Subsurface Heat Wave and Coral Bleaching in the Southern Red Sea Linked to Local and Remote Forcings

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Research on Marine heat waves (MHWs) in the Red Sea has predominantly focused on the surface signatures of these extreme warm events (i.e., sea surface temperature, SST). This may potentially overlook the detrimental impacts of subsurface marine heatwaves. The unprecedented coral bleaching event observed in the southern Red Sea in 2015, despite SSTs being less intense than an MHW in 2002, highlights this oversight. High-resolution reanalysis for the Red Sea (RSRA) reveals contrasting subsurface heat content anomalies at depths up to 100m for both years, characterized by positive anomalies in 2015 and negative anomalies in 2002. A heat budget analysis attributes advection from the southern boundary connecting with the Gulf of Aden (GoA) as the primary heat source. This advection of negative and positive temperature anomalies from the GoA contributed to decreased subsurface heat content in 2002 and increased content in 2015. The augmented subsurface heat content in 2015 is attributed to reduced Red Sea surface waters (RSW) and Gulf of Aden Intermediate waters (GAIW). Seasonal variations at near-surface (10m) and subsurface (100m) levels show horizontal pressure gradients between the southern Red Sea and the GoA, consistent with the diminished transport of RSW and GAIW in 2015. We have implemented a simple model for further analysis. Results from this model experiments show that at synoptic timescales, in 2015, reduced surface layer transport is influenced by occasional southerly wind bursts over the strait. In contrast to local effects governing horizontal current anomalies, temperature anomalies result from anomalous westward propagating upwelling Rossby waves originating as far as the western coast of the Indian Ocean.