Spatial variability in isotopic composition of surface snow along the East Antarctic International Ice Sheet Traverse (EAIIST)

Agnese Petteni[1], Barbara Stenni[1], Giuliano Dreossi[1,2], Ilaria Crotti[1], Mathieu Casado[5], Amaelle Landais[5], Joel Savarino[3], Andrea Spolaor[2], Arianna Caneva[1], Massimo Frezzotti[4] and Barbara Delmonte[6]

1. Ca' Foscari University of Venice, Department of Environmental Sciences, Informatics and Statistics, Venice, Italy;
2. Institute of Polar Sciences, National Research Council of Italy, Venice, Italy;
3. IGE, Grenoble, France;
4. Roma Tre University, Department of Science, Rome, Italy;
5. LSCE/IPSL, CEA-CNRS-UVSQ, Université Paris-Saclay, Gif-sur-Yvette, France;
6. University of Milano-Bicocca, Department of Earth and Environmental Sciences Milan, Italy

INTRODUCTION

The isotopic composition ($\delta^{18}O$ and δD) of snow precipitations is an important proxy of climatic conditions. This signal depends on several parameters and, in regions where the snow accumulation in very low, it may be affected by spatial variability induced by post-depositional processes. Restoring the original signal, when possible, is essential to improve paleoclimatic reconstructions through ice core science.

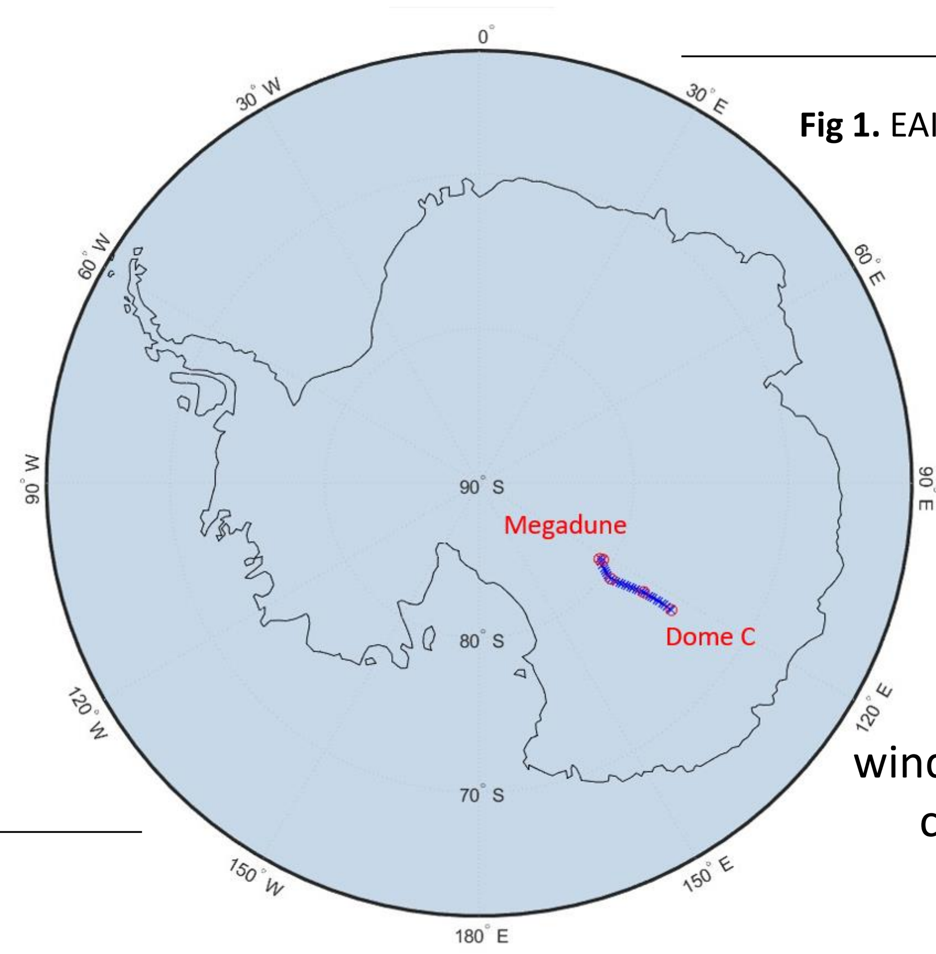

Fig 1. EAIIST traverse

AREA OF STUDY

The EAIIST traverse took place during the summer 2019-2020 in an un-explored region from Concordia Station (DC) towards the South Pole (Fig 1).

