A DIAGNOSTIC ANALYSIS OF MESOSCALE SNOW BANDS, WHICH OCCURRED ON 26 FEBRUARY 2003

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Case Study Overview

The following is a brief overview of upper-air, surface, and snowfall characteristics associated with the 26 February 2003 case study:

1) Zonal mid-tropospheric flow is predominate in this case.

2) There is a weak 500 hPa trough over Utah and Arizona.

3) At 700 hPa there is confluent flow over the area of interest (i.e., central Missouri).

4) The only surface feature of note is an inverted trough, which extends from northeastern Texas to northeastern Missouri.

5) The snow bands initiated along a 700 - 850 hPa layer moisture gradient.

6) The snow band initiation site is along the Kansas/Missouri boarder and they propagated from east-central Missouri to southwestern Illinois.

7) Some areas received as much as four (4) inches of snowfall in a narrow band that stretched across central Missouri.

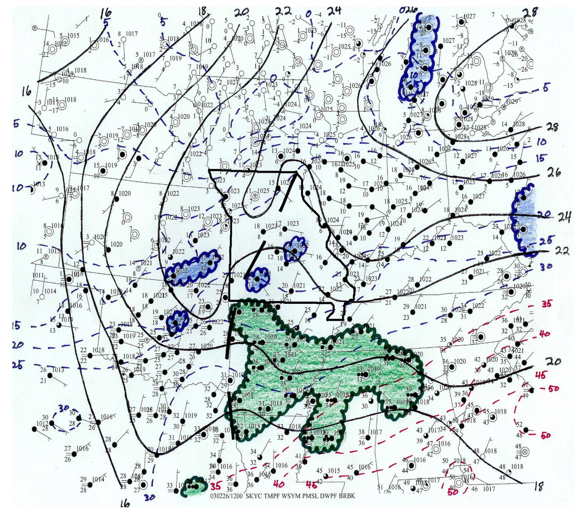
8) The maximum intensity and extent of this event is 1200 UTC.

Research Objective

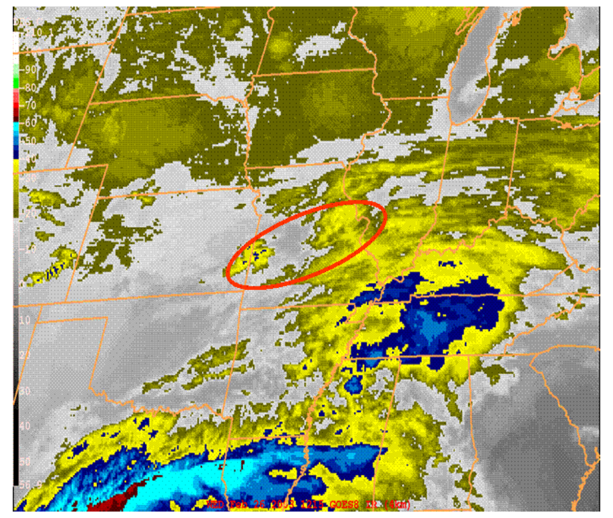
The objective of the present study is to focus upon the horizontal and vertical location, depth, and variability of the magnitude of key processes as they synergistically interact to modify upward vertical motion, mesoscale instability, and the depth of moisture in the formation of mesoscale snow bands.

In this way, a composite was created for this case utilizing key processes. With the composite created from this case study along with composites from three other cases and collaboration with the National Weather Service Forecast Office, St. Louis, Missouri, a conceptual model was developed. The conceptual model is illustrated on an adjacent poster.

