Polar WRF Forecast Performance for Antarctica and the Southern Ocean

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The Polar Weather Research and Forecasting model (Polar WRF) has been upgraded to the version 4.1 with an improved NoahMP Land Surface Model (LSM). To assess the model performance over the Antarctic and Southern Ocean, downscaling simulations with different LSM (NoahMP, Noah), WRF versions (Polar WRF 4.1.1 and earlier version 4.0.3, WRF 4.1.1), and driving data (ERA-Interim, ERA5) are examined with two simulation approaches: the short-term that consists of a series of 48 h segments initialized daily at 0000 UTC with the first 24 h selected for model spin-up, whereas the long-term component used to evaluate long-term prediction consists of a series of 38−41 day segments initialized using the first 10 days for spin-up of the hydrologic cycle and planetary boundary layer structure. Simulations using short-term mode driven by ERA-Interim with NoahMP and Noah are selected for benchmark experiments. The results show that Polar WRF 4.1.1 has good forecast skill over the Antarctic and Southern Ocean and better performance than earlier versions. The reduced downward shortwave radiation bias due to boundary layer cloud prediction in MYNN PBL scheme (first released with WRF 4.1.1) performed well with PWRF411. Although NoahMP and Noah led to very similar conclusions, NoahMP is slightly better than Noah, particularly for the 2 m temperature and surface radiation because the minimum albedo is set at 0.8 over the ice sheet. Moreover, a suitable nudging setting plays an important role in long-term forecasts, such as reducing the surface temperature diurnal cycle bias near the coast. The characteristics investigated in this study provide a benchmark to improve the model and guidance for further applications of Polar WRF in the Antarctic.