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Title: Evidence of ENSO and the Indian Ocean Dipole derived from coral-based reconstructions of SSTs in the Indonesian-Throughflow-sensitive eastern Indian Ocean

Abstract: Modern corals of the eastern Indian Ocean appear to be reliable proxies of the prospective influence of the Pacific on Indian Ocean coupled variability and, the possible role of the Indian Ocean on the triggering of ENSO in the recent past. Coral-based geochemical records are allowing observation of climatic and oceanographic changes to be deciphered on decadal timescales over periods of up to several 100 years. Coral-based reconstructions of sea surface temperatures provide evidence for locations in the eastern Indian Ocean for which instrumental data sets are incomplete or lacking. This evidence assists in resolving ongoing discussions of the variability of an Indian Ocean dynamic mode, its inherent evolution, relationship with external influences such as ENSO, monsoon, Arctic oscillation and its teleconnections on interannual time scales. The currently available coral records lead for the locations investigated to an improved understanding of the effect of the internal Indian Ocean dynamic signal such as the Indian Ocean Dipole, of how the signal interacts/modifies the Indian Ocean ENSO signal and of the influence of the two above signals on Australian climate variability in the recent past. Such coral records for the region are clearly needed to detect sub-millennial to sub-decadal scale oscillations of climate variability over Australia and to understand the influence of the Indian Ocean mode on long-term climate change in Australia In conjunction with records of numerous associated or independent proxies, the coral-derived observations are important on many levels. They permit links to be drawn between climate variations and ecosystem shifts; they illustrate variability in water mass distribution and structure in the ocean; they contribute to the construction of global-scale climate records and the understanding of the relationships between climate forcing and effects; and they yield insight into the magnitude and direction of exchange of climatically important gases between ocean and atmosphere. The available records further indicate that future studies are needed which show how the Indian Ocean-Monsoon system can modulate the amplitude and the frequency of ENSO and produce interdecadal variations. In particular, studies based on model simulations that investigate the causes of these events, including thresholds or feedbacks in the climate system, are needed to complement coral studies. Most importantly, those studies are needed which may give evidence that the Indian Ocean has its own coupled mode of variability that is weak on its own but grows under the influence of external forcing from the Pacific Ocean. Overall, the main focus of future work in the field should be addressing the importance of significant regional anomalies of the eastern Indian Ocean on hemispheric and global scale climate. These would include studies addressing the different spatial and temporal time scales of significant climate events, how they are expressed in proxy and model data, the temporal coherence with spatial forcing fingerprints as well as additivity characteristics of individual forcing components, and identification of previously underestimated factors.

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