2nd review of "ICONGETM v1.0 – Flexible NUOPC-driven two-way coupling via ESMF exchange grids between the unstructured-grid atmosphere model ICON and the structured-grid coastal ocean model GETM"

Major comment

I consider that the authors have carefully analyzed the remarks I formulated for the first review but I still think that my main remark about the impossibility to have a fully conservative interpolation with non-matching sea-land mask between the ocean and the atmosphere is not answered properly. Contrary to what the authors state in their reply (" Therefore, interpolation via the ESMF exchange grid guarantees global conservation ..."), the exchange grid ensures **locally** conservative data exchange but cannot ensure the global conservation if the sea-land masks of the two models do not match, and this should be clarified in the text. Furthermore, the authors seem to agree with my analusis when they write "A conservative atmosphere-ocean-system requires the surface area of the sea water fraction in an ICON cell being identical to the corresponding area in the exchange grid, see also next point." and when they discuss the possibility/difficulty to implement mixed land/ocean cells in ICON. Therefore, I strongly suggest that the following sentences be modified so not to mislead the reader:

- L.4 : add "locally" before "conservative data exchange via ESMF exchange grids"
- L.54-55: at the end of the sentence, add: ", even if the exchange grid cannot force their global conservation if the sea-land masks do not match between the ocean and the atmosphere models.".
- L.220: At the end of this paragraph: "It is also obvious that in case 2, a part of the flux calculated by the atmospheric cells will be lost as it cannot be attributed to any ocean cell in GETM; the global conservation of the fluxes cannot be ensured if the sea-land masks do not match between the ocean and the atmosphere models."
- L.351-352: Modify the sentence for "The applied ESMF exchange grid guarantees a conservative flux exchange, except in the case of non-matching sea-land masks between the ocean and the atmosphere."
- L.355-356: Modify the sentence for "Their calculation directly on the ESMF exchange, even if it cannot solve the problem of different land-sea masks (Balaji et al., 2006) ensures physical consistency ..."
- L.365-366: Modify the sentence "Their calculation directly on the ESMF exchange grid also solves the problem of different land/sea masks (Balaji et al., 2006) and ensures physical consistency in the sense that no fluxes calculated over land, i.e. not influenced by the sea surface temperature, are provided to the ocean." by something like :

  "Even if the ESMF exchange grid does not solve the problem of different land/sea masks (Balaji et al., 2006), it ensures physical consistency in the sense that no fluxes calculated over land, i.e. not influenced by the sea surface temperature, are provided to the ocean.

  Regarding the problem of matching land/sea masks between the atmosphere and the ocean, it is worth mentioning here that the only way to have a well-posed coupled problem, is to adopt the following best practice, which is applicable only if the atmosphere model can consider water and land sub surfaces. The original sea-land mask of the ocean model should be taken as is. For the atmosphere model, the fraction of water in each cell should be defined by the conservative remapping of the ocean mask on the atmospheric grid. Then, the atmospheric coupling mask should be adapted associating a valid/active index to cells containing at least a fraction of sea. This method ensures that the total sea and land surfaces are the same in the ocean and atmosphere models, allowing global conservation of sea or land integrated quantities. ICON mask was not defined following this best practice (and it would involve some non-trivial modifications to do so, so the global conservation of fluxes cannot be fully ensured in the current coupled model."

Other important comments:

- p.14, l.272: I don't understand what "a good concurrent load-balancing with minimum idle/waiting times for the single model components was empirically ..." means. Do you mean that the elapsed time for running ICON as single model on 864 processes was almost the same as the

elapsed time for running GETM as single model on 384 processes, and therefore you suppose that using these number of processes for each component in the coupled system will lead to minimum idle/waiting time? If so, it should be rephrased for something like "For the present set-up, ICON was run on 864 processes and GETM on 384 processes. It is supposed that this distribution leads to minimum idle/waiting time of any of the component as the elapsed time for running ICON as a single model on 864 processes was about the same than the elapsed time for running GETM as a single model on 384 processes."

- p.15, l.292-293: The statistics presented are extremely difficult to understand. I suppose that 1.6 K/1.5K are for the two-way coupled simulation and that 1.9K/2.0K are for the uncoupled simulation. But e.g. for the two-way coupled, I don't understand what the two numbers (1.6 K and 1.5K) relate to; are these for different averaging periods (maybe 01-10 July and 10 July onward?) ? What does "01/10 July 2012 onward" stand for? I have the same remark for the Pearson coefficient. This remark about the need to better quantify the improvement brought by the two-way coupling was done by myself and by the other reviewer. I consider that the answer brought by the author is not satisfying, at least under the current form.

Minor comments

- p.2, l.26: I suppose that the sentence "The atmosphere model WRF ...with MCT." describes COAWST? If so, it would be clearer by linking the two sentences with something like: "is COAWST (Warner et al., 2010) into which the atmosphere model WRF ... with MCT."
- p.2, l.27: "the ocean model" is missing before "ROMS"
- p.2, l.37 : consider changing "... are the coordinated execution of and the data exchange between the individual models." with "... are the coordinated execution of the individual component models and the data exchange between these models."
- p.2, l.39: It looks like you are doing a distinction between "coupling libraries" and "coupling frameworks" which is fine to me. But ESMF is mentioned as an example of both categories. In the coupling library list, you should replace OASIS by OASIS3-MCT (which has been introduced just above), you should remove "ESMF" and maybe replace it with "YAC (Yet Another Coupler, Hanke et al., 2016)" and put the reference to YAC there in the text (and remove it at l.97).
- p.2, l.47: consider changing "from the models are received during runtime" for "are received during runtime from the models"
- p.2, l.52: I don't think that Balaji restricted his definition of an exchange grid to two rectangular grids. Therefore, please consider changing the two sentences for "They have been introduced in Balaji et al. (2006). ESMF implements this functionality to unstructured grids, ..."
- p.3, l.66, and p.22, l.372: why do you call ICON a "next-generation" atmosphere; ICON exists today so it is not a next-generation" model; please consider changing "next-generation" for "state-of-the-art" or something similar.
- p.3, l.85: I think a verb is missing in "can be configured to various models", maybe "can be configured to produce various models"
- p.4, l.100: the link under www.getm.eu does not work (at least for me). Should it be "https://getm.eu" ?
- p.6, Table 1 captions: consider adding "although exchange of state variables is not activated in the simulations reported in this paper" after "same model environment."
- p.7 l.133: consider adding ", although exchange of state variables is not activated in the simulations reported in this paper" after "the exchange of flux data". Make a new sentence for "See Tab. 1 for a list ..."
- p.7, l.139: replace "will be used" by "are used".
- p.7, l.142: add "the" before "Initialization phase".
- p.7, l.159: why do you write "compare with Fig.1" and not simply "see Fig.1"?
- p.8, l.182: replace "domain distributing" by "domain distribution"
- p.13, l.234: add a coma after "Baltic Sea setup"
- p.14, l.272: add a coma after "For the present setup"
- p.20, l.346: add "see" before "Fig. 15 D"
- p.20, l.347, add "see" before "Fig. 15 A and C"