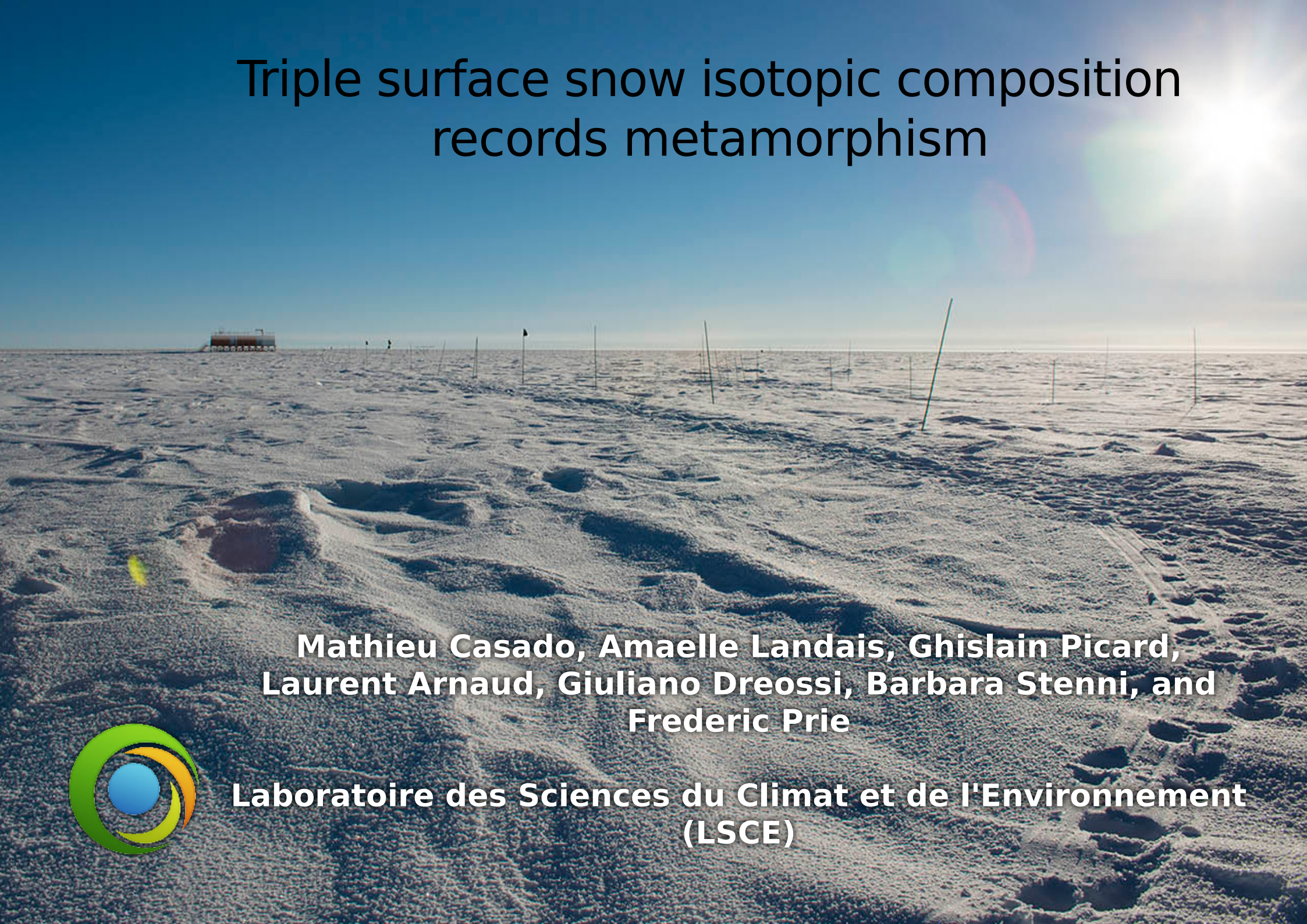
Triple surface snow isotopic composition records metamorphism



Mathieu Casado, Amaelle Landais, Ghislain Picard, Laurent Arnaud, Giuliano Dreossi, Barbara Stenni, and Frederic Prie

Laboratoire des Sciences du Climat et de l'Environnement (LSCE)

Ice is a natural archive

Inside a snow pit, the ice layering is visible.

