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A Self-Organizing Maps approach to assess the wave climate of the Adriatic Sea

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The assessment of wave conditions at sea is fruitful for many research fields in marine and atmospheric sciences and for the human activities in the marine environment. To this end, in the last decades the observational network, that mostly relies on buoys, satellites and other probes from fixed platforms, has been integrated with numerical models outputs, which allow to compute the parameters of sea states (e.g. the significant wave height, the mean and peak wave periods, the mean and peak wave directions) over wider regions.
Apart from the collection of wave parameters observed at specific sites or modeled on arbitrary domains, the data processing performed to infer the wave climate at those sites is a crucial step in order to provide high quality data and information to the community. In this context, several statistical techniques has been used to model the randomness of wave parameters. While univariate and bivariate probability distribution functions (pdf) are routinely used, multivariate pdfs that model the probability structure of more than two wave parameters are hardly managed. Recently, the Self-Organizing Maps (SOM) technique has been successfully applied to represent the multivariate random wave climate at sites around the Iberian peninsula and the South America continent. Indeed, the visualization properties offered by this technique allow to get the dependencies between the different parameters by visual inspection.
In this study, carried out in the frame of the Italian National Flagship Project "RITMARE", we take advantage of the SOM technique to assess the multivariate wave climate over the Adriatic Sea, a semi-enclosed basin in the north-eastern Mediterranean Sea, where winds from North-East (called "Bora") and South-East (called "Sirocco") mainly blow causing sea storms. By means of the SOM techniques we can observe the multivariate character of the typical Bora and Sirocco wave features in the Adriatic Sea. To this end, we used both observed and modeled wave parameters. The "Acqua Alta" oceanographic tower in the northern Adriatic Sea (ISMAR-CNR) and the Italian Data Buoy Network (RON, managed by ISPRA) off the western Adriatic coasts furnished the wave parameters at specific sites of interest. Widespread wave parameters were obtained by means of a numerical SWAN wave model that was implemented on the whole Adriatic Sea with a 6x6 km^2 resolution and forced by the high resolution COSMO-I7 atmospheric model for the period 2007-2013.