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Interaction of Large Amplitude Interfacial Solitary Wave of Depression with Bottom Step

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The dynamics and energy balance of large amplitude interfacial solitary wave of depression transformed at the bottom step are studied. Three runs of numerical modeling are done in the frame of the non-hydrostatic extension of the Princeton Ocean Model (POM) based on the fully nonlinear Navier-Stokes equations with the Boussinesq approximation. The first run is done when the ratio of the thickness of step height to lower layer is about 0.4 and the incident wave amplitude is less of the limiting value estimated for the Gardner soliton. It shows the applicability of the weakly nonlinear model (the Gardner equation) to describe the transformation of strongly nonlinear wave in this case. In the second run the incident wave amplitude is increased and is described by Miyata-Choi-Camassa soliton solution. The process of wave transformation is accompanied by shear instability and formation of the Kelvin-Helmholtz billows resulted thickening interface layer in this case. In the third run the same Miyata-Choi-Camassa solitary wave passes through step when ratio of the step height to thickness of lower layer is 0.8 undergoes strong reflection and mixing between layers whereas the Kelvin-Helmholtz instability is absent. The energy budget of the wave transformation is calculated. It is shown that energy loss in a vicinity of a step grows with the increase of ratio of incident wave amplitude to the thickness lower layer over the step.