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High resolution unstructured grid for wave forecansting at coastal areas.

Angel Martinez-Ferrer (1), Justo Conde-Criado (2), and Ernesto Barrera-Rodriguez (3)

(1) Spanish Meteorological Agency, Madrid, Spain (amartinezf@aemet.es), (2) Spanish Meteorological Agency, Madrid, Spain (jcondec@aemet.es), (3) Spanish Meteorological Agency, Canary Islands, Spain (jbarrerar@aemet.es)

The evolution of ocean waves is determined by the energy conservation equation. This is an advection non-lineal equation with independent term that takes into account sources and sinks of the wave energy. This equation is numerically solved through the Finite Differences Method on a regular rectangular grid with spatial resolution (Δx, Δy).

WaveWatch III (NOAA) and WAM (ECMWF) are the most used wave forecasting models. Both are based on an explicit scheme, so time step Δt for solution wave propagation -at speed c_g- is limited by the Courant-Friedrichs-Levy (CFL) condition to avoid flux instabilities:

$\Delta t \leq \min(\Delta x, \Delta y) / c_{gmax}$

This means that higher spatial resolutions would need shorter time steps, which implies bigger computer consumption and slower obtention of forecasts: a resolution of Δx=1' at midle lattitudes requires a time step $\Delta t \leq 80$ seconds.

A numerical model with different principles should then be adopted. The SWAN model (Simulating WAves Near shore) is semi-lagrangian and semi-implicit, and can accept unstructured grids. CFL restriction is therefore avoided and nesting of increasing resolution grids could be replaced by unstructured grids with higher node density on areas where details are required, such as coasts, areas with high gradients of bathymetry or with shoaling effects.

Wave forecasting at higher resolution grids must be forced with higher resolution wind fields. Current atmospherical limited area models have been improved with the introduction of HARMONIE, with a spatial resolution of 2.5 km.

The environment of Gulf of Cadiz-Gibraltar pass- Alboran Sea is specially critical due to its meteorological conditions, a highly changing bathymetry and the dense maritime traffic. So high resolution wind fields forcing a forecasting model without instability issues is the ideal frame to obtain accurate, quick wave predictions for the above mentioned environment.