Multivariable extremes of metocean events (extreme and freak as the examples)

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Problem of estimation of high waves became clearer due to development of numerical models of wave hindcasting and forecasting, advent of reanalysis of meteorological data (as the input to models) and high performance computing. As a result it is possible to make continues hindcasting (30 years and longer duration) of wave parameters for any region. There exist different approaches to estimation of probability of wave heights with n-years return period. (Review of one dimensional methods and their comparison is published by World Meteorological Organization. See: WMO/TD-No. 1041, 2000, JCOMM Technical Report. www.jcommweb.net). In estimation of joint extremes (e.g., wave-heights and periods, wave heights and wind or current speed, wave heights in two different points simultaneously, etc) arise some problems. In particularly, the estimates with single return period belong to a set of pairs of random values. This problem may be solved by introduction of risk function. Some proposals will be presented.

One of interesting extreme phenomenon is freak (or rogue) waves. Physical hypotheses of freak wave generation allow their arising in any place of an Ocean. There is no common definition of a freak wave. Freak waves are unusual not by their height, but also by the form and have to posses some principal difference from extreme wave. This uncommonness specified by means set of parameters; e.g., $h > 2.4h_s$, $crest > 0.65h$, unusual steepness d of a wave and (or) it front or back slope, deep trough (twice as greater than preceding and subsequent waves), etc. Not all of these parameters are realized simultaneously. The approach regarded freak wave as multivariable random event is needed. The details of approach, comparison with other methods and known freak wave records will be presented.