Ice is a natural archive

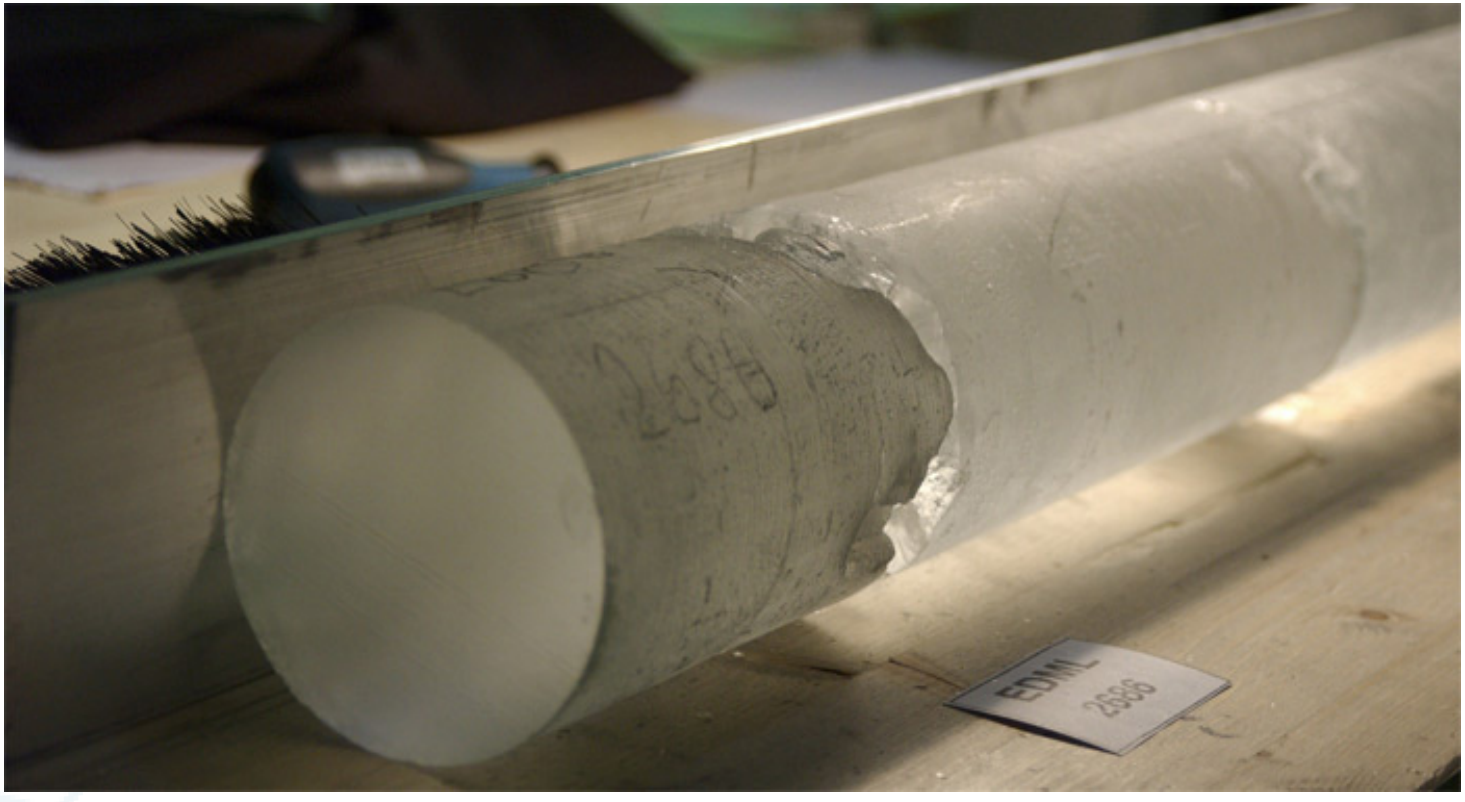
In ice cores, past climatic conditions are stored for thousands of years through:

Ice isotopic composition

Gas in the air bubbles trapped inside the ice (CO_2, CH_4, O_2, Ar, Kr...)