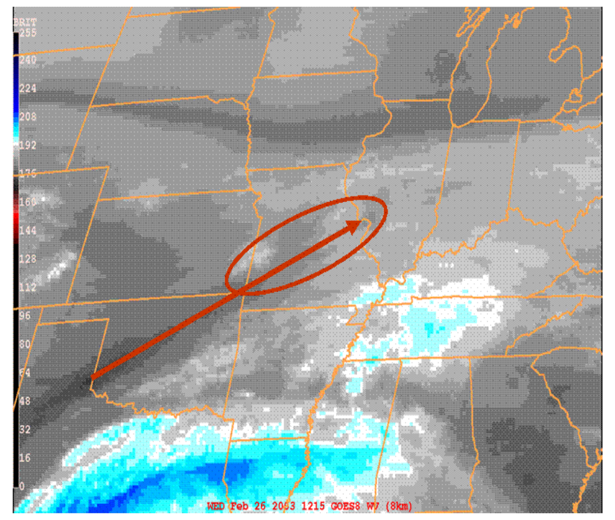
Maximum Intensity and Extent of Event



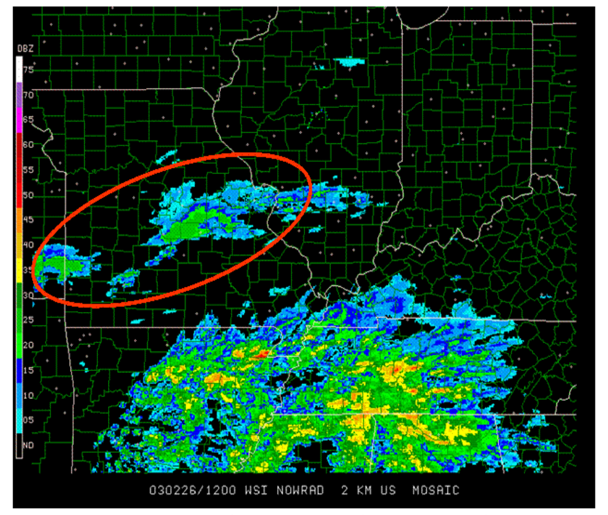
Regional Surface Analysis
(1200 UTC)



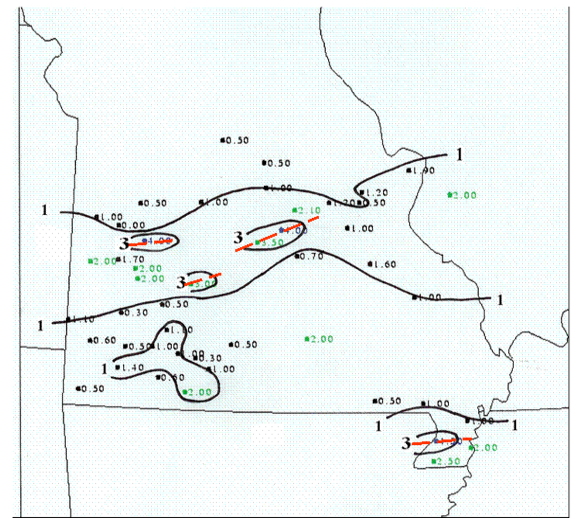
GOES-8 Infrared Imagery
(1215 UTC)



GOES-8 Water Vapor Imagery
(1215 UTC)

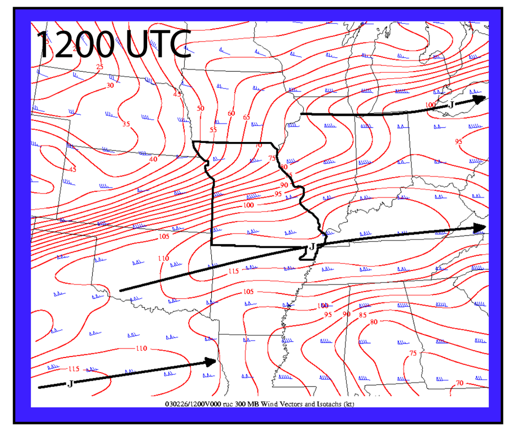


Regional Doppler Radar
(1200 UTC)
Data courtesy of NCDC

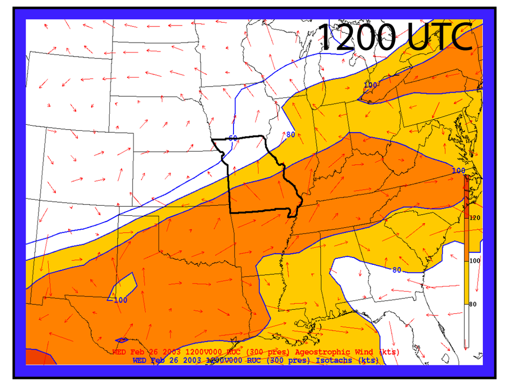


48-h Snowfall Isohyet Map
COOP data courtesy of NCDC

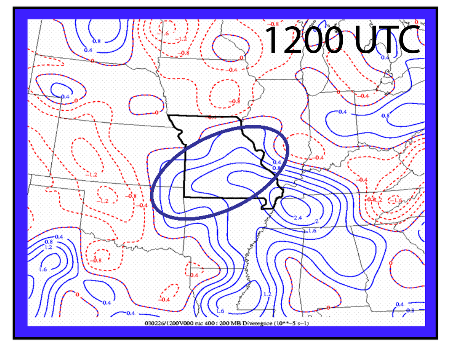
Rapid Update Cycle (RUC)-II Initialization Upper-level winds, Moisture and Instability



