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Statistical and dynamical downscaling to transfer wave climate to coastal areas

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The term “wave climate” usually refers to the statistical distribution of several oceanographic geophysical variables at a particular site. Components of the wave climate are variables such as wind velocity, wind direction, significant wave height, peak period, and mean wave direction. In the last decade, long-term wave reanalysis (hindcast) data bases from numerical models have been developed improving the knowledge of deep water wave climate, especially at locations where instrumental data are not available. The reanalysis data present the advantages of having enough spatial (say 0.1 to 1º) and temporal resolution (more than 400.000 sea states) to characterize deep-water wave climate. This huge amount of information needs to be dealt with statistical downscaling techniques that enable an easy analysis of the multi-dimensionality of wave climate. Besides, coastal wave climate requires a more detailed spatial resolution (say, 100 m) in order to correctly evaluate different coastal processes. This specific problem of dynamical downscaling, enhancing the spatial resolution and defining in detail shallow water areas, is called “wave propagation” and usually requires numerical models that consider the wave propagation processes such as refraction, shoaling, diffraction and dissipation by wave breaking.

In this work, a combination of statistical and dynamical downscaling is presented. The statistical downscaling includes the use of classification (Self-organizing maps) and selection algorithms (Max-Diss). The dynamical downscaling is carried out using different nested state-of-the-art wave propagation models, increasing the spatial resolution near the coast. A multidimensional interpolation scheme based on Radial Basis Functions is used to obtain quantitatively valid time series of wave climate at coastal areas, which are validated using instrumental data.