Plinius Conference Abstracts
Vol. 14, Plinius14-24, 2012
14th EGU Plinius Conference on Mediterranean Storms
and MEDEX Final Conference

Modelling and errors for short duration Mediterranean storm events: ranking of uncertainties

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Western Mediterranean, as many others semi-enclosed systems, is a region with sharp topo-bathimetric gradients that result in a strong local variability of mete-oceanographic patterns. This variability is super imposed to more permanent synoptic situations such as for instance the Mestral (North or North-West) wind fluxes. In addition the low pressure centres, depending on the atmospheric patterns over the Cantabric Sea and Central Europe, may show a tendency to recirculate in front of the Eastern Spanish coast, producing a succession of storm events sometimes called twin storms. Because of this complex situation the relative errors of meteo-oceanographic models are much larger than elsewhere and there is a need to rank the various sources responsible for these discrepancies between observations and simulations.

In the paper we consider two storm periods in 2010 and 2011, for which there are meteorological fields with two mesh resolutions (12 and 3km respectively) and two different models (MM5 and WRF). We have run two different wave models (WW3 and WAM) with resolutions from 9 to 3km. This gives a combination of 4 wind-wave models, at 2 different scales. Finally we have compared the obtained simulations with six wave buoys along the Catalan coast, belonging to the XIOM network (Catalan Government) and to the Puertos del Estado network (Ministry of Public Works). The resulting error time series for the significant wave high have been analysed in statistical and physical terms, with emphasis on the best scale for the analysis (natural versus logarithmic) and the error levels for the different meteorological patterns (mainly from the Eastern, Southern and North Western sectors).

The paper will end with a ranking of error sources and some conclusions on how the fetch length, the storm duration and the coastal orientation, together with the employed modelling sequence, affect the overall robustness and accuracy of the local scale predictions. The overall behaviour in bias is a general underestimation of Hs for the storm peaks together with a slight overestimation for calmer conditions. In the framework used, WAM shows a similar bias independently of the wind model and scale, while WW3 bias improves in the higher resolution. In terms of root mean square error, better resolution winds generate better waves whichever wave model is used. Prediction at the central Catalan Coast is particularly bad in this regard, which can be attributed to the irregular coast geometry and the prevalence of transient patterns. Finally, in terms of prediction-observation correlation coefficients, WAM offers better results than WRF at all scales and for all wind sources (specially using log-scale, i.e. downweighting the storm peaks). These results suggest that WW3 might capture coastal phenomena leading to a storm prediction slightly better than WAM, while WAM is reproducing better the overall trend shapes in open sea, albeit not the “real” magnitude of wave height.