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Edge waves above a cylindrical shelf: focusing, instabilities and interactions

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Dynamics of multimodal edge waves above a shelf with a cylindrical bottom relief is investigated. In the framework of the linear theory the possibility of their spatial-temporal focusing is shown. The adiabatic theory of shallow linear edge waves above inclined bottom with depth slowly varying in alongshore direction is proposed. On a base of asymptotic theory the equation, describing alongshore changes of wave amplitudes is obtained. The analytical formulations are performed for three various profiles of cylindrical shelf: infinite linear slope, concave exponential and step shelf - with variable alongshore parameters. It is shown, that slow changes of shelf topography can result both in amplification, and in attenuation of edge waves. The effect of minimum frequency is marked out - it can result in dispropagation of higher mode edge waves. The mechanism of formation of single-mode large amplitude groups of edge waves above infinite linear shelf is investigated in the framework of nonlinear Schrodinger equation. Two mechanisms of focusing are considered: self-modulation as a result of modulation instability of nonlinear wave packets and nonlinear spatial-temporal focusing as a result of dispersive compression. The nonlinear three-wave interactions of edge waves, extending both in one, and in opposite directions on a shelf of arbitrary profile are considered. The conditions of synchronism are determined and the coefficients of interaction are calculated for cases, when waves of four lowest modes participate in interaction. Detailed analytical study is carried out for three aforementioned shelf profiles. Spatial-temporal dynamics of interaction is illustrated for one interacting edge wave triad. The effect of radiation at interaction of counterpropagating edge waves above infinite linear shelf is shown. Interpretation of wave field characteristics and coastline forms is given in the framework of exact solutions of three-dimensional nonlinear equations for waves propagating above infinite linear shelf. Comparison

with short-period edge wave observational data and natural morphological features of the coastline accompanying these waves observed on Kuril Islands is performed.