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Seasonal Variability of M_2 Internal Tides Energetics in the Western Bay of Bengal

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Abstract : The Internal Waves (IWs) are generated by the flow of barotropic tide over the rapidly varying and steep topographic features like continental shelf slope, subsurface ridges, and the seamounts, etc. The IWs of the tidal frequency are generally known as internal tides. These waves have a significant influence on the vertical density and hence causes mixing in the region. Such waves are also important in submarine acoustics, underwater navigation, offshore structures, ocean mixing and biogeochemical processes, etc. over the shelf-slope region. The seasonal variability of internal tides in the Bay of Bengal with special emphasis on its energetics is examined by using three-dimensional MITgcm model. The numerical simulations are performed for different periods covering August-September, 2013; November-December, 2013 and March-April, 2014 representing monsoon, post-monsoon and pre-monsoon seasons respectively during which high temporal resolution in-situ data sets are available. The model is initially validated through the spectral estimates of density and the baroclinic velocities. From the estimates, it is inferred that the internal tides associated with semi-diurnal frequency are more dominant in both observations and model simulations for November-December and March-April. However, in August, the estimate is found to be maximum near-inertial frequency at all the available depths. The observed vertical structure of the baroclinic velocities and its magnitude are found to be well captured by the model. EOF analysis is performed to decompose the zonal and meridional baroclinic tidal currents into different vertical modes. The analysis suggests that about 70-80% of the total variance comes from Mode-1 semi-diurnal internal tide in both observations as well as in the model simulations. The first three modes are sufficient to describe most of the variability for semidiurnal internal tides, as they represent 90-95% of the total variance for all the seasons. The phase speed, group speed, and wavelength are found to be maximum for post-monsoon season compared to other two seasons. The model simulation suggests that the internal tide is generated all along the shelf-slope regions and propagate away from the generation sites in all the months. The model simulated energy dissipation rate infers that its maximum occurs at the generation sites and hence the local mixing due to internal tide is maximum at these sites. The spatial distribution of available potential energy is found to be maximum in November ($20 kg/m^2$) in northern BoB and minimum in August ($14 kg/m^2$). The detailed energy budget calculation are made for all the seasons and results are analysed.

Keywords : available potential energy, baroclinic energy flux, internal tides, Bay of Bengal
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