A Climatology and Statistical Classification of Midwestern Snow Bands: A Process-Oriented Approach
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Introduction
- By 2010, one of NOAA’s performance objectives is to increase the lead time on winter storm warnings by 21% (from 14 to 17 hours). However, NOAA states that winter storms forecast, tracking, and precipitation amounts and types need to be better understood and quantified to provide more effective forecasts and warnings.
- In this presentation, a 4-yr climatology of organized synoptic-scale snow events (bands) in the Midwest is presented in an effort to develop guidance that will support operations at the Hydrometeorological Prediction Center’s Winter Storm Desk.
- Using the National Climate Data Center (NCDC) Cooperative Summary of the Day (CSDP) data, a 4-yr database of organized snow events in the Midwest was developed and their temporal and spatial characteristics were examined. In addition, using hourly surface data from the Automated Surface Observing Systems (ASOS) and the North American Regional Reanalysis (NARR) dataset, the synoptic-climatological relationship between heavy snowfall and surfacelower-level features was examined.

Methodology

Climatology - Overview

- High Snow events with SW/NE oriented snow bands are typically found with southwest flow at mid-levels (Hoskins and Hodges 2002).
- Although they usually have a weak signature in surface analyses, often they have a strong influence on the moisture distribution across the region.
- System strength is normally weaker when compared to SW/NE cases due to zonal flow dynamics.
- Tracks of lower-tropospheric (850-700 hPa) features are more consistent in relation to the axis of heaviest snowfall (cf. surface and 500-hPa features).

Climatology - Northwest/Southeast Oriented Bands

- Snowfall (in.) for the set of W/E banded snow events in the database is shown.
- A yearly distribution of the all the organized banded snow events reveals that the 1999–2000 and 2000–2001 winter seasons had a higher frequency of snow events.
- Snowfall (in., shading) for the 48-h period ending at 1200 UTC 14 February 2007. 30th, 50th, and 90th percentiles are shown.

Climatology - Southwest/Northeast Oriented Bands

- Data from events with SW/NE orientation are used to examine the connection between surface and upper-level features.
- Where a surface system is in dynamic opposition to the upper-air flow over the Midwest will enhance the potential for heavy snowfall.
- Average width (km) of NW/SE oriented snow events for the period November 1998 – March 2003. In each category the horizontal line represents the average, q0.3 is the 30th percentile, q0.7 is the 70th percentile, and q0.9 is the 90th percentile.

Conclusions - Future Research

- Banded snow events in the Midwest tend themselves to be organized into three distinct categories: NW/SE, SW/NE, and W/E.
- NW/SE bands are the strongest and widest, followed by W/E and NW/SE bands.
- In all banded snow types, variance decreases with increasing snow amount category.
- Tracks of lower-tropospheric (850-700 hPa) features are more consistent in relation to the axis of heaviest snowfall (cf. surface and 500-hPa features).
- Expand the period of study to include more years (~25 yrs) and examine the relationship between the strength of organized bands and their accompanying surface/upper-level features.
- Investigate other process-oriented parameters (Qv convergence maxima) and their correlation in the axis of heavy snowfall.
- Use the climatology for the development of an existing system. This system would include model initialization and identify case studies that could key updates of the forecast. From the identified past cases, probabilistic forecasts of snowfall potential (e.g., probability of 3-in or more snowfall) can be developed.
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