

MESOSCALE SNOWBAND CROSS SECTION

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Introduction

Forecasting mesoscale snowband formation is a major challenge to operational weather forecasters. The intense precipitation found within the bands occurs on limited spatial and temporal scales, but results in significant snowfall accumulation that may render forecasts inadequate. Wiesmueller and Zubrik (1998) showed that these bands might be forecast in an operational setting by identifying regions of weak stability and frontogenetical forcing. Snowfall accumulation is further enhanced when the maximum vertical motion coincides with the maximum dendritic growth temperature layer (-12°C to -16°C) (Wetzel et al. 2001).

Part 1 of this ATN is a set of instructions for constructing an AWIPS Procedure to display a four-panel cross-section of mesoscale banding potential (see Figure 1). The resultant cross-section is intended to provide forecasters a quick assessment of banding potential within a storm, highlighting atmospheric stability, forcing, snowfall efficiency, and moisture. Part 2 details the steps to follow to use the mesoscale banding procedure in D2D.

The upper left panel utilizes saturated Equivalent Potential Vorticity (EPV) and equivalent potential temperature (θ_e) to assess the atmospheric stability. Ideally, saturated equivalent potential temperature (θ_{es}) would be used (Shultz and Schumacher 2001), but θ_{es} is equivalent to θ_e when the atmosphere is saturated. Regions of small or negative EPV correspond to either a conditionally unstable or conditional symmetrically unstable atmosphere depending on the stratification of θ_e (refer to Moore and Lambert 1993 for the use of EPV to distinguish convective potential). Regardless of whether upright or slantwise instability is favored, significant precipitation is possible in either situation. The upper right panel utilizes quasi-geostrophic frontogenesis and θ_e to assess the frontogenetical forcing and frontal structure. The lower left panel utilizes the model omega and temperature fields to assess the microphysical properties of the snowfall. Finally the lower right panel displays the relative humidity, which helps determine the type of instability released and general cloud structure.

An example of the fields presented in the display is shown in Figure 1. At this time 4 in/hr snowfall rates were recorded in the middle of the cross section. This may be expected given the

thick layer of small or negative EPV (upper left panel), intense frontogenesis (upper right panel), favorable microphysical parameters (lower left panel), and deep saturation (lower right panel). Variations in the magnitudes of these parameters should roughly be proportional to the strength of the mesoscale band. The procedure is intended to alert forecasters to such events utilizing the RUC or Eta 12 – 18 hour forecast fields.

The position of the cross-section is critical. Users of this procedure will need to be educated as to how best the cross-section is displayed and where the cross-section should be placed within the model data. Users of this procedure should be informed to place the AWIPS Baseline (used to delineate the cross-sectional area) into the desired orientation by pulling the ends of the baseline with the left mouse key held down. It is imperative that the baseline be oriented normal to the 1000-500 hPa thickness at the time of investigation. Details regarding this phase of the mesoscale banding interrogation are provided in **Part 2** of the **Procedure** section. The **Part 2** instructions should be posted where forecasters can reference them quickly.

Beginning with AWIPS Build 5.1.2, users may change a number of parameters in a saved AWIPS Procedure, including the point or baseline, the radar site (if it's a radar procedure), or the model, using the Procedure GUI. Details are provided in the steps below in **Part 2**. In this AWIPS Procedure, changing the baseline and model are appropriate.

Assumptions

This ATN assumes the user is familiar with constructing AWIPS Procedures. The procedure is created under the 'awipsusr' account. The forecaster using this Procedure needs to have performed a preliminary interrogation of the model data. This is a necessary step because the position of the cross-section relative to the parameters displayed is critical.

STAFF TRAINING OF THE APPROPRIATE USE OF THIS AWIPS PROCEDURE IS CRITICAL!

If you experience any problems when applying this AWIPS Technical Note, STOP immediately and contact the authors.

Procedure

Part 1

The steps in Part 1 enable the creation of the AWIPS Procedure as user 'awipsusr'

1. Change to user 'awipsusr' and create an empty four panel display with baselines.

1a. Under the File menu in D2D select "Select User ID". In the pop-up menu choose "awipsusr".

