On the dynamics of the Zanzibar Channel

Authors

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Abstract

The Zanzibar Channel lies between the mainland of Tanzania and Zanzibar Island in the tropical western Indian Ocean, is about 100 km long, 40 km wide, and 40 m deep, and is essential to local socioeconomic activities. This paper presents a model of the seasonal and tidal dynamics of the Zanzibar Channel based on the Regional Ocean Modeling System (ROMS) and a comparison of the model and observations. The seasonal dynamics of the channel is forced by remote processes and the local wind. Remote forcing creates the East African Coastal Current, a portion of which flows through the channel northward with a seasonally varying magnitude. The local wind enhances this seasonality in the surface Ekman layer, resulting in a stronger northward flow during the southwest monsoon season and a weak northward or occasionally southward flow during the northeast monsoon season. The tidal flows converge and diverge in the center of the channel and reduce the transport in the channel. The remotely forced, wind-forced, and tidal dynamics contain 5%, 3%, and 92% of the total kinetic energy, respectively. Despite their low kinetic energy, the remotely forced and wind-forced flows are most relevant in advecting channel water to the open ocean, which occurs in 19 days at the peak of the southwest monsoon season. The channel is well mixed, except during brief periods in the two rainy seasons, and temporarily cools between December and February. The dispersion of passive tracers is presented as an example of potential model applications.