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Projecting Three-dimensional Ocean Thermohaline Structure in the North Indian Ocean from the Satellite Sea Surface Data Based on a Variational Method

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This study uses a variational method combined with satellite observations to reconstruct three-dimensional temperature and salinity profiles for the Northern Indian Ocean (NIO). Sensitivity experiments show that sea surface temperature (SST) dominantly improve the temperature reconstruction of upper 100 m; sea surface salinity (SSS) determines salinity estimation in the upper 100 m; sea surface height anomaly (SSHA) dominates the reconstruction of thermocline. The reconstructed temperature fields can be greatly improved in the thermocline by removing barotropic signal from the altimeter SSH data through a linear regression method. Ocean reanalysis and in situ temperature and salinity data are used to evaluate the results of reconstruction. Comparing with Simple Ocean Data Assimilation (SODA) in 2016, the spectral correlation between the reconstruction and the SODA density anomalies show that the reconstruction fields can retrieve mesoscale and large-scale signals better. Moreover, the reconstruction salinity is much more accurate than SODA salinity in the upper ocean over the Bay of Bengal (BoB). Compared with CTD section observations, the reconstruction fields can capture the mesoscale eddy structure in the Arabian Sea (AS) and BoB well, respectively. The long time series of reconstruction along Argo trajectory shows that the reconstruction fields can better reproduce the observed intraseasonal oscillations of thermocline/halocline in the BoB. Compared with the World Ocean Atlas 2013 (WOA13) climatology, the reconstruction fields can better characterize upper ocean water mass variability.