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The Identification and Nowcasting of High Impact Winter Weather Events

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In the Great Lakes are of North America, hazardous winter weather from synoptic frontal systems, lake effect squalls and multi-layer mixed phase clouds has a profound impact on public safety. The Environment Canada King City C-band Doppler radar has been collecting dual polarization data on such events since 2004. This study describes a fuzzy logic approach that nowcasts high impact winter weather events using dual polarimetric radar parameters and model-based temperature profiles. The algorithms diagnose and produce short term forecasts of the bright band location, the precipitation type and the precipitation rate.

A prime source for the validation of the output of these algorithms is the GPM Cold Season Precipitation Experiment (GCPEx) that was conducted in the winter of 2011/2012. Environment Canada and NASA were the lead agencies in GCPEx that also involved a number of university research groups including the University of Bonn and the University of Cologne. Within 100 km of the radar, five enhanced measurement sites contained vertically pointing X-band and Ku band radars, microwave radiometers, wind profilers, in-situ 2D video disdrometer measurements, and a suite of emerging technologies to measure instantaneous precipitation rate.

In major synoptic systems, the algorithms demonstrated great skill in distinguishing among winter precipitation types. However, precipitation rates, particularly in lake effect systems, were less reliable due to precipitation evolution in the lowest levels and to the wide variety of particle types, shapes and densities that occur in close proximity. The C-band radar showed no skill in icing events from mixed phase mid-level clouds due to the relatively weak signals that made the precision of the measurements inadequate.

Methods to improve the algorithms will be discussed. They include the fusion of information from remote sensing technologies other than the C-band radar into the algorithms and scenario dependent multi-parameter algorithms to determine precipitation rate.