Subsurface trapped core formed within second-mode nonlinear internal waves over the shelf break of the East China Sea

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Second-mode nonlinear internal waves (NLIWs) were observed over the shelf break of the East China Sea in July 2018. Two acoustic Doppler current profilers (ADCPs) mounted in trawl-resistance bottom mounts were deployed in an upward looking configuration on the seabed, where the water depth is about 120 m. During the observation period of two days, wave trains arrived at an interval of approximately one day, suggesting that these NLIWs are generated in association with the diurnal tide. The amplitude, propagation direction, and propagation speed of the second-mode NLIW were estimated from along-beam velocities using the iterative method that takes into account the effects of the background flow as well as the inevitable beam-spreading of the ADCP. The results of the iteration show that second-mode NLIWs propagate shoreward at a speed of about 0.3 ms^{-1}, consistent with a 6-hour lag of the arrival time between two ADCPs spaced 7.4 km apart, perpendicular to isobaths of the continental slope. At the offshore ADCP, the amplitude and maximum velocity of the leading wave are estimated to be 20 m and 0.4 ms^{-1}, respectively. The estimated maximum velocity along the propagation direction exceeds the propagation speed, resulting in the formation of the subsurface trapped core with closed streamlines in the depth range of 60-80 m. On the other hand, no subsurface trapped core is recognized at the onshore ADCP, where both the amplitude and maximum velocity of the leading wave are much smaller than those at the offshore one. These results suggest breaking of the second-mode NLIWs by convective instability and leakage of fluid in the subsurface trapped core between two ADCPs.

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