Abstract

The motion of mesoscale snowbands in northeast U.S. winter storms

The spatial distribution of snowfall accumulation accompanying winter storms is a product of both snowfall rate and duration. Winter storms are commonly associated with mesoscale snowbands that can strongly modulate snowfall accumulation. Although the development of mesoscale snowbands can usually be anticipated, snowband residence time at a fixed location is often a forecasting challenge. However, given that snowband residence time is related to characteristics of band motion, an improved understanding of band motion presents an opportunity to improve snowfall-accumulation forecasts.

This study investigates environmental features associated with specific snowband motion characteristics. Using radar reflectivity data, snowband events in the northeast United States spanning a 6-yr period are categorized according to a band-motion classification scheme, with this scheme consisting of laterally translating, hybrid, laterally quasi-stationary, and pivoting snowbands. On the basis of this classification, composite analysis is performed to identify common environmental features associated with particular band-motion categories. Results indicate that snowband motion is related to cyclone-relative band position, the confluence/diffluence and curvature of midlevel streamlines, and the distribution of horizontal temperature advection. Snowband motion is also related to hodograph shape, as well as to the across- and along-isotherm components of the Q vector. Composite results are supplemented with case studies, which suggest that laterally quasi-stationary and pivoting snowbands can favor distinct gradients in snowfall accumulation. The present study proposes that snowband motion warrants consideration during the forecasting process and, to that end, conceptual models are presented to synthesize key findings for operational application.