC Products <ul style="list-style-type: none"> ○ Part 1: El Niño, La Niña, and the Southern Oscillation (ENSO) 	<p>L4.2 Describe effects of ENSO, on North American weather</p> <p>L4.3 Describe effects of ENSO on North American weather.</p> <p>L4.4 Know where to find further current and predictive information</p>	<p>P4.2 Determine significant physical mechanisms which lead to increased probability of wintertime precipitation.</p> <p>P4.3 Use the web to identify current ENSO conditions.</p>
<ul style="list-style-type: none"> • Lesson 1 <ul style="list-style-type: none"> ○ Part 2: Madden Julian Oscillation (MJO) 	<p>L4.5 Understand the spatial and temporal aspects of the MJO.</p> <p>L4.6 Identify physical mechanisms of the MJO that are responsible for enhancing or suppressing winter weather.</p> <p>L4.7 Describe effects of the MJO on N.A. weather</p>	<p>P4.4 Demonstrate the ability to recognize patterns that enhance/suppress winter storms.</p> <p>P4.5 Determine significant physical mechanisms which lead to increased probability of wintertime precipitation</p> <p>P4.6 Use different data sets to determine the state of the MJO and its significance to winter weather systems affecting the U.S.</p>
<ul style="list-style-type: none"> • Lesson 1 <ul style="list-style-type: none"> ○ Part 3: Climatology-Teleconnections 	<p>L4.8 Understand the spatial and temporal aspects of slowly evolving systems that affect winter weather.</p> <p>L4.9 Identify the “phase” of any given teleconnection.</p> <p>L4.10 Describe effects of teleconnections on North American weather.</p>	<p>P4.7 Demonstrate the ability to recognize patterns that enhance/suppress winter storms.</p> <p>P4.8 Determine significant physical mechanisms which lead to increased probability of wintertime precipitation.</p> <p>P4.9 Distinguish between different teleconnections and know what the significance is of those affecting the US.</p>
<ul style="list-style-type: none"> • Lesson 2: Climatological Degree of Rarity of Hazardous Winter Weather 	<p>L4.10 Identify what is needed to create a climatology.</p> <p>L4.11 Determine the significance and potential</p>	

<ul style="list-style-type: none"> ○ Part 1: Building a Climatology 	<p>impact from anomalies on expected winter weather</p> <p>L4.12 Identify the strengths and limits of climatic anomalies.</p>	
<ul style="list-style-type: none"> • Lesson 2 <ul style="list-style-type: none"> ○ Part 2: Applying Climatic Anomalies to EPS Data 	<p>L4.13 Identify the strengths and limits of applying climatic anomalies to deterministic model and ensemble prediction system (EPS).</p>	<p>P4.5 Demonstrate how to use a climatology anomaly to assess potential impact of winter storms.</p>
<ul style="list-style-type: none"> • Lesson 3: Microclimates: Interaction of Synoptic Pattern with Local Terrain 	<p>L4.14. Define Microclimate.</p> <p>L4.15 Identify some of the terrain features that impact winter weather.</p> <p>L4.16 Identify strengths and weaknesses of NWP models with respect to microclimates.</p>	<p>P4.6 Identify microclimates in your CWA.</p> <p>P4.7 Demonstrate how specific synoptic patterns interact with your CWA's terrain.</p> <p>P4.8 Apply knowledge of microclimates to your forecasts (routine and warning type).</p>
<p>IC 5: Precipitation Forcing Mechanisms and Conceptual Models</p> <ul style="list-style-type: none"> • Lesson 1: Using Potential Vorticity in Operations 	<p>L5.1 Be able to list under what two conditions potential vorticity is conserved.</p> <p>L5.2 Be able to identify where synoptic-scale forcing for lift exists based upon examination of tropopause maps.</p> <p>L5.3 Be able to list two advantages of using tropopause maps vs examining potential vorticity on pressure levels.</p> <p>L5.4 Be able to list two advantages of using tropopause maps over Q-vectors analysis</p>	<p>P5.1 Be able to recognize jets, fronts, troughs, and ridges on a tropopause map.</p> <p>P5.2 Be able to develop forecast techniques that allow the display of both upper-level (PV) forcing and low-level (frontal) forcing for the development of intense precipitation.</p>
<ul style="list-style-type: none"> • Lesson 2: Diagnosing 	<p>L5.5 List the two ways that frontogenetical circulations try</p>	<p>P5.3 Determine which form of the frontogenesis</p>

