



## **Characteristics of High-Impact Long-Duration Freezing Rain Events over North America**

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While even short periods of freezing rain can be hazardous, the most severe economic and public health impacts tend to occur when it persists for many hours. Predicting the precise and often fragile temperature stratification necessary for freezing rain to persist remains an important forecast challenge. To better elucidate the conditions responsible for the most severe impacts, we concentrate on surface observations of long-duration (6 or more hours) freezing rain events over North America from 1979-2015. Furthermore, we analyze cases in which multiple stations observe long-duration events simultaneously. Following these cases over successive days allows us to generate maps of freezing rain “tracks” which are then categorized by their geographic distributions. We then analyze the conditions that lead to the occurrence of freezing rain for each of these categories.

The climatology of long-duration freezing rain events is largely controlled by a combination of synoptic patterns and local terrain effects, which help to maintain or replenish cold air at the surface. As with freezing rain in general, long-duration events occur most frequently from southeastern Canada into the northeastern United States, with a maximum in the St. Lawrence River Valley of Quebec. An examination of the longest-duration events at each station shows a broader geographic distribution, with local maxima in the frequency of 18+ h events over Oklahoma and surrounding states in the South Central United States (SCUS) – a region with relatively low annual freezing rain frequencies. Classification of individual events shows us that in many instances, the SCUS and northeastern North America are impacted by long-duration freezing rain during the same cases.

Indeed, the category responsible for the greatest number of freezing rain observations over the largest area is one which begins in the SCUS (often Texas or Oklahoma), with freezing rain occurring over a broad southwest-northeast swath (2-3000 km) into the northeastern United States and eastern Canada. These storms regularly affect some of Canada’s largest metropolitan areas, including Toronto, Montreal, and Ottawa. Examples of this event category include the January 1998 ice storm that devastated southern Quebec and the December 2013 storm which severely affected the Toronto region. The combination of the large geographic extent and particularly long durations associated with this pattern make it an especially impactful one. Through an analysis of the planetary-, synoptic-, and mesoscale patterns associated with this and several other categories of events, we hope to improve forecasters’ understanding of and ability to forecast long-duration freezing rain events and better communicate their potential impacts to the public.