Geophysical Research Abstracts
Vol. 12, EGU2010-8178, 2010
EGU General Assembly 2010

Modeling oxygen isotopes distribution on present day and last glacial maximum in a global ocean model

Xu Xu (1), Gerrit Lohmann (1), Martin Butzin (1,2), and Martin Werner (1)

(1) Alfred-Wegener-Institut for Polar-und Meeresforschung, Paleoclimate Dynamics, Bremerhaven, Germany (xu.xu@awi.de), (2) University of Bremen MARUM - Center for Marine Environmental Sciences

Oxygen isotopes in seawater provide a clear record of the past hydrological cycle which is intimately determined by climate variability. Therefore, a precisely established relationship between the oxygen isotopes and regional climate change is critical to quantitative interpretation. In this study, water isotopes H2O16 and H2O18 were incorporated as passive tracers in the ocean-sea ice component of the Max-Planck-Institute climate model MPIOM to examined the ratio of O18 to O16 (O18) in water of the world oceans on both present day (PD) and last glacial maximum (LGM). This ratio is regulated by fractionation effect due to the phase change of water during evaporation and sea ice formation, and by the isotopic content of precipitation and runoff entering the ocean. The atmospheric fractionation effects are obtained from the atmospheric general circulation model including water isotope tracers.

Applying multicentennial simulations of the present (preindustrial) climate with a horizontal resolution of 3 degrees and 40 vertical layers, the modeled thermohaline circulation had settled down to a quasi-steady state and O18 at each grid depicted a balance between local precipitation, evaporation, as well as ocean and sea ice processes. The ratio of oxygen isotopes matched good to the global gridded data set from NASA Goddard Institute which is constructed from a large set of observations over the last 50 years combined with estimates from regionalO18 to salinity relationships in areas of sparse data. Equilibrated surfaceO18 indicated a pattern of high values around 0.2 to 1.6%■ in the subtropical oceans and low value approximately from -1.5 to -0.25%■ at middle-to-high latitude oceans. High values are located in Atlantic and Indian oceans and the highest were found in Mediterranean Sea. Arctic oxygen isotopic ratios are low in particular where runoff enters. An experiment under LGM (21kyr BP) climate demonstrate distinct different distribution of oxygen isotopes in the Atlantic which is due to the changed climatology, oceanic advection and runoff. For later improvement, the fine gridded run will be obtained and compared with ice core, coral and sediment data.

The final objective of this study is to combine the general ocean circulation and biochemistry model to simulate the PD and LGM general oxygen isotopes distribution and chemical environment of global ocean. These results will be used as the background circumstance of a foram model which analog the carbonate chemistry in the microenvironment of foraminifera to construct the oxygen isotopes ratio of foraminifera shell.