Dust and ashes

Or even, the borehole temperature directly.

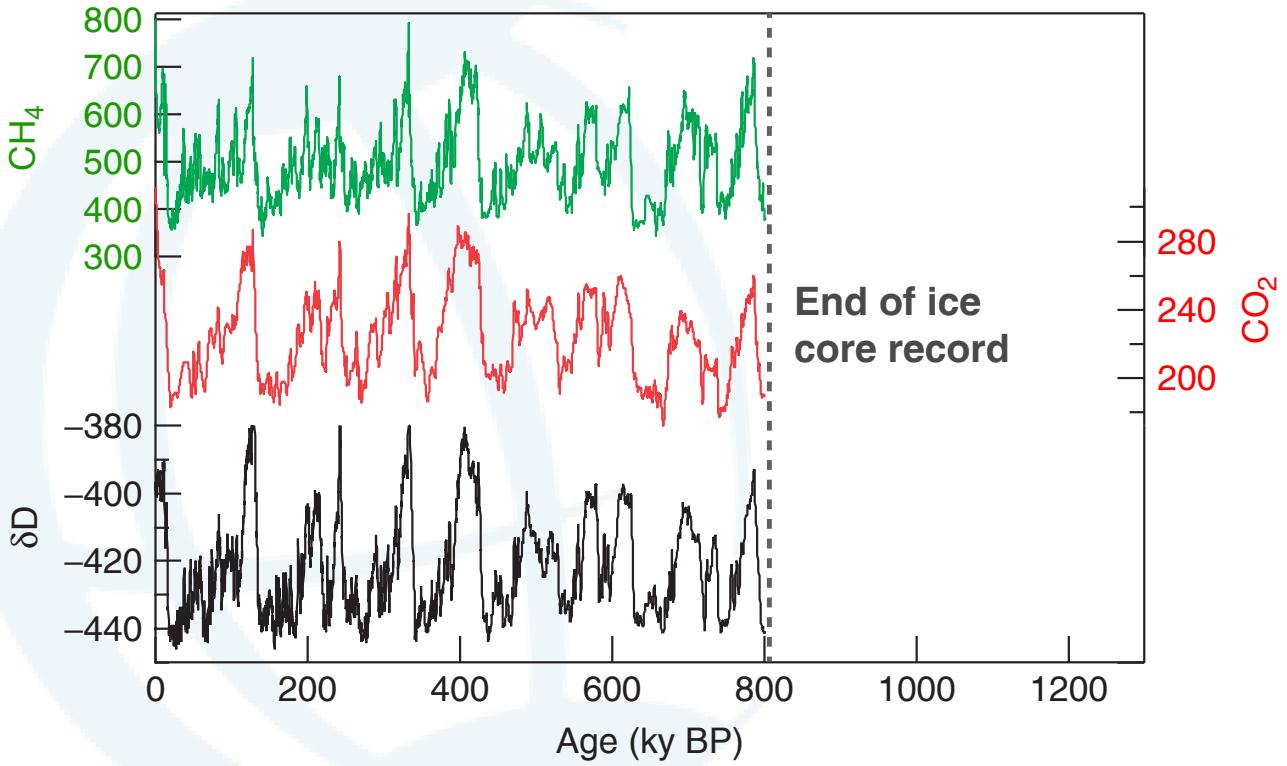


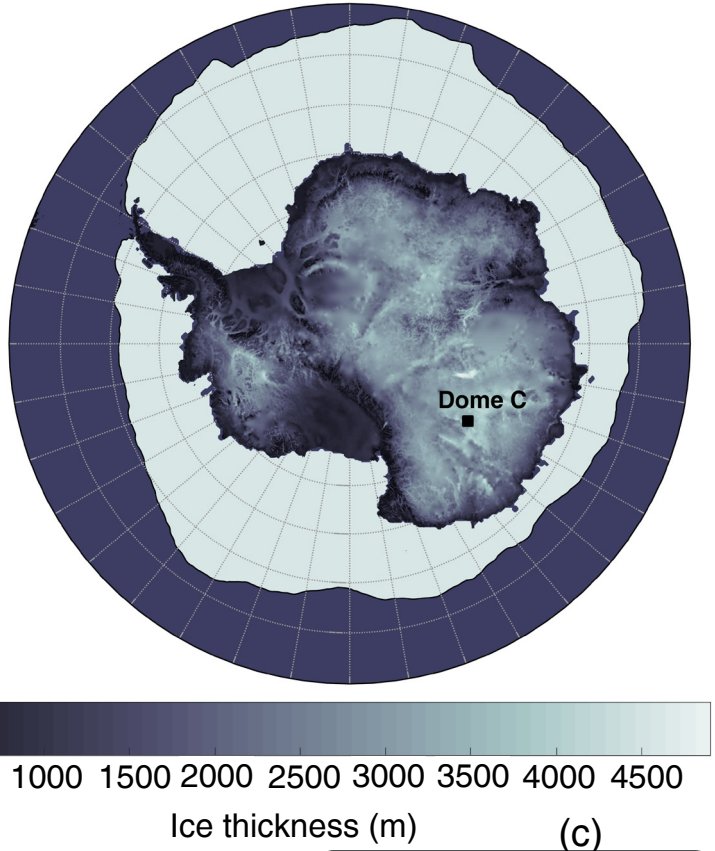
Ice cores from the EPICA project

Past Climate records

In Antarctica the oldest ice records are found due to the low accumulation, the cold temperature and the important thickness of the ice.

Ice core records provide high resolution and continuous recordings of past climatic conditions covering several glacial and interglacial cycles.

