AWOC Winter Weather Track **September 5, 2011**
Instructional Goals

IC# title: Lessons	Learning Objectives	Performance Objectives
IC 1: Orientation to AWOC Winter Wx Track (only 1 lesson delivered via live Gotomeeting)	L1.1. Students, facilitators and management should be able to identify the objectives and timelines for the course. L1.2. Students, facilitators, and management should be able to identify their roles and responsibilities for the course.	P1.1 (For facilitators) Register all your forecasters in the LMS for the course. P1.2 (For students) Complete pre-course survey. P1.3 (for MICs) Discuss performance expectations of the forecasters from the course.
IC 2: Winter Wx Products and Services • Lesson 1: Products and Policy	L2.1 Based on NWSI 10-513, 10-514, and 10-515, identify why certain winter weather products are issued. .	
• Lesson 2: Forecast and Product Collaboration	L2.2 Identify the key elements of collaboration in the winter weather forecasting process. L2.3 Review effective collaboration techniques for consistency and accuracy in winter products and services	P2.1 Execute an effective collaboration process within the forecast process. P2.2 Identify and demonstrate effective and appropriate use of collaboration tools. P2.3 Demonstrate knowledge of collaboration triggers. P2.4 Effectively integrate opportunities for collaboration as part of HPC's Winter Weather Desk and SPC's Winter Mesoscale Discussions

IC 3: User Needs to Mitigate Societal Impacts of Winter Weather: Road Weather • Lesson 1: Significant Impacts to Users	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. .	
• Lesson 2: Road Weather Impacts & Surface Transportation Management Strategies	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. L3.3 Explain the significance of the strategic and tactical planning timeframes for DOT mitigation activities. L3.4 Indicate which parameters most often indicate event severity for significant warning-criteria and sub-advisory winter weather events. 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.	
• IC3.3: Tools for Monitoring Road Weather	L3.6 Explain the benefits of RWIS and other local mesonet data available to NWS	P3.1 After completing this lesson, you should be able to access local mesonet data

	forecasters in real-time via MADIS and other sources. L3.7 Identify the two different kinds of RWIS sites and what factors may impact the usefulness of these data. L3.8 Explain the most common issues NWS forecasters may encounter with quality controlling and using local mesonet data in an operational environment.	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.
• IC3.4, The NWS-Ground Transportation Partnership	L3.11 Identify the topics discussed that may help NWS forecasters and DOTs better meet their respective missions. L3.12 Characterize the discussion of each topic presented in this lesson, including how the topic impacts the NWS-DOT partnership.	
• IC 3.5, Comparing Timelines of NWS Products & Ground Transportation Mitigation Strategy Implementation	L3.13 Identify how weather information and surface transportation management strategies fit into the basic DOT concept of operations presented. L3.14 Describe, in general terms, how NWS products and services may fit into an event timeline for various types of weather events.	
IC 4: Climatology of Winter Storms	L4.1 Understand the spatial and temporal aspects of slowly evolving systems that affect winter weather	P4.1 Demonstrate the ability to recognize patterns that enhance/suppress winter storms.

• Lesson 1: Using CPC Products o Part 1:El Nino, La Nina, and the Southern Oscillation (ENSO)	L4.2 Describe effects of ENSO, on North American weather L4.3 Describe effects of ENSO on North American weather. L4.4 Know where to find further current and predictive information	P4.2 Determine significant physical mechanisms which lead to increased probability of wintertime precipitation. P4.3 Use the web to identify current ENSO conditions.
• Lesson 1 o Part 2: Madden Julian Oscillation (MJO)	L4.5 Understand the spatial and temporal aspects of the MJO. L4.6 Identify physical mechanisms of the MJO that are responsible for enhancing or suppressing winter weather. L4.7 Describe effects of the MJO on N.A. weather	P4.4 Demonstrate the ability to recognize patterns that enhance/suppress winter storms. P4.5 Determine significant physical mechanisms which lead to increased probability of wintertime precipitation P4.6 Use different data sets to determine the state of the MJO and its significance to winter weather systems affecting the U.S.
• Lesson 1 o Part 3: Climatology-Teleconnections	L4.8 Understand the spatial and temporal aspects of slowly evolving systems that affect winter weather. L4.9 Identify the “phase” of any given teleconnection. L4.10 Describe effects of teleconnections on North American weather.	P4.7 Demonstrate the ability to recognize patterns that enhance/suppress winter storms. P4.8 Determine significant physical mechanisms which lead to increased probability of wintertime precipitation. P4.9 Distinguish between different teleconnections and know what the significance is of those affecting the US.
• Lesson 2: Climatological Degree of Rarity of Hazardous Winter Weather	L4.10 Identify what is needed to create a climatology. L4.11 Determine the significance and potential	

