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Internal tides over the shelf edge of the Western Bay of Bengal

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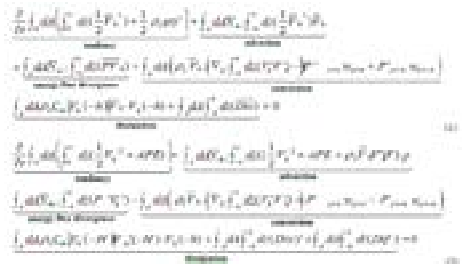
Introduction: The energetics of internal tides using Massachusetts Institute of Technology general circulation model (MITgcm) in the coastal waters of the extended shelf of the Western Bay of Bengal (BoB) is investigated. The model open-boundaries are forced with barotropic tidal velocity components from TPXO model. The spectral estimate of density indicates that the peak estimate is associated with the semidiurnal frequency at all the depths. The baroclinic zonal and meridional components of velocity are found to be in the order of 0.3 and 0.4 ms^{-1}, respectively in observations as well as in the simulations. The energy flux calculated using the velocity-pressure correlation is predominantly seen in zonal direction from both observations and simulations. The calculation of Richardson number reflected the presence of local mixing due to density overturning in the shelf region. The model simulation suggests that the internal tides are generated all along the shelf-slope region and maximum amount of energy propagates towards the coast. The study of seasonal variability of internal tides suggests that the magnitude of energy flux is more in November compared to other 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 more at these sites. The spatial distribution of Available Potential Energy (APE) (20 kJm^{-2}) is found to be maximum in November and minimum (14 kJm^{-2}) in August in the northern BoB. The APE is found to be more in the north and hence the internal tide energy is more. The detailed energy budget calculations are made for different seasons and the results are analyzed in this study.

Methodology & Theoretical Orientation: The characteristics of internal tides, such as source of generation, direction of propagation and subsequent dissipation are investigated quantitatively based on their energetics. The barotropic and depth-integrated baroclinic energy equations are given by:



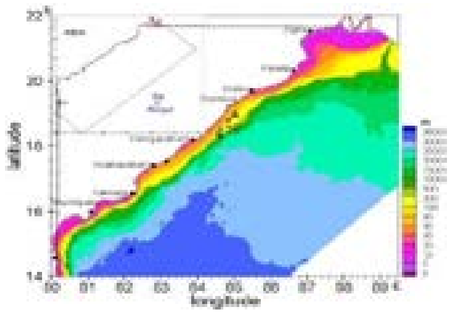


Figure 1: Bathymetry of the study region. The locations of in-situ observations are marked by A, B, C. Model analysis area is shown in the inset map.

Findings: Model simulated spectral estimate of density and baroclinic velocity are reasonably well compared with the available *in-situ* observations; Potential regions of generation, propagation and dissipation of internal tides are investigated; Detailed energy budget of internal tides and its seasonal variability are examined.

Conclusion & Significance: The computations of energy flux and energy conversion of barotropic to baroclinic rate suggest that there are multiple source/sink sites in the domain. The energy conversion rate is seen between the isobaths of 500 and 1500 m. The baroclinic energy flux is perpendicular to that of barotropic which propagates toward the coast. The dissipation rate is responsible for maximum mixing over the shelf-slope region. From the spatial distribution of APE, the maximum value is pronounced in the north of the western BoB. This implies that the internal tide is more dominant over this region. The mixing due to density overturning over the continental shelf is studied through the Richardson number which causes vertical mixing.

Recent Publications

1. **Sachiko Mohanty, A D Rao and G Latha (2018) Energetics of semidiurnal internal tides in the Andaman Sea. Journal of Geophysical Research-Oceans 123(9): 6224-6240.**
2. **Mohanty, A D Rao and Himansu K Pradhan (2017) Estimates of internal tide energetics in the western Bay of Bengal. IEEE Journal of Ocean Engineering 43(4):1015-1023.**
3. **Sachiko Mohanty, A D Rao and Himansu K Pradhan (2017) Effect of seasonal and cyclonic winds on internal tides over the Bay of Bengal. Natural Hazards 87(2):1109-1124.**
4. **Poulose Jismy, A D Rao and Prasad K Bhaskaran (2017) Role of continental shelf on non-linear interaction of storm surges, tides and wind waves: An idealized study representing the west coast of India. Estuarine, Coastal and Shelf Science 1-14.**

Biography

Devendra Rao Ambarukhana has completed his MSc in Applied Mathematics at Andhra University in 1978 and PhD at IIT Delhi in 1982 for his doctoral work on Numerical Storm Surge Prediction in India. He joined the faculty of IIT Delhi in 1982. He is currently holding a Professor position at CAS, IIT Delhi since 2002. His research interests include development of numerical models for storm surges, internal waves, ocean state forecast and air-sea interaction processes. His contribution to the surge prediction system is very significant as the inland intrusion of surge waters is the main cause for extensive damage along the Indian coasts. He has published more than 190 papers in various national and international journals.

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