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Wave extremes in the climate change perspective: the Adriatic Sea case study

S. Carniel (1), F. Fedele (2), A. Benetazzo (1), M. Sclavo (1), A. Ricchi (3), and E. Bucchignani (4)

(1) CNR-ISMAR, Dept. Oceanography, Venice (Italy) (sandro.carniel@ismar.cnr.it, 0039 329 0845720), (2) Georgia Institute of Technology, Atlanta, Georgia (USA), (3) University "Parthenope", Napoli (Italy), (4) Centro Italiano Ricerche Aerospaziali, Capua, CE (Italy)

We present a study on wave climate changes in the Adriatic Sea for the period 2070-2099 and their impact on wave extremes. To do so, the phase averaged spectral wave model SWAN (www.swan.tudelft.nl) is forced using results of the regional climate model CLM (the climate version of the COSMO model, maintained at CIRA) downscaled from a global climate model running under the IPCC A1B scenario. Namely, the wind fields adopted are resulting from the C14E5 dataset (spatial resolution 14 km, boundary conditions from CMCC-MED, atmospheric component ECHAM5 at 80 km resolution).
Firstly, a model validation is performed by comparing numerical predictions for the period 1965–1995 with available buoy data, in order to infer model's accuracy in predicting seasonal changes and extreme events.
A statistical analysis is then exploited to predict the climate changes on coastal and offshore waves and their extremes for the simulated scenario. In particular, a Generalized Extreme Value (GEV) theory is used to predict changes of extreme storms. In contrast to a GEV analysis that requires data fitting in describing extremes, we also adopt the Equivalent Power Storm (EPS) model (Fedele and Arena, 2010) to predict return periods of storms and their largest waves. Such model is based solely on probabilistic principles and it improves the stochastic representation of the significant wave height history locally at storm peaks by an equivalence to random storms of parabolic or cusp shape.
Finally, Adler's theory of Euler-Characteristics of random fields (Fedele et al., 2011) is applied to predict space-time extremes defined as maxima of the sea surface over a given area during time. Results confirm that in short-crested seas the occurrence of wave extremes in space increases with respect to that expected at a given point in time.

References

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