WISE meeting 2013

L.Cavaleri, L.Bertotti, A.Roland

Nested grids: accuracy and problems. Towards the unstructured grids

We have explored the accuracy achievable by nested coastal modelling with the usual structured grids. Our field of action has been the west coasts of the Orkney Islands, at the upper end of U.K.. The offshore input information has been the wave data from the ECMWF archive. We have analysed a one month period, October 2009. Our aim was 1) to check that the combination "offshore information and local, nested modelling" is the right starting point, and 2) to analyse and quantify the accuracy we can expect and the problems involved in the procedure.

Simple approaches, aiming at transferring the offshore conditions to the coast using only refraction and possibly local dissipation, are not adequate. First, taking wind, hence local wind wave generation, into account is essential to avoid non-negligible underestimates at the inner target points. In stormy conditions, if not supported by wind, the sea rapidly dissipates part of its energy. Then in any case the availability of two-dimensional spectra is a strong requirement to avoid summarising into single integral parameters, typically the significant wave height H_s, mean frequency (or period) f_m (T_m), and direction θ_m more complicated situations.

Archived data is often at relatively large intervals (6 h at ECMWF). We have explored as the interpolation, in space and time, of the 2D boundary spectra may affect the nested grid results. The unavoidable deformation of the spectra implies a lack of dynamical equilibrium of the nested spectra, with a consequent enhanced dissipation. It follows that nested significant wave heights are often underestimated. This is more the case when different models are used for the parent and nested grids, e.g. WAM and SWAN. We have explored this aspect repeating the full month meteo- and wave analysis (hindcast) saving the results, to be used as input to the nested grid, at one hour interval.

Problems with nesting become more manifest in, meteorologically or geometrically, complicated situations or rapidly changing fields. Most of these problems naturally disappear when using an unstructured grid. The typical increasing density while approaching a coast implies a natural continuity. The positive aspects are highlighted including the various points to pay attention to.