A Comparison of the Radar Characteristics and Mesoscale Environments of Two Mesoscale Snowband Events in the Upper Midwest

Emily. B. Eisenacher and C. E. Graves

Department of Earth and Atmospheric Sciences Saint Louis University

Case Study: 14-15 March 2002

Event Overview

A strong low pressure system developed across the upper Mid-West, resulting in an impressive mesoscale snowband. The mesoscale snowband impacted the region from 0000 UTC on the 14th through 1000 UTC on the 15th. The mesoscale snowband was oriented W-E and propagated northward through MN. Snowfall totals were 20 in at Askov, 17.5in at St. Cloud and 10.8in at Chanhassen. There were some reports of thunder and lightning in the Twin Cities area.

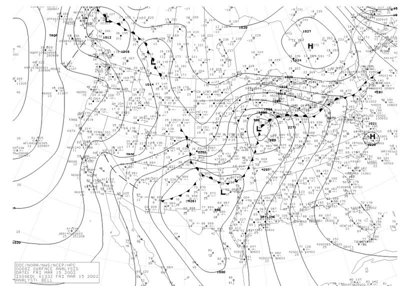


Figure 1: 0000 UTC Surface Analysis

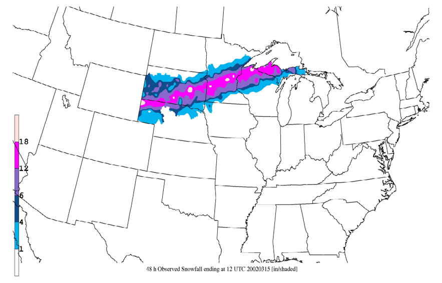


Figure 2: 48 Hour Snowfall

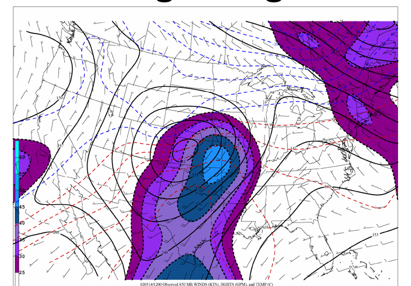


Figure 3: 850 hPa 14th 1200 UTC

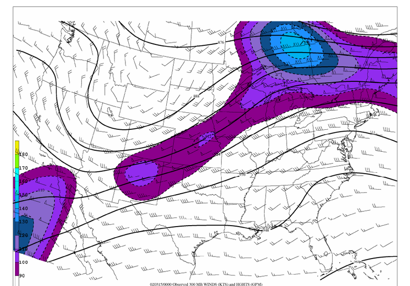


Figure 4: 300 hPa 14th 1200 UTC

Radar Characteristics

0005 UTC: Snowband forms over SD/NE border

0505 UTC: The main snowband begins to form at MN/IA border

1205 UTC: Multiple snowbands across NE, SD, MN, WI. CCW rotation of snowbands in NE

1645 UTC: Snowbands merge to form a single immense snowband

1645-2005- UTC: Single snowband intensifies, rotates CCW, and breaks apart

2005 UTC: Single snowband merges again and remains quasi-stationary over MN

0130-0815UTC: Single snowband rotates CCW, weakens, and breaks up into multiple snowbands, dissipating by 1000 UTC

