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Joint influence of the Indo-Pacific Warm Pool and Northern Arabian Sea Temperatures on the Indian Summer Monsoon in a Global Climate Model Simulation

Daniel J. Befort (1,2), Gregor C. Leckebusch (1), and Ulrich Cubasch (2)

(1) University of Birmingham, School of Geography, Earth and Environmental Sciences, Birmingham, United Kingdom (d.j.befort@bham.ac.uk), (2) Institute of Meteorology, Freie Universität Berlin, Germany

Proxy-based studies confirmed that the Indian Summer Monsoon (ISM) shows large variations during the Holocene. These changes might be explained by changes in orbital conditions and solar insolation but are also thought to be associated to changes in oceanic conditions, e.g. over the Indo-Pacific-Warm-Pool region. However, due to the nature of these (proxy-based) analyses no conclusion about atmospheric circulation changes during dry and wet epochs are possible.

Here, a fully-coupled global climate simulation (AOGCM) covering the past 6000 years is analysed regarding ISM variability. Several dry and wet epochs are found, the most striking around 2ka BP (dry) and 1.7ka BP (wet). As only orbital parameters change during integration, we expect these "shorter-term" changes to be associated with changes in oceanic conditions.

During 1.7ka BP the sea surface temperatures (SST) over the Northern Arabian Sea (NARAB) are significantly warmer compared to 2ka BP, whereas cooler conditions are found over the western Pacific Ocean. Additionally, significant differences are found over large parts of the North Atlantic. To explain in how far these different ocean basins are responsible for anomalous conditions during 1.7ka BP, several sensitivity experiments with changed SST/SIC conditions are carried out. It is found that neither the SST's in the Pacific nor in the Indian Ocean are able to reproduce the anomalous rainfall and atmospheric circulation patterns during 1.7ka on its own. Instead, anomalous dry conditions during 2ka BP and wet conditions during 1.7ka BP are associated with a shift of the Indo-Pacific-Warm-Pool (IPWP) and simultaneous anomalous sea-surface temperatures over the NARAB region.

Eventually, it is tested in how far this hypothesis holds true for other dry and wet events in the AOGCM data during the whole 6000 years. In general, a shift of the IPWP without anomalous SST conditions over the NARAB region (and vice versa) is not sufficient to cause long-lasting rainfall variations over India on a centennial time-scale.