Annenkov, Sergei

Direct numerical simulation of the evolution of high-order statistical momenta of weakly nonlinear water wave field (joint work with V.I. Shrira)

The aim of this work is to investigate by means of direct numerical simulations (DNS) the long-term evolution of the wave field higher statistical momenta, linked to the probability of the extreme waves.

We employ a particular DNS approach based on the integrodifferential Zakharov equation. The numerical method includes building of a dense grid of waves coupled by resonance interactions, with subsequent grouping into a smaller number of wave packets, so that each packet has the amplitude of the envelope of harmonics it comprises and a randomly chosen phase, with all the resonant interactions of the original harmonics taken into account.

Formation of powerlike spectra corresponding to direct cascade of energy to high frequencies and inverse cascade of wave action is demonstrated. Initial part of evolution obtained with DNS has considerably shorter timescale than that predicted by the statistical theory, and, in fact, represents and effective modification of its initial conditions. The wave field is shown to react more quickly and differently to rapidly varying forcing (for example, wind gusts), which is instanteneous in terms of statistical theory. It is found that the evolution can be significantly affected by higher-order (five-wave) interaction processes, which are usually ignored. Special attention is paid to the evolution of higher statistical momenta, in particular kurtosis, known to be a measure of the extreme waves probability.

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