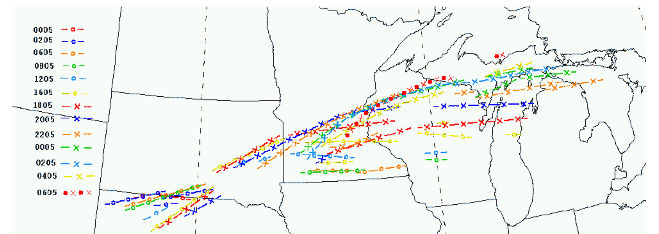


Figure 5: Time Evolution of Mesoscale Snowband

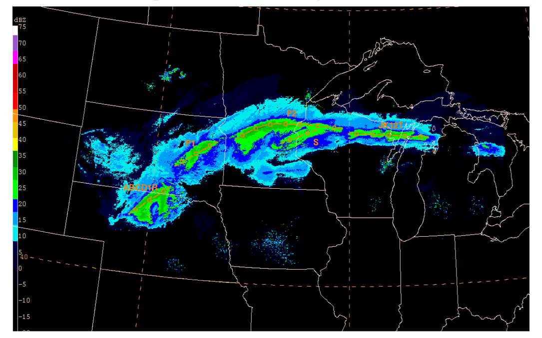
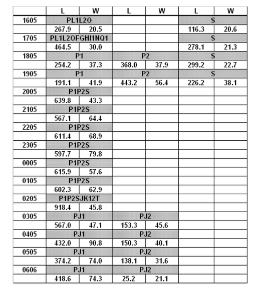


Figure 6: Composite Radar Reflectivity 1905 UTC

Table 1: Length and width of the snowband



•Length and width calculated from the longitude and latitude of the endpoints of the main snowband

