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Coastal upwelling features in the Arabian Sea from ROMS model

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Upwelling is an important oceanic phenomenon in which subsurface cold and nutrient enriched water rises near to the surface and enhances biological productivity and therefore, affects the regional coastal climate. Coastal upwelling generally occurs when surface alongshore wind blows equatorward (poleward) along the eastern (western) boundary of an ocean. Horizontal divergence at the surface layer caused by Ekman transport is responsible for the ascending motion from the subsurface layers due to convergence below. During Indian summer monsoon (June-September) the strong southwest winds blows over the North Indian Ocean (NIO) basin, producing upwelling at the coasts of Somalia, Oman and the west coast of India. In this study, we use a free surface, hydrostatic, primitive equation ocean model- Regional Ocean Modeling System (ROMS) to simulate upwelling features along eastern and western boundaries of Arabian Sea (AS). The model follows sigma coordinate in the vertical. The horizontal and vertical resolutions of model are 0.25° × 0.25° and 32 vertical levels, respectively. The domain of the study is set as 30°E-120°E and 30°S-30°N with boundaries closed in north and west. The east and south boundaries are open and relaxed to climatology. The model is initialized with annual mean climatology and forced by Comprehensive Ocean Atmosphere Data Sets (COADS) Ocean surface monthly climatology. The model is spun up for 20 years to simulate the upwelling features in the Indian Ocean. In general, the model is able to capture the coastal upwelling features. The Ekman transport, as calculated from the data, is found to be four times larger at the Somali coast as compare to the eastern boundary of AS near Kerala Coast. Large transport values are evidence of significant upwelling observed near these coasts with a maximum in July. The capability of the model to simulate upwelling is analyzed by comparing the model temperature profiles and vertical velocity with earlier studies/observations. It is observed that the model is able to capture upwelling phenomenon along the Somali and Oman coast during the summer monsoon season. Although, the model simulates colder temperature during this season with the minimum temperature remaining lower than the climatological value.

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