

Review comments on the preprint titled:

Using two-way nesting technique AGRIF with MARS3D V11.2 to improve hydrodynamics and estimate environmental indicators

by Sébastien Petto, Valérie Garnie, Matthieu Caillaud, Laurent Debreu and Franck Dumas

The article describes an application of the integrated MARS3D-AGRIF model for two-way nested coastal modelling, particularly for estimation of environmental indicators.

Major points:

1. The article looks like a project report as technical details and data information take quite a lot of space. It is a bit short of novelty but an extended application of existing model techniques. As the authors have stated that the AGRIF software has already been implemented into the MARS3D model and two-way nesting has been reported by Debreu et al (2012). Authors may try to restructure the article and clarify what has been done before and what is done in this study, minimising duplication of published materials.

2. Whether this technique is suitable for coastal marine application is still a question though the authors have claimed it is 'well suited'. There are three reasons for this questioning:

a) The two-way interaction is only built between the mother grid and each child grid. Although it could create a chain of child grids along coastlines and some child grids may even overlap, there is no direct interaction among the child grids, neither two-way nor one-way. This casts a doubt on whether the child grids could really represent the coastal processes as whole. The mixed effects reported by the article may be evidence.

b) AGRIF is designed for adaptive refinement in open ocean, may not be a good approach for coastal refinement. The final example of 3-level refinement with 1 mother grid at 2 km, 19 grids at 1 km and 61 grids at 500 m resolutions is complicated as a coastal model. Nevertheless, the 3-level refinement may not be enough for coastal models. For instance, the 500 m fine resolution may not be enough to resolve the 1.8 km wide 50 m deep narrow channel (Goulet de Brest). The 2 km mother grid may not be suitable for a large regional model to cover key regions desired for far-reaching effects. It looks the software may struggle if more levels are required.

c) Although the AGRIF software has removed the burden to save boundary files for the child grids, there is still a requirement to save the output from these child grids. Otherwise, the enhancement by the refinement will be lost. The duplication of data over same areas (as the mother and child grids overlap) also increases disk demand, not to mention that some child grids may also overlap, and the rectangular domain shape wastes some disk spaces for land areas.

3. Parallelization is an important feature of large models, like this coastal application. The article does include some description of parallelization but may extend it to give more details, at least, to clarify some results as given in section 3.1.

Minor points:

L40-51: This paragraph stated that it is difficult for unstructured grids to handle adaptive refinement both temporally and spatially but failed to clarify that the present application is not adaptive as well though the AGRIF software is originally designed for adaptive mesh refinement. There is also multi-resolution unstructured grid, such as the spherical multiple-cell grid (Li 2021),

which can offer static coastal refinement and prevent the finest cell CFL restriction from spilling over the entire grid.

L53: It is a bold claim that overlapping grids would be "well suited" for coastal applications.

L75: The section title is ambiguous. Using the sub-section titles directly may be good enough.

Section 2.1: An important feature of a 3-D marine dynamical model is the vertical discretisation or vertical coordinate scheme. The sigma coordinate used in the MARS3D model is better to be mentioned in this section rather than quite later in section 3.1. Authors may simplify the MARS3D model description, such as shortening the description of the C-grid as it is well documented, and concentrate on any update for this study, such as any modified equations or changed schemes.

Section 2.2: Similar as comment for section 2.1. Is the two-way nesting algorithm differ from Debreu et al (2012) one? If so, what is new in this model implementation?

Sub-section 2.2.3: Parallelization is an important feature of large models. Better start a new section for it and explain a bit more about it.

L195: Do you mean distributing the MPI processors among all child grids?

Sub-section 2.2.4: Is this part of the two-way nesting algorithm? If so, better merge it into sub-section 2.2.1.

Section 2.3 and 2.4: These sections could be reduced to essential information, so they are just enough for demonstrating the two-way nesting effect.

L227: Move the 3 in 'm3' to a superscript.

Section 3.1: May change the section title to: Computing cost. It may serve as part of the model parallelization. Explain more on how many runs are used for the computing time average and clarify the computing node usage, particularly for the hybrid one.

L368: "computing coast" should be computing cost".

Table 2: what do you mean 56 MPI nodes with 8 OMP each? Do you mean the total number of nodes are 56x8? Better to clarify in terms of MPI ranks and OMP threads as number of processors on one computer node may vary from machine to machine. Reducing the runtime to 1/4 with 8 times of computing resources in hybrid mode is a good result.

Section 3.2-3.4: Limited by my knowledge about coastal models and environment indicators, I could not comment much on these sections.

Section 4. Would it be better to merge the discussion with the result section?

L616-630: The paragraph for possible multi-resolution approach with AGRIF library may be shortened as it is not part of this study. Fig.10 gives readers a false impression that the 3-level configuration has been tested. It is better removed.

L700: Better not quote conference abstract with a broken web link.

Reference

Li, J.G. 2021: Filling oceans on a spherical multiple-cell grid. *Ocean Modelling*, **157**, 101729. DOI: 10.1016/j.ocemod.2020.101729