Along the traverse, areas with homogeneous accumulation rates can be compared to areas influenced by wind scouring and mega-dunes formation (MD). Extremely low accumulation and wind-surface snow interaction observed in these areas could be representative of glacial period conditions on the Antarctic Plateau.

RESULTS

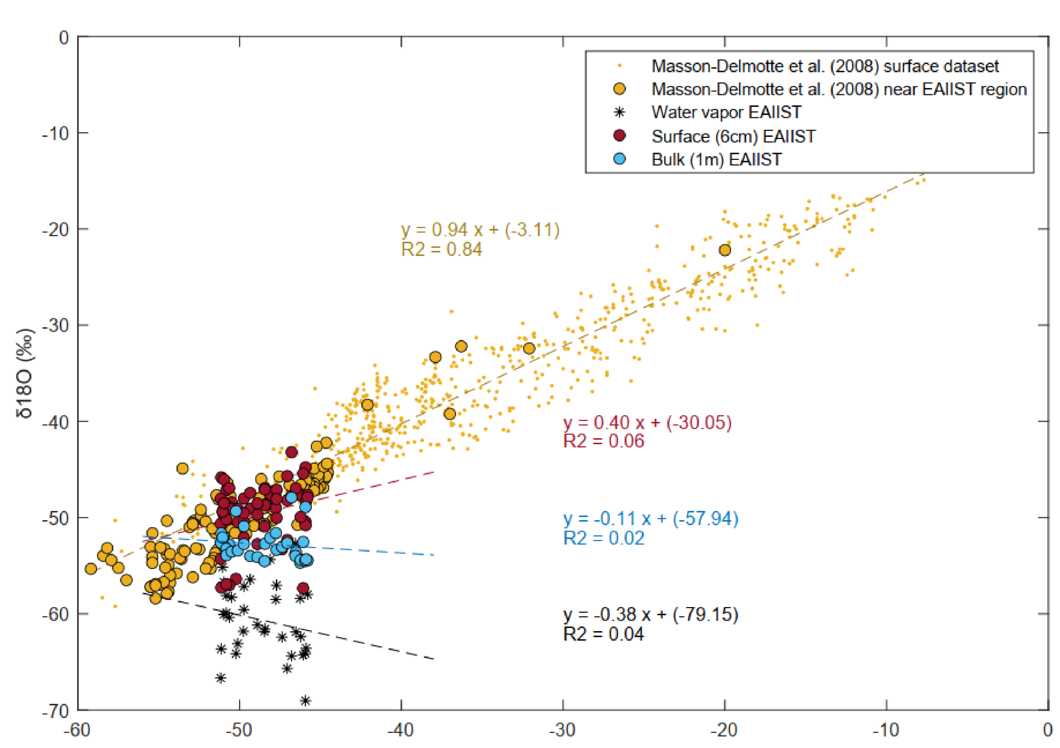

Fig 2. $\delta^{18}O$/T relationship for surface, bulk samples and water vapor along the EAIIST, compared with the all surface dataset of Masson-Delmotte et al. (2008). T2m (°C) from ERA5 reanalysis data (mean 1980-2020)

