The DATETRENCH project has been able to successfully date a snow trench obtained at Dome C, in central Antarctica.

In 2019, a team from the Alfred Wegener Institute (Germany), the Institut des Géosciences de l'Environnement (IGE) and the Laboratoire des Sciences du Climat et de l'Environnement (LSCE) recovered a two-meter deep snow trench in Antarctica in order to study local variability in the isotopic signal. Thanks to the support of the Antarctic Science Bursary, we have been able to measure the chemical composition of the snow samples. Indeed, the sulfate, as well as the MSA exhibit variability which is not erased inside the snowpack and can be used to find snow layer deposited at the same time. This dataset was used to align and to date the snow profiles. Overall, it was possible to ascertain that the 35 snow profiles are covering 20 years of snow accumulation.

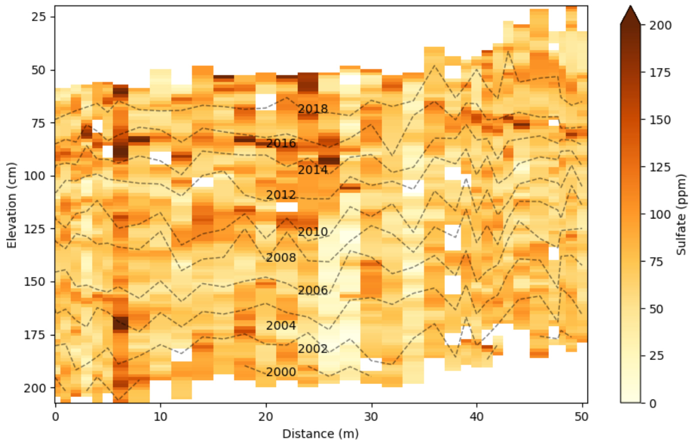

Figure 1: Sulfate content in the trench. with dated sulfate

The data, being analysed in the framework of the PhD thesis of Adrien Ooms at LSCE, has shown that snow accumulation presents high spatial variability at the scale of a few meters. This is due to the strong influence of meter to decameter scale topography on snow deposition, which exhibits small scale height variations (roughness) of the same order as annual accumulation rates at Dome C. We showed that this accumulation pattern is indeed imprinted in the snowpack, consistently with direct observations of accumulation at the surface. A particularly noteworthy feature is a presence of a dune continuously visible over the 20 years at the same location.

Accumulation rates in Antarctica have been the subject of extensive research in the recent years in an effort to better assess changes in surface mass balance of the Antarctic ice-shelf, in particular in the last decades under the influence of climate change. In this context, our trench study offers an innovative way of assessing accumulation rates, which works retrospectively and gives a diagnostic directly inside the snow-pack.

The patchiness of the accumulation also has important consequences for climate reconstruction from ice core records. Indeed, our results show that a significant redistribution is mixing the snow, or even often removing snow layers, with one in five profiles including a hiatus in snow accumulation of more than a year. Furthermore, snow that remains exposed to the surface for a longer time will have more exchanges with the atmosphere before being buried. These uneven post depositional fluxes add a non-climatic signal with an important spatial variability into the isotopic record. This way, two profiles sampled a few meters apart might produce very different isotopic series at multi-annual resolution, which poses a problem for climatic interpretation. Our description of how accumulation dynamics are being recorded in the snowpack helps to better understand how the isotopic signal is being affected. By comparing profiles across the trench, this will let us evaluate how much of the isotopic signal can be linked to the climatic signal. Indeed, we are able to show that the trench isotopic composition is significantly different than the surface snow isotopic composition, indicating that during the archiving of the snow, exchanges with the atmosphere are modifying the snow isotopic composition. These results will be included to upcoming scientific publications.

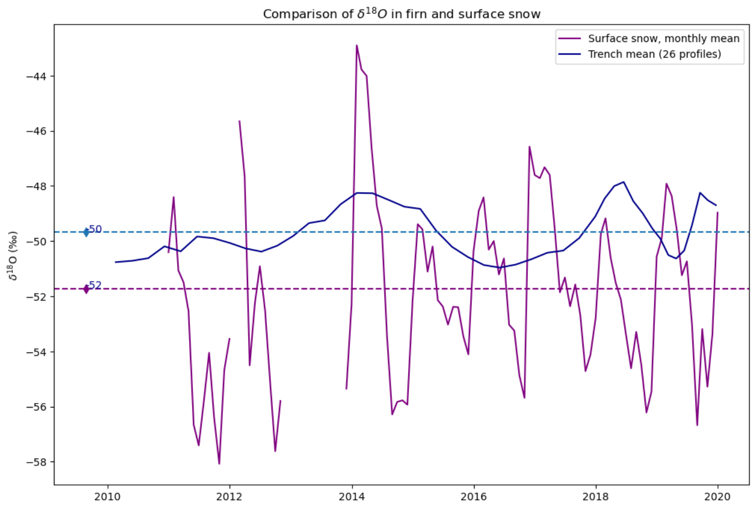

Figure 2: Isotopic d18O timeseries in the dated trench compared to surface snow