1b. Right-click and hold the mouse button down in the main D2D panel.

1c. From the popup menu, choose "Four Panel Layout".

1d. Choose a scale for the main D2D window. Regional is most appropriate.

2. Load variables to the upper left panel.

2a. Right-click and hold anywhere on the upper left panel. An option menu will appear.

2b. Choose "Load To This Window". A yellow L should appear in the bottom left corner of the panel.

2c. Choose the Browser (vb) from the D2D Volume menu.

i. In the vb change "Plane view" to "Cross section".

ii. Choose the desired model from the *Sources* pull-down menu

iii. Choose **Equivalent Potential Temperature** and **Equivalent Potential Vorticity** from the *Fields* section. Note that these fields may be abbreviated in the menus.

iv. Choose any Baseline in the *Specified* menu under the *Planes* section.

v. Center-click on **Equivalent Potential Vorticity** (EPV) in the *Product Selection List* to load this field as an image.

vi. Click on "load". A cross section of $_e$ and an image of EPV should appear in the upper left panel.

vii. DO NOT CLOSE THE VOLUME BROWSER!

3. Edit color shading of the upper left panel.

Since we are interested in highlighting areas of negative or small EPV, we will only shade EPV values below 0.25. To edit the shading:

3a. Right-click on the upper left panel. A pop-up edit window will appear.

3b. Choose "Control Color of This Image". An image options pop-up window will appear.

3c. Move the top color arrow along the color spectrum (found in the middle of the window) to 0.25, and then move the bottom color arrow as far positive as possible.

3d. Move each of the three color bars found at the top of the window (under "upper color") as far to the left as possible (creating the color black). Then choose "fill". Now the only shading along the color spectrum should be from 0.25 and below.

3e. Choose "Apply". This same color scheme should transfer to the upper left panel display of EPV.

4. Load variables to the upper right panel.

4a. Right-click and hold anywhere on the upper right panel. An option menu will appear.

4b. Choose "Load To This Window". A yellow L should appear in the bottom left corner of the panel.

4c. Choose the Browser from the D2D Volume menu. The desired model and baseline from Step 2, above, should still be displayed in the vb windows. If not, reselect them.

i. Choose **Equivalent Potential Temperature** and **QG Frontogenesis** from the *Fields* section. Note that these fields may be abbreviated in the menus.

ii. Center-click on **QG Frontogenesis** (QGF) in the *Product Selection List* to load this field as an image.

iii. Click on "load". A cross section of $_e$ and an image of QGF should appear in the upper right panel.

iv. DO NOT CLOSE THE VOLUME BROWSER!

5. Edit color shading of the upper right panel.

Since we are interested in highlighting areas of positive QGF, we will only shade QGF values above 3. To edit the shading:

5a. Right-click on the upper right panel. A pop-up edit window will appear.

5b. Choose "Control Color of This Image". An image options pop-up window will appear.

5c. Move the top color arrow along the color spectrum (found in the middle of the window) to as far negative as possible, and then move the bottom color arrow to 3.

5d. Move each of the three color bars found at the top of the window (under "upper color") as far to the left as possible (creating the color black). Then choose "fill". Now the only shading along the color spectrum should be from 3 and above.

5e. Choose "Apply". This same color scheme should transfer to the upper right panel display of QGF.

6. Load variables to the lower left panel

6a. Right-click and hold anywhere on the lower left panel. An option menu will appear.

6b. Choose "Load To This Window". A yellow L should appear in the bottom left corner of the panel.

6c. Choose the Browser from the D2D Volume menu. The desired model and baseline from Step 2, above, should still be displayed in the vb windows. If not, reselect them.

i. Choose **Omega** and **Temperature** from the *Fields* section. Note that these fields may be abbreviated in the menus.

ii. Center-click on **Temperature** in the *Product Selection List* to load this field as an image.

iii. Click on "load". A cross section of omega and an image of temperature should appear in the lower left panel.

iv. DO NOT CLOSE THE VOLUME BROWSER!

7. Edit color shading of the lower left panel.

We are interested in highlighting the -12°C to -16°C temperature layer. To edit the shading:

7a. Right-click on the lower left panel. A pop-up edit window will appear.

