The Northern Antarctic Peninsula – A Suitable Site for Isotope-Based Studies of Antarctic Atmospheric Rivers?

Kirstin Hoffmann-Abdi* , Hanno Meyer[1], and Francisco Fernandoy[2]

[1]Alfred Wegener Institute [Potsdam] – Germany
[2]Universidad Andrés Bello [Viña del Mar] – Chile

Abstract

The northern Antarctic Peninsula has experienced several extreme warm air events triggered by atmospheric rivers in recent years. However, little is known about how these events are recorded in the Antarctic Peninsula ice cap. Here, we present the results of an isotope-geochemical analysis of a 20 m long firn core retrieved in 2016 from Plateau Laclavere, located at the northernmost tip of the Antarctic Peninsula. This site is characterized by a strongly maritime climate with high annual snow accumulation (_˜2500 kg m-2 a-1) and surface melt, particularly during summer. On the one hand, these characteristics make Plateau Laclavere a challenging site for firn- and ice-core-based climate studies, as stable water isotopes exhibit high intra-annual variability that obscures the seasonal cycle. On the other hand, the high annual snow accumulation allows for excellent signal preservation at the subseasonal scale due to reduced post-depositional processes. Annual layer counting based on hydrogen peroxide revealed that the firn core covers the period 2012-2015, with a dating uncertainty of ±2 months. Although the record is short, it includes the exceptional warm air event caused by an atmospheric river in March 2015. In the stable water isotope composition and stratigraphy of the firn core, we identified several indications that this event was recorded in the snowpack on Plateau Laclavere. At the time of the warm air event, δ18O values reached their absolute maximum (–7.0 ‰) for the period 2012-2015, while d-excess values dropped to their absolute minimum (1.4 ‰), likely reflecting a high-humidity moisture source (South Pacific Ocean). Concurrently, two thick melt layers (21 mm, 39 mm) appear in the firn core stratigraphy, potentially corresponding to the intense surface melt that was triggered by the atmospheric river across the northern Antarctic Peninsula. However, to test whether such isotopic and stratigraphic features can indeed serve as direct indicators of Antarctic atmospheric rivers, additional firn cores from the northern Antarctic Peninsula covering more recent atmospheric river-induced warm air events, such as the one in 2022, are needed.

*Speaker