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Analysis of wave groupiness in space and time derived from time series of marine radar images of the sea surface

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It is well known that ocean gravity waves form wave groups. These groups are observed as sequences of high waves with nearly equal periods, or wavelengths. Wave groups are often responsible for serious damages to marine systems (i.e. ships, off and onshore structures, etc.) when the period of the individual waves in the group are close to the resonance period of the system. Traditionally, wave groups have been studied in the temporal domain by using wave elevation time series measured by moored buoys. From these buoy records, time-dependent group properties can be derived at a fixed location of the ocean (e.g., the buoy deployment position). In contrast to those buoy records, which describe wave grouping properties as a function of time, conventional X-band marine radars are able to scan time series of sea surface areas. Therefore, marine radars obtain information of the sea surface in three dimensions (e.g. the two-dimensional sea surface coordinates and time).

The analysis of those radar data sets permit to derive wave field properties, such as wave spectra, as well as their integrated sea state parameters (e.g. mean and peak wavelengths, periods, wave propagation directions, significant wave height, etc.). Furthermore, recent results using these radar devices permit to estimate the wave elevation field for the area illuminated by the radar and for the temporal duration where the radar image time series are acquired. Thus, these results let derive local and individual wave properties in space and time, such as the groupiness features.

This work presents some results obtained from the study of wave group features and their evolution in the spatial and the temporal domain. The presented results were obtained from data acquired by on-shore measuring stations based on conventional X-band marine radar technology. The data analysis is based on the computation of the three-dimensional wave envelope derived from the wave elevation field computed from the time series of radar images of the sea surface. Hence, from this analysis it is possible to detect the areas of the ocean where consecutive individual waves higher than a given threshold are travelling together. Furthermore, these areas can be quantified including the number of waves inside. In addition, the temporal evolution of these areas of high waves is derived as well.