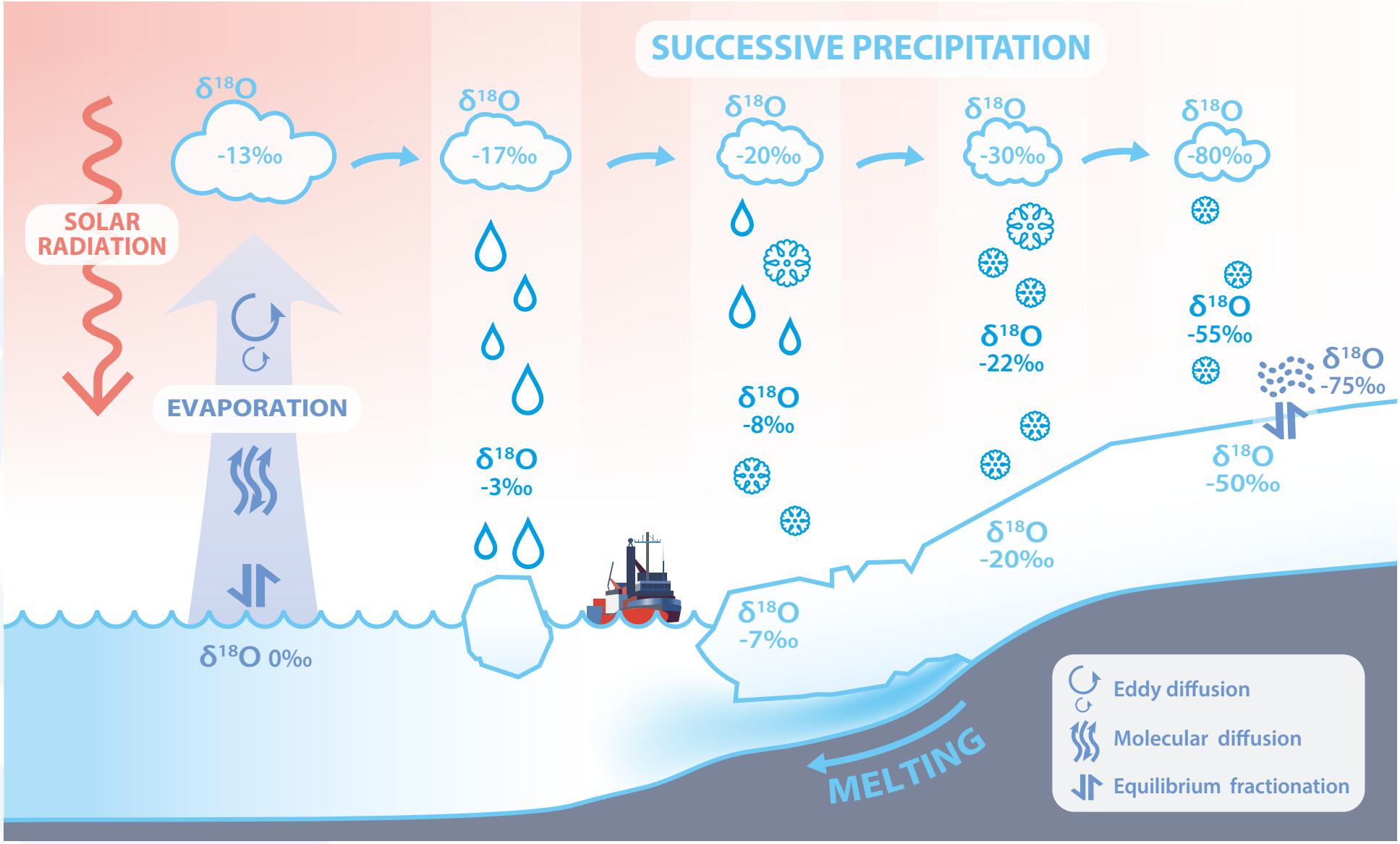




Methane, Carbon dioxyde and water stable isotopic composition from the Dome C ice core

Jouzel et al., 2010

