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Water vapor isotopic signature along the EAIIST traverse (East Antarctica Plateau)

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Stable water isotopes are effective hydrological tracers due to fractionation processes throughout the water cycle, and thus, the stable isotopes from ice cores can serve as valuable proxies for past changes in the climate and local environment of polar regions. Proper interpretation of these isotopes requires to understand the influence of each potential fractionating process, such as initial evaporation over the ocean and precipitation events, but also the effects of post-depositional exchange between snow and moisture in the atmosphere. Thanks to new developments in infrared spectroscopy, it is now possible to continuously monitor the isotopic composition of atmospheric water vapor in coordination with discrete snow sampling. This allows us to readily document the isotopic and mass exchanges between snow and vapor as well as the stability of the atmospheric boundary layer, as has recently been shown on the East Antarctic Plateau at Kohnen (Ritter et al., TC, 2016) and Dome C (Casado et al., ACP, 2016) stations where substantial diurnal isotopic variations have been recorded.

In this study, we present the first vapor monitoring of an East Antarctic transect that covered more than 3600 km over a period of 3 months from November 2019 to February 2020 as part of the EAIIST mission. The isotopic record therefore describes the evolution from typical coastal values to highly depleted values deep inside the continent on the high-altitude plateau. In parallel, we also monitored the vapor isotopic composition at two stations: the coastal starting point of Dumont D'Urville (DDU) and the plateau halfway point of Dome C. Two automatic weather stations (at Paleo and Megadunes sites) were also installed in a previously unexplored region of the East Antarctic plateau that was covered by this transect. This suite of cross-calibrated vapor isotope observations and weather stations, coupled with Modele Atmospherique Régional (MAR) climate modeling, offers a unique opportunity to compare the spatial and temporal gradients of humidity, temperature, and water vapor isotopic composition in East Antarctica during the summer season, and to estimate how the water vapour isotope measurements at Dome C and DDU are representative of the conditions in East Antarctica. The quantitative agreement between the EAIIST record and those recorded at DDU and Dome C stations at the times the raid was nearby, gives

confidence in the quality of the results acquired on this traverse. Although further comparisons with the surface snow isotopic composition are required to quantify the impact of the snow-atmosphere exchanges on the local surface mass balance, these initial results of vapor isotopic composition show the potential of using water stables isotopes to evaluate hydrological processes in East Antarctica and better reconstruct past climate changes through ice cores.