ABSTRACT

The surface circulation in the Bay of Bengal (BoB) is unique due to the influence of seasonal reversal of monsoon winds and large amount of fresh water influx from various rivers. In addition, the basin circulation is also significantly influenced by the equatorial wind anomalies associated with the interannual climate mode Indian Ocean Dipole (IOD) through its remote and local forcing. The western part of the BoB circulation is sensitive to the variability in all time scales with the formation of northward flowing Western Boundary Current (WBC) during February-May and southward flowing East Indian Coastal Current (EICC) during August-December. Although the seasonality of the BoB circulations are well investigated, a little is known about its interannual variability.

In this study, the interannual variability of boundary currents, mesoscale eddies and Mixed Layer Depth (MLD) in the BoB are studied comprehensively using the measurements and high resolution Regional Ocean Modeling System (ROMS) simulation. The automated eddy detection and tracking technique reveals two distinct eddy productive zones in the western BoB: offshore of Visakhapatnam dominated by the anticyclonic eddies (ACEs) and the northern part of western BoB, where the cyclonic eddies (CEs) are more frequent. The ACEs generally move westward, whereas the CEs tend to follow southwestward and southward along the western coastal region of BoB. The CEs are more energetic and persists longer than ACEs. The occurrence of eddies was more during the positive IOD (pIOD) years 1997-1998 and 2006 as compared to other years. Analysis of model simulations from 2006-2012 shows that the EICC is more sensitive than the WBC to the IOD signals. It is found that the strength of EICC was ~5 Sv in October 2010 but a weaker EICC dominated by the eddies was observed in October 2006. During pIOD year 2006, the strong easterly winds over the equatorial IO result in low SSH and drive anomalous upwelling Kelvin waves (KWs) throughout the summer and autumn. So the second downwelling coastal KW is completely absent and it makes the EICC disorganized. The study on MLD reveals that the southern BoB is largely affected by the intensity of seasonal winds, whereas the negative heat flux contributes significantly to the deepening of MLD in the northern BoB. In 2006, MLD was shallow, but the negative phase of IOD is associated with deepening of MLD in BoB. The anomalous upwelling (downwelling) KWs and the reflected Rossby waves in the central BoB during the pIOD (nIOD) year 2006 (2010) rise (suppress) the thermocline and produce shallow (deep) MLD. The positive net heat flux at the air-sea interface also plays a dominant role in shoaling of the MLD as shortwave radiation increases and exceeds the latent heat flux cooling during this period.

Keyword: BoB, Mesoscale eddy, ROMS, IOD, WBC, EICC, MLD.