Isotopic paleothermometer



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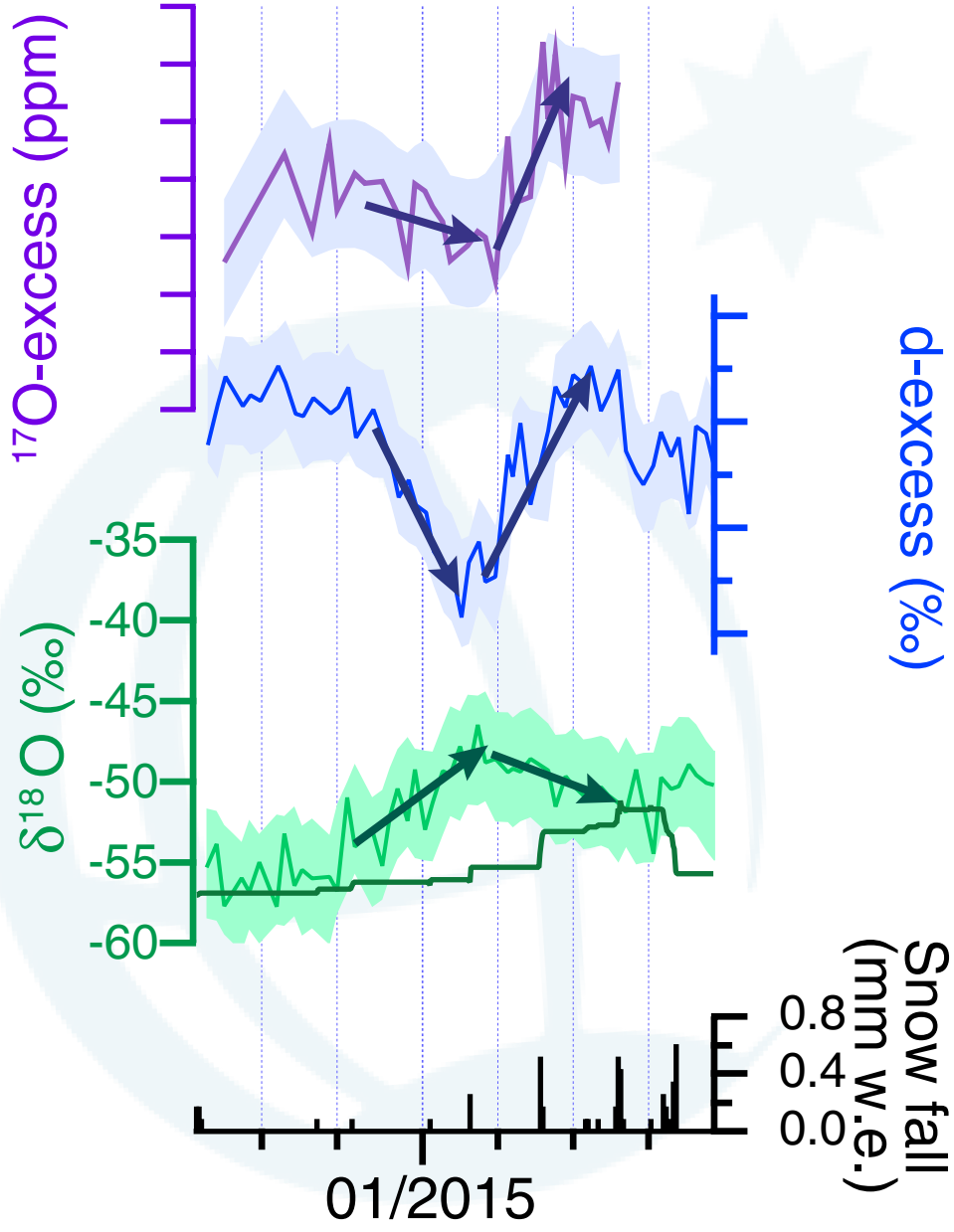
Changes of surface snow isotopic composition



