3.5 Antarctic clouds simulated by Polar WRF and AMPS.

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The polar-optimized version of the Weather Research and Forecasting Model (Polar WRF) is used for both real-time forecasting for Antarctic operations and research applications by international users through the Antarctic Mesoscale Prediction System (AMPS). Accurate simulations of cloud cover are critical for aviation safety in this extreme environment. Yet, observational and modeling studies of clouds are relatively rare for the pristine Antarctic region. In contrast, multiple studies have detailed how WRF microphysics schemes represent the complicated Arctic clouds, including mixed-phase clouds. How well our understanding of Arctic clouds can translate to Antarctic region still is not well known, so new Antarctic studies are needed. The recent ARM West Antarctic Radiation Experiment (AWARE) provides an opportunity to evaluate Polar WRF with unprecedented observations of Antarctic clouds, radiation and surface energy balance. The primary AWARE site is McMurdo, the main U.S. research station in Antarctica, where observations were taken from late 2015 to early 2017. A secondary site of observations is West Antarctic Ice Sheet (WAIS) Divide camp during December 2015 and January 2016. An unusually strong West Antarctic melting event occurred during January 2016, and was captured by the AWARE observations.

We have evaluated the representation of Antarctic clouds by AMPS for the WAIS Divide site against AWARE observations during the austral summer, and are conducting new Polar WRF 3.9.1 simulations to test the capability of advanced microphysics schemes for the Antarctic environment. Observations show that cloud water can exist at low temperatures over Antarctica. The evaluation has shown that AMPS with WRF single-moment five-class microphysics scheme underestimates liquid water within clouds for WAIS Divide. The slow spin-up of liquid water clouds may be a contributing factor. Other microphysics schemes, including the Morrison 2-moment scheme, the Thompson-Eidhammer aerosol-aware scheme, and the new Morrison-Milbrandt P3 scheme, show promise in better representing the cloud water of Antarctic clouds.

The results of the Polar WRF simulations for AWARE can be used to suggest improvements to the AMPS forecasting system. The Polar WRF evaluations will be expanded to cover the more extensive observations at McMurdo.