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Modelling the impact of cloud condensation and ice nuclei on the near-surface climate of Dronning Maud Land (East Antarctic) using the regional climate model COSMO-CLM²

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By serving as condensation and ice nuclei, aerosols play a vital role in the formation of clouds. This has significant implications for the radiation balance and precipitation amounts over the Antarctic Ice Sheet, where type and amount of aerosols differ significantly from other places because of its remote location. However, that is also the reason observations are sparse, and consequently, few studies exist examining this effect. Recently, a module was added to the COSMO-CLM² regional climate model to account for the aerosol-cycle. The model was integrated for the region around the Princess Elisabeth Antarctic research station (PEA) in Dronning Maud Land for a period of 10 days in January 2016, of which the first 3 days were discarded. Varying cloud condensation and ice nuclei were prescribed to the model, based on observations from PEA. The model output was compared to observations of cloud structure and precipitation amounts taken at PEA, as well as the unmodified COSMO-CLM² model. The model integrations indicate that the number of ice nuclei has a significant impact on the microphysical composition of clouds, with higher numbers being associated with a lower amount of liquid water content of clouds and higher precipitation amounts. Additional runs are performed to confirm and extend these findings for an entire year. Recent measurements of ice nuclei particle concentrations obtained during two austral summers are also considered. Moreover, we analysed how atmospheric dynamics affect the cloud-aerosol interaction by analysing the model sensitivity for different weather regimes.