Orbital-scale variations of δ18Oatm in response to low latitudes changes: a modelling approach

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Résumé

The δ18Oatm (i.e. δ18O of atmospheric O2) is a complex marker that combines past variations of the global sea-level, the low latitude water cycle and of the biosphere productivity. Over the last 800 000 years, the δ18Oatm measured in the air bubbles trapped in the EPICA Dome C ice core shows orbital and millennial variations which are similar to the low latitude hydrological cycle variations. However, a quantitative interpretation of the δ18Oatm including the evolution of oxygen fluxes and associated isotopic fractionation at orbital scale is missing.
This study presents a modelling approach with the objective of accurately estimating the oxygen fluxes and the variations of the δ18Oatm over several climatic cycles. To do so we have coupled an intermediate complexity climate model, iLOVECLIM, with the vegetation model CARAIB in order to quantify the photosynthesis and respiration processes as well as the oxygen fractionation during oxygen uptake by the terrestrial biosphere.

The results obtained from this new coupled model allow us to discuss changes in the spatial and temporal evolution of oxygen fluxes associated with the distribution of the terrestrial vegetation. The simulation of the δ18Oatm over several glacial-interglacial cycles shows that millennial variations are superimposed to the dominant precession signal and provides us a way to better understand the interactions between the climate, the low latitude water cycle and the terrestrial biosphere.

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