5. Conclusions and Future Work

This thesis investigated the formation and evolution of low-level flow channeling in the Mohawk and Hudson River valleys of New York, which produces confluent low-level flow in the vicinity of KALB. This confluent flow creates a zone of near-surface convergence, resulting in a phenomenon called Mohawk–Hudson convergence (MHC) by local forecasters. From time to time, this phenomenon has been known to generate a mesoscale area of snow, the formation and behavior of which has been difficult to forecast accurately.

A concise definition of the weather features which comprise MHC events was developed in order to systematically distinguish instances of MHC from other precipitation-producing processes. This definition, based principally on radar presentation, helped to identify seven occurrences of MHC which spanned November 2002–January 2008. Each case was investigated through various means including radar, satellite, radiosonde, and surface data. A synoptic overview of upper-air weather features present during each case study was constructed using the initialized 0-hour analyses from the 1.0° gridded NCEP GFS, and the 32-km NCEP NARR.

A positive SLP difference was found from west-to-east (north-to-south) across the Mohawk (Hudson) River valley during all of the MHC cases studied. The Mohawk and Hudson valleys were found to be inherently susceptible to pressure-driven channeling, one of the four mechanisms shown by Whiteman and Doran (1993) to produce in-valley winds which differ in speed and direction from ambient winds. Thus, the aforementioned positive SLP difference across the Mohawk and Hudson valleys was deemed to be the principal physical factor which drives the confluent flow and the formation of the resultant zone of low-level convergence. Other key aspects of the typical environment present during MHC events include: (1) an absence of strong forcing for vertical motions, which could overpower the weaker vertical motions generated by terrain and convergence effects; (2) an absence of strong CAA, which precludes strong subsidence and drying of the boundary layer; and (3) a statically stable atmospheric stratification, which prevents downward momentum transfer and the elimination of mesoscale terrain-induced wind patterns. The synoptic pattern which typically gives rise to this type of environment includes the presence of an intensifying area of surface low pressure, passing off the east coast on a track that is south of 40°N and/or east of 70°W, and the presence of a weak area of surface high pressure located over the Great Lakes. Several composite maps of the idealized weather conditions present during MHC events, and a decision tree aimed at increasing the accuracy of forecasting MHC, were presented in Figs. 4.1 and 4.2, respectively.

The ability of the Mohawk and Hudson valleys to influence the local warm-season severe weather climatology was previously documented by Wasula et al. (2002), LaPenta et al. (2005), and Bosart et al. (2006); however, this thesis represents the first systematic effort to date addressing the MHC. In reality, the seven events studied likely represent a fraction of the total number of MHC events that occurred over the six-year research period. As a real-time evaluation of potential cases for study was employed for this thesis, fleeting occurrences of MHC and events that had a negligible impact on the general public were likely overlooked. Future research would certainly benefit from the development of a larger repertoire of cases, including those which occur during the warm season, if such cases exist.

Additional cases would increase the total number of hourly observations on which to perform statistical analyses of parameters such as SLP, and wind direction. A larger sample size may lead to new correlations of these parameters, such as whether the magnitude of the SLP gradient across the Mohawk and Hudson valleys alone can influence precipitation intensity, or what factors influence the specific location over which the initial precipitation echoes form. Within the case studies themselves, the incorporation of surface observations from a consistent and reliable bellwether site in the western Mohawk Valley (perhaps KRME or KSYR) would allow for a more rigorous definition of the range in which west–east SLP-difference values must fall in order for MHC to occur.

An assessment of the forecast skill shown by the decision tree (see Fig. 4.2) would be helpful in updating the current methodology to generate more accurate forecasts. Investigating scenarios in which MHC is favored by the synoptic-scale pattern but none occurs ("null cases") could lead to further understanding and refinements in the forecasting methodology. Mesoscale modeling of MHC cases might facilitate determining the sensitivity of this phenomenon to SLP gradient, wind speed and direction, static stability, or topography.