Geophysical Research Abstracts
Vol. 15, EGU2013-8545, 2013
EGU General Assembly 2013

Probability of occurrence of rogue sea states

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Owing to many research efforts in the last decade, the occurrence of rogue waves, their mechanism, and detailed dynamic properties are now becoming clear. Consistency between numerical models and experimental data has been documented by several authors. The focus is now on forcing terms like wind and current and wave breaking that are not typically included. Despite recent achievements, consensus on the definition of rogue waves and particularly their probability of occurrence has not been reached yet. Such consensus, however, is essential for the evaluation of possible revision of offshore standards and classification society rules, which currently do not include rogue waves explicitly.

It is well known that sea states characterised by high steepness and narrow directional distribution are prone to modulational instability mechanisms and hence the formation of rogue waves. Further, wave systems crossing under a particular angle can also be responsible for generation of these abnormal waves. The present study is addressing these rogue-wave-prone sea states and their probabilities of occurrence. The analysis is based on hindcast data from the North Atlantic, the North Sea and Australia. The data have been generated by the wave model WAM and are covering the time period ranging from 10 to 50 years. Long-term probabilistic description of rogue-wave-prone sea state characteristics is established. Further, an attempt is made to provide probability of occurrence of such rogue-wave-prone sea states. Low, intermediate and high sea states considered. The results are discussed from the perspective of design and operations of ships and offshore structures.