Geophysical Research Abstracts
Vol. 17, EGU2015-13573, 2015
EGU General Assembly 2015

Explicit simulation of oxygen and hydrogen isotopes changes in the hydrological cycle induced by a North Atlantic freshwater hosing event

Martin Werner, Gregor Knorr, Xu Zhang, Paul Gierz, and Gerrit Lohmann
Alfred Wegener Institute for Polar and Marine Research, Paleoclimate Dynamics Section, Bremerhaven, Germany (martin.werner@awi.de)

During the past two decades, several atmospheric and oceanic general circulation models (GCMs) have been enhanced by the capability to explicitly simulate the hydrological cycle of the two stable water isotopes H218O and HDO. They have provided a wealth of understanding regarding changes of the water isotope signals in various archives under different past climate conditions. However, so far the number of fully coupled atmosphere-ocean GCMs with explicit water isotope diagnostics is very limited. Such coupled models are required for a more comprehensive simulation of both past climates as well as related isotope changes in the Earth's hydrological cycle.

Here, we report results of idealized North Atlantic freshwater hosing experiments performed with the Earth system model ECHAM5-JSBACH/MPIMOM. Both H218O and HDO and their relevant fractionation processes are included in all compartments and branches of the water cycle within this model. An idealized freshwater hosing experiment has been performed starting from both pre-industrial (PI) and Last Glacial Maximum (LGM) background conditions. Characteristics of the hosing experiment (duration: 150 yrs, amount: 0.2 Sv, O-18 composition: -30‰) have been chosen in accordance with previous modelling studies and available paleodata. Simulation results reveal a maximum isotopic enrichment of down to -6‰ in ocean surface waters at the end of the hosing experiment and a full recovering to the surface background state after a few centuries, as well as much longer response times in the deeper ocean. Over terrestrial surfaces, the fresh water hosing results in spatially varying isotope depletion in precipitation between -5‰ and +3‰ in agreement with data from various isotope records and previous modelling studies. In further model analyses we investigate how the relation between water isotopes and key climate variables, e.g. land and ocean surface temperatures, precipitation amounts, and oceanic salinity, might has changed for different regions of the Earth due to assumed intermittent North Atlantic fresh water input.