Part 1: Building a Climatology	impact from anomalies on expected winter weather L4.12 Identify the strengths and limits of climatic anomalies.	
• Lesson 2 o Part 2: Applying Climatic Anomalies to EPS Data	L4.13 Identify the strengths and limits of applying climatic anomalies to deterministic model and ensemble prediction system (EPS).	P4.5 Demonstrate how to use a climatology anomaly to assess potential impact of winter storms.
• Lesson 3: Microclimates: Interaction of Synoptic Pattern with Local Terrain	L4.14. Define Microclimate. L4.15 Identify some of the terrain features that impact winter weather. L4.16 Identify strengths and weaknesses of NWP models with respect to microclimates.	P4.6 Identify microclimates in your CWA. P4.7 Demonstrate how specific synoptic patterns interact with your CWA's terrain. P4.8 Apply knowledge of microclimates to your forecasts (routine and warning type).
IC 5: Precipitation Forcing Mechanisms and Conceptual Models • Lesson 1: Using Potential Vorticity in Operations	L5.1 Be able to list under what two conditions potential vorticity is conserved. L5.2 Be able to identify where synoptic-scale forcing for lift exists based upon examination of tropopause maps. L5.3 Be able to list two advantages of using tropopause maps vs examining potential vorticity on pressure levels. L5.4 Be able to list two advantages of using tropopause maps over Q-vectors analysis	P5.1 Be able to recognize jets, fronts, troughs, and ridges on a tropopause map. 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.
• Lesson 2: Diagnosing	L5.5 List the two ways that frontogenetical circulations try	P5.3 Determine which form of the frontogenesis

Mesoscale Internal Forcing in the Atmosphere	to restore thermal wind balance. L5.6 List the two types of wind flows from Pettersen's frontogenesis equation that are frontogenetical. L5.7 List the one term missing from QG frontogenesis that is part of Pettersen frontogenesis. L5.8 List two situations where diabatic processes can result in frontogenesis. L5.9 Describe how frontal circulations are impacted by upper-level forcing.	equation available in AWIPS is most appropriate for diagnosing frontal bands. P5.4 Use satellite to help identify areas where differences in diabatic heating could enhance frontogenesis. 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.
• Lesson 3: The Effect of Stability on the Response to Internal Forcing	L5.10 Identify the two types of stability that can impact the vertical response to frontal and synoptic scale forcing. L5.11 Identify two conditions associated with weak symmetric stability (or symmetric instability). L5.12 Describe one way that static-stability and one way that symmetric stability can be changed. L5.13 List two advantages and one disadvantage of using EPV vs M- and theta-es surfaces for diagnosing symmetric instability. L5.14 Describe the difference in the shape and width of the frontal circulation based upon	P5.6 Determine what layer to examine EPV when forecasting winter weather. P5.7 Assess the impact that stability can have on snowfall rate and the width of a snowband.

	changes in symmetric stability. L5.15 Identify two conditions that can help determine what layer to examine EPV.	
• Lesson 4: Examples of Frontal Precipitation Bands	L5.16 Recognize features in observational data sets and model forecasts indicating intense snow bands within major storms. L5.17 Recognize features that indicate weaker, but still significant bands in weaker storms L5.18 Identify the issues related to model resolution and time scale involved in snow band forecasting.	P5.8 Apply the diagnostics shown in this lesson to snowfall forecasts during events featuring deep cyclones. P5.9 Apply the diagnostics shown in this lesson to snowfall forecasts during more subtle events.
• Lesson 5: Structure of Trowals	L5.19 Identify the □rowel using several analysis methods. L5.20 Evaluate dynamic and kinematic parameters to assess the active regions of a trowel structure.	P5.10 Analyze data and model output to identify □rowel location. P5.11 Analyze data and model output to predict continued trowel evolution.
• Lesson 6: Externally produced forcing	L5.21 Identify the important physical processes for understanding the manifestations of terrain forcing on precipitation distributions. L5.22 Identify the critical microphysical processes for understanding the manifestations of terrain forcing on precipitation distributions. L5.23 Describe the primary orographic precipitation	P5.12 Demonstrate how the various terrain-related forcing mechanisms are actuated for several mountain ranges in your CWA.

	mechanisms. L5.24 Identify the various forms of terrain-induced convergence and the impacts on forcing of ascent. L5.25 Describe some useful forecasting techniques and challenges associated with precipitation distributions in complex terrain.	
• Lesson 7: Lake Effects	L5.26 Identify the key components that produce lake effect snow. L5.27 Identify the processes that contribute to local instability between water and air. L5.28 Identify the processes responsible for parallel role convection and cloud development. L5.29 Identify roles that frictional and thermal convergence play in snowband development. L5.30 Identify the role that shoreline shape and orientation play in snowband development. L5.31 Identify the role that topography has in producing heavy snowfall.	P 5.13 Demonstrate how to use various forecast procedures and tools to predict lake effect snows.

