



Rogue waves in the ocean – review and progress

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Rogue waves in the ocean and physical mechanisms of their appearance are discussed. These waves are among waves naturally observed by people on the sea surface that represent an inseparable feature of the Ocean. Rogue waves appear from nowhere, cause danger and disappear at once. They may occur at the surface of a relatively calm sea, reach not very high amplitudes, but be fatal for ships and crew due to their unexpectedness and abnormal features. The billows appear suddenly exceeding the surrounding waves twice and more, and obtained many names: abnormal, exceptional, extreme, giant, huge, sudden, episodic, freak, monster, rogue, vicious, killer, mad- or rabid-dog waves; cape rollers, holes in the sea, walls of water, three sisters. . . Freak monsters, though living for seconds, were able to arouse superstitious fear of the crew, cause damage, death of heedless sailors or the whole ship. All these epithets are full of human fear and feebleness.

The serious studies of the phenomenon started about 20–30 years ago and have been intensified during the recent decade. The research is being conducted in different fields: in physics (search of physical mechanisms and adequate models of wave enhancement and statistics), in geoscience (determining the regions and weather conditions when rogue waves are most probable), and in ocean and coastal engineering (estimations of the wave loads on fixed and drifting floating structures). Thus, scientists and engineers specializing in different subject areas are involved in the solution of the problem.

The state-of-art of the rogue wave study is summarized in our book [Kharif, Ch., Pelinovsky, E., and Slunyaev, A. *Rogue Waves in the Ocean*. Springer, 2009] and presented in given review. Firstly, we start with a brief introduction to the problem of freak waves aiming at formulating what is understood as rogue or freak waves, what consequences their existence imply in our life, why people are so worried about them. Then we discuss existing observations and measurements of freak waves. Two approaches to the rogue wave description (deterministic and statistical) are presented. Briefly, the physical mechanisms that have been already suggested as possible explanations of the freak wave phenomenon are: i) wave-current interaction; ii) geometrical (spatial) focusing; iii) focusing due to dispersion (spatio-temporal focusing); iv) focusing due to modulational instability; v) soliton collision; vi) atmospheric action.

In conclusion we emphasize that most of the developed theories are applicable to other physical phenomena starting from ocean waves of different nature and ending with nonlinear optics (for instance optical rogue waves in fibers) and astrophysical plasma processes. The recent trends in study of the oceanic rogue waves are discussed as well.