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Modes of ITCZ and ENSO changes over the last glacial period deduced from eastern equatorial Pacific hydrological variability

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Latitudinal movements of the Intertropical Convergence Zone (ITCZ), analogous to its present-day seasonal shifts, and El Niño Southern Oscillation (ENSO)-type interannual variability both potentially impacted the tropical Pacific hydrology during the last glacial period. However, changes in ENSO activity and in the ITCZ dynamics are difficult to disentangle from paleoceanographic reconstructions because they are both embedded in the tropical hydrological signal derived from marine sediment cores.

In this presentation we will compare tropical Pacific sedimentary records of paleoprecipitation to decipher which climate mechanism was responsible for the past rainfall changes. We suggest that latitudinal movements of the ITCZ are consistent with the observed rainfall patterns, challenging the ENSO hypothesis for explaining the rapid rainfall changes at low latitudes. The ITCZ-related mechanism appears to reflect large-scale atmospheric re-arrangements over the tropical belt, with a pronounced Heinrich–Dansgaard/Oeschger signature. This observation is coherent with the simulated tropical rainfall anomalies induced by a weakening of the Atlantic thermohaline circulation in modeling experiments.

This result further implies that changes in ENSO variability are difficult to extract from paleoceanographic reconstructions because they are superimposed on changes in seasonal variability that modulate the first-order climate signal. We circumvent this difficulty by reconstructing thermocline structure from a key sediment core retrieved from the eastern equatorial Pacific. At the core location, changes in hydrologic parameters within the thermocline are linked to ENSO activity, with a reduced influence of seasonal variability compared to surface waters. We performed repeated isotopic analyses (d18O) on single specimens of the thermocline-dwelling planktonic foraminifera Neogloboquadrina dutertrei at several targeted time periods over the last 50 ka to extract the total thermocline variance, a parameter supposed to reveal changes in ENSO. No fundamental changes in amplitude and frequency of the events were detected despite differences in climatic background. However, our data suggest that long-term variations at the thermocline occurred over the last 50 ka, with the highest and lowest ENSO activities occurring during the last glacial period and the Last Glacial Maximum, respectively.