In Antarctica, snow is very rare

In between precipitation events, the surface snow isotopic composition keeps changing

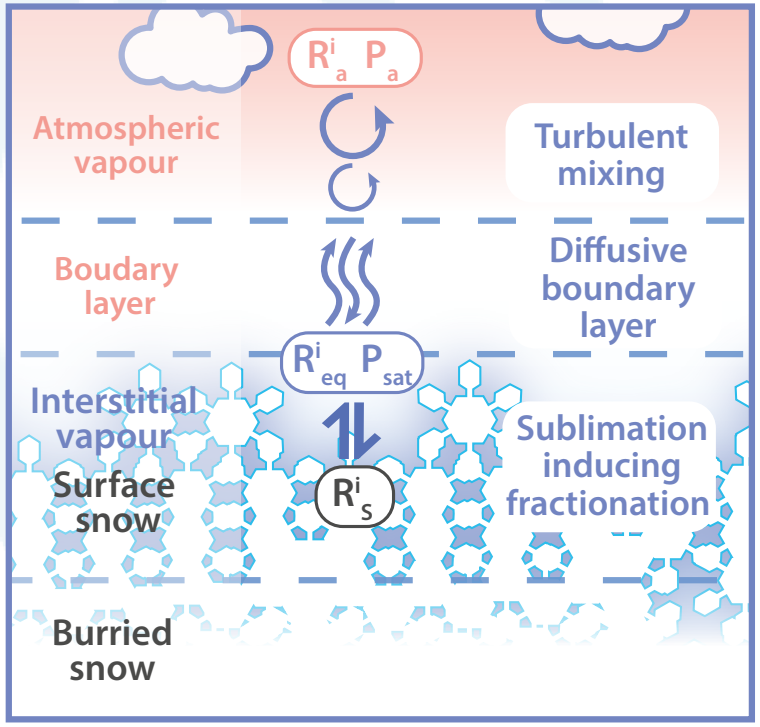
We use the triple isotopic composition to evaluate these changes.

Sublimation case study

Sublimation with a Craig and Gordon Model can explain the observations.

