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Understanding winter storm over complex terrains from a microphysics perspective

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Forecast of heavy downstream snowfalls at regions associated with a mixture of lake and mountain effect events has been a challenge. Besides the difficulties in satellite observations of snow storms, such as in snowfall rate estimations, for weather prediction models, this is mainly due to our lack of understanding on how the topography, moisture transport and resulting complex thermodynamic environments would influence the micro- and macro-physical process. In order to improve the understanding and predictability of these snow events, the winter storm with a complex terrain of 7 January 2014 in the upstate New York mountainous region adjacent to the Lake Ontario has been simulated using the Weather Research and Forecasting (WRF) model coupled with three different microphysics schemes – two bulk microphysics schemes that predetermine the particle size distributions (PSD), and a Spectral Bin Microphysics (SBM) scheme that allows for a naturally evolving PSD to be simulated. The analysis area has an extensive network of ground based in-situ and remote meteorological measurements, which provides not only accurate initial and boundary conditions for model simulations but also practical tools in validations of simulated results. The results are compared with simulations where the lake or the tug hill plateau to the east of the lake (where the maximum precipitation occurred) are removed. The results show that the topography has little effect on the micro- and macro-physics properties of a synoptic weather system (front, etc.) but would strongly affect the formation and development of the lake band and precipitation properties.