7b. Choose "Control Color of This Image". An image options pop-up window will appear.

7c. Move the top color arrow along the color spectrum (found in the middle of the window) to -12, and then move the bottom color arrow to the far right.

7d. Move each of the three color bars found at the top of the window (under "upper color") as far to the left as possible (creating the color black). Then choose "fill" and then "Apply". All values above -12 should be filled black.

7e. Move the top color arrow along the color spectrum (found in the middle of the window) to the far left, and then move the bottom color arrow to -16.

7f. Move each of the three color bars found at the top of the window (under "upper color") as far to the left as possible (creating the color black). Then choose "fill". All values below -16 should be filled black.

7g. Choose "Apply". This same color scheme should transfer to the lower left panel display of temperature and the -12°C to -16°C region will be highlighted.

8. Load variables to the lower right panel.

8a. Right-click and hold anywhere on the lower right panel. An option menu will appear.

8b. Choose "Load To This Window". A yellow L should appear in the bottom left corner of the panel.

8c. Choose the Browser from the D2D Volume menu. The desired model and baseline from Step 2, above, should still be displayed in the vb windows. If not, reselect them.

i. Choose **Relative Humidity** from the *Fields* section. Note that this field may be abbreviated in the menu.

ii. Center-click on **Relative Humidity** in the *Product Selection List* to load this field as an image.

iii. Click on "load". An image of relative humidity should appear in the lower right panel.

iv. Close the volume browser.

9. Edit color shading of the lower right panel.

Since we are interested in highlighting areas of high moisture, we will only shade relative humidity values above 75%. To edit the shading:

9a. Right-click on the upper right panel. A pop-up edit window will appear.

9b. Choose "Control Color of This Image". An image options pop-up window will appear.

9c. Move the top color arrow along the color spectrum (found in the middle of the window) to the far left, and then move the bottom color arrow to 75.

9d. Move each of the three color bars found at the top of the window (under "upper color") as far to the left as possible (creating the color black). Then choose "fill". Now the only shading along the color spectrum should be from 75 and above.

9e. Choose "Apply". This same color scheme should transfer to the lower right panel display of relative humidity.

10. Save display as new procedure.

Under the File menu in D2D select "Procedures". In the pop-up menu choose "New", then "Copy In". Finally, name the procedure by choosing "Save As". The procedure is now saved under the 'awipsusr' user.

Part 2

The steps in Part 2 enable the forecaster to load the mesoscale banding procedure, alter the baseline or model used, and save the procedure under their unique AWIPS ID.

1. Load the desired model 1000-500 hPa thickness forecasts and an AWIPS baseline.

1a. Under the File menu in D2D select "Select User ID". In the pop-up menu choose "awipsusr".

1b. Choose a scale for the main D2D window. Regional is most appropriate.

1c. From the Volume D2D menu, choose the desired model family.

1d. Left-click to display the 1000-500 hPa thickness forecasts.

1e. Left-click to hide other displayed variables.

1f. Choose "BASELINES "under the D2D Tools menu. Choose one of the lines offered in the menu that appears. Make a mental note of the baseline label to use in Step 2, below.

1g. Center-click to zoom into the area of interest.

1h. Move the chosen baseline into the desired orientation by pulling the ends of the baseline with the left mouse key held down. It is imperative that the baseline be oriented normal to the 1000-500 hPa thickness at the time of investigation. Use this baseline in Step 2, below.

2. Load the mesoscale banding cross section procedure

2a. Under the File menu in D2D select "Procedures". In the pop-up menu choose "Open", then something resembling "mesoscale banding cross section". A new window will appear.

2b. In the new window, labeled "Procedure - <Meso-banding>", choose the "Alter..." button. A new window labeled "Alter Bundle on Loading" will appear.

2c. Choose the baseline you set up in Part 2, Step 1h, above, in the "Line" section of the window.

2d. Choose "Load" from the "Alter Bundle on Loading" window. The procedure should load to the main D2D panel.

