Development of a Freak Wave Warning system at ECMWF.

Peter A.E.M. Janssen
formerly at E.C.M.W.F., Shinfield Park, Reading, U.K.

In this presentation I will discuss how in the context of modern wave forecasting, which gives the average sea state in terms of the two-dimensional wave spectrum, useful statistical information on extreme events such as freak waves can be obtained.

If, at a certain location and time, the wave spectrum is known then all wave quantities such as wave height, period, energy flux and mean wave direction can be obtained. But knowledge of the wave spectrum also allows to obtain information on the statistics of waves. I will discuss a theoretical development that results in an expression for the probability distribution function (p.d.f.) of the envelope wave height. This p.d.f. depends, because of the nonlinearity of the wave evolution equations, on the skewness and kurtosis of the sea surface. This framework allows to make statements on the occurrence probability of extreme events, and it is shown that nonlinear effects play an important role in making these events plausible.

However, by way of a specific example, namely the Draupner freak wave event and by way of a comparison with observations, it will be argued that our freak wave forecasting systems has obvious limitations because it is based on an ensemble prediction. This implies that we can only predict the p.d.f of the sea surface elevation and wave energy but not the actual surface elevation.