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CL2.12 Exploiting Polar Observations to Improve Weather and Climate Predictions
OR
AS2.9 Polar meteorology and climatology and their link to changes in the cryosphere

The vertical structure of atmospheric rivers and their impact in the Atlantic sector of Antarctica from the Year of Polar Prediction observations

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The Year of Polar Prediction in the Southern Hemisphere (YOPP-SH) had a special observing period (SOP) from November 16, 2018 to February 15, 2019 showing the greatest observational activity during austral summer in the Antarctic. More than 2000 additional radiosondes were launched during this 3-month period, roughly doubling the routine program. Further, several YOPP-endorsed projects contributed to enhanced data collection on various atmospheric and oceanic properties, including CAALC project at King George Island (Antarctic Peninsula) and DACAPO-PESO in Punta Arenas (Sub-Antarctic Chile). Here we use the YOPP-SH-SOP observations to investigate the vertical structure of the atmospheric rivers (ARs), along with their impact on cloud properties, radiative budget, and precipitation in the Atlantic sector of the Antarctic ice sheet, including sub-Antarctic Chile, Antarctic Peninsula and Dronning Maud Land (DML) coastal areas. ARs can transport anomalous heat and moisture from subtropical regions to the Antarctic, with important impacts on Antarctic surface mass balance. On the Antarctic Peninsula, the surface mass balance can be especially sensitive to the AR events during summer, when surface temperatures vary around zero and frequent transitions occur between snow and rainfall. The importance of the ARs for the coastal DML is more linked to extreme snowfall events also during summer, and such events have resulted in anomalously high snow accumulation in DML in the recent years.

We will present case studies that demonstrate how combining extensive ground-based observations and radiosoundings from stations in the sub-Antarctic and Antarctica allow for detailed characterization of the temporal evolution of AR events. Analysis of the observations and model sensitivity studies with additional radiosonde assimilation show the influence of the ARs on Antarctic atmospheric and cloud properties and surface precipitation, as well as the challenges in correctly forecasting conditions during such events. Further, we use SOP enhanced radiosonde programs at Neumayer and Syowa stations to investigate the AR signatures in the atmospheric vertical profiles in the DML coastal areas. The AR events observed during YOPP-SH are put in the context of the longer-term radiosonde observations using 10-year of the Integrated Global Radiosonde Archive (IGRA) Version 2 data. Increased frequency of radiosonde observations during YOPP showed an important contribution of these rare events to the moisture transport towards Antarctica.