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Variability of coastal upwelling along the east and west coast of India

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A three-dimensional orthogonal curvilinear-grid Princeton Ocean Model (POM) has been implemented to study the seasonal circulation and coastal upwelling off the west coast during July, the active phase of the southwest monsoon. The model uses a horizontal grid with higher resolution near the coast. In the vertical, a terrain following sigma coordinate is used, having fine resolution near the surface and bottom and relatively coarse one in the mid-depths. The POM has been configured for the southwest coast of the Indian peninsula, from 7oN to 21oN, covering the west coast, with an east-west extent of the model of about 250 km. The experiments are initially aimed to carry out model simulations on climatological scale, before proceeding for model evaluation on real-time basis. The response of the coastal ocean to mean wind stress forcing is studied on monthly time-scale for July 2000 and 2003 and on weekly-scale for the second and last weeks of July 2002. The model simulations could show that the shallow mixed layer depth and weak vertical thermal stratification to be susceptible for upwelling. The surface circulation and SST in the horizontal and the vertical cross-shelf section of temperature at selected locations are discussed. The model simulated SST is fairly in good agreement with the corresponding analyzed in-situ and satellite SST imageries.

The POM model is also configured for the east coast of India from 130N to 220N with an offshore breadth of about 250 km. The experiments are initially aimed to carry out model simulations to find the response of the coastal ocean on monthly climatological scale to simulate currents, temperature and salinity using the mean monthly winds, before proceeding for model evaluation on real-time basis. The model is forced with wind stress inferred from the winds derived from COADS. During the pre-monsoon, the wind direction is mostly south-westerly which is conducive to upwelling processes. The bearing of the thermal stratification and the mixed layer depth and the initial temperature and salinity fields on coastal upwelling processes are discussed. The model simulations could ascertain that the shallow mixed layer depth and weak vertical thermal stratification to be more susceptible for upwelling. The model could simulate western boundary current along the coast. However, it is interesting to note that the initial temperature and salinity fields, derived from Levitus monthly climatology play an important role in influencing the upwelling processes in the region north of Paradip. The density stratification tends to produce southerly current north of Paradip, weakening of the western boundary current. This tendency also causes the wind stress effect being confined to shallow layers. The surface circulation and SST in the horizontal and the vertical cross-shelf section of temperature at Visakhapatnam and Paradip are discussed to elucidate the spatial variations. The model simulated SST is fairly in good agreement with the Levitus and Boyer atlas as well as analyzed in-situ and satellite SST imageries obtained from the International Research Institute for climate Prediction (IRI).