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Southern Caribbean Sea temperature and salinity variability since the mid-Holocene from monthly resolved coral records

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In the tropical Atlantic, proxy reconstructions of Holocene sea surface temperature and salinity that resolve seasonality and interannual to decadal variability are sparse. However, ocean-atmosphere interactions on these timescales play a critical role for climate extremes such as droughts, floods and hurricanes. Consequently, a better understanding of the natural range of sea surface variability on these timescales is important for projections of future tropical Atlantic climate change. Here we present monthly resolved reconstructions of sea surface temperature (SST) and $\delta^{18}O_{seawater}$ (used as proxy for sea surface salinity, SSS) in the southern Caribbean Sea for snapshots throughout the mid- to late Holocene, derived from Sr/Ca and $\delta^{18}O$ analyses of fossil shallow-water corals (*Diploria strigosa*) from Bonaire (Netherlands Antilles). The corals were dated by the $^{230}Th/U$-method and provide a total of $\sim$300 years of record, with individual time windows reaching up to 68 years in length.

Our coral records indicate that mid- to late Holocene SST and SSS were characterized by persistent quasi-biennial and prominent interannual to multidecadal variability. However, the amplitude of variability on individual timescales has varied over the last 6200 years. We find that on interannual to multidecadal timescales, warmer conditions were accompanied by more saline conditions at the sea surface, and vice versa. Potential forcing mechanisms of this observed pattern are discussed, including the wind-induced advection of surface waters from the South and the variations in the strength of the Atlantic Meridional Overturning Circulation. Compared to the late Holocene, SST variability on inter- to multidecadal timescales was more pronounced during the mid- Holocene, and accompanied by enhanced SSS variability. Moreover, an increased amplitude of the SSS annual cycle is reconstructed for the mid- Holocene, very likely resulting from increased summer precipitation at that time, which is consistent with our climate model simulations (COSMOS). A time interval of anomalous sea surface conditions in the southern Caribbean is indicated at 2350 years ago, which is characterized by enhanced interannual SST variability at typical ENSO periods, an increased amplitude of the SST annual cycle, and a reversal of the SSS annual cycle.

In summary, whereas the amplitude of the reconstructed interannual to multidecadal SST variability was quite variable, the amplitude of the SST annual cycle was within the modern range during most of the coral-based snapshots that cover a total of $\sim$300 years during the last 6200 years. Exceptions include a slightly increased SST seasonality at 6200 years ago, which we attribute to insolation forcing on orbital timescales, consistent with our model simulations, and a significantly increased SST seasonality at 2350 years ago, which we attribute to internal dynamics of the climate system. This work is a contribution to the DFG Programme INTERDYNAMIC.