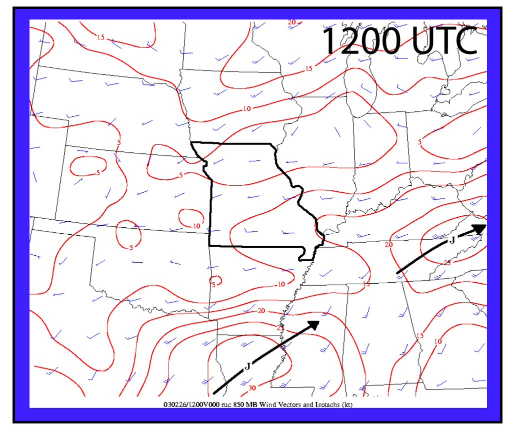
300 hPa Wind Barbs
and Isotachs



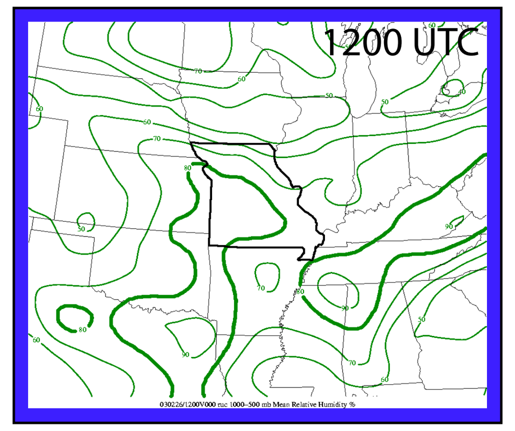
300 hPa Ageostrophic Wind
Vectors and Observed Isotachs



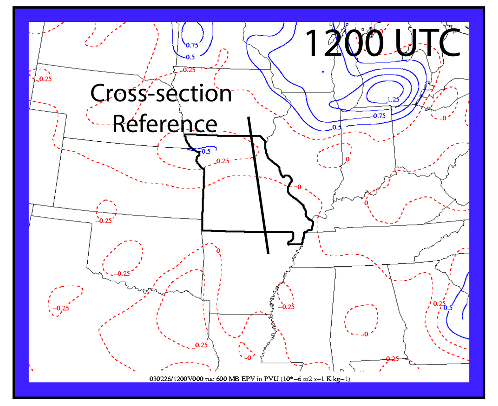
400-200 hPa
Average
Divergence



850 hPa Wind Barbs
and Isotachs

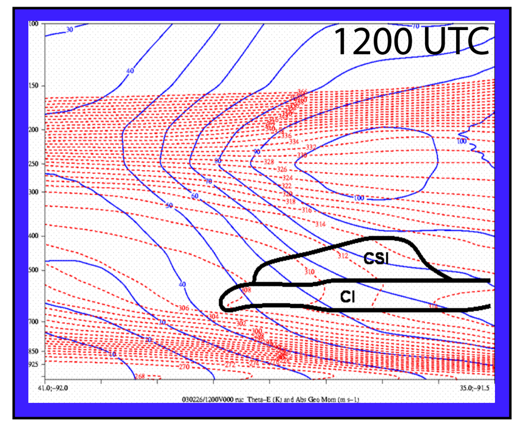


1000-500 hPa Average
Relative Humidity

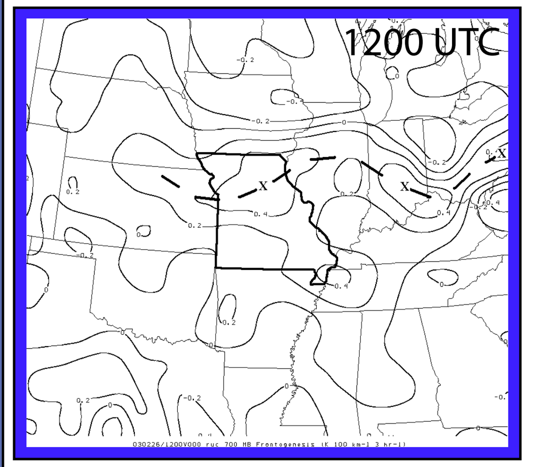


600 hPa Equivalent
Potential Vorticity
(EPV)

Cross-section of Absolute
Geostrophic Momentum
and Equivalent Potential
Temperature

