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Seasonally resolved climate variability during the last interglacial from southern Caribbean corals

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A range of future climate scenarios have been predicted for a warmer Earth as a result of varying anthropogenic greenhouse emissions. The Last Interglacial period (∼125,000 years ago, Marine Isotope Stage 5) offers a period in time which is estimated to have been in the range of 0.1 to > 2oC warmer than present (AD 1961-1990). Although this period is not considered completely analogous for future climate states, the mechanisms behind such changes have the potential to be well understood. Here we present the initial findings of a study which aims to augment current understanding by quantifying the climate dynamics of the tropical southern Caribbean using high resolution marine climate archives. In doing so, we highlight geochemical proxies obtained from aragonitic coral skeletons as a proxy for seasonality and interannual to decadal climate variability.

Unique fossil coral material has been collected from an uplifted reef terrace on the island of Bonaire (Netherlands Antilles), which according to 230Th/U dating, was deposited during the Last Interglacial. The sampling technique employed here has been focused using C/T scanning and X-radiography which revealed annual density bands in 21 individual coral colonies. Due to a high average extension rate of greater than 6mm/year, monthly records are available which represent growth periods from 9 to 40 years and so cover various time windows across the Last Interglacial. We discuss the results from geochemical signals of Sr/Ca and oxygen isotope ratios (δ18O) which reflect, respectively, regional temperature and hydrological balance at the sea surface. The finding that Sr/Ca and δ18O cycles occur alongside visible annual density bands allows the quality of the fossil coral material to be considered high and reliable. To further supplement the interpretation of these records greyscale increment analysis, Mg/Ca and δ13C records are presented.

The implications of these findings, when compared to Holocene records, identify the variability of internal and external forcing mechanisms behind the local behaviour of climate patterns and phenomena. By comparing our findings to “state of the art” climate models, the reconstructed index states of such patterns can be placed into a larger spatial context. This work is a contribution to the DFG Programme INTERDYNAMIC