Upscaling of local models into regional models in coastal areas

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Abstract

An upscaling method is under development for the MOHID modeling system and in this communication the current stage of the ongoing work is presented. MOHID is a finite volume 3D hydrodynamic and biogeochemical model with hydrostatic and boussinesq approximations, developed at Maretec center (Instituto Superior Técnico) for the last 3 decades. Typical coastal applications with MOHID model involve the use of a downscaling one-way nesting system in order to better represent near shore bathymetric features. One-way nesting using a downscaling methodology implies good agreement of coarser (parent) and finer (child) grid solutions near their boundary to avoid errors reflections and propagation. Therefore, finer grid open boundaries need to be set at a place with weak hydrodynamic features and smooth bathymetry where local features do not diverge from regional ones, which often occurs far from the application focus area. An ever increasing methodology comes from the assumption that a higher resolution child domain holds more accurate hydrodynamic solution, and should, thus, feedback finer grid results to the coarser grid solution – Two-Way nesting – by adding the effect of local features into regional domains. This technique also opens the door for smaller area finer grids while still providing good hydrodynamic nearshore solutions. Another advantage of this methodology is the improvement of regional applications which do not consider fresh water discharges, with local high resolution estuarine applications. These local applications feedback the influence of a river plume into the regional application, instead of discharging the river flow directly in only a few numerical coarser grid cells. There are several different upscaling methods, with different ways to address conservation and noise problems at the boundaries. For the MOHID case, a nudging scheme will be used for the entire overlapped area with the exception of a sponge area near the border to avoid destructing regional features entering the child domain. Nudging will consider a time decay that can be adjusted by a user, and will address velocities, temperature and salinity fields, leaving the water level undisturbed to be computed by the parent domain after the feedback. This methodology is expected to be of use not only to renewables studies with underwater turbines, but also for narrow straits and watershed and agricultural applications. The methodology and results obtained for the Tagus estuary will be presented.