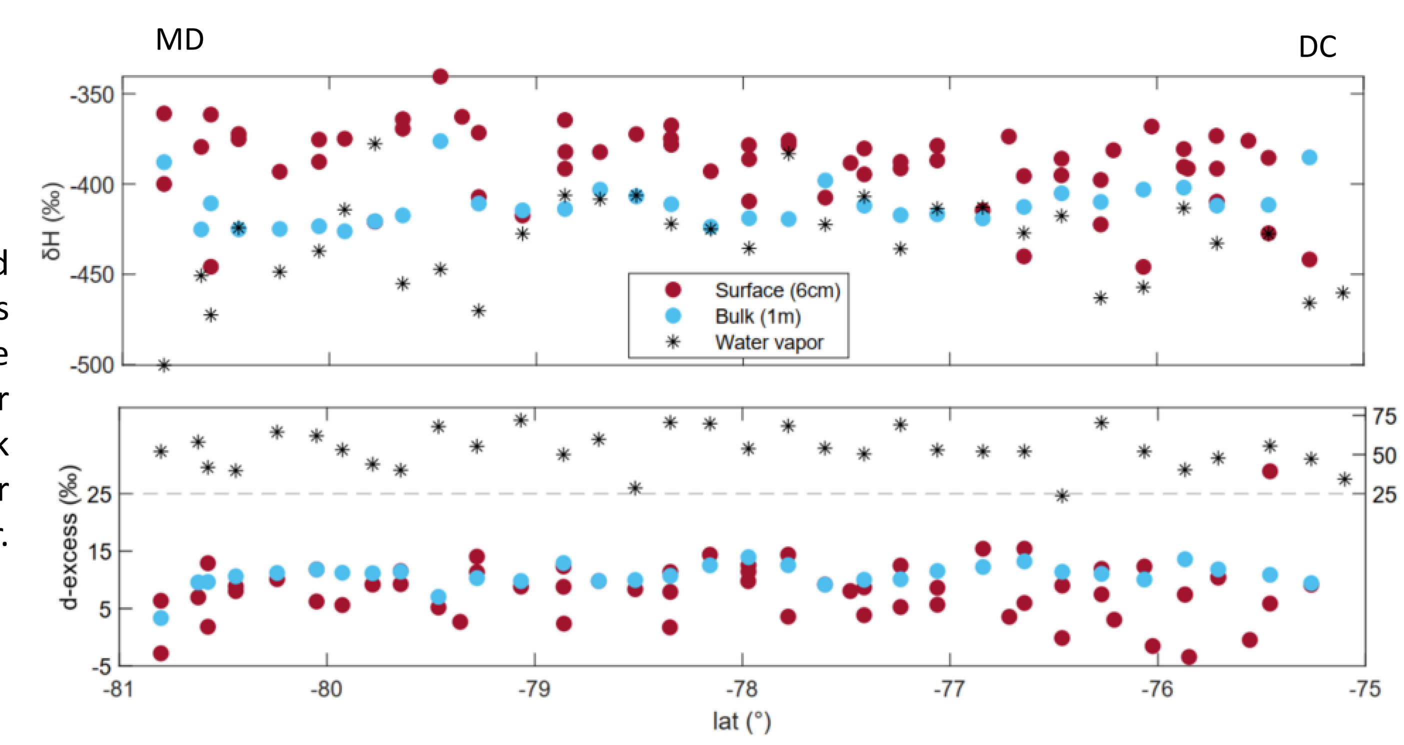

Fig 3. δD and d-excess along the traverse for surface, bulk and water vapor.

The **isotope signal** ($\delta^{18}O$ and δD) of **surface snow** (6cm), **bulk samples** (1m) and **water vapor** show an unexpected **no-correlation** with **surface temperature** (Fig. 2). The same low correlation is also observed for other parameters, such as altitude, latitude (Fig. 3) and distance from the coast. This suggests that other factors play an important role influencing the isotope composition of the snow precipitations along the traverse, as the different moist air origins.

