

Tracing Water Masses in the Gulf of Aden Using a Passive Tracer

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Abstract

In the present study, the Aden Gulf water masses have been detected using a concentration passive tracer with the MITgcm model. The modeling domain is in the range 0.5°N-30°N, 44°E-77°E. The initial data (Temperature, salinity, wind, net heat flux, evaporation and precipitation) is appropriate to the model and modeling has been run for 20 years. Comparing the results of the model with the measured data shows a good agreement. The results of modeling indicate that there are three water masses up to 900 meters deep (modeled depth) in the Gulf of Aden. The Aden Gulf surface water mass is to the depth of 100-200 meters with a maximum salinity of 37 psu and density of 1023-1024 kg/m³. The water mass of the Aden Gulf's intermediate layers with the salinity of 35.9 to 36.9 psu and density of 1024-1026 kg/m³ at a depth of 100-600 m and deep water mass with salinity of 35.9-36.9 psu and density 1026-1027.5 kg/m³ located at depths of 400-900 meters and below. The horizontal density gradient due to salinity changes between the deep salty water and the low salty water of the Gulf of Aden leads to the creation of baroclinic instability. The calculation of the density ratio represents the establishment of a thermohaline convective regime between the Gulf of Aden water masses. The results of the release of passive tracer with a concentration of 100% in the Gulf of Aden from surface to depth also confirm the existence of three water masses. The surface plume spread to the length of the 46°E after 270 days under the influence surface currents of the Gulf of Aden. The output of plume at depths of 200 and 400 meters in two northern and southern channels extended to 47°E after 270 days in the Gulf of Aden. The critical width of the deep water flow for separation from the coastal boundary was calculated, by calculating the radius of Rossby deformation, as 30.25 km in the winter and 50.4 km in the summer.

Keywords: Passive tracer, MITgcm, Surface water mass, Intermediate, Deep water, Baroclinic instability, Entrainment, Gulf of Aden.
