The DEEPICE research and training network

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Exciting challenges lie ahead for the European ice-core community! A new continuous deep ice core will soon be drilled down to the bedrock in East Antarctica, as part of the Beyond EPICA Oldest Ice core (BE-OI) project to potentially recover ice from 1.5 million years (Myr) ago. This new deep ice core should enable us to address major scientific questions regarding the role of ice-sheet size and greenhouse gas concentrations on the dynamics of past climate changes. In particular, a key challenge is to understand why the periodicity of glacial to interglacial cycles changed from 41 to 100 thousand years during the Mid-Pleistocene Transition, between 0.8 and 1.2 Myr before present, while at the same time the orbital forcing given by astronomical parameters keeps the same periodicity (Fig. 1).

In addition to the logistical challenges associated with the drilling of a ~3 km-long ice core in extreme climatic conditions, large technological and scientific challenges need to be tackled in order to exploit the precious archive in the field and back in the laboratory. The new records between 0.8 and 1.5 Myr before present will be located at the bottom of the ice core and, hence, the ice will be extremely thinned: 1 m of ice is expected to contain 10,000 years of climate and environmental history. Retrieving the best scientific outputs from this precious ice requires the development of new techniques to be able to precisely analyze very small quantities of ice. The proxies measured in the ice should then be translated into climate or environment parameters, which requires the determination of the associated transfer functions. Finally, the results related to atmospheric greenhouse gas concentrations, ice-sheet dynamics, and climate changes will have to be compared with climate and ice-sheet model simulations, in order to set the ice-core-based interpretations in a global context with the ultimate aim to better understand the climate dynamics of the Mid-Pleistocene Transition.

The H2020-MSCA Deep icE corE Proxies to Infer past antarctiC climatE dynamics (DEEPICE; pastglobalchanges.org/deepice) Innovative Training Network (2021–2025), with its team encompassing 12 research institutes and seven non-academic partners from 11 countries, capitalizes on this unique European scientific endeavor. It will provide an educational and training program to 15 PhD students, benefiting from the momentum created by the BE-OI drilling project and its societal impact by complementing it with a program of basic and applied science questions to prepare for the BE-OI ice-core analysis that will start in the coming years. Moreover, the DEEPICE network will offer unique links with non-academic partners that will provide the students with the extended skill set required for pursuing either academic or non-academic careers.

The DEEPICE science goals
The overall objective of DEEPICE is to equip the 15 early-career researchers (ECRs) with a solid background in ice-core-related climate science, with a particular focus on Antarctica, technical and communication expertise, and access to a large collaborative network within the academic and non-academic worlds. The DEEPICE specific science goals are to:

- develop novel techniques required for the analyses of the precious ice samples of the BE-OI ice core to obtain the highest possible resolution records of climate and environment;

- document surface climate parameters in the East Antarctic plateau, where weather data are rare and instrumentation deployment is difficult;

- quantify potential effects that may affect the quality of climate records in the deepest ice;

- document past ice-sheet dynamics and flow in East Antarctica in relation to climate change;

- study and document the past climate dynamics in Antarctica on short and long timescales, with the ultimate aim to improve predictions on future climate and the state of the Antarctic ice sheet;

- communicate state-of-the-art research on climate change with a focus on the role of Antarctica in the climate system.

The DEEPICE training program
Through a number of networking events, three training schools, and collaborative efforts between host institutions including the opportunity for the ECRs to receive training at multiple institutions, the DEEPICE training program will provide the ECRs with experience in the following fields:

- Development of novel, state-of-the-art specialized instrumentation;

- Climate and ice-sheet modeling;

- Statistical analysis of signal processing;

- Mediation, education;

- Interdisciplinary and cross-sectoral research.

Calls for DEEPICE PhD applications will start in January 2021. Please spread the word to students who are interested in experimental, statistical, or modeling approaches applied to past climate questions!

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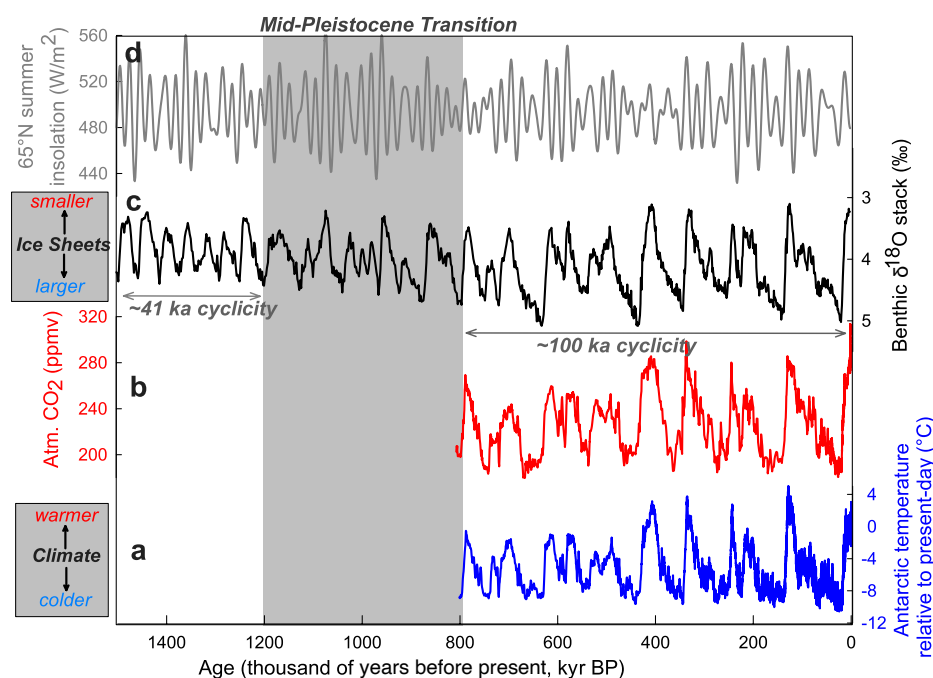
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Figure 1: Key paleoclimatic records over the past 1.5 Myr. **(A)** Antarctic climate (Jouzel et al. 2007) and **(B)** atmospheric CO_2 concentration measured on Antarctic ice cores (Bereiter et al. 2015); **(C)** Marine benthic foraminifera δ^{18}O indicative of ice-sheet volume changes (Lisiecki and Raymo 2005); **(D)** 65°N summer insolation (Laskar et al. 2004).