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Simulation of circulation in the Red Sea and Gulf of Aden

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The aim of the present work is to simulate the circulation patterns in the Red Sea and Gulf of Aden during the NE (December-March) and SW (June-September) monsoon periods of the North West Indian Ocean. The total circulation of this region was simulated taking into consideration the effects of the thermo-haline and the wind driven motions. The simulation of circulation was done using the three-dimensional model; Princeton Ocean Model (POM). All the available hydrographic data collected during the period from 1923 up to 2001 were used in this simulation. The bathymetry of the area was obtained from the National Geophysical Data Center (NGDC) (ETOPO2; 2 minute Worldwide Bathymetry). The model results reveal that during winter a surface flow is directed into the Red Sea through the straits of Bab El-Mandeb from the Gulf of Aden. In the southern Red Sea there is a flow from south to north along the Arabian (Asian) and African coasts with intensification of the along-axis flow toward the coasts, with a transition from western intensified boundary flow in the south to eastern intensified flow in the north, and a series of strong seasonal or permanent eddy-like features and the most prominent eddy (large cyclonic gyre) that dominate the circulation in the northern Red Sea and is involved in the formation of Red Sea Outflow Water (RSOW). Over the sill at Bab el Mandeb during winter there is two layer system; the upper one is moving northward from the Gulf to the sea and the lower one is moving southward from the sea to the Gulf and during summer season three layers are distinguishable over the sill; an out flowing surface layer, a deep Red Sea water out flowing over the bottom of the sill, and an inflowing layer (the summer time intrusion of Gulf of Aden) from the Gulf of Aden. During winter, the field of the current in the northern part is more complicated while in summer the southern part is the more complicated. During summer the surface water of the Gulf of Aden flows out into the Arabian Sea as an east-going current, and this is replaced by water flowing from Red Sea through the Strait of Bab el Mandeb. During winter, the north-east monsoon directs water from the Arabian Sea into the Gulf of Aden, while the surface water of the latter flows into the Red Sea through the Strait of Bab el Mandeb. Good agreement with is noticed where in summer; the prevailing south-west winds direct the surface current mainly eastward from the Gulf of Aden into the Arabian. In the central part of the Gulf of Aden gyro-type motions are indicated, with a cyclonic eddy in winter and anti-cyclonic one in summer. The surface currents in front of the southern coast of Yemen are generally flowing with general trend of the coastline, being directed either east-northeastward in summer or west-southwestward in winter.

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