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Numerical experiment of lake-effect snowstorm in C3VP campaign using the WRF model coupled with spectral bin microphysics

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The next-generation Global Precipitation Measurement (GPM) mission will offer a global view of precipitation systems including over middle and high latitudes and enable accurate measurement of frozen precipitation and light rainfall. The project of a synthetic GPM simulator was proposed to offer a vitual cloud libraty (VCL) to support development of the retrieval algorithm. The VCL is composed of ground validation (GV)-constrained 3D database of cloud resolving model (CRM) output and simulated GPM L1 product. The satellite retrieval algorithm can be cross-checked with a physical-based approach by using the VCL as a priori database.

The first experiment for making VCL is planned for a snowfall event during the Canadian CloudSAT/CALIPSO Validation Project (C3VP) field campaign. This campaign was took place at the site located between the Lakes Huron and Ontario in south central Ontario, Canada. A cold wind passing over the lakes causes a snowstorm specific to areas over the lee side during winter season. Shi et al. [2010] showed a numerical simulation of the lake-effect snowstorm on Jan. 20, 2007 using the Weather and Research Forecasting (WRF) model with newly implemented the Goddard microphysics scheme (1-moment bulk for 2-water, 3-ice classes). The simulation reasonably represented the locally intensive frozen precipitation in agreement with King-city C-band radar observation. The structures of ice clouds were generally consistent with those in CloudSat and AMSU-B observations also.

This study is aimed at a follow-up study of their research using the WRF in conjunction with the spectral bin microphysics for clouds (WRF-SBM), especially targeted to cloud microphysics of the snowfall event. This SBM (1-moment 33 bins for 1-water, 6-ice classes) is based on the Hebrew University Cloud Model (HUCM) [e.g., Khain et al., 2000; Iguchi et al., 2008, Appendix A].

We will offer a discussion of ice cloud microphysics on a lake-effect snowstorm with sensitivity tests to improve the reproducibility and with reference to aircraft and ground measurements. A comparison of ice particle density with aircraft and ground observations showed that snow particle density set in the present model is small in the radius range roughly less than 1mm and too large in the range over than 1mm. Some microphysical characteristics, e.g. inertial collision efficiency are dependent on the particle density through a change of the bulk radius. A supplemental simulation with a new setting of the particle density is conducted and the result will be checked with the measurements.