Palaeoclimate perspectives on the Indian Ocean Dipole

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The Indian Ocean Dipole (IOD) has major climate impacts worldwide; most profoundly for nations around the Indian Ocean basin. It has been 20 years since the IOD was first formally defined and research since that time has focused primarily on examining IOD dynamics, trends and impacts in observational records and in model simulations. However, considerable uncertainty exists due to the brevity of reliable instrumental data for the Indian Ocean basin and also due to known biases in model representations of tropical Indian Ocean climate. Consequently, the recent Intergovernmental Panel on Climate Change (IPCC) report on the Ocean and Cryosphere in a Changing Climate (SROCC) concluded that there was only *low confidence* in projections of a future increase in the strength and frequency of positive IOD events. This talk examines the additional perspectives that palaeoclimate evidence provides on IOD trends, variability and impacts.

Palaeoclimate data show that recent trends towards more frequent and intense positive IOD events have been accompanied by a mean shift toward a more positive IOD-like mean zonal SST gradient across the equatorial Indian Ocean (enhanced warming in the west relative to the east). The increasing frequency of positive IOD events will imminently move outside of the range of natural variability in the last millennium if projected trends continue. Across a range of past climate states, periods of a mean positive IOD-like state in the Indian Ocean have been accompanied by elevated IOD variability. This includes events that exceed the magnitude of even the strongest measured historical events, demonstrating that the Indian Ocean can harbour even stronger variability than what has been observed to date. During the last millennium there has been a tight coupling between the magnitude of interannual IOD and ENSO variability, although positive IOD events have frequently occurred without any indication of a co-occuring El Niño event. This IOD–ENSO may not have persisted across past climates that were very different to today, raising questions of whether their interaction will change in a rapidly warming future. Paleoclimate evidence for hydroclimate changes during the last millennium further points to the importance of interannual IOD and ENSO variability in breaking droughts in regions that are impacted by these modes of variability. Overall, palaeoclimate evidence provides rich insights into the IOD, and when used alongside observations and model output, these multiple lines of evidence improve confidence in future projections of IOD change.