Microphysics of Summer Clouds in Central West Antarctica Simulated by Polar WRF and AMPS

Keith M. Hines, David H. Bromwich, Sheng-Hung Wang, Israel Silber, Johannes Verlinde, Dan Lubin

The Ohio State University

The Atmospheric Radiation Measurement (ARM) West Antarctic Radiation Experiment (AWARE) provided a highly detailed set of remote sensing and surface observations to study Antarctic clouds and surface energy balance, which have received much less attention than for the Arctic due to greater logistical challenges. Limited prior Antarctic cloud observations has slowed the progress of numerical weather prediction in this region. The AWARE observations from WAIS Divide during December 2015 and January 2016 are used to evaluate the operational forecasts of the Antarctic Mesoscale Prediction System (AMPS) and new simulations with Polar WRF 3.9.1. The Polar WRF 3.9.1 simulations are conducted with advanced microphysics schemes and with the WRF single-moment 5-class microphysics (WSM5C) also used by AMPS. AMPS simulates few liquid clouds during summer at WAIS Divide, inconsistent with observations of frequent low-level liquid clouds. Polar WRF 3.9.1 simulations show that this result is a consequence of WSM5C. More advanced microphysics schemes simulate more cloud liquid water and produce stronger cloud radiative forcing, resulting in downward longwave and shortwave radiation at the surface more in agreement with observations. Similarly, increased cloud fraction is simulated with the more advanced microphysics schemes. All of the simulations, however, produce smaller net cloud fractions than observed. Ice water paths vary less between the simulations than liquid water paths. The colder and drier atmosphere driven by GFS initial and boundary conditions for AMPS forecasts produces lesser cloud amounts than the Polar WRF 3.9.1 simulations driven by ERA-Interim.