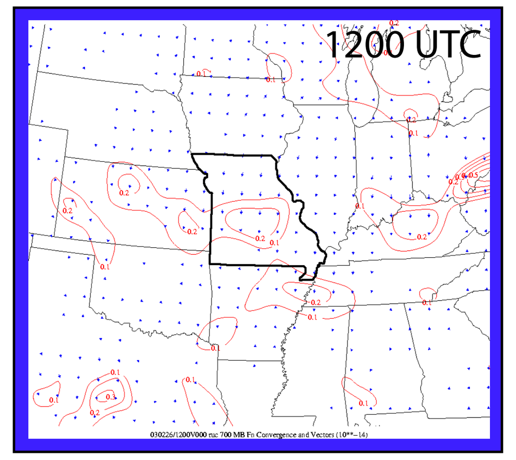


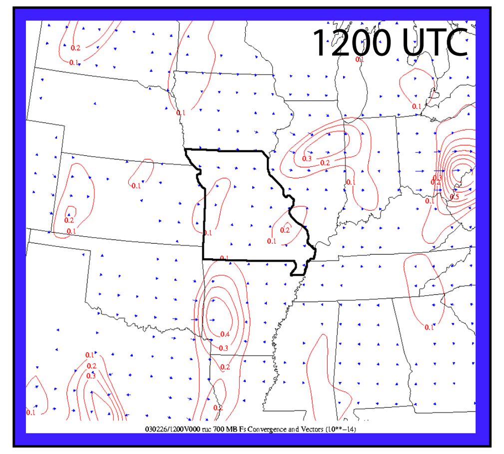
Frontogenesis and Upward Vertical Motion



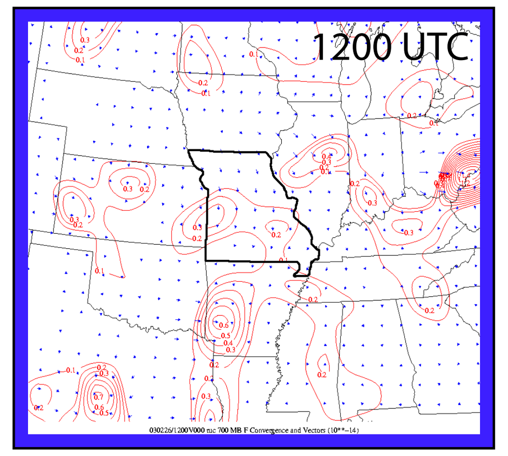
700 hPa Frontogenesis

700 hPa Magnitudinal
Vector Frontogenesis
(Fn) and Convergence

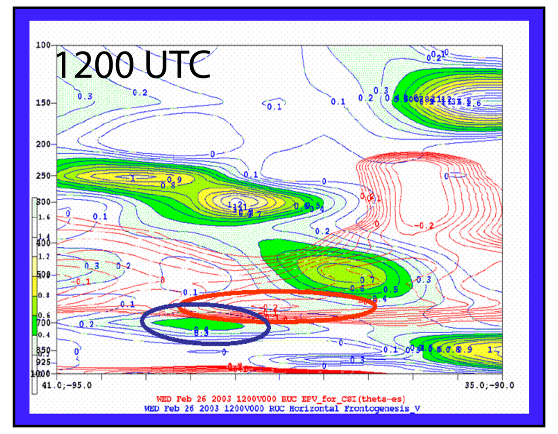




700 hPa Directional
Vector Frontogenesis
(Fs) and Convergence



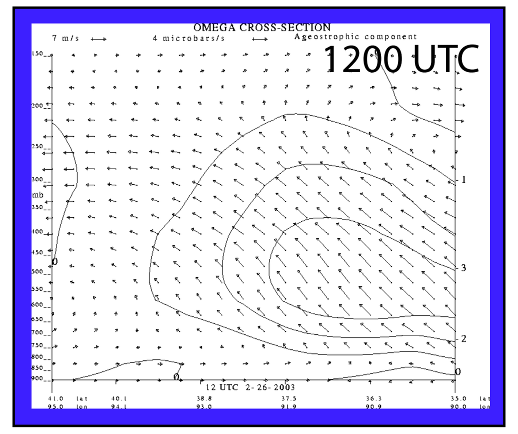
700 hPa Total Vector
Frontogenesis (F) and
Convergence



