Polar WRF Modeling of a May 2022 Atmospheric River Impact on the Antarctic Peninsula

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As part of the Southern Hemisphere component to the international Year of Polar Prediction (YOPP-SH), a modeling and observational study aims to improve Antarctic weather forecasting. A particular emphasis here is the simulation of relatively warm clouds for coastal Antarctica. Thus, Polar WRF simulations are run for a Targeted Observing Period (TOP) during May 2022 that includes an atmospheric river strike resulting in significant precipitation over the Antarctic Peninsula (AP) during 10-12 May. Enhanced observations are available for the TOP, including for the AP stations Rothera, Vernadsky, and Escudero. A surprise finding during the SOP is the intrusion of stratospheric air into the middle troposphere behind the frontal system of the atmospheric river. Correspondingly, observations and modeling show a dry zone adjacent to the deep layer of frontal clouds and precipitation. As Antarctica is a pristine environment where cloud-forming aerosols for ice and liquid are less abundant than elsewhere, Polar WRF simulations are run with three microphysics configurations: (1) the wide-used Morrison microphysics scheme with an adjustment for the reduced ice-forming aerosols, (2) the Thompson-Eidhammer aerosol-aware (TE) microphysics scheme with initial and boundary cloud-forming aerosol settings from global GOCART chemistry simulations, (3) TE with ice-friendly aerosols reduced to match a formula based upon observations of pristine conditions over the Southern Ocean. The simulations show a strong atmospheric river forming over the ocean to the west of the AP. The synoptic system then is modified by the orography of the AP. Model results are compared to station observations to discern how well the microphysics representations are able to simulate clouds near the AP.