Examining Atmospheric River Dynamics and Their Influence on Ice-shelf Surface Processes, East Antarctica

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Abstract

Atmospheric Rivers (ARs) are long, narrow bands of intense vertically integrated water vapour transport (vIVT), typically forming within the warm sector of extratropical cyclones. Favourable mesoscale synoptic conditions can steer ARs to the Antarctic coastline, delivering intrusions of sub-tropical warm, moist marine air together with high wind speeds and strong radiative forcing. Thus, ARs are associated with anomalously high surface temperatures, precipitation, and surface melt. Although ARs make landfall in Antarctica relatively infrequently (_˜3 days yr-1 on average at any given location along the coastline), they can be a key driver of local and regional surface mass balance variability. However, the surface impacts of Antarctic AR events exhibit regional and inter-event variability, and, to date, the reasons for this are unclear. This study uses an ensemble of SAR imagery, a polar-specific AR detection tool, and a regional climate model forced with atmospheric reanalysis data, to examine AR dynamics and their influence on ice-shelf surface energy balance (SEB) and surface melt. For a case study ice shelf in Dronning Maud Land, East Antarctica, this study analyses modelled daily vIVT and SEB components in combination with satellite observations of the ice-shelf surface prior to, during, and following a series of AR landfall events. In doing so, it aims to elucidate the variability of AR-induced impacts on ice-shelf SEB and, in turn, on surface melt. The study seeks to offer possible explanations for the regional, local, and inter-event variability of AR surface impacts, and therefore contribute towards a better understanding of the role of ARs within East Antarctic surface mass balance and ice-shelf (in)stability.

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