Simulating Blowing Snow Events in the Northern Great Plains with Polar WRF

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Abstract

The polar optimized version of the Weather Research and Forecasting model (Polar WRF or PWRF) has been adapted to run interactively with the bulk two-moment Piektuk-D blowing snow model of Déry and Yau (2001). The model fields of temperature, moisture, and winds are modified by low-level atmospheric changes induced by blowing snow impacts such as from the sublimation of blowing snow particles.

During winter, blowing snow events in the northern Great Plains can be extreme and life threatening. To evaluate the performance of Polar WRF coupled with Piektuk-D, the well documented blowing snow event of 12 February 2020 is considered. At Grand Forks, the passage of a very marked cold front on 12 February was associated with an abrupt 30°C temperature drop, the sudden onset of wind speeds of 18 m s^{-1} gusting up to 30 m s^{-1}, and a ground blizzard with low visibilities. Surface observations, frequent radiosonde launches, radar and lidar data, and GOES imagery are compared with model predictions of the evolving blowing snow event. Emphasis is on the vertical profiles that have received limited attention previously. From a bulk perspective, PWRF captures the event with fidelity. Still to be examined are the detailed blowing snow characteristics such as the blowing snow flux and particle size distribution.

Future work will implement the triple moment Piektut-T blowing snow model, investigate additional major blowing snow events, and likely couple the blowing snow model with MPAS. The coupled model will be applied to the polar ice sheets where blowing snow is a very frequent phenomenon. The Piektuk blowing snow model coupled with Polar WRF is scheduled for release to the scientific community in 2025.