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A modeling sensitivity study of the influence of the Atlantic meridional overturning circulation on neodymium isotopic composition at the Last Glacial Maximum

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Abstract. Using a simple parameterisation that resolves the first order global Nd isotopic composition (hereafter expressed as ε_{Nd} in an Ocean Global Circulation Model, we have tested the impact of different circulation scenarios on the ε_{Nd} in the Atlantic for the Last Glacial Maximum (LGM), relative to a modern control run. Three different LGM freshwater forcing experiments are performed to test for variability in the ε_{Nd} oceanic distribution as a function of ocean circulation. Highly distinct representations of the ocean circulation are generated in the three simulations, which drive significant differences in ε_{Nd}, particularly in deep waters of the western part of the basin. However, at the LGM, the Atlantic is more radiogenic than in the modern control run, particularly in the Labrador basin and in the Southern Ocean. A fourth experiment shows that changes in Nd sources and bathymetry drive a shift in the ε_{Nd} signature of the basin that is sufficient to explain the changes in the ε_{Nd} signature of the northern end-member (NADW or GNAIW glacial equivalent) in our LGM simulations. All three of our LGM circulation scenarios show good agreement with the existing intermediate depth ε_{Nd} paleo-data. This study cannot indicate the likelihood of a given LGM oceanic circulation scenario, even if simulations with a prominent water mass of southern origin provide the most conclusive results. Instead, our modeling results highlight the need for more data from deep and bottom waters from western Atlantic, where the ε_{Nd} change in the three LGM scenarios is the most important (up to 3 ε_{Nd}. This would also aid more precise conclusions concerning the evolution of the northern end-member ε_{Nd} signature, and thus the potential use of ε_{Nd} as a tracer of past oceanic circulation.

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