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Interaction of the strongly nonlinear internal solitary wave of second mode with the bottom step: breather formation

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Second mode internal waves are widespread in offshore areas, and they frequently follow the first mode internal waves on the oceanic shelf. To study the main properties of interaction of second mode internal waves with a bottom features we consider simple configuration of numerical tank with a bottom step. The tank is filled by symmetricaly stratified three-layer fluid. Depending on the parameter of blocking B (ratio of the lower layer depth over the step to incident wave amplitude [1]) a several regimes can be separated. If $B > 4$, that means that the lower layer is deep enough in comparison with amplitude of the incident wave, then the second mode internal wave pass the step without significant changes. At the range of $0< B<0.5$, that corresponds to the case when amplitude of the incident wave is greater than the depth of the lower layer over the step, incident second mode wave completely transforms into a solitary wave of the first mode and into reflected wave of the second mode. These transformations are opposite to the well-known mechanism of formation of the second mode wave in result of the first mode wave interaction with bottom relief. The most interesting is the transitional regime with the range of blocking parameter $0.5<B<4$. Under these conditions the transmitted wave amplitude decreases after step whereas first mode wave is radiated in front of the transmitted second mode internal wave. So the first and the second mode internal waves coexist over the step. During this transformation internal wave breathers are generated after the step. Thus in the frame of numerical modeling new mechanism of the breather generation was found: in the case of three-layer stratification internal wave-breather can occur due to interaction of the second mode internal wave with abrupt changes of the bottom topography. The dependencies for transformation coefficients (reflection and transmission) on the parameter of blocking are similar for incident long and intermediate waves of second mode.

References

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