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Gravitational and dynamical adjustment of the Red Sea Outflow Water in the western Gulf of Aden

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Hydrographic, direct velocity and subsurface float observations from the 2001 Red Sea Outflow Experiment (REDSOX) are analyzed to investigate the gravitational and dynamical adjustment of the Red Sea outflow where it is injected into the open ocean in the western Gulf of Aden. During the winter REDSOX cruise, when outflow transport was large, several intermediate-depth salinity maxima (product waters) were formed from various bathymetrically-confined branches of the outflow plume, ranging in depth from 400 to 800 m, and in potential density from 27.0-27.5 σ_θ, a result of different mixing intensity along each branch. The outflow product waters were not dense enough to sink to the sea floor during either the summer or winter REDSOX cruises, but analysis of previous hydrographic and mooring data and results from a one-dimensional plume model suggests that they may do so during wintertime surges of strong outflow currents, or about 20% of the time during winter. Once equilibrated in the Gulf of Aden, the shallowest Red Sea Outflow Water (RSOW) was strongly influenced by mesoscale eddies that swept it farther into the gulf. The deeper RSOW was initially more confined by the Tadjura Rift, but eventually it escaped from the rift and was swept mainly southward along the continental slope. There was no evidence of a continuous boundary undercurrent of RSOW similar to the Mediterranean Undercurrent in the Gulf of Cadiz. This is explained by considering (1) the variability in outflow transport, and (2) several different criteria for separation of a jet at a sharp corner, which indicate that the outflow currents should separate from the boundary where they are injected into the gulf.