Using Wind Anomalies to Forecast East Coast Winter Storms

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Forecasting major winter storms is a critical function for all weather services. Conventional model-derived fields from numerical weather prediction models most frequently utilized by operational forecasters, such as pressure level geopotential height, temperature fields, quantitative precipitation forecasts, and model output statistics, are often insufficient to determine whether a winter storm represents a large departure from normal, or has the potential to produce significant snowfall. This paper presents a method, using normalized departures from climatology, to assist forecasters in identifying long-duration and potentially significant winter storms. The focus of this paper is on anomalous low- and upper-level wind anomalies associated with winter storms along the U.S. east coast.

Observed and forecast low-level (850 hPa) and upper-level (300 and 250 hPa) easterly wind anomalies are compared with a 30-yr (1961–90) reanalysis climatology. Anomalous easterly low-level winds are correlated with enhanced low-level forcing and frontogenesis. Strong low-level winds can also contribute to enhanced precipitation rates. Upper-level winds that are anomalously below normal, represented as easterly wind anomalies, are also correlated with systems that are cut off from the main belt of westerlies, which may result in slower movement of the system, leading to long-duration events. The proposed method of evaluating easterly wind anomalies is shown to assist in identifying potentially slow-moving storms with extended periods of enhanced precipitation.

To illustrate this method, winter storms on 25–26 December 2002 and 2–4 January 2003 will be compared with past historical winter storms. The results suggest that the low- and upper-level wind anomalies in the two recent snowstorms share common characteristics with several record snowstorms over the past 52 yr. Many of these storms were associated with easterly wind anomalies that departed significantly (2 or more standard deviations) from normal. The examination of climatic anomalies from model forecasts may assist forecasters in identifying significant winter storms in the short range (2–3 days) and potentially out to ranges as long as 7 days when ensemble forecast guidance is utilized.