Transient simulation of the past 2000 years with the isotope-enabled coupled model MPI-ESM-wiso

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The Common Era (CE, i.e. the past 2000 years) is among the periods selected by the Paleoclimate Modelling Intercomparison Project (PMIP) for transient experiments contributing to PMIP4. For PMIP4, novel estimates and updates of external forcing have been compiled [1]. In addition to the Tier-1 category simulation past1000 for the period 850 CE to 1849 CE, the Tier-3 past2k experiment covers the entire CE, extending the possibilities to evaluate the models' response to natural external forcing like volcanic activity.

In this context, we present here a past2k experiment performed with the fully coupled model MPI-ESM-wiso [2]. This version of the MPI-ESM model is able to simulate stable water isotopes ($H_2^{16}O$, $H_2^{18}O$ and $HD^{16}O$). Because water isotopes are tracers that are integrating climate processes occurring in diverse parts of the hydrological cycle, they are widely used to reconstruct past climate changes like the temperature variations in polar regions and past monsoon dynamics. We evaluated our simulation results with the isotope database Iso2k [3]. We also examined the relationships of modeled climate variables (e.g., surface temperature, precipitation) with water isotope signals in precipitation in terms of temporal trends over different regions. The modeled water isotopes –climate links during extreme events were also investigated.

Our simulation products can also be used to reconstruct the climate variations of the last 2000 years, which is crucial to bring baseline information about Earth's natural climate variability in comparison of the current global warming. The PAGES 2k community made considerable efforts to produce such reconstructions based on different statistical technics using observations and/or model outputs. Thanks to our isotope-enabled model, we can use offline data assimilation directly on our isotope modeled results to reconstruct variations in climate variables over the past 2000 years. First results and issues related to this technic will be discussed.

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Keywords: water isotopes, past2k, MPI-ESM-wiso, coupled GCM, data assimilation