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Evaluation of Polar WRF from Modeling the Atmospheric Boundary Layer over Antarctic Sea Ice in Autumn and Winter

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Adequately validated regional simulations of the atmospheric boundary layer over Antarctic sea ice are rare. To address this gap, the doubly nested Polar Weather Research and Forecasting (Polar WRF) mesoscale model was used to simulate the data collected at the Ice Station Weddell (ISW) during the austral autumn and winter of 1992. The WRF simulations tested two boundary-layer schemes: Mellor-Yamada-Janjic and the Asymmetric Convective Model. Validation is against surface-layer and sounding observations from ISW. Simulated latent and sensible heat fluxes for both boundary layer schemes had poor correlation with the observed fluxes. Simulated surface temperature had better correlation with the observations, with a typical bias of 0 to 2 K and a root-mean-square error of 6-7 K. For surface temperature and wind speed, the Polar WRF yielded better results than the ERA-Interim reanalysis. A more challenging test of the simulations is to reproduce features of the low-level jet and the temperature inversion, which were observed, respectively, in 80% and 96% of the ISW radiosoundings. Both boundary layer schemes produce only about half as many jets as were observed. Moreover, only about 30% of the time did the simulated jet coincide with the observed one. The number of temperature inversions and the height at the inversion base were better reproduced, although this was not the case with the depth of the inversion layer. Simulations of the temperature inversion improved when forecasts of cloud fraction agreed to within 0.3 with observations. The modeled inversions were strongest when the incoming longwave radiation was smallest, but this relationship was not observed at ISW.