<p>Mesoscale Internal Forcing in the Atmosphere</p>	<p>to restore thermal wind balance.</p> <p>L5.6 List the two types of wind flows from Pettersen's frontogenesis equation that are frontogenetical.</p> <p>L5.7 List the one term missing from QG frontogenesis that is part of Pettersen frontogenesis.</p> <p>L5.8 List two situations where diabatic processes can result in frontogenesis.</p> <p>L5.9 Describe how frontal circulations are impacted by upper-level forcing.</p>	<p>equation available in AWIPS is most appropriate for diagnosing frontal bands.</p> <p>P5.4 Use satellite to help identify areas where differences in diabatic heating could enhance frontogenesis.</p> <p>P5.5 Apply the concept of coupling between upper-level waves and lower-level fronts to determine where the ascent associated with a frontal circulation may be strongest.</p>
<ul style="list-style-type: none"> Lesson 3: The Effect of Stability on the Response to Internal Forcing 	<p>L5.10 Identify the two types of stability that can impact the vertical response to frontal and synoptic scale forcing.</p> <p>L5.11 Identify two conditions associated with weak symmetric stability (or symmetric instability).</p> <p>L5.12 Describe one way that static-stability and one way that symmetric stability can be changed.</p> <p>L5.13 List two advantages and one disadvantage of using EPV vs M- and theta-es surfaces for diagnosing symmetric instability.</p> <p>L5.14 Describe the difference in the shape and width of the frontal circulation based upon</p>	<p>P5.6 Determine what layer to examine EPV when forecasting winter weather.</p> <p>P5.7 Assess the impact that stability can have on snowfall rate and the width of a snowband.</p>

	<p>changes in symmetric stability.</p> <p>L5.15 Identify two conditions that can help determine what layer to examine EPV.</p>	
<ul style="list-style-type: none"> Lesson 4: Examples of Frontal Precipitation Bands 	<p>L5.16 Recognize features in observational data sets and model forecasts indicating intense snow bands within major storms.</p> <p>L5.17 Recognize features that indicate weaker, but still significant bands in weaker storms</p> <p>L5.18 Identify the issues related to model resolution and time scale involved in snow band forecasting.</p>	<p>P5.8 Apply the diagnostics shown in this lesson to snowfall forecasts during events featuring deep cyclones.</p> <p>P5.9 Apply the diagnostics shown in this lesson to snowfall forecasts during more subtle events.</p>
<ul style="list-style-type: none"> Lesson 5: Structure of Trowals 	<p>L5.19 Identify the trowal using several analysis methods.</p> <p>L5.20 Evaluate dynamic and kinematic parameters to assess the active regions of a trowel structure.</p>	<p>P5.10 Analyze data and model output to identify trowal location.</p> <p>P5.11 Analyze data and model output to predict continued trowel evolution.</p>
<ul style="list-style-type: none"> Lesson 6: Externally produced forcing 	<p>L5.21 Identify the important physical processes for understanding the manifestations of terrain forcing on precipitation distributions.</p> <p>L5.22 Identify the critical microphysical processes for understanding the manifestations of terrain forcing on precipitation distributions.</p> <p>L5.23 Describe the primary orographic precipitation</p>	<p>P5.12 Demonstrate how the various terrain-related forcing mechanisms are actuated for several mountain ranges in your CWA.</p>

	<p>mechanisms.</p> <p>L5.24 Identify the various forms of terrain-induced convergence and the impacts on forcing of ascent.</p> <p>L5.25 Describe some useful forecasting techniques and challenges associated with precipitation distributions in complex terrain.</p>	
<ul style="list-style-type: none"> Lesson 7: Lake Effects 	<p>L5.26 Identify the key components that produce lake effect snow.</p> <p>L5.27 Identify the processes that contribute to local instability between water and air.</p> <p>L5.28 Identify the processes responsible for parallel flow convection and cloud development.</p> <p>L5.29 Identify roles that frictional and thermal convergence play in snowband development.</p> <p>L5.30 Identify the role that shoreline shape and orientation play in snowband development.</p> <p>L5.31 Identify the role that topography has in producing heavy snowfall.</p>	<p>P 5.13 Demonstrate how to use various forecast procedures and tools to predict lake effect snows.</p>

