Abstract

The present study investigates the conspicuous shortcomings of the whitecapping dissipation model implemented in WAM Cycle 4.5 [1], following the lead of the work of [2] and [3]. Its dependence on an overall wave steepness unavoidably yields systematic errors when more than one wave system is propagating.

The distinctive, complex orography of the Catalan littoral and the fact that the Mediterranean Sea is comparable to a semi-enclosed basin, brings about added difficulty when it comes to wave modeling. Additional reasons for the limited predictability include the shadow effect of waves due to the Balearic Islands, high wind variability in time and space, marked seasonality and relatively short periods associated with swell waves. These characteristics challenge the applicability of the current whitecapping formulation.

The main purpose of this study, therefore, is to investigate the effect of whitecapping dissipation on the temporal evolution of the wave spectrum, identify the causes that lead to significant errors and propose a suitable calibration of the tunable parameters of this least understood part of the physics, supported on comprehensive spectral and integral analyses. Such modifications attempt to correct, or at least improve, the frequent disagreement between predicted and observed wave data at the Catalan coast, especially during storm conditions. Particular attention is drawn to the Ebro delta area, not only because of the growing need to properly track its evolution but due to the common presence of characteristic bimodal spectra, caused by the coexistence of wind-seas and swells.

The WAM Cycle 4.5 [4] is run in two nested grids covering all the Northwestern Mediterranean Sea with a grid resolution from 9 to 3 km (Figure 10), forced with corresponding low and high-resolution six-hourly wind fields (WRF), for two typical storm events during January 2010. The results are validated at three different locations, where Directional Waverider buoys provide direct pitch-and-roll wave measurements. Identification of different wave systems is accomplished through reconstruction of buoy’s two-dimensional spectra and further application of spectral partitioning techniques.

The aforesaid notwithstanding, results obtained from the tuning of parameters in the whitecapping dissipation function show a clear enhancement of the mean and peak wave periods for the study area, decreasing considerably the negative bias reportedly observed, whereas it is not possible to distinguish a representative improvement of wave heights by only tuning the whitecapping dissipation function. Even though new formulations seek for a more physical description of wave energy dissipation processes [5], [6], in the mean time, and for practical purposes, it is demanded a suitable set-up for the present model, in parallel with a full validation of upcoming source functions. As a final note, an improvement of wind field spatial and temporal resolution is required if aiming to capture local features such as coastal wind jets.

References