•Greatest length 918.4 km

Mesoscale Environment

Analysis of 32 km NARR data from NCDC

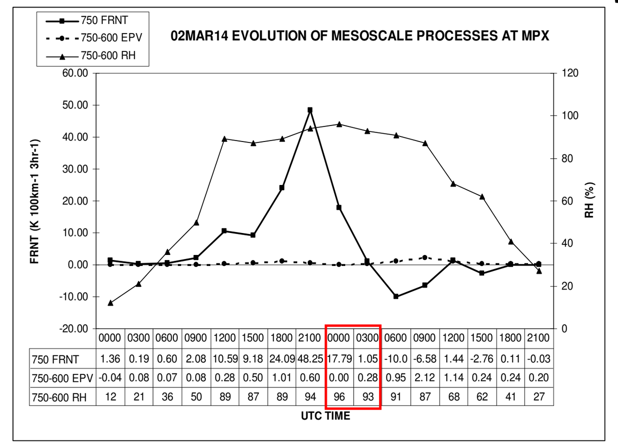


Figure 7: Evolution of Frontogenesis and EPV at MPX

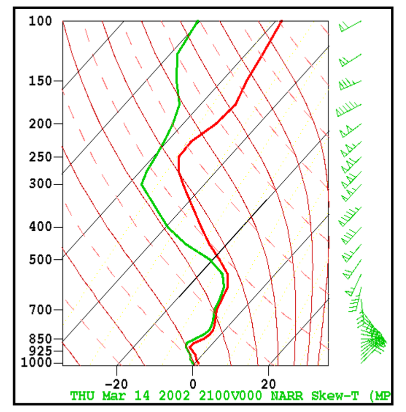


Figure 8: Skew T at MPX on 14th at 2100 UTC

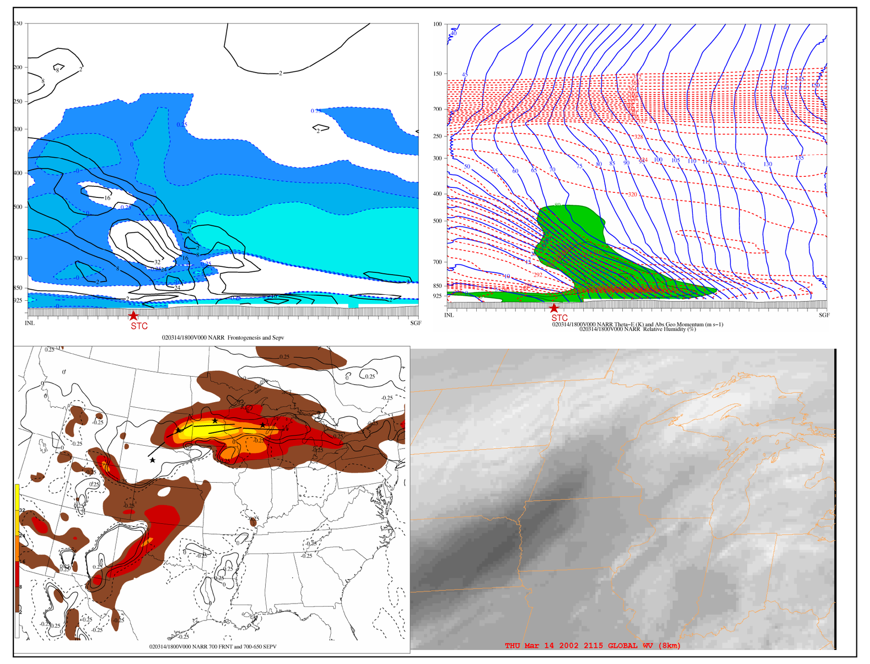


Figure 9: 1800 UTC

Top Left – Frontogenesis cross section from INL to SGF

Top Right – CSI cross section from INL to SGF

Bottom Left – 700 hPa Frontogenesis and 700-650 hPa Saturated EPV. Black line represents snowbands at 1800 UTC

Bottom Right – GOES 12 water vapor imagery 2115

•Frontogenesis was strong at multiple levels and synoptic forcing deepened mesoscale forcing

•At MPX EPV was in the 0-0.25 threshold after frontogenesis was maximized

•CSI was present in the environment

•A dry air intrusion beginning at 1800 UTC helped intensify the snowband

Research Objective

1. Document the *temporal* and *spatial characteristics* of contrasting mesoscale snowbands
2. Investigate the *evolution* and *time scale* of the *mesoscale processes* associated with contrasting mesoscale snowbands
3. Compare and Contrast the *mesoscale processes* and the *radar characteristics* to provide further insight into how the mesoscale processes worked together to form different types of mesoscale snowbands

Conclusions

1. Strong synoptic forcing deepens mesoscale forcing in cases with strong surface systems
2. Dry air is an important component to the intensification of mesoscale snowbands regardless of the synoptic system's strength
3. The timing of Frontogenesis and EPV varied
   a. In the weak case, EPV was minimized before Frontogenesis was maximized
   b. In the strong case, Frontogenesis was maximized, then EPV was minimized

Future Work

1. Further investigate the interaction between the synoptic forcing and mesoscale forcing by comparing Q vectors to mid-level frontogenesis
2. Look for a pattern of evolution of EPV and frontogenesis through time for weak and strong cases
3. Simulate these cases with the WRF model and compare the simulated radar reflectivity to the observed radar reflectivity

Case Study: 04-05 January 2004

Event Overview

An extremely narrow, SW-NE oriented mesoscale snowband developed over Iowa. The heaviest snowfall occurred in the south central and eastern parts of the state. The mesoscale snowband developed just before 1200 UTC near OAX and propagated NE across IA, leaving some areas with 8-10 inches of snow.

