

# ***Interactive comment on “Upscaling of regional models into basin-wide models” by Luc Vandenbulcke and Alexander Barth***

**Anonymous Referee #1**

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General Comments:

In this study, the authors present the "upscaling" method in order to emulate two-way nesting, not implemented in operational systems. The "upscaling" technique consists of assimilating pseudo-observations from a child model in the parent model. The up-scaling system is applied over the Mediterranean Sea, with the child model covering the north-western part of the region. The DA scheme is based on a variant of the EnKF assimilating only T, S. The concluding remark is that "upscaling" emulates successfully two-way nesting, but the study does not provide arguments whether the child model is more realistic than the parent.

The manuscript is clear, concise and well written. The study shows some interesting results and supports to some extent the argument of using the "upscaling" technique in

operational systems. However, my main concern is the limited impact of the study using a similar setup between the child and the parent models. Overall, I find the manuscript worthy of publication, after a minor revision. Please find below a list of comments that I would like the authors to address. The most important comments are listed first.

Specific comments:

1) My main concern is that "upscaling" appears to be feasible only if a similar setup is made between the child and the parent models. For instance, the authors use two models based on the same platform, i.e. NEMO, with an exact ratio between horizontal grids and I suspect (not written in the text) with an identical vertical grid. All these are OK coinciding with the options to emulate two-way nested simulation. However, within a DA framework one would expect to see more general options, for instance, assimilating pseudo-observations on an entirely different grid (especially vertical for the T, S). The latter would support a more general argument for "upscaling" approaches, using for instance a different setup/grid/platform for the nested model. I leave it up to the authors choice if they wish to perform a DA experiment with a slightly different projection of the pseudo observations. However, I find useful the authors to discuss the limitations of their method.

2) page 2, line 16: "By upscaling the child model into the parent, the latter is brought closer to the former.". The benefits for the child model are obvious, though not so obvious for the parent model. Can the authors provide some guidance for "safe upscaling"? The way this work is constructed, suggests that a forecasting center should only "upscale" in case the child model has a similar modelling setup with the parent, e.g. same platform, vertical discretization, physics, parametrizations etc. The authors should also provide more information in the text about the setup of both models, in order to highlight their differences.

3) page 4, line 23: "these pseudo-observations coming from the nested model are considered independent". This is a very strong assumption, since observations are on

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horizontal resolution  $1/80^\circ$ . In DA a common practice to avoid correlated errors is thinning or superobbing. Can the authors justify their option not to apply these techniques?

4) page 4, lines 21-22: "Ensemble Kalman filter" and page 5, line 11: "Ensemble Tranform Kalman Filter variant of the EnKF". Use also in page 4 the word "variant". In addition, the authors should write in this section the DA method in more details. For instance, it should be mentioned that this is a deterministic approach of the EnKF, i.e. pseudo-observations from the child model are not perturbed and the perturbation approach is only applied in the parent to obtain model errors. All these are not apparent to the reader, at least not before start reading the results section.

5) page 6, lines 13-14: "to update directly the tiles from the Mediterranean model restart files, influenced by the nested model, without including the other tiles in the state vector". This is an interesting technical capability of OAK, but if not mistaken that means that there is a crude correction cutoff in the neighboring tiles just outside the nested domain. I would assume that the localization is enough to constrain the correction in an area slightly broader than the nested domain. Can the authors clarify what is the purpose of this capability?

6) page 9, lines 7-8: "The ability to ... would be beneficial to constraint the model". This is more a concluding remark, rather than a result of the study. The phrase should be moved in the Conclusions section 5.

7) Figure 5. The SST is L4 or L3? In section 3.4 it is mentioned as L3.

8) Figure 8. The units are missing from the axes.

9) whole page 16: "Advantages of using upscaling include ...". This is a nice summary of "upscaling" advantages supporting the method. Can the authors provide possible disadvantages (if there are any) and suggest possible remedies?

Best regards.

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