Abstract

Tide generated Internal Solitary–like Waves (ISWs) are ubiquitous phenomenon in the global ocean and are known to transport baroclinic energy to large distances. However, the major part of this energy is confined to certain hotspot regions. Few such regions are located in the Andaman Sea. These large amplitude nonlinear waves can influence important oceanic processes like mixing, biological productivity, ocean acoustics and are proven hazard to offshore oil and gas drilling platforms. Remote sensing observations from space can be able to delineate these waves from their ocean surface signatures. Mostly images from two sensors, (i) Moderate Resolution Imaging Spectroradiometer (MODIS) sunglint true colour and (ii) Synthetic Aperture Radar (SAR), are used.

This study uses remote sensing observations along with a numerical model to identify a major hotspot of ISWs in the Andaman Sea and discuss their generation mechanism and initial propagation characteristics. Exploitation of MODIS true colour images indicate the presence of five hotspot regions in the Andaman Sea. Further, it is found that bidirectional long–living ISWs are generated from a shallow ridge connecting the northern Nicobar Islands, namely Car Nicobar and Chowra Islands. Batti Malv Island separates this shallow ridge into two sections, represented as NBM (North of Batti Malv) and SBM (South of Batti Malv). Moreover, Synthetic Aperture Radar (SAR) images over the region reveal the generation of mode-1, and higher mode ISWs emerging from NBM and SBM. The generation mechanism(s) and propagation characteristics of the ISWs radiating from SBM and NBM is explored using a nonlinear, unstructured and nonhydrostatic model, SUNTANS (Stanford Unstructured Nonhydrostatic Terrain-following Adaptive Navier-Stokes Simulator). Numerical simulations show that supercritical tidal flow develops over NBM and mode-1 ISWs are generated at both tidal phases by a Lee wave mechanism. However, the flow over SBM is subcritical with respect to mode-1 long wave and supercritical for higher modes. The bidirectional propagating mode-1 (mode-2) ISWs evolve from a long wave disturbance induced by upstream influence (Lee wave mechanism) respectively. An energy budget comparison reveals that the region surrounding NBM is efficient in radiating low-mode baroclinic energy ($0.98GW$), while SBM is highly efficient in converting barotropic to baroclinic energy ($4.1GW$).

The higher mode ISWs observed to the west of SBM in the SAR images are explored using numerical simulations. Simulations show that, after the end of flood tide (west to east barotropic tidal flow), a downward propagating internal tidal beam (ITB) is generated on the western slopes of SBM. This ITB reflects from the seafloor and excites a mode-3 type of ISW after impinging on the pycnocline at about $26km$ west of

SBM–a generation mechanism referred to as local generation. Later, it is shown that the westward propagating mode-1 ISW from SBM, will overtake the locally generated mode-3 ISW and also the SBM generated mode-2 ISW of previous tidal cycle. After the interaction of first mode with higher modes, short internal waves appear behind higher mode waves, pertaining to the resonance between tail of mode-1 ISW and higher mode solitary waves.

Keywords: Internal Solitary Waves; Synthetic Aperture Radar; ISW generation; ISW interaction; SUNTANS