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Monsoon versus ocean circulation controls on paleoenvironmental conditions off southern Sumatra during the past 300,000 years

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A multi-proxy record has been acquired from a piston core (SO139-74KL) taken offshore southern Sumatra, an area which is situated in the southwestern sector of the tropical Indo-Pacific Warm Pool. The high-resolution data sets (XRF, total organic carbon and C37 alkenones) were used to track changes in paleoproductivity, freshwater budget, and sea surface temperature (SST) of the tropical climate system at orbital timescales over the past 300 ka. Our paleoclimatic data show that enhanced marine paleoproductivity was directly related to strengthening of coastal upwelling during periods of increased boreal summer insolation and associated SE monsoon strength with a precessional cyclicity. Changes in freshwater supply were primarily forced by precession-controlled changes in boreal NW winter monsoon rainfall enclosing an additional sea-level component. SST variations of 2-5°C occurred at eccentricity and precessional cyclicity. We suggest that the sea surface temperature variability off southern Sumatra is predominantly related to three major causes: 1. Variations in upwelling intensity. 2. An elevated freshwater input into the southern Makassar Strait leading to reduced supply of warmer surface waters from the western Pacific, and increased subsurface water transport via the Indonesian Throughflow (ITF) into the Indian Ocean. 3. Long-term changes in the intensity or frequency of low-latitude climate phenomena, such as ENSO.