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Long-lived mesoscale eddies in the Gulf of Aden and their origin in the Arabian Sea

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The Gulf of Aden (GOA), located in the northwestern Indian Ocean, connects the Red Sea to the Arabian Sea. Archived air-deployed XBT data and recent LADCP, CTD and RAFOS float data reveal that large-scale, surface-to-bottom eddies are commonly present in the GOA. These eddies have been shown to stir the saline Red Sea Water with the ambient GOA water (Bower et al., 2002) in the Gulf, and thus are a critical mechanism for setting the Indian Ocean salt properties at intermediate depths. In this study, we focus on the origin and periodicity of these eddies, and the link with the Arabian Sea monsoon system. These eddies can be tracked with the sub-surface (650 meter) float data from the mouth of the Gulf (51E) to about 46E, where tall seamounts break up the mesoscale features into smaller vortices. We show that the eddies are strongly correlated with sea surface height anomaly (SSHA) data, and track the documented eddies backwards in time with AVISO merged SSHA data. We discover that some have a point of origin in the central Arabian Sea, which has not been documented in previous studies. Time series analyses reveal an annual progression of four eddies per year east to west through the Gulf. One of the eddies in this train of cyclones and anticyclones is the previously identified Somali Current Ring (Fratantoni et al., 2005). We explore how these eddies are directly or indirectly driven by the annual cycle of monsoon forcing.