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Atmospheric rivers landfalling at the Antarctic Peninsula: the Year of Polar Prediction summer special observing period measurements for model and forecast improvement

Irina Gorodetskaya[1], Penny Rowe[2], Heike Kalesse[3], Patric Seifert[4], Sang-Jong Park[5], Yonghan Choi[5], and Raul Cordero[6]

[1]University of Aveiro, Centre for Environmental and Marine Studies (CESAM), Department of Physics, Aveiro, Portugal (irina.gorodetskaya@ua.pt)

[2]NorthWest Research Associates, Redmond, WA, USA

[3]Institute for Meteorology, University of Leipzig, Germany

[4]Leibniz Institute for Tropospheric Research (TROPOS), Leipzig, Germany

[5]Korea Polar Research Institute, Korea

[6]University of Santiago, Santiago, Chile

During the last several decades, the Antarctic Peninsula (AP) has shown a much stronger warming trend compared to the rest of the ice sheet and other land areas in the Southern Hemisphere (Jones et al, 2019). Recent studies have also highlighted that the AP has experienced both an increase in precipitation and in surface melt. Atmospheric rivers (ARs) – long corridors of intense moisture transport from subtropical and mid-latitude regions poleward - are known for prominent role in moisture transport (Gorodetskaya et al, 2020) and intense precipitation in Antarctica (Gorodetskaya et al 2014). At the same time, ARs have been also associated with major surface melt events at the AP and adjacent ice shelves (Wille et al 2019). In this study, we explore the double role of ARs, as carriers of both heat and moisture, in their impacts on precipitation (rain and snow), cloud radiative forcing and air temperature at the AP. Observations from the Year of Polar Prediction (YOPP, Bromwich et al 2020) endorsed sites/projects are used: Escudero station (the Characterization of the Antarctic Atmosphere and Low Clouds, or CAALC project) and King Sejong station (South Korean Antarctic Program projects) on King George Island, as well as Punta Arenas (southern Chile; the Dynamics, Aerosol, Cloud, And Precipitation Observations in the Pristine Environment of the Southern Ocean, or DACAPO-PESO project). These projects employed a set of ground-based remote sensing instrumentation for water vapor, cloud and precipitation observations, as well as frequent radiosonde launches during the YOPP Special Observing Period in austral summer 2018/2019. We present case studies characterizing the temporal evolution of ARs, focusing on thermodynamic and dynamic conditions accompanying the transition between snowfall and rain. Further, we demonstrate the added value of assimilating more frequent radiosonde observations in improving the forecast of weather conditions during ARs using the Polar-WRF model, including wind and precipitation prediction, which have important consequences for air, ship and station operations in Antarctica.

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