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Coral Records of Sea-surface Temperature, Salinity and Density in Western Indonesia: Implications to 20th Century Indonesian Throughflow Variations

Intan Suci Nurhati (1), Sri Yudawati Cahyarini (2), and Edward Boyle (3)

(1) Center for Environmental Sensing and Modeling. Singapore-MIT Alliance for Research and Technology, Singapore (intan@smart.mit.edu), (2) Research Centre for Geotechnology. Indonesian Institute for Sciences, Bandung, Indonesia, (3) Earth, Atmospheric and Planetary Science Department. Massachusetts Institute of Technology, Cambridge, USA

As the main conduit of oceanic mass and heat from the West Pacific Warm Pool to the Indian Ocean, changes in the strength of the Indonesian Throughflow (ITF) are linked to Indo-Pacific climate variability. ITF monitoring via mooring buoys have provided insights on seasonal ITF dynamics over the last decade. One prominent feature is the role of monsoonal winds in advecting low density seawater from the western Indonesian seas into the ITF main pathway at the Makassar Strait during the NE monsoon, thus seasonally weakens the ITF. However, the absence of continuous decades-long instrumental ITF measurements limits our understanding on its modern evolution over the recent century. Here, we present monthly resolution coral δ18O and Sr/Ca records from western Indonesia over the period 1923-2011. Coral Sr/Ca is a known sea-surface temperature (SST) proxy, whereas coral δ18O values are sensitive to changes in SST as well as the δ18O of seawater (δ18Osw). Our seawater measurements confirm the sensitivity of δ18Osw to salinity variations in the region that is driven by rainfall and ocean advection. Therefore we can derive δ18Osw-based salinity proxy record by removing the SST component from coral δ18O, and subsequently reconstruct past seawater density variations at our site. Surface seawater density variations of our coral reveal pronounced decadal-scale variations that are attributed to salinity changes, with a long-term trend toward less dense seawater due to ocean warming (+0.52°C) and freshening (-0.32 psu) trends. Given the observed relationship between lower seawater density at our site and a weaker ITF on seasonal timescales, our western Indonesian coral records may hint at a weakened ITF over the recent century. Climate models have projected that such trend would impact the regional Indo-Pacific climate by restricting the distribution of heat from the Pacific into the Indian Oceans.