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The Tectonic Closing of the Indonesian Passages and Mid-Pliocene Climate Change

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The Indonesian throughflow (ITF) refers to the transfer of upper ocean waters from the tropical Pacific to the Indian Ocean through the Indonesian Seas. It has been proposed by Cane and Molnar (2001) that the northward displacement of New Guinea during Early- and Mid-Pliocene constricted the Passages and switched the source of Indonesian throughflow waters from warmer S-Pacific to relative cool N-Pacific waters. By using a global climate model (GCM) and an earth system model of intermediate complexity (EMIC), we study the climate response to changes in the geometry of the Indonesian Passages. We compare control experiments using the present day topography (constricted set-up) with experiments using a topography resembling the early Pliocene situation (widened set-up). We find that circulation through the Indonesian Archipelago is considerably changed down to a depth of 1000 meters. In the constricted setting the ITF is weakened while the strength of the Pacific western boundary currents increases. Consistent with recent proxy evidence, this results in warmer subsurface waters in the Indian Ocean while surface waters of the Pacific warm pool area exhibit a slight increase in temperature. Even though sea surface temperature anomalies do not exceed 1°C we observe strong changes in precipitation of the Indo-Pacific. In particular the Australian continent experiences a pronounced aridification.