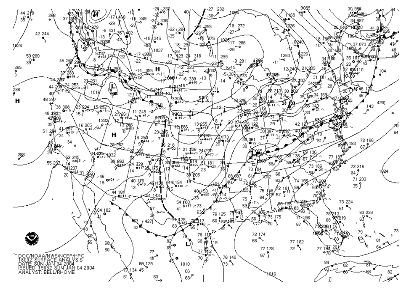


Figure 10: 1800 UTC Surface Analysis

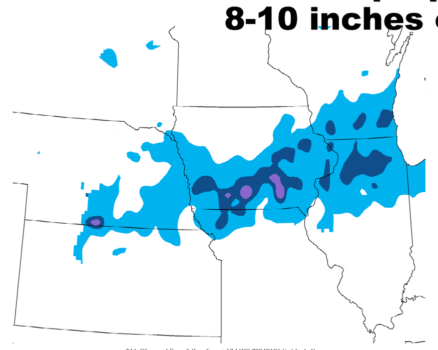


Figure 11: 24 Hour Snowfall

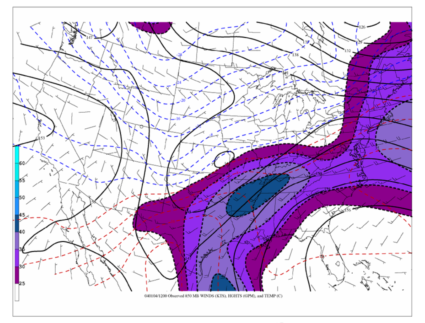


Figure 12: 850 hPa 4th 1200 UTC

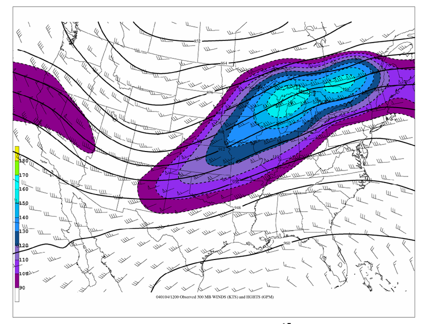


Figure 13: 300 hPa 4th 1200 UTC

Radar Characteristics

1145 UTC: Major snowband forms over OAX, multiple snowbands in Southern IA

1430 UTC: The multiple snowbands in Southern IA merge

1605 UTC: Multiple snowbands

1730 UTC - 1945 UTC: Single snowband is persistent and intense

1945 UTC: Single snowband begins to break up

2205 UTC: CCW rotation and dissipation of the snowbands

2345 UTC: Multiple snowbands merge again and dissipate by 0305 UTC

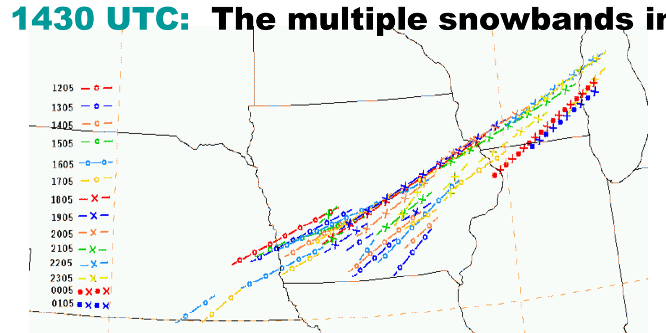


Figure 14: Time Evolution of Mesoscale Snowband

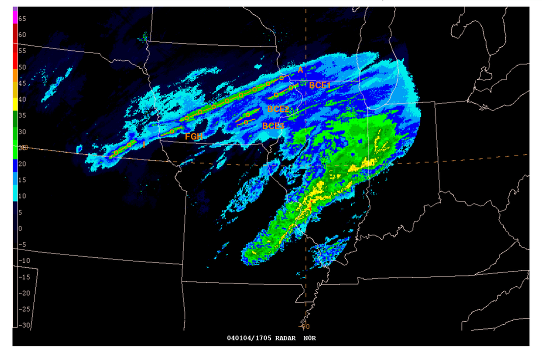
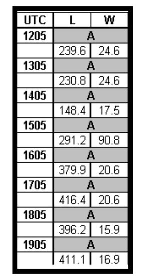


Figure 15: Composite Radar Reflectivity 1705 UTC

Table 2: Length and width of the snowband



•Length and width calculated from the longitude and latitude of the endpoints of the main snowband