2e. To change the model used in the procedure, select it from the "Alter Bundle on Loading" window, then choose "Load" from the "Alter Bundle on Loading" window. The procedure should load to the main D2D panel with the newly selected model.

3. Save the procedure under your unique D2D User ID

3a. Under the File menu in D2D select "Select User ID". In the pop-up menu choose your unique D2D user id.

3b. Under the File menu in D2D select "Procedures". In the pop-up menu choose "New", then "Copy In". Finally, name the procedure by choosing "Save As".

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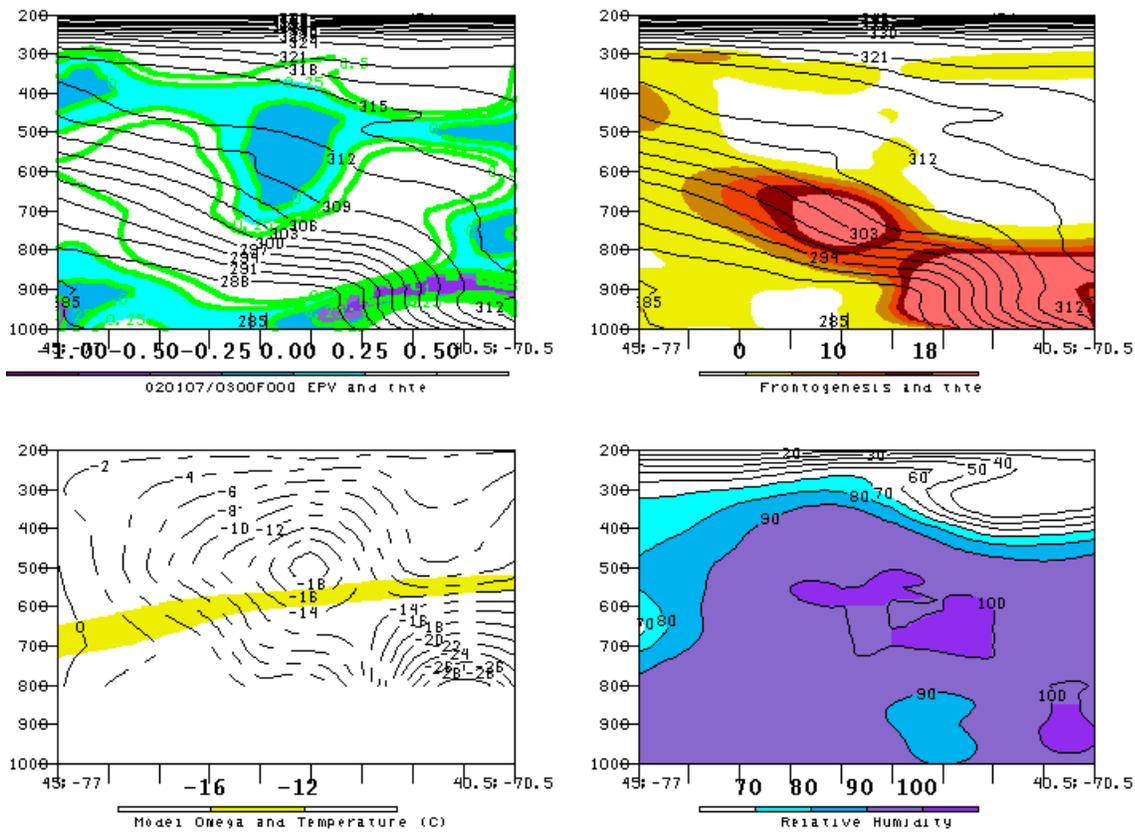


Fig. 1. Example of how the fields would appear for a band in the middle of the cross section. (Upper left panel) Saturated equivalent Potential Vorticity (contoured in green, shaded according to), and equivalent potential temperature contoured every 3°K. (Upper right panel) Frontogenesis (shaded > 3° C per 100 km per day) and equivalent potential temperature (contoured every 3° K). (Lower left panel) Model omega contoured every $2 \cdot 10^{-3}$ hPa/s (dashed when negative), and the -12 to -16_C layer (shaded). (Lower right panel) Relative humidity contoured every 10%, shaded > 70%.