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Nonlinear internal wave packets in shelf zone

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The problem on nonlinear internal waves propagating permanently in shallow fluid is studied semi-analytically in comparison with the field data measured on the sea shelf. This paper deals with periodic cnoidal-type wave packets considered in the framework of mathematical model of continuously stratified fluid. Basic model involves the Dubreil-Jacotin–Long equation for a stream function that results from stationary fully nonlinear 2D Euler equations. The long-wave approximate equation describing periodic non-harmonic waves is derived by means of scaling procedure using small Boussinesq parameter. The fine-scale density plays important role here because it determines the nonlinearity rate of model equation, so it permits to consider strongly nonlinear dispersive waves of large amplitude. As a result, constructed asymptotic solutions can simulate periodic wave-trains of sub-surface depression coupled with near-bottom wave-trains of isopycnal elevation. It is demonstrated that calculated wave profiles are in good qualitative agreement with internal wave structures observed by the authors in the field experiments.

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