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A new proxy for continental palaeo temperature reconstruction based on membrane lipids of soil bacteria in marine sediments

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Information about past climate is inevitable as input in, and verification of climate models, and is largely obtained by means of proxy data. Considering temperature, different rather well established sea surface temperature proxies have been developed to obtain past ocean temperatures. Continental palaeo temperature data are more difficult to obtain, firstly because of the strong inhomogeneity of the terrestrial environment compared to the oceans and, secondly, because of a lack of sufficient long time climate archives on land. Therefore, analysing terrestrial biomarkers in marine sediments in front of large river outflows, could provide an additional means to obtain catchment-integrated palaeo climate information.

Over the last years a new group of three slightly different branched glycerol dialkyl glycerol tetraether (GDGT) membrane lipids has been discovered in peat bogs and soils, containing either none, one or two additional methyl groups on their carbon chains. They are produced by an as yet unknown group of anaerobic soil bacteria. Here we show, by a survey of ca. 80 globally distributed soils, that the ratio of these three different branched GDGTs correlates linearly with the mean annual air temperature. These lipids are transported via rivers to the ocean where they are buried in marine sediments.

In order to test the applicability of this new proxy, a sediment core (GeoB 6518) in front of the Congo River outflow, spanning the last deglaciation and Holocene period,

was analysed for its branched GDGT content. The results very clearly show a gradual change in the distribution of the three branched GDGTs, which corresponds according to our calibration to a temperature increase of about 4˚C over the last deglaciation for equatorial central Africa. Moreover, the record shows a short interruption of this temperature increase during the Younger Dryas period, suggesting that this proxy is also able to record relatively short term climate events, even though it represents a catchment-integrated signal.

As soils are widespread on continents, we think this proxy could be a promising tool in reconstructing continental palaeo-temperatures.