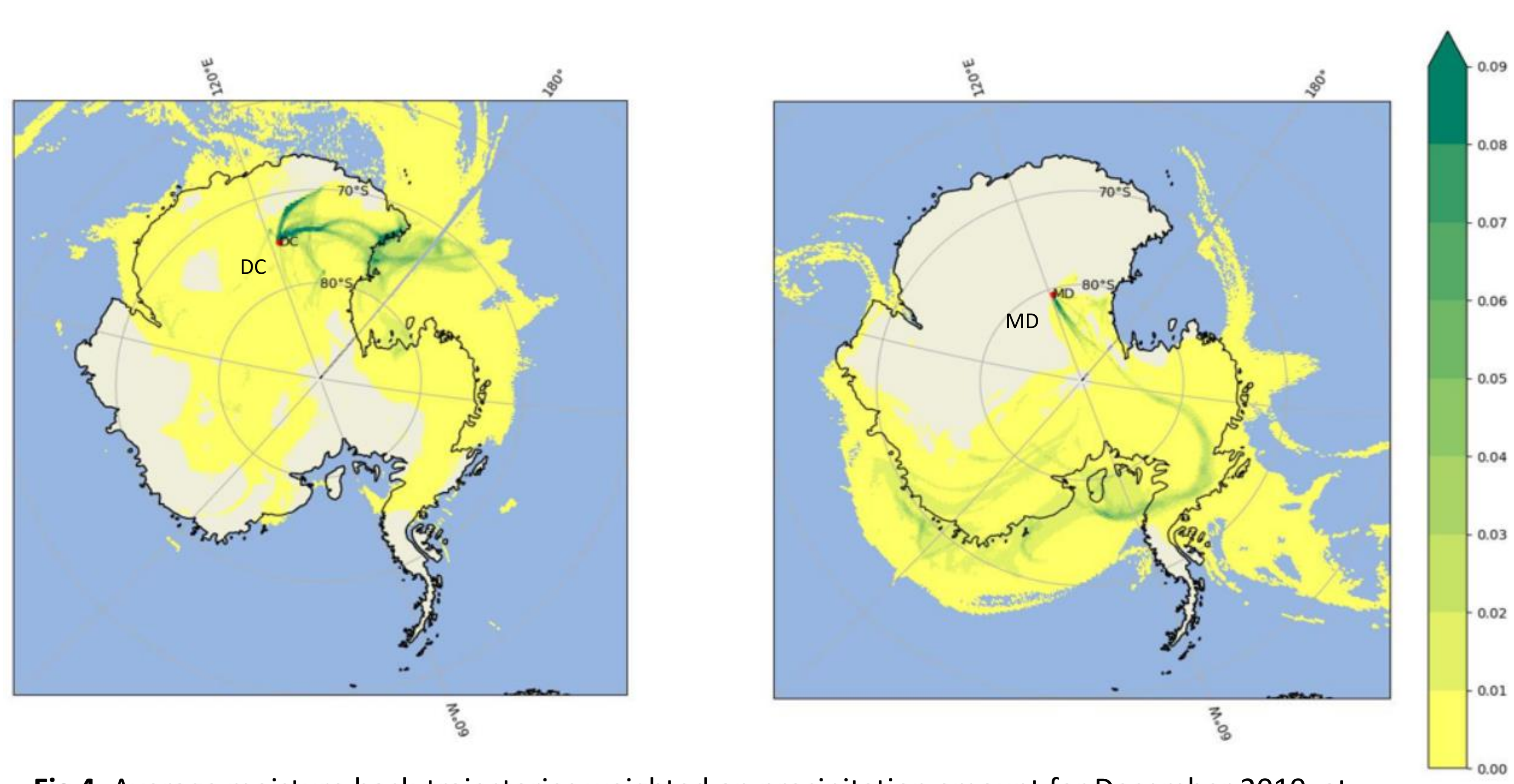

Fig 4. Average moisture back-trajectories weighted on precipitation amount for December 2019, at Dome C (left) and Megadune area (right). The color bar refers to particle density of the air masses.

In December 2019 (while the traverse was running) the difference between the **origins of the air mass pathway** at Dome C and Megadune is evident (Fig.4).

For the period January 2019 - January 2020 it is possible to define that:

- DC is more influenced by moist air masses arriving from the Indian Ocean;
- while MD is more influenced by the Atlantic and Pacific sector.

Moreover, comparing surface samples during the traverse with the back way (Fig. 5), it is evident that, in absence of significant precipitation events, a decrease in d-excess is present indicating **sublimation effects**.

