Introduction

- Branick (1997) found that during a 13-year period, 12% of all winter weather events that occurred in the continental United States qualified as an ice storm (based on the National Weather Service criteria of either structural damage or ice accumulations of at least 0.25”).
- Ice storms, while relatively rare, are capable of posing a significant forecast challenge due to limited research on these events and their associated environments.
- One approach is to examine the climatology of ice storms and their environmental conditions to provide situational awareness for forecasters.
- Previous research such as Beebe (1956), Glass et al. (1995), Bierly and Winkler (2001), Moore et al. (2003), Thomas and Martin (2007), and Novak et al. (2010) have shown the effectiveness of a composite analysis approach to diagnose the robust synoptic and mesoscale signals associated with certain weather events.
- In this presentation, ice storms that affected the Central United States over a 35-year period are analyzed using composite fields to illustrate the evolution of common features.

Methods

- An ice storm start time was defined as the hour at which 2 or more FZRA surface observations occurred within the domain, a maximum coverage time was defined as the hour at which the greatest number of FZRA surface observations occurred within the domain, and an end time was defined as the hour at which no FZRA surface observations remained within the domain.
- Using the General Meteorological Package (GEMPAK) with the North American Regional Reanalysis (NARR), system-relative composites were generated using software developed by Saint Louis University.
- The intersection of the low-level moisture axis (based on 850 mb mixing ratio field) and the 2-m 32°F isotherm were determined for each ice storm at the start, maximum coverage, and end times. These locations were used to create system-relative composites to analyze each stage of a typical Central United States ice storm.
- Finally, the average latitude and longitude positions of the low-level moisture axis and the 2-m 32°F isotherm at each stage were used to display the resulting composite fields in a geographical framework.

Characteristics of Ice Storms (≥0.25”) in the Central United States

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Synoptic-Scale Composites

- Common synoptic-scale features include: a dome of high pressure to the north, an area of cold air to the north and west, and associated cold fronts or cold advections.
- A cold front at the surface pole, and an upper-level jet stream anchored in the Great Lake region providing support for upward vertical motion.
- A thermal profile just behind the sub-freezing surface conditions depicts a 100 mb warm layer (i.e., 6-10°C) centered at 850 mb capable of melting ice crystals. Furthermore, a warm layer that exceeded 3°C was present in 70% of the storms.

Temperature, Moisture, and Isentropic Composites at Maximum Coverage Time

- The temperature, moisture, and isentropic composites at maximum coverage time provide a comprehensive view of the environment at the peak of the ice storm.
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Conclusions

- The cold region research engineering laboratory (CERREL) ice storm database, which contains data from the National Climate Data Center (NCDC), and NWS office event archives were examined for ice storms between January 1979 and March 2010 (October–March).
- This analysis revealed 51 ice storms containing maximum ice accumulations ≥0.25” in a domain containing the County Warning Areas (CWAs) of SDF, TOP, EAX, LSX, ICT, PAM, OUN, TSA, LKZ, and HEG.
- Of the 51 ice storms, 37 had maximum ice accumulations ≥0.75” (major), and of those 37 events, 24 had a southwest-northeast 1-3 m 32°F isotherm orientation at the ice storm start time.
- Ultimately, these 20 major ice storms were used in the composite analysis (4 events were considered outliers – FZRA within the TROWAL structure of a mid-latitude cyclone).

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