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# Freak wind waves: measurements, hindcasting and forecasting

L. Lopatoukhin (1,2) and A. Boukhanovsky (2)

(1) University, Oceanology, St. Petersburg, Russian Federation (leonid-lop@yandex.ru), (2) St. Petersburg State University of Information technologies, Mechanics and Optics.

One of the most interesting extreme phenomena is freak (or rogue) waves. Such waves may arise in any place of an Ocean and had been measured. The example of recent freak wave event is the loss of ship “Aurelia” (Class of Russian Register of shipping) in February 2005 in the North Pacific. The main difference between extreme and freak waves is in their form. This uncommonness specified by means set of parameters; e.g., h>2.4hs, crest>0.65h, unusual steepness, deep trough (twice as greater than preceding and subsequent waves), etc. Not all of these parameters are realized simultaneously. A lot of hypotheses try to explain freak wave generation. All the reasons may be separated to external and internal. The internal reasons – are connected mainly with the frequency and (or) amplitude wave modulation in a random sea, effects of four and five-wave interactions, the high-order nonlinearities, nonlinear focusing, etc. The external reasons – are metocean and include the opposing wave-current interaction, refraction around shoals or from inclined seabed, wave caustics from diffraction at coastlines, crossing wave systems, etc. “Aurelia” sunk during passing of atmospheric front with veering wind, changing wind waves.
The most of freak wave measurements are records in some point of a sea. Short-term statistics do not consider such phenomenon. Directional spectrum of wave record does not reveal existing of freak wave. Classical statistical analysis of time series do not allows estimating the probabilities of freak waves occurrence and associated weather conditions. Random model with so called contaminated distribution as the approach to statistics of freak waves is proposed.
Results of hindcasting for any specific time do not display any suspicion to freak wave. But synthesis of hindcasted spectra as climatic wave spectra, i.e. their long-term (climate) features opens the perspective to estimation the probability of freak wave phenomena. One of metocean scenarios leading to freak wave generation is rapid changing of wave conditions. For climatic wave spectra this is situation with jump from one class of spectra to another and returning back to initial situation. Therefore prediction of spectral jumps is one of the early warning to possibility of a freak wave arising. In order to efficiently use calculated statistics in practice it is important to focus on the measure of risk, which is taken as acceptable limit. This is very delicate balance of factors in which consequence of damage, cost of construction, and cost of mitigation of possible accident are major players.
The details of approach, comparison of methods and known freak wave records and observations will be examined.