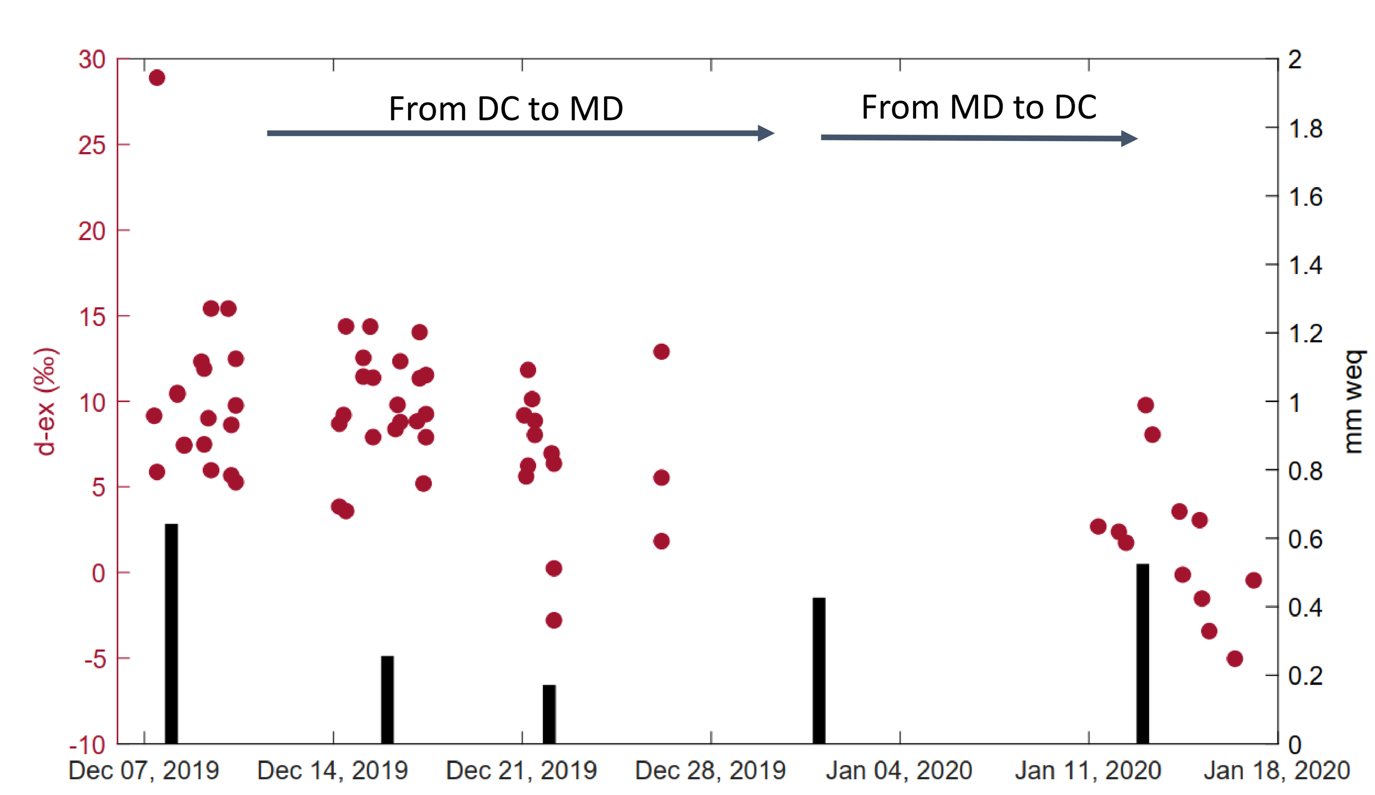

Fig 5. In red the d-excess values of surface samples collected during the traverse from Concordia to Megadune and back, in time. In black the amount (in mm water equivalent) of the main snow precipitation events.

FUTURE PRESPECTIVE

Implementing the dataset with further surface samples, collected between Durmond D'Urville to Megadune:

- Quantifying the influence of climatic factors and geographic features on isotopic signal
- Determine if sublimation processes strongly affect the final isotopic composition of the snow