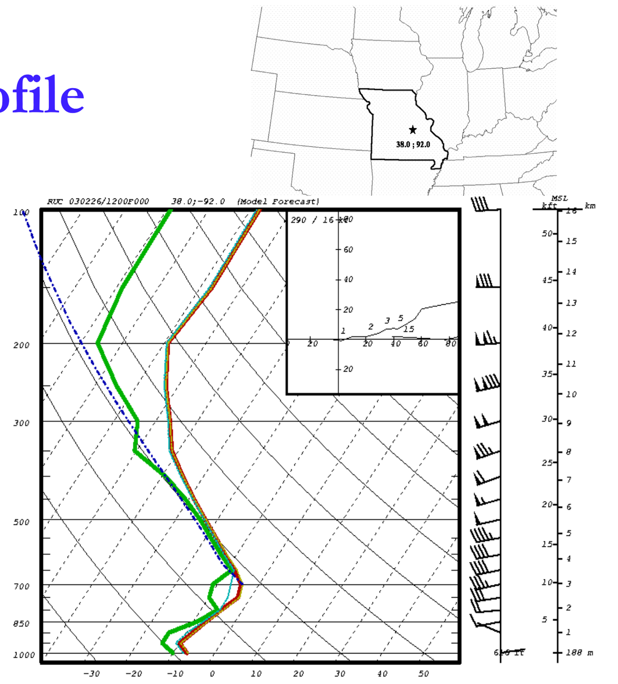
Cross-section of
Frontogenesis and EPV.

(Shaded regions, outlined by blue lines, represent frontogenesis and red lines represent EPV of .25 PVU or less.)

Cross-section of
Ageostrophic Wind
Vectors and Upward
Vertical Motion

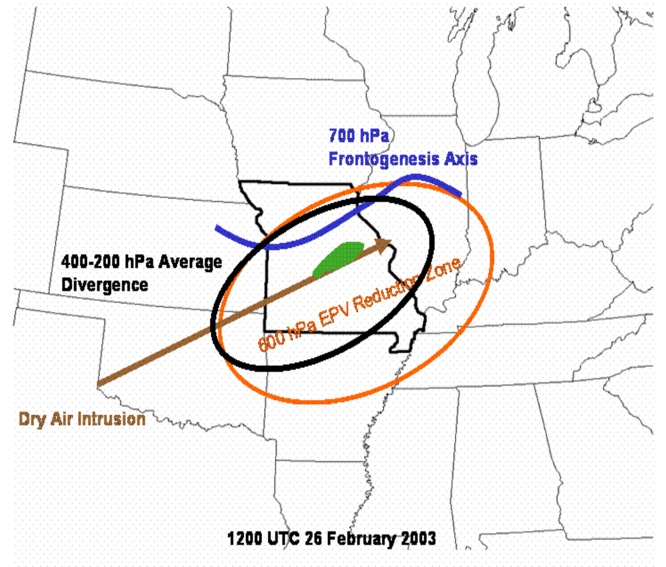


Vertical Profile



This is a RUC-II sounding, located at 38.0N;92.0W, which shows the temperature, dewpoint temperature, and wind profile from the surface to 100 hPa (approximately 16 km). The wind profile is also depicted in a hodograph. This particular sounding does not favor long-lived, well-developed banded snowfall (Banacos 2003).

Composite



This composite relates the position of the snow band to the location of the mid-level frontogenesis, zone of EPV reduction, upper-level divergence, and the dry air intrusion at 1200 UTC. The dry air intrusion was the key component in destabilizing the atmosphere within a region which was already condusive for mesoscale snow bands.

Conclusions

The snowfall was on the warm side of the mid-level frontogenesis axis. This illustrates that the snowfall was associated with the direct thermal circulation, which provided lift to the area. The banded nature of the snow bands was related to the magnitude component of the total vector frontogenesis rather than the directional component.

Conditional symmetric instability and convective instability was over the area of banded snowfall.

These snow bands do not necessarily form in the classical entrance region of upper-level jet streaks. The area above the region of interest resembles an entrance region due to the winds crossing isotachs from relatively weak to strong wind speeds. This helps enhance lift through upper-level divergence.

The banded snowfall was not directly associated with a southerly low-level jet. Also, diagnostically, the trowal was not associated with the snow bands.

Future Research

With the insight gained from this study, numerical mesoscale simulations will be generated to further explore the small-scale atmospheric processes that are associated with banded snowfall. It would also be advantageous to examine the vertical structure of the snow band using Doppler radar cross-sections. This will verify the perception that these snow bands are very tenuous and therefore more difficult to forecast. Also, trajectories will be investigated to understand the three-dimensional characteristics of the conveyor belts associated with weak cyclogenesis.