HARBOUR WAVE CONDITIONS IN THE NW MEDITERRANEAN COAST. NESTING AND FORECASTING.

Daniel González Marco [1]*, Agustín Sánchez-Arcilla [1], Rodolfo Bolaños [1], Joan Pau Sierra [1], Sergi Paricio [2] and Eliseu Vilaclara [2].

[1] Laboratori d´Enginyeria Marítima, LIM-CIIRC DEHMA. ETSECCPB Universitat Politécnica de Catalunya. c/ Jordi Girona 1-3, Módul D-1, Campus Nord, C.P. 08034, Barcelona, Spain.
*daniel.gonzalez-marco@upc.es, agustin.arcilla@upc.es, rodolfo.bolanos@upc.es, joan.pau.sierra@upc.es
[2] Servei Meteorològic de Catalunya, c/ Berlín nº 38-46 C.P. 08029, Barcelona, Spain. sparicio@meteocat.com, evilaclara@meteocat.com

Abstract

This paper addresses the performance envelope of wave forecasting under fetch and duration limited conditions such as those found in the NW Mediterranean. The main aim is to develop an operational tool, which helps harbour and coastal authorities on taking decisions. The emphasis is thus on: 1) Accuracy, 2) Resolution, 3) Forecasting horizon, 4) Robustness of the obtained predictions. The sequence of nested wave models will be validated for this purpose with the meteorological and oceanographic data recorded by the XIOM network (Oceanographic and Meteorological Instruments Network) of the SMC (Catalan Meteorological Service).

Keywords: wave generation, wave propagation, nesting

Harbour and coastal issues in a coast such as the Spanish Mediterranean are extremely significant for the economic activities of the zone and for the safety of the numerous populations there concentrated. The forecasting of wave conditions is within this framework important for the management of harbour activities and also for the management of beach touristical activities (under operational conditions). Likewise the forecasting of wave conditions is essential for the design of harbour infrastructures and for the mitigation of erosion and flooding damages and even loss of life (survival or extreme conditions).

For this purpose a suite of nested models has been adapted to the fetch and duration limited conditions found in the NW Mediterranean. This sequence (schematised in Fig. 1) starts with the WAM model for wave generation (1). This third generation model feeds a phase averaged wave model (LIMWAVE, 2) which propagates the spectral density function from the closest WAM grid point to the harbour entrance area. This result is used to feed a third model (LIMPORT) which can be, depending on the objectives, either a Boussinesq based model (3) or an elliptic wave model (based on the Mild-Slope equation, 4). This nesting introduces a number of hard to quantify uncertainties through closure submodels (e.g. bottom friction, e.g. wind shear stress) and trough the "internal" boundary conditions. These uncertainties are then checked with the available Meteo and Oceanographic data recorded by the XIOM network (Oceanographic and Meteorological Instruments Network) managed by the SMC (Catalan Meteorological Service).

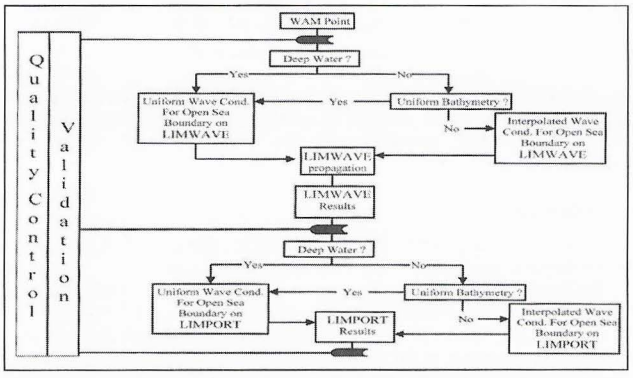

Fig. 1. Schematisation of model nesting for wave predictions near and inside harbour domains.

The combination of nested simulations and observations has allowed a robust prediction of wave conditions with a time horizon of up to 36 hours. The accuracy and resolution also allow a system of warnings for harbour and beach operation, which includes the following variables:

1. Wave agitation
2. Wave overtopping
3. Long waves
4. Wind strength

This allows a safer and better operation of harbour infrastructures and beach areas. As a sample of the obtained results, Figure 2 shows the wave agitation corresponding to the recent recorded storm during October 2003 for a Spanish Mediterranean Harbour. The sequence of models nested is been continuously validated and updated with the meteo-oceanographic database available.

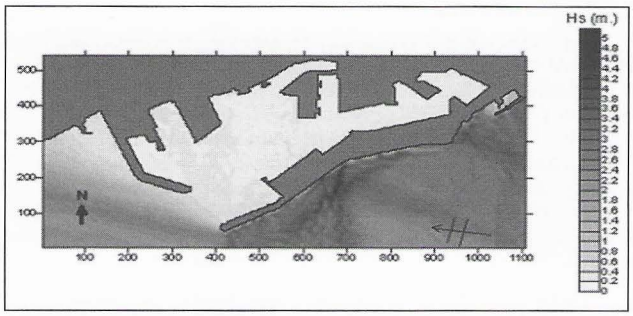

Fig. 2. Sample illustration of simulated wave conditions inside a Spanish Mediterranean harbour.

Acknowledgements. The authors wish to acknowledge the support given by the project PREVIMED (contract number: J00838REN2002-03415)

References

1 - Wamdi Group, 1988. The WAM model – A tirad generation ocean waves prediction model. *J. Phys. Oceanogr.*, 18: 1775-1810.
2 - Cáceres, I., González Marco, D., Alsina, J.M., Sierra, J.P., Sánchez-Arcilla, A., 2002. Hydro-Morphodynamics for a LCS. A firs approach for a Mediterranean case. Delos 1st Year Meeting, Barcelona 01/2002.
3 - Sierra, J.P., Sánchez-Arcilla, A., Egozcue, J.J., Monsó, J.L., 1988. Effect of Boussinesq-type equations on wave spectra propagation. XXI Int. Conf. On Coastal Engineering, Torremolinos, pp. 350-362.
4 - Liu, P.L.-F., 1990. Wave transformation. Pp. 27-63.In: The sea, Wiley-Interscience Publication. v. 9.