•Greatest length 416.4 km shortest length 148.4 km

•Greatest width 90.8 km, smallest width 15.9 km

Mesoscale Environment

Analysis of 32 km NARR data from NCDC

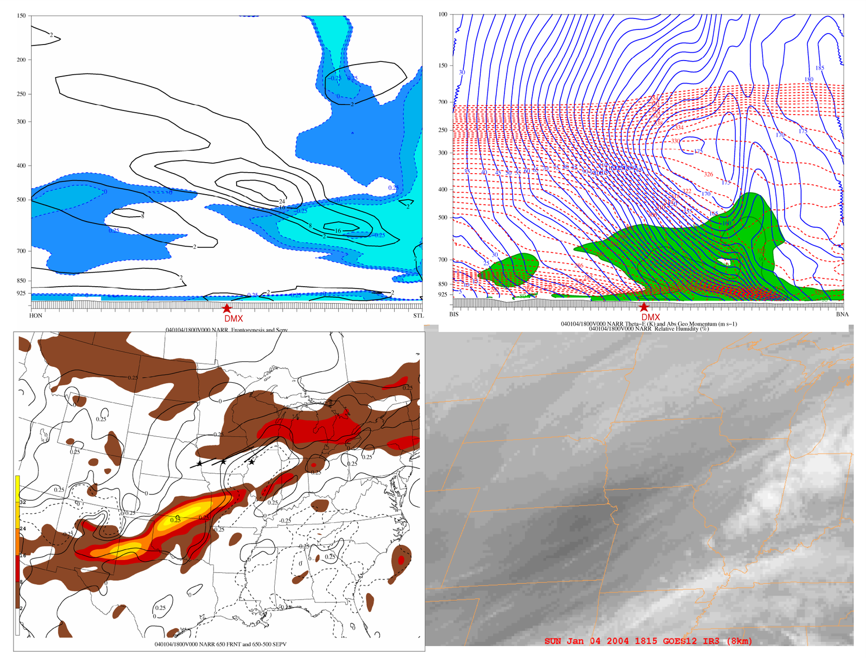


Figure 16: 1800 UTC

Top Left – Frontogenesis cross section from HON to STL

Top Right – CSI cross section from BIS to BNA

Bottom Left – 650 hPa Frontogenesis and 650-500 hPa Saturated EPV. Black line represents snowband at 1200, 1800, and 0000 UTC

Bottom Right – GOES 12 water vapor imagery 1815 UTC

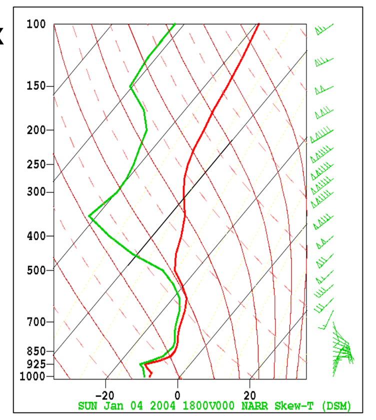


Figure 17: Skew T at DMX on 4th at 1800 UTC

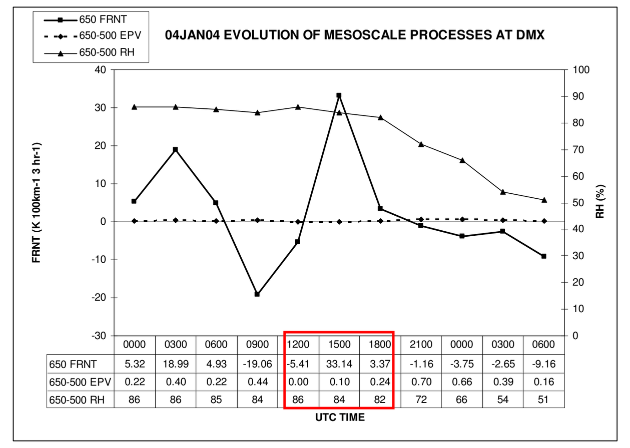


Figure 18: Evolution of Frontogenesis and EPV at DMX

•The snowband was intense at 1800 UTC, after frontogenesis was maximized at 1500 UTC

•While frontogenesis was at a maximum, EPV was within the 0-0.25 threshold for WSS

•CSI was present in the environment

•A dry air intrusion beginning at 1800 UTC helped intensify the snowband