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Pliocene ocean and climate dynamics in the eastern Indian Ocean and their implications for the global climate state.

David De Vleeschouwer[1], Angelina Füllberg[1], Rebecca Smith[2], Gerald Auer[3], Benjamin Petrick[4], Isla Castañeda[2], and Beth Christensen[5]

[1]Universität Bremen, MARUM, MARUM, Bremen, Germany (ddevleeschouwer@marum.de)
[2]Department of Geosciences, University of Massachusetts at Amherst, Amherst, USA
[3]Department of Biogeochemistry, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Kanagawa, Japan
[4]Max-Planck-Institut für Chemie, Mainz, Germany
[5]Rowan University, USA

The Indonesian Throughflow (ITF) operates as an important link in global thermohaline circulation and is often considered a modulator of global past climate changes, with effects as far as Africa or the Atlantic Ocean. Yet, to what extent ITF variability accounted for oceanographic change along the west Australian coast remains controversial. A tectonically reduced ITF has been invoked to explain the short, but intense Pliocene glaciation Marine Isotope Stage (MIS) M2 (3.3 Ma). The hypothesis hinges on a reduced equator-to-pole heat transfer in the Indian Ocean, in response to low connectivity with the Indo-Pacific warm pool. To clarify links between regional oceanographic change and global climate, we present a two-site multiproxy reconstruction from the Perth (U1459) and the Carnarvon (U1463) Basin. These sites provide the opportunity to unravel the Pliocene history of the Leeuwin Current (LC). We use the LC as a proxy for ITF connectivity, as the ITF is the source for the warm, low-salinity, nutrient-deficient LC. A U1459-U1463 comparison thus allows for investigating the possible relationship between mid-Pliocene glaciations and ITF heat flux. We show that the LC was active throughout the Pliocene, albeit with fluctuations in intensity and scope. We identify three main factors that controlled LC strength. First, a tectonic ITF reorganization caused an abrupt and permanent LC reduction at 3.7 Ma, coeval with the remarkably intense Pliocene glacial MIS Gi4. On shorter timescales, eustatic sea level and direct orbital forcing of wind patterns hampered or promoted the LC. At 3.3 Ma, LC intensity plunged in response to a eustatic ITF restriction. MIS M2 caused the latitudinal U1463–U1459 planktonic oxygen isotope gradient to steepen from 1.2 to 2.0‰ and the TEX_{86} sea surface temperatures gradient to increase from 3 to 6°C. Yet, comparison with Exmouth Plateau Site 763 shows that the LC did not shut down completely during MIS M2: The ITF heat flux dwindled but did not cease. Weakened ITF connectivity led to a significant drop in Indian Ocean poleward heat transport and thus constitutes a positive feedback mechanism that contributed to the relative intensity of MIS M2 and the thermal isolation of Antarctica. This positive feedback mechanism is ultimately driven by orbital-scale changes in relative sea level in the ITF region.