IC 6: Synoptic and Mesoscale Forecasting of Precipitation Type and Amounts		
<p>IC 6: Synoptic and Mesoscale Forecasting of Precipitation Type and Amounts</p> <ul style="list-style-type: none"> Lesson 1: Introduction to Utilizing the Top-down Methodology 	<p>L6.1 Identify activation temperatures for ice nuclei</p> <p>L6.2 Be able to assess impacts of warm layer and surface layer considerations.</p> <p>L6.3 Be able to describe impacts of wet-bulb effects, the seeder-feeder mechanism, and precipitation intensity.</p>	<p>P6.1 Be able to utilize the top-down methodology in an operational setting:</p> <ul style="list-style-type: none"> Assess potential for heterogeneous nucleation. Assess impact of warm layer. Interrogate near surface layer (i.e., wet bulb effects).
<ul style="list-style-type: none"> Lesson 2 : Part 1 Strengths and Weaknesses of P-Type Algorithms (Baldwin and Ramer Techniques) 	<p>L6.4 Identify strengths and weaknesses of each p-type algorithms.</p> <p>L6.5 Assess algorithm failure modes.</p>	<p>P6.2 Be able to assess the validity of algorithm output in different forecast situations.</p> <p>P6.3 Be able to assess potential algorithm failures in an operational setting.</p> <p>P6.4 Compare algorithm output with an understanding of each algorithms strengths and weaknesses.</p>
<ul style="list-style-type: none"> Lesson 2 : Part 2 Strengths and Weaknesses of P-Type Algorithms (Bourgouin Method and Partial Thickness Technique) 	<p>L6.4 Identify strengths and weaknesses of each p-type algorithms.</p> <p>L6.5 Assess algorithm failure modes.</p>	<p>P6.2 Be able to assess the validity of algorithm output in different forecast situations.</p> <p>P6.3 Be able to assess potential algorithm failures in an operational setting.</p> <p>P6.4 Compare algorithm output with an understanding of each algorithms strengths and weaknesses.</p>
<ul style="list-style-type: none"> Lesson 3: Using Ensembles in Winter Weather Forecasting 	<p>L6.6 Identify the strengths and limitations of EPS products such as mean, spaghetti,</p>	<p>P6.5 Demonstrate why you should use ensemble forecast information during</p>

	spread, plume charts, and probability of exceedance.	winter storms in the outlook, watch, and warning phases. P6.6 Demonstrate how to recognize uncertainty /high probability outcomes in EPS data. P6.7 Demonstrate how probabilistic forecasting duties in winter weather are related to ensemble forecasting.
<ul style="list-style-type: none"> • Lesson 4: The Ingredients-Based Method for Forecasting Heavy Precipitation 	<p>L6.7 Identify the main components in the ingredients method.</p> <p>L6.8 Display the individual ingredients.</p> <p>L6.9 Combine ingredients to produce a conceptual model for heavy precipitation.</p> <p>L6.10 Develop your own AWIPS procedures to display the ingredients.</p>	P6.8 Use the AWIPS procedures provided in IC 8 (WES case) to display and use the ingredients approach for an actual winter precipitation event.
<ul style="list-style-type: none"> • Lesson 5: Snowfall Forecasting <ul style="list-style-type: none"> ○ Part 1: Climatologies of Snow Ratios and Snow Ratio Microphysics 	<p>L6.11 Be able to identify climatological variations of snow ratios across the country.</p> <p>L6.12 Be able to identify how temperature and humidity directly affect type and density of growing snow crystals.</p> <p>L6.13 Be able to define Dendritic Growth Zone (DGZ) and explain its relationship to snow crystal growth and snow ratios.</p>	

