CORAL REEF DEATH LINKED TO TROPICAL WILDFIRES IN INDONESIA DURING THE 1997 INDIAN OCEAN DIPOLE


(1) Research School of Earth Sciences, The Australian National University, Canberra ACT 0200, Australia, (2) Research and Development Center for Geotechnology, Indonesian Institute of Sciences, Bandung 40135, Indonesia.
(nerilie.abram@anu.edu.au)

The coral reefs of the Mentawai Islands, Indonesia, experienced catastrophic mortality of close to 100% of the coral and the fish during the 1997 Indian Ocean Dipole (IOD) upwelling event. The link between elevated sea surface temperatures (SST) and coral death is now well known, however the unanticipated Mentawai reef mortality coincided with anomalously cool SSTs and a giant red tide. Ocean productivity in the Indonesian region is generally proportional to the strength of upwelling; therefore the severity of the 1997 Mentawai reef death raises the question of whether the magnitude of the IOD upwelling and red tide during 1997 was unprecedented. Here we examine the tolerance of Mentawai corals to IOD upwelling events over the past 6,300 years using coral skeletal growth and palaeothermometry. High-resolution coral Sr/Ca and δ¹⁸O reconstructions of SST reveal pre-historic IOD cold anomalies of up to 5.8°C. The magnitudes of these events exceed the strong 1997 IOD upwelling by as much as 1.9°C, yet we find no evidence of past coral mortality. From these results it seems that the intensity of the 1997 Mentawai red tide was much greater than expected based on the magnitude of IOD upwelling alone. This implies that an additional source of nutrients must have supported the catastrophic red tide and we propose that these nutrients were provided by the 1997 Indonesian wildfires. These fires were the worst in south-east Asian history and were the combined results of land clearing, past forest disturbance and intense drought driven by the 1997 El Niño–Southern Oscillation and Indian Ocean Dipole events. Using mass balance calculations we show that iron
fertilisation of the upwelled nutrient-enriched water by atmospheric fallout from the 1997 wildfires was sufficient to produce the extraordinary red tide, ultimately leading to the unprecedented death of the Mentawai reefs. These findings highlight the escalating phenomenon of tropical wildfire as a potential new threat to coastal marine ecosystems.