Planetary and synoptic-scale analysis of freezing rain events in the St. Lawrence River Valley

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Freezing rain is a major environmental hazard that affects many parts of Canada; however, it is especially common along the St. Lawrence River Valley (SLRV) in southern Quebec. For large cities such as Montreal, severe events can have a devastating effect on people, property, and commerce. A tragic reminder is the 1998 Ice Storm, during which 80-100 mm of freezing rain fell in the Montreal area. To date, much of the research in the area of freezing rain has focused on analyzing the climatology, conducting individual case studies, or using statistical models to improve prediction. Few studies have conducted a thorough synoptic-scale analysis of freezing rain events, fewer still in Quebec. Therefore, the goal of this project is to characterize the relevant synoptic-scale features of a SLRV freezing rain event, in hopes to better understand event causation, duration, and severity.

Environment Canada hourly surface observations at Montreal (CYUL) and Quebec City (CYQB) for the period 1979-2008 are utilized to construct a complete list of freezing rain occurrences. From this list, 46 and 48 severe events are defined for Montreal and Quebec City, respectively.

Two separate manual synoptic typing procedures are employed to identify key synoptic-dynamic precursors and structures associated with severe freezing rain events in Montreal and Quebec City. The methodologies and composite structures of mass fields such as 500-hPa height, 1000-500-hPa thickness, and mean sea level pressure are presented. Results indicate that while freezing rain is frequently associated with the passage of an extratropical cyclone, many events are sustained primarily by low-level frontogenesis enhanced by the topography of the SLRV. The results of this study provide a complete picture of the mechanisms necessary for the production of freezing rain in the SLRV and should work to improve the forecaster's ability to anticipate such events.