Understanding teleconnections important for atmospheric rivers in future climates

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Abstract

Atmospheric rivers (ARs) impacting the Antarctic continent typically transport both heat and moisture sourced from lower latitudes. They are both dynamically and thermodynamically driven, and are fundamentally connected to Southern Hemisphere storm tracks and teleconnection patterns. Although only a few ARs actually reach past the coastal regimes and onto the ice sheets each year, they hold an outsized impact to the local hydroclimate by producing either local melt events, or significant snow accumulations, depending on their thermal characteristics. Teleconnection patterns can be used to diagnose AR timing, placement, and impacts to ice shelves and ice sheets, therefore, shifts to these patterns matter for the regional climatology.
Here, we present analysis based on large ensembles simulations of historical and future climate scenarios from two different Earth System models (Community Earth System Model, Version 2, CESM2, and Energy Exascale Earth System Model, version 2, E3SMv2) to diagnose future AR pathways driven by various teleconnection patterns. We focus on modes of variability that have been shown to hold importance for Southern Hemisphere variability in both models and observations, including the PSA2 (Pacific South American Mode 2) and the IOD (Indian Ocean Dipole), with and without ENSO (El Nino Southern Oscillation). Under climate change, both models consistently simulate a decrease in AR activity over the Southern hemisphere storm track, however they differ in hotspots locations on the continent itself, thus adding uncertainty to projections.

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