Coherent wave groups causing rogue waves

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Abstract:

The probability of rogue waves deviates significantly from the Rayleigh distribution function due to wave-wave interactions, which make the dynamics of different spectral components coherent. Due to this effect waves may form long-living groups, which manifest themselves through their own dynamics. In the limit of weakly nonlinear modulated waves over deep water the groups are envelope solitons or breathers described by the integrable nonlinear Schrödinger equation. The paper is focused on the question how the long-living nonlinear wave groups behave in the conditions of strong wave nonlinearity, irregular sea states and could be revealed in instrumental measurements of oceanic waves.
The envelope soliton solution of the nonlinear Schrödinger equation is examined by means of fully nonlinear simulations of the Euler equations and also in laboratory experiments in the situation of strong nonlinearity. It is shown that strongly nonlinear effects do not destroy the solitary wavegroup even when the steepness is high.
The attempt to map the weakly nonlinear analytic description of modulated nonlinear waves (due to the Inverse Scattering Technique) to the case of strong nonlinearity is undertaken. Qualitative comprehension of the strongly nonlinear wave dynamics and qualitative description of it would provide elements of short-term forecasting for rogue waves. The accessibility of this goal is discussed.

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