Geophysical Research Abstracts,
Vol. 11, EGU2009-6174, 2009
EGU General Assembly 2009

Evaluating 20th century warming trends with modern Porites corals from the western Indian Ocean

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Recent studies suggest that instrumental records of sea surface temperature (SST) are unreliable prior to 1965 due to changes in the measurement procedures. Thompson et al. (2008) identified an artificial cool bias of up to 0.3˚C in global mean SSTs between 1945 and the mid-1960s.

Geochemical parameters in skeletons of massive corals can be used to infer past changes in climate on seasonal to centennial time scales. The Sr/Ca ratio of coral aragonite is a widely used tool for deriving high-resolution proxy records of past sea surface temperatures. Application of the Sr/Ca paleothermometer relies on the assumption that coral Sr/Ca varies predictably with temperature and that seawater Sr/Ca is invariant on millennial timescales due to the long residence time of Sr and Ca in the ocean. In contrast, the oxygen isotope ratios (δ^{18}O) of coral aragonite vary in response to temperature and changes in the δ^{18}O of seawater, the latter depending on the freshwater balance. Thus, coral δ^{18}O may be used as a record of past sea surface temperatures only at sites were δ^{18}O seawater variations are negligible.

SST in the western tropical Indian Ocean closely follows global mean temperature trends (Funk et al., 2008). Here we present a set of *Porites* coral Sr/Ca and/or oxygen isotope records from the tropical Indian Ocean covering the past 120-336 years (Seychelles, Chagos Archipelago). We computed a composite sea surface temperature record for the Western Indian Ocean using δ^{18}O (Seychelles) and Sr/Ca (Chagos). This record clearly follows instrumental SST trends in the Western tropical Indian Ocean, except in the 1945-1965 interval, were instrumental SST data show a pronounced cooling not evident in the coral proxy index (the linear correlation coefficient between the coral index and instrumental SST is r=0.86 if we omit the most problematic time period from 1945 to 1960). However, the coral index follows the global land surface air temperature trend, which is free of systematic biases due to changes in the measurement technique. We therefore conclude that the cooling of the tropical Indian Ocean indicated by instrumental SST is an artifact that may result from changes in the SST measurement techniques, as suggested by Thompson et al., 2008). Our results will have important implications for the investigation of large-scale teleconnections in the oceans (for example, the apparent shift in the Indian Ocean SSTs around 1945 has been related to a regime change in the North Pacific Ocean).

Thompson et al. (2008): A large discontinuity in the mid-twentieth century in observed global-mean surface temperature, Nature, 453: 646-649, DOI:10.1038/nature06982.

Funk, C. et al. (2008): Warming of the Indian Ocean threatens eastern and southern African food security but could be mitigated by agricultural development, PNAS, 105: 11081–11086, DOI: 10.1073_pnas.0708196105.