Development of a high-resolution nearshore wave forecasting system for the Algerian coasts

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Résumé
This paper describes a research aimed to the development of a high-resolution nearshore wave forecasting system for the Algerian coasts. The model uses the results of the large scale meteorological forecasting system named ALADIN/AROME managed by, the numerical weather prediction group (P.N.T) at the Algerian Met Office (ONM), as wind input for WW3 (Wave Watch 3 model) and SWAN models. The traditional technique One way is used for different grid points on the bay of Algiers. One intermediate SWAN grid and two nested grids have been used. Keywords : Wave Forecasting — Nearshore — WW3 — SWAN — Algerian coasts

1. Introduction

Wave predictions in deep waters have experienced significant developments during the last few decades and the skill of the state of the art models has been shown to be generally improving.

However, the predictions are very sensitive to the used wind fields, as demonstrated by various authors Teixeira et al. (1995b) Holthuijsen et al. (1996). Wave predic- tions near the coasts are subjected to more complicated physics than in deep water, due to the greater influence of bathymetry and breaking processes near the shore, which, combined with the uncertainty from wind models, make wave modelling in coastal waters as a challenge.

Many meteorological centers produce wave forecasts for the Mediterranean Sea. Most of these tend to under- estimate the wind velocity and consequently the wave height. The reason is that global meteorological models have poor spatial resolutions for restricted seas such as the Western Mediterranean Sea. Cavaleri and Sclavo (Cavaleri and Sclavo (2006)) have shown that the results can be highly improved using nested models with high resolution. This motivated the implementation of Limited Area Models over the Mediterranean Sea as the one used in this work. High quality wind data from the ALADIN and AROME models are used in this study.

However, while it is generally accepted that wind predictions can improve using higher resolution models, it is not clear if the grid resolution does play an important role in wave prediction modules. In deep waters areas, where the water depth is larger than 100 meters, it is unlikely that a better description of the bathymetry, that could be achieved using high resolution models, can give significant improvements. On the contrary in shallow waters regions as those near to coasts, it is reasonable to expect that nested small scale grids can give better results than coarse ones.

The key point of this work is that a new high-resolution wave forecasting system, based on multi-nested on-way chains of WW3/SWAN models Holthuijsen et al. (1989), running on one near shore grids covering the bay of Al- giers has been applied. The boundary conditions for the SWAN finer grids are obtained using the results of the larger scale runs based on the WW3 model in the Mediter- ranean Sea, while the wind field is that produced on the large scale at 08 km resolution by ALADIN for the coarse grid and on the high resolution at 03km by AROME for the Intermediate grid Swan.

The forecasting models :
The forecasting system is composed by a sequence of numerical atmospheric and oceanographic models. The limited area meteorological model used in the system are called ALADIN (Aire limitée Adaptation dynamique Développement International) and AROME (Application de la Recherche à l'Operationnel à Meso-Echelle). It is composed by two high-resolution and very-high-resolution meshes, one coupled into the other one-way. The run with the coarsest resolution, 08km , is called ALADIN, the run with the finest resolution, 03km, is called AROME. It is nested on the grid of the previous run and it covers part of the Mediterranean Sea. Its outputs temporal resolution is 3 hours.