Impacts of Atmospheric Rivers on Sea-Ice and Snow Thickness at a Coastal Site in East Antarctica

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Abstract

Antarctic sea ice and its snow cover play a pivotal role in regulating the global climate system. Understanding the intricate interplay between atmospheric dynamics, ocean circulation and mixed-layer properties, and sea ice is essential for predicting future climate change scenarios. This study investigates the relationship between atmospheric conditions and sea-ice and snow characteristics at a coastal East Antarctic site using *in situ* measurements from the winter-spring of 2022. Congruent with previous studies, the observed sea-ice thickness (SIT) follows the seasonal solar cycle with only minor deviations, while the snow thickness variability corresponds closely to cyclonic atmospheric forcing, with significant contributions from katabatic flows and atmospheric rivers (ARs). The *in-situ* measurements highlight the substantial effects of warm and moist air intrusions on the sea-ice, snow and atmospheric state. A high-resolution simulation with the Polar Weather Research and Forecasting model for the 14 November AR highlights the effects of the katabatic winds in slowing down the low-latitude air masses as they approach the Antarctica coastline, with the resulting low-level convergence leading to precipitation rates above 3 mm hr-1. Including the observed sea-ice extent and a realistic SIT in the model does not yield more skillful predictions of surface/near-surface variables and atmospheric profiles. This suggests other factors such as boundary-layer dynamics and/or land/ice processes may play a more important role than sea-ice concentration and thickness during AR events. Our findings contribute to a better understanding of the complex interactions within the Antarctic system, providing valuable insights for climate modeling and future predictions.

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