Climatology of Heatwaves and Their Connection to Atmospheric Rivers in Patagonia and Implications for the Northern Antarctic Peninsula

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Abstract

The Patagonian Icefields are major contributors to global sea level rise. In recent decades, these ice masses have experienced significant retreat and thinning, primarily driven by global warming. Additionally, extreme weather events, such as heatwaves, may have intensified their surface melting. When associated with Atmospheric Rivers (ARs), these warming events could also impact the northern Antarctic Peninsula (AP), where these synoptic patterns may trigger warm air temperatures and extreme precipitation events.

In this study, we identified heatwaves between 1980 and 2020 using daily temperature observations from eight climatological stations obtained from the PatagoniaMet dataset, along with high-resolution (5 km) daily outputs from the Modèle Atmosphérique Régional (MAR) forced every 6 hours by the ERA5 reanalysis over 1940-2023. Heatwave events are defined using the 90th daily percentile threshold and a minimum duration of three consecutive days. We analyzed the frequency of heatwave days associated with ARs using a new catalog that incorporates latent heat transport analysis for the same period. Preliminary results show a maximum of 521 heatwave days at station Bariloche Aero and a minimum of 259 days at station El Tepual Puerto Montt during the whole period. Between 1988 and 2016, all observational stations exhibited a similar pattern of heatwaves, with an annual total exceeding 13 day events per year. Using MAR data for the nearest grid stations, we observed that heatwave events increase by an average of 56%. Based on observed identification, for the eight stations a total of 401 heatwave days were associated with ARs.

Although this analysis focuses on Patagonia, ongoing studies suggest potential teleconnections with the northern AP. Atmospheric rivers influencing Patagonia may simultaneously trigger rain-on-snow events and warm anomalies in the AP, driven by shared anticyclonic systems. Understanding these inter-latitudinal links is crucial to assess how AR-triggered heatwaves and extreme weather synchronously impact glacier mass balance in both regions.

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