M10 A SYNERGETIC COMBINATION OF MEASUREMENTS AND MODELS TO ASSESS RENEWABLE WIND ENERGY IN SEMI ENCLOSED DOMAINS

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Abstract
The paper will present the need to combine high resolution simulations and observations for calculating in a robust manner the highly variable wind, wave and circulation conditions in the Catalan coast. The paper will discuss the difficulties of both the instrumental equipment and the numerical codes and how they must be validated and combined for semi enclosed domains illustrated by the Catalan shelf sea.

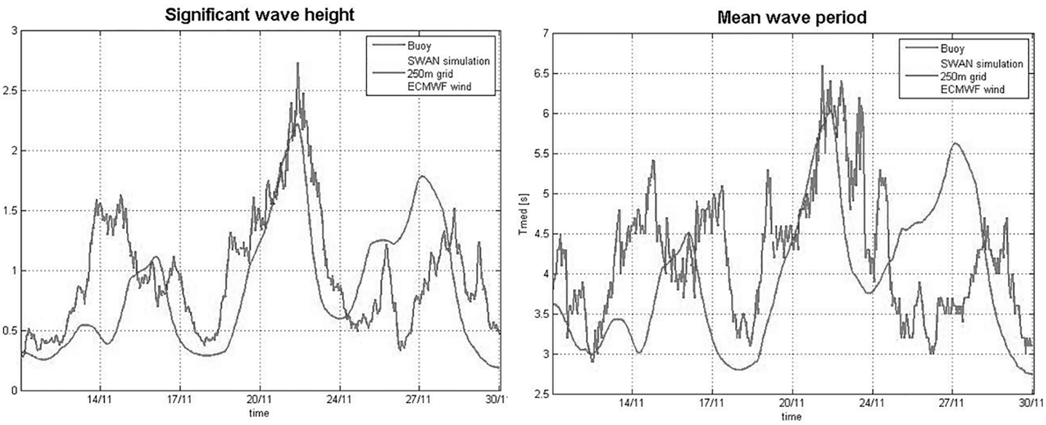
Keywords: marine energy, waves, currents, modelling and observations

The present limitations of meteo-oceanographic models in providing accurate and robust estimates in irregular semi-enclosed domains such as the Northwestern Mediterranean together with the challenges to measure directly meteo and oceanographic parameters in a narrow continental shelf require a synergetic approach. In the paper we shall present the development of a LIDAR buoy developed within the NEPTUNE project and prepared to measure meteorological and oceanographic parameters at a range of water depths, suitable for the Catalan continental shelf. This buoy has been tested in our laboratory flume to optimize the motion compensation (figure 1).
The numerical modelling sequence prepared for this same purpose is based on combining a meteo model such as WRF, a circulation model such as ROMS and a wave models such as SWAN. The use of a variable grid or the nesting of various subdomains into a validated pre-operational system is a task fraught with difficulties and which requires a careful validation (figure 2). This validation entails improving the physics of the models, such as for instance in this case the physics of the dissipation or whitecapping term to correct for the wave height under prediction (figure 2a) and the frequency integration interval and the same whitecapping term to compensate for the systematic under estimation of the wave period (figure 2b).
The paper will present the mechanical and electronic development carried out for the LIDAR buoy, together with the program to test it in our laboratory premises, under controlled conditions and then in the Catalan coast, near an instrumented coastal section. After that the paper will discuss the nesting and coupling strategy to achieve high resolution reliable results of oceanographic parameters. The focus will be on the wave-current codes and their respective coupling. The paper will briefly review the more relevant coupling mechanisms with a numerical influence in our studied shelf sea. The model cascading to simulate high resolution wave and current fields will also be discussed, showing the error transmission and the "dangers" of multiple artificial boundaries between domains and, therefore, the potential pros and conts of this approach against a variable grid discretization.
The paper will end with a review of the potential of a synergetic combination of measurements and models to assess the renewable energy resource and to estimate the interactions of the recovery structures with the prevailing meteo-oceanographic conditions.

ACKNOWLEDGEMENTS:
This research was partially financed by the NEPTUNE (contract no. 006-2012-R01-IREC-OFF-AERO) project. The theoretical and numerical issues for the high resolution oceanographic results together with part of the field data come from the Covariance project (contract no. CTM2010-19709) whose support is also acknowledged.

1.a. 1.b.

Fig.1. Sample image showing the rotating platform to assess the motion induced errors in the LIDAR buoy (1.a.). The buoy structure and floating volumes have been optimized to avoid and compensate resonant motions for the Mediterranean conditions (1.b.).



2.a. 2.b.

Fig.2. Sample numerical results of significant wave height (2.a.) and mean wave period (2.b.) computed off the Catalan coast using the SWAN model prior to the tuning carried out to improve the physics and the resulting numerical simulations. The numerical series are compared with the measurements from a directional wave buoy deployed at 40 meters water depth. The meteo-fields come from the European centre.