Constraining the LGM ocean circulation in a climate model with multiproxy data

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Résumé

Orbital forcing is the driving force of the climate system at the scale of glacial-interglacial cycles. During the Last Glacial Maximum, changes in insolation led to the growth of extensive ice sheets in the Northern Hemisphere and to a consequent lower sea-level. In the oceans, this slight modification of bathymetry constraints was associated with different surface conditions (SST, SSS, sea-ice extent, wind patterns...), which impacted the density of water masses and the deep ocean circulation. The carbon storage capacity of this huge carbon reservoir increased, playing a key role in lowering the atmospheric CO2 concentration.

Models are very useful to investigate the potentially complex response of the climate system to any perturbation. The Paleoclimate Modelling Intercomparison Project (now in phase 4) has proposed standardized LGM boundary conditions which notably allows for an evaluation of the model performance under cold conditions, as a relatively good amount of diverse proxy data is available for the LGM. During past PMIP phases, the simulation of the LGM deep ocean circulation has proven to be challenging (Otto-Bliesner et al. [2007], Muglia and Schmittner [2015]), as most models struggle to reproduce the larger and slower AABW inferred from paleotracer data (Curry and Oppo [2005], Howe et al. [2016]).

In this study, the iLOVECLIM model (of intermediate complexity, Goosse et al. [2010]) is used under the PMIP4 experimental design, with a new bathymetry implementation method and both the ICE-6G-C and GLAC-1D topographies. A variety of data (including carbon

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isotopes) allows us to better constraint the LGM ocean circulation leading to an improved model-data agreement. Efforts are made to identify the sources of differences with previous model configurations in order to see which processes seem the most critical to the correct representation of water masses.