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Dynamics of surfactants in the field of edge and internal waves in coastal areas

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Edge waves are topographically trapped waves, which can be considered as an important factor impacting upon coastline and nearshore bottom relief, beaches and coastal constructions. Large amplitude nonlinear edge waves are possible due to the action of different mechanisms. Their dynamics can be described by nonlinear Shrodinger equation, and the signs of its coefficients correspond to modulation instability of wave packets. The mechanisms of possible anomalous edge wave appearance are dispersion enhancement and self-modulation; they can lead to forming of abnormal edge wave. In the present paper we consider processes of edge wave propagation and amplification along a cylindrical shelf taking into account horizontal alongshore flow and Earth rotation.
Internal waves exist in stratified coastal areas, and for them extreme regimes are also well-known, including propagation of such energetic events as solitary waves and breathers.
The existence of waves of both type lead to formation of wave-induced currents, which can be quite strong and can significantly affect the surrounding environment. In particular, these currents can influence upon pollutants, admixtures and films on the surface of the sea causing their redistribution according to zones of convergence and divergence of the velocity fields. These specific pictures on the surface can be used in the interpretation of remote sensing data and diagnostics and identification of underlying wave processes.
In the present study we demonstrate dynamics of surfactants in the field of edge and internal waves in coastal areas. Numerical modeling is based on the balance equation of the surface concentration. Film dynamics was considered in the advection - diffusion - relaxation model. We show a number of unsteady effects in the edge and internal waves and their manifestation in the surfactants. For edge waves we considered the passage of linear traveling and standing waves, the wave amplitude changes due to slow longshore variations in the underwater topography, interactions of edge wave triads, effects of dispersive focusing and nonlinear self-modulation. Calculations are performed for various combinations of the parameters of the shelves, waves of different modes and their superposition, as well as for fully nonlinear edge wave solution in Lagrangian coordinates, for different values of diffusion coefficient and time of relaxation. For internal waves we consider large-amplitude soliton transformation along a section of variable depth and density profile, and the image of this process in the surfactant film.

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