IC 6: Synoptic and Mesoscale Forecasting of Precipitation Type and Amounts • Lesson 1: Introduction to Utilizing the Top-down Methodology	L6.1 Identify activation temperatures for ice nuclei L6.2 Be able to assess impacts of warm layer and surface layer considerations. L6.3 Be able to describe impacts of wet-bulb effects, the seeder-feeder mechanism, and precipitation intensity.	P6.1 Be able to utilize the top-down methodology in an operational setting: • Assess potential for heterogeneous nucleation. • Assess impact of warm layer. • Interrogate near surface layer (i.e., wet bulb effects).
• Lesson 2 : Part 1 Strengths and Weaknesses of P-Type Algorithms (Baldwin and Ramer Techniques)	L6.4 Identify strengths and weaknesses of each p-type algorithms. L6.5 Assess algorithm failure modes.	P6.2 Be able to assess the validity of algorithm output in different forecast situations. P6.3 Be able to assess potential algorithm failures in an operational setting. P6.4 Compare algorithm output with an understanding of each algorithms strengths and weaknesses.
• Lesson 2 : Part 2 Strengths and Weaknesses of P-Type Algorithms (Bourgouin Method and Partial Thickness Technique)	L6.4 Identify strengths and weaknesses of each p-type algorithms. L6.5 Assess algorithm failure modes.	P6.2 Be able to assess the validity of algorithm output in different forecast situations. P6.3 Be able to assess potential algorithm failures in an operational setting. P6.4 Compare algorithm output with an understanding of each algorithms strengths and weaknesses.
• Lesson 3: Using Ensembles in Winter Weather Forecasting	L6.6 Identify the strengths and limitations of EPS products such as mean, spaghetti,	P6.5 Demonstrate why you should use ensemble forecast information during

	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.
• Lesson 4: The Ingredients-Based Method for Forecasting Heavy Precipitation	L6.7 Identify the main components in the ingredients method. L6.8 Display the individual ingredients. L6.9 Combine ingredients to produce a conceptual model for heavy precipitation. L6.10 Develop your own AWIPS procedures to display the ingredients.	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.
• Lesson 5: Snowfall Forecasting o Part 1: Climatologies of Snow Ratios and Snow Ratio Microphysics	L6.11 Be able to identify climatological variations of snow ratios across the country. L6.12 Be able to identify how temperature and humidity directly affect type and density of growing snow crystals. L6.13 Be able to define Dendritic Growth Zone (DGZ) and explain its relationship to snow crystal growth and snow ratios.	

• Lesson 5: Snowfall Forecasting o Part 2: Snow Production, Diagnosing Snow Ratio and Snowfall, and examples of snow amount tools	L6.14 Be able to explain the role of vertical motion in producing snow crystals on different densities. L6.15 Be able to define processes that contribute to compaction.	P6.9 Improve estimates of snow density: • 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. P6.10 Be able to apply two diagnostic tools to assess snow ratio and snowfall.
IC 7: Monitoring System Evolution • Lesson 1: Monitoring model accuracy	L7.1 Identify the benefits the diagnosis. L7.2 Identify the 8 pitfalls of NWP for winter weather: • 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	P7.1 For each of the 8 pitfalls, demonstrate: • the impact • how to assess the pitfall – what tools and methodology are used • corrective action needed • hazards change • awareness of false indications

• Lesson 2: Winter Weather Precipitation Estimation • Part 1:WSR-88D Precipitation Estimates	L7.3 Using the radar base volumetric data, and other environmental data, you will be able to: – Identify areas within a radar domain where estimated precipitation rates will be in error from these considerations: • 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	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.
Lesson 2: Winter Weather Precipitation Estimation • Part 2: Case Study	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: • Overshooting precipitation generation • Overshooting sub-beam evaporation • Bright banding	P7.3 Be able to apply a methodology to analyze on a radar map three major sources of radar-based winter precipitation estimates.
• Lesson 3: Effective Use of Spotters and Webcams	L7.5 Identify sources of spotter and webcam sources along with their strengths and weaknesses.	P7.4 Demonstrate the ability to identify and collect quality supplemental information that will assist in monitoring the progress

	L7.6 List considerations in the use of these types of uncontrolled data sources. 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. L7.8 Show how spotter and webcam information can be used to improve Situational Awareness.	and evolution of a winter storm.
• Lesson 4: Diagnosing Unexpected Precipitation Areas	L7.9 Describe why a methodology for responding to unexpected precipitation is important. L7.10 Identify the five steps comprising the methodology. L7.11 Identify which steps are associated with the recognition phase and which are associated with the response phase of the methodology.	P7.5 Demonstrate the ability to quickly recognize unexpected precipitation. P7.6 Demonstrate the ability to appropriately respond to unexpected precipitation.
IC 8: Nonprecipitation Warning Considerations		
• IC 8.1 Forecasting Downslope Winds	L8.1 Provide a basic understanding of linear mountain wave dynamics. L8.2 Identify atmospheric mean state conditions that can lead to downslope windstorms. L8.3 Identify ways to predict the evolution and intensity of the event. L8.4 Identify observational resources that can be used to assess the impact of a	P8.1 Demonstrate an ability to identify critical mean state conditions that can lead to the development of a mountain wave. - static stability - cross barrier flow - mean state critical level P8.2 Evaluate the performance of model guidance in the prediction of mountain wave development and resulting downslope winds.

	mountain wave on winds at the surface.	P8.3 Identify local resources that could be used monitor impacts of the event.
IC 9: WES simulations		P9.1 Using performance objectives defined from each IC, demonstrate proficiency in completing assigned tasks.