Predictability of the 22–24 January 2005 Northeast Blizzard

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ABSTRACT

Improving the prediction of high-impact weather such as heavy snow and strong winds associated with extratropical cyclones poses a critical scientific challenge. The 22–24 January 2005 blizzard that affected the Northeast U.S. is a recent example of a high-impact weather event that was not well forecast more than a few days in advance. Motivated by the need to identify precursors to such events, we present a multi-scale case study of the January 2005 Northeast blizzard.

Data sources include the NCEP Global Forecast System (GFS) gridded model forecasts and analyses, the NCEP–NCAR gridded reanalysis, and NCEP-provided extratropical Northern Hemisphere (NH) geopotential height anomaly correlations between GFS forecasts and analyses.

An analysis of coarse-resolution (2.5°) gridded GFS model forecasts reveals that the strength of a short-wave trough over the Northeast at the time of the blizzard was significantly underforecast by the GFS model as few as two to three days prior to the event. In addition, inspection of the fine-resolution (0.5°) gridded GFS model forecasts indicates that the merger of three coherent tropopause disturbances (CTDs) over the eastern U.S. just prior to the event was inadequately resolved, likely contributing to the observed error in the position and strength of the surface cyclone associated with the Northeast blizzard.

Results suggest that the extratropical cyclone associated with the blizzard is partly attributable to dramatic changes in the NH planetary-scale flow pattern in the following ways: First, the abrupt transition from an extreme negative to an extreme positive Pacific–North American (PNA) pattern (12–17 January) resulted in a dynamically favorable flow regime for cyclogenesis near the eastern U.S. coast by establishing a deep trough over the eastern U.S. and western North Atlantic. The regime transition also facilitated an arctic cold surge over the eastern U.S. that preconditioned the Northeast for warm-air advection and heavy snow. Second, the eastward propagation of a long-lived Rossby wave train initiated over the western Pacific by an arctic CTD (18 January) may have helped spawn cyclogenesis near the Northeast coast by amplifying the planetary-scale flow pattern. Third, the rapid transition from an extreme positive to extreme negative North Atlantic Oscillation pattern (18–25 January) associated with the onset of North Atlantic blocking contributed to the development of a meridional storm track near the eastern U.S. coast. Finally, high-latitude northwesterly flow induced by the extreme positive PNA pattern helped extract a deep CTD from the arctic (21 January) that subsequently contributed to coastal cyclogenesis.