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Sensitivity of simulated oxygen isotopes in ice cores and speleothems to Last Glacial Maximum surface conditions

André Paul[1], Alexandre Cauquoin[2], Stefan Mulitza[1], Thejna Tharammal[3], and Martin Werner[4]
[1]MARUM - Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany (apaul@marum.de)
[2]Institute of Industrial Science, The University of Tokyo, Kashiwa, Japan
[3]Indian Institute of Sciences, Bangalore, India
[4]Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI), Bremerhaven, Germany

In simulations of the climate during the Last Glacial Maximum (LGM), we employ two different isotope-enabled atmospheric general circulation models (NCAR iCAM3 and MPI ECHAM6-wiso) and use simulated (by coupled climate models) as well as reconstructed (from a new global climatology of the ocean surface duing the LGM, GLOMAP) surface conditions.

The resulting atmospheric fields reflect the more pronounced structure and gradients in the reconstructions, for example, the precipitation is more depleted in oxygen-18 in the high latitudes and more enriched in low latitudes, especially in the tropical convective regions over the maritime continent in the equatorial Pacific and Indian Oceans and over the equatorial Atlantic Ocean. Furthermore, at the sites of ice cores and speleothems, the model-data fit improves in terms of the coefficients of determination and root-mean square errors.

In additional sensitivity experiments, we also use the climatologies by Annan and Hargreaves (2013) and Tierney et al. (2020) and consider the impact of changes in reconstructed sea-ice extent and the global-mean sea-surface temperature.

Our findings imply that the correct simulation or reconstruction of patterns and gradients in sea-surface conditions are crucial for a successful comparison to oxygen-isotope data from ice cores and speleothems.