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High resolution modeling of the monsoon circulation in the Indian Ocean

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Results on the monsoon circulation in the Indian Ocean simulated with a ó-coordinate ocean model developed at the Institute of Numerical Mathematics, the Russian Academy of Sciences is presented. The model has a horizontal resolution of $1/8^\circ \times 1/12^\circ$ and contains 21 σ-layers of uneven thickness. Realistic bottom topography and land geometry are used. The numerical experiments were carried out for 15 years starting from the Levitus climatology for January and monthly mean climatic atmospheric forcing from the NCEP reanalysis data. The annual cycle of the surface and subsurface currents and temperature and salinity fields were analyzed. The model reproduces well the Summer Monsoon and the Winter Monsoon currents and their time evolution and spatial structures. The Somali Current is adequately modeled. During the Summer Monsoon, the velocities of the current exceed 2 m/s, while the total mass transport is approximately 70 Sv. The model results show that a reversal of the Somali Current from the northern direction in the summer to the southern direction in the winter is accompanied by the generation of anticyclonic eddies, which drift westward owing to the β-effect and dissipate either near the Somali shore or in the Gulf of Aden. The monsoon variability of the equatorial surface current and equatorial subsurface countercurrent system are analyzed. It is shown that these currents are generated predominantly by the zonal component of wind stress, in which the half-year harmonic dominates. This leads to the fact that the equatorial surface current also changes its direction with a half-year periodicity almost in phase with the wind. The oppositely directed subsurface compensational countercurrent changes its direction with a time lag of approximately one month. Gradient currents, which appear in the Bay of Bengal due to the riverine runoff, make an important contribution to the circulation. This effect manifests itself especially strongly in the summer during the

peak of the Ganges River runoff, which transports fresh turbid waters. The principal features of the large-scale quasi-stationary gyre structure of the Indian Ocean such as the Great Whirl, Socotra high, and Laccadive high and low are simulated.