<ul style="list-style-type: none"> • Lesson 5: Snowfall Forecasting <ul style="list-style-type: none"> ○ Part 2: Snow Production, Diagnosing Snow Ratio and Snowfall, and examples of snow amount tools 	<p>L6.14 Be able to explain the role of vertical motion in producing snow crystals on different densities.</p> <p>L6.15 Be able to define processes that contribute to compaction.</p>	<p>P6.9 Improve estimates of snow density:</p> <ul style="list-style-type: none"> • Diagnose the snow ratio category (light, average, heavy) by inspection of NWP profiles of temperature, dewpoint, and vertical motion • Modify snowfall accumulation rates based on sub-cloud and surface conditions. • Convert NWP forecasts of equivalent liquid precipitation to snowfall. <p>P6.10 Be able to apply two diagnostic tools to assess snow ratio and snowfall.</p>
<p>IC 7: Monitoring System Evolution</p> <ul style="list-style-type: none"> • Lesson 1: Monitoring model accuracy 	<p>L7.1 Identify the benefits the diagnosis.</p> <p>L7.2 Identify the 8 pitfalls of NWP for winter weather:</p> <ul style="list-style-type: none"> • Upper trough mergers / split-stream phasing • Surface low track and intensity • Baroclinic zones; placement, strength (surface and aloft) • Dry slots • Mesoscale structures (banding, etc.) • Precipitation transition zones / vertical temperature profiles • Influence of convection/diabatic processes • Orographic influences 	<p>P7.1 For each of the 8 pitfalls, demonstrate:</p> <ul style="list-style-type: none"> • the impact • how to assess the pitfall – what tools and methodology are used • corrective action needed • hazards change • awareness of false indications

<ul style="list-style-type: none"> Lesson 2: Winter Weather Precipitation Estimation <ul style="list-style-type: none"> Part 1: WSR-88D Precipitation Estimates 	<p>L7.3 Using the radar base volumetric data, and other environmental data, you will be able to:</p> <ul style="list-style-type: none"> Identify areas within a radar domain where estimated precipitation rates will be in error from these considerations: <ul style="list-style-type: none"> beam overshoot bright band effects precipitation evaporation horizontal drift of falling snow precipitation particle shape and size for the above considerations, determine the most likely sign of the error 	<p>P7.2 Given radar and environmental data, demonstrate (in an actual event or WES case) how to identify sources of error effecting radar-based precip estimates and estimate the sign of the error.</p>
<p>Lesson 2: Winter Weather Precipitation Estimation</p> <ul style="list-style-type: none"> Part 2: Case Study 	<p>L7.4 Be able to identify a process to analyze the locations in the radar domain of three major errors of radar derived precipitation due to:</p> <ul style="list-style-type: none"> Overshooting precipitation generation Overshooting sub-beam evaporation Bright banding 	<p>P7.3 Be able to apply a methodology to analyze on a radar map three major sources of radar-based winter precipitation estimates.</p>
<ul style="list-style-type: none"> Lesson 3: Effective Use of Spotters and Webcams 	<p>L7.5 Identify sources of spotter and webcam sources along with their strengths and weaknesses.</p>	<p>P7.4 Demonstrate the ability to identify and collect quality supplemental information that will assist in monitoring the progress</p>

	<p>L7.6 List considerations in the use of these types of uncontrolled data sources.</p> <p>L7.7 List the steps that can be taken to make this information more useful in the warning process and when they should be taken.</p> <p>L7.8 Show how spotter and webcam information can be used to improve Situational Awareness.</p>	and evolution of a winter storm.
<ul style="list-style-type: none"> Lesson 4: Diagnosing Unexpected Precipitation Areas 	<p>L7.9 Describe why a methodology for responding to unexpected precipitation is important.</p> <p>L7.10 Identify the five steps comprising the methodology.</p> <p>L7.11 Identify which steps are associated with the recognition phase and which are associated with the response phase of the methodology.</p>	<p>P7.5 Demonstrate the ability to quickly recognize unexpected precipitation.</p> <p>P7.6 Demonstrate the ability to appropriately respond to unexpected precipitation.</p>
IC 8 : WES simulations		P8.1 Using performance objectives defined from each IC, demonstrate proficiency in completing assigned tasks.