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High resolution coastal wave climate in the Western Mediterranean

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Wave reanalysis are adequate to improve the knowledge of large-scale (say 0.1 to 1º spatial resolution) wave climate. In this work, we use a 0.125º hourly wave reanalysis GOW 2.1 in the Mediterranean Sea (Global Ocean Waves 2.1, IH Cantabria). GOW2.1 is a wave reanalysis generated using WW3 and is forced by 15-km resolution wind fields from a dynamic downscaling (WRF model) nested in ERA-INTERIM 1989-2009 atmospheric reanalysis. In the west boundary (Cadiz Gulf) the hourly directional spectra taken from a global wave reanalysis is introduced.

Although the spatial resolution (10 km) is good enough for many purposes, coastal wave climate requires a more detailed spatial resolution (say, 100 m) in order to correctly evaluate different shallow water coastal processes, such as littoral sediment transport, local wave height, etc. This specific problem of 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.

Therefore, a hybrid methodology to determine high-resolution wave climate in the western mediterranean sea, based on statistical and dynamical downscaling, is proposed. The statistical downscaling includes the use of classification (self-organizing maps) and selection algorithms (Max Diss Algorithm, MDA). The MDA selects a reduced number of multivariate sea states uniformly distributed over data, covering the edges, which results very convenient for a later interpolation. The dynamical downscaling is carried out in 30 grids 100-m spatial resolution that cover the Spanish coast using SWAN, a state-of-the-art wave propagation models. 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 shallow and deep water buoys. These propagated time series of significant wave height, mean period and mean direction along the Spanish coast are essential to correctly evaluate flooding level, littoral transport, design wave heights for maritime works, etc.