

Space-time extreme wind waves: Observation and analysis of shapes and heights

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We analyze here the temporal shape and the maximal height of extreme wind waves, which were obtained from an observational space-time sample of sea surface elevations during a mature and short-crested sea state (Benetazzo et al., 2015). Space-time wave data are processed to detect the largest waves of specific 3-D wave groups close to the apex of their development.

First, maximal elevations of the groups are discussed within the framework of space-time (ST) extreme statistical models of random wave fields (Adler and Taylor, 2007; Benetazzo et al., 2015; Fedele, 2012). Results of ST models are also compared with observations and predictions of maxima based on time series of sea surface elevations.

Second, the time profile of the extreme waves around the maximal crest height is analyzed and compared with the expectations of the linear (Boccotti, 1983) and second-order nonlinear extension (Arena, 2005) of the Quasi-Determinism (QD) theory. Main purpose is to verify to what extent, using the QD model results, one can estimate the shape and the crest-to-trough height of large waves in a random ST wave field.

From the results presented, it emerges that, apart from the displacements around the crest apex, sea surface elevations of very high waves are greatly dispersed around a mean profile. Yet the QD model furnishes, on average, a fair prediction of the wave height of the maximal waves, especially when nonlinearities are taken into account. Moreover, the combination of ST and QD model predictions allow establishing, for a given sea condition, a framework for the representation of waves with very large crest heights. The results have also the potential to be implemented in a phase-averaged numerical wave model (see abstract EGU2016-14008 and Barbariol et al., 2015).

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