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Seasonality of the global hydrological cycle during interglacial warm periods

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Forward modelling of climate proxies, such as oxygen isotopes in the global water cycle, is a powerful tool to interpret information from isolated paleoclimate archives. In this study, the Hamburg Echam4 atmospheric GCM, including an isotope module, has been employed to investigate changes in the hydrological cycle during and between interglacial warm periods, namely the mid-holocene (6kyr b.p.) and Eemian (124kyr b.p.). The simulation of kinetic and equilibrium fractionation effects during phase changes allows to draw a physically consistent global picture of the complete hydrological cycle. The resulting patterns of isotopic composition are commonly described as continental, altitude, or amount effect.

An increased seasonality in the hydrologic balance is indicated by oxygen isotope and Sr/Ca records from northern Red Sea corals from the mid-Holocene. The oxygen isotopic composition of corals is influenced mainly by the temperature and delta-18O of the ambient sea water during growth. Indeed, model results show an increased evaporation signal during the mid-Holocene in the northernmost Red Sea area. Changes in the modelled atmospheric circulation pattern have been identified to alter moisture transport and therefore the source region of the precipitation. Modelled oxygen isotopic composition of evaporated water from the northern Red Sea region reacts sensitively to these changes during interglacial warm periods. Amount averaging even results in large interannual to decadal variations in the isotopic composition of precipitation and evaporation in the northern Red Sea area.