Isotopic composition of the sublimated vapour:

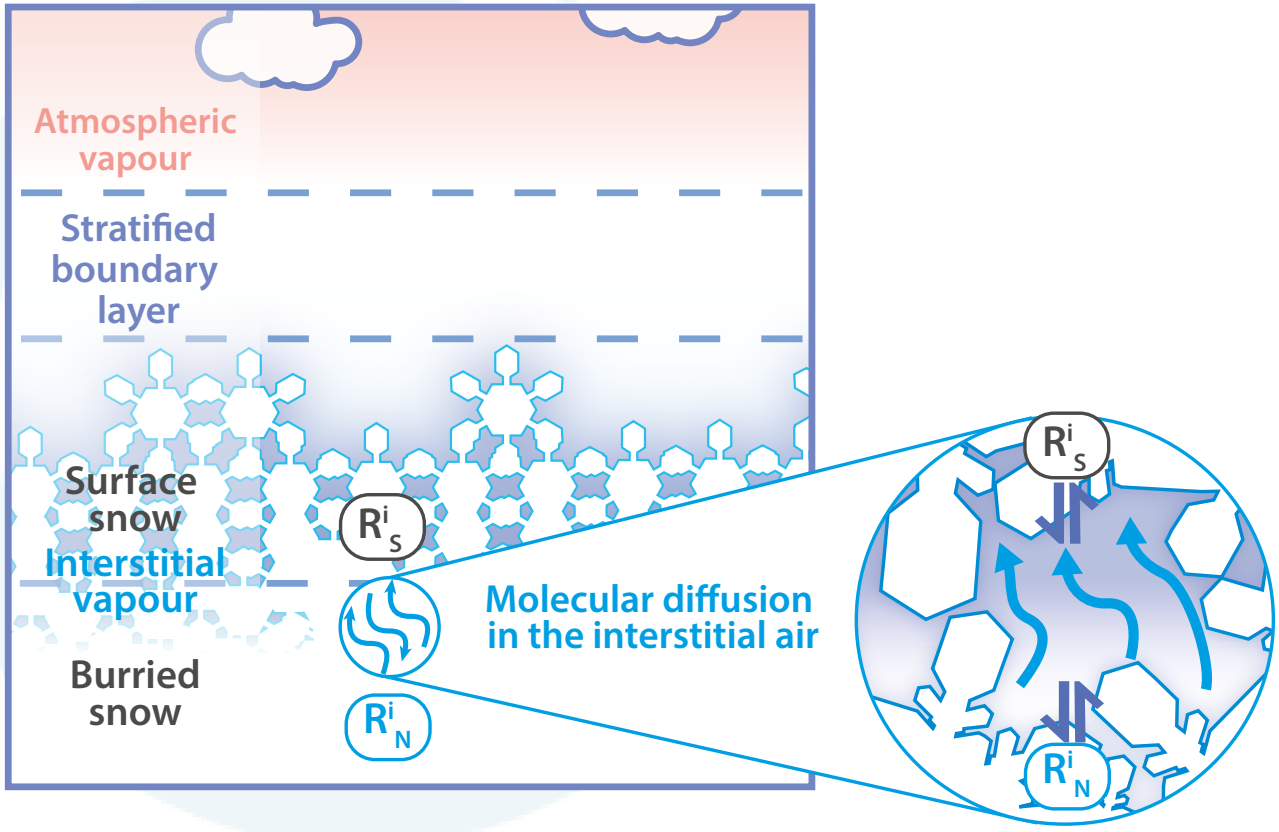
$$R^i_{sub} = \left(\frac{D^i}{D}\right)^{\frac{2}{3}} \frac{\left(R^i_{eq} - RH\ R^i_a\right)}{1 - RH}$$



Deposition case study

Condensation of vapour from the interstitial air

Temperature gradient within the firn creates a gradient of specific humidity and lead to diffusion



Isotopic tracer of the surface mass balance

Different contributions to the mass balance leave different signature on the snow isotopic composition:

	Δ d-exc / $\Delta\delta^{18}O$	$\Delta^{17}O$-exc / $\Delta\delta^{18}O$
Precipitation	- 1.6 ‰.‰$^{-1}$	~+ 3 ppm.‰$^{-1}$
Sublimation	- 2.7 ‰.‰$^{-1}$	- 1.4 ppm.‰$^{-1}$
Deposition	- 6 ‰.‰$^{-1}$	-11.2 ppm.‰$^{-1}$


Thank you