Complex Precipitation Phase and Impact on Snowpack Evolution in Eastern Canada

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ABSTRACT

Accurate estimation of precipitation phase at the surface is critical for hydrological modelling in cold regions. Different precipitation phase partitioning methods (PPM) exist and were developed with local data; however, their application across a variety of climatic regions in numerical snow models is often limited. In particular, PPMs used in hydrological and land surface models struggle to represent near-0 °C complex precipitation phase, such as freezing rain and wet snow, and their impact on snowpack simulations. The goal of this study is to evaluate PPMs of varying complexity using high-quality observations of precipitation phase and to assess the impact on simulated snowpack evolution over a winter season. To do so, we use meteorological data including air temperature, relative humidity, wind speed, and precipitation amount collected at Edmundston, New Brunswick, during the Saint John River Experiment on Cold Season Storms field campaign. These data are combined with observations of snow on the ground, such as snow depth, snow surface temperature, and snow water equivalent. The reference precipitation phase is derived from measurements from a laser-optical disdrometer, micro-rain-radars (MRR), and a Multi-Angle Snowflake Camera (MASC) operating during SAJESS. The snowpack evolution during the 2020-2021 winter was simulated using the model Crocus and the impact of the different PPMs on simulated snowcover dynamics was evaluated across the winter season. The results show that commonly used PPM are limited when representing wet snow and freezing rain events, which mostly impacted the snowpack evolution in spring due to a succession of storms associated with complex precipitation phase. Overall, this study highlights the difficulty in estimating precipitation phase at the surface during near 0 °C conditions and its impact on snow modeling.

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