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Geoscientific Model Development Discussions

Interactive comment on "Regionally refined capability in E3SM Atmosphere Model Version 1 (EAMv1) and applications for high-resolution modelling" *by* Qi Tang et al.

Anonymous Referee #2

Received and published: 16 April 2019

The authors of the reviewed manuscript present a framework for testing physics parametrizations on there scale awareness. They analyse the differences in a globally refined model (RRM) against a global high-resolution model (HRM). The advantage of a refined model lies in the computational cost. The authors state that the RRM model can mimic the outcome of the HRM model and can be used for future developments. Here, a selected area over the United States (CONUS) is used for the model evaluation. The authors compare the model results, both of HRM and RRM against measurements. The focus is set on hydrological values as precipitation. In addition, the authors focus on variables suitable for dynamical characterisation.
The manuscript needs major revisions. First of all, the category of this paper

should be revised. As stated on the web page for manuscript types: https://www.geoscientific-model-development.net/about/manuscript_types.html#item2 Development and technical papers should include details about the model improvements in terms of speed or accuracy. Here, some additional benchmarks in terms of computational time are missing. In addition, while reading the manuscript, I got the overall impression, that the authors are focussing more on the used parameterizations, than the code development. This focus has to be shifted, in order to address the demands of this specific manuscript type.
The overall objective is also a bit vague. Based on the abstract only, I can get three objectives. These are climate applications, usage as a testbed for physics parametrisations and hydrologic research. These are three points only discussed in a shallow way. I suggest to aim for the point of testbed usage. Here, the side by side comparisons shown in the result section would gain weight and the authors could discuss a bit more how to tackle occurring obstacles in the RRM model against HRM.
The introduction is a bit packed with acronyms. It is a overwhelming while reading the manuscript for the first time. In general, I would recommend a table of acronyms in the end. Plus, it would end in a better readability if less acronyms would be used.
The results you show are limited do DJF and JJA. I suggest to provide other seasons as well and at least discuss why you are not using these seasons for more intense studies. The last general point is, that I would wish for a detailed description of the technical implementation of the RRM.

After the major revision, the manuscript may be published in GMD.

Specific comments:

1. P1L13 *[. . .] process-level representation at finer resolutions is a pressing need in order [. . .].*
Could you please add a number here? What means finer? Finer than . . . ?

2. P1L14 *[. . .] regarding extreme events in a changing climate.*

This is a bit too vague. Why do model simulations in a higher resolution provide more information to policy makers? I would suggest to rewrite the start of the abstract to get a bit more precise.

3. P1L22/23 *Differences between the RRM and HRM over the HR region are predominantly small, demonstrating that the RRM reproduces both well- and poorly simulated behaviours of the HRM over the CONUS.*
Again, too vague. In addition, the phrasing is a bit misleading. Roughly speaking, you have the same errors in both models. Please, rephrase.

4. P1L25 *influenced by the different parameter choices[. . .]*
This is a statement that is very obvoius. I won't mention that in an abstract.

5. P1L31 *[. . .] hydrologic research.*
No given context.

6. P2L4 *finer in the horizontal*
Finer means xx degrees?

7.P2L6 *and they must often be done at HR.*
I suggest to remove that part of the sentence.

8.P2L8 *one-year HR (0.25 average)*
Already defined - please erase

9.P2L12-15 *The RRM simulation cost is usually dominated by the computational cost of the HR region, and thus the total model cost is roughly proportional to the size of the region with finer resolution, referred to as a "mesh" (typically chosen to be about 10% of the globe, making the cost about 10% of a uniform HRM simulation.*
This is a bit self explanatory. Could you please include more details about the load balancing, computational costs, scaling factors and memory efficiency?

10. P2L16 *E3SMv2 science goals*
Please explain.

11 P2L20 *with 3 km horizontal grid*
Please be consistent with the units here. You've started with degrees, now switching to km.

12 P3L5 *play in future E3SM scientific and energy applications*
The aspect of energy application just pop up right here. Could you please describe those in more detail?

13 P3L12 *when increasing model resolution.*
You mean the horizontal resolution?

14 P3L30-32

related to fast physics [. . .] [. . .] to fast physics, such as clouds and precipitation.

Please add a careful definition of fast and slow physics here.

15 P4L15-20 This paragraph is much too long. The phrasing of e.g. "higher" should be more precises, e.g. higher than . . .

16 P4L26 Here, you name the definition of LRM and HRM again. Just leave that out.

17 P4L29 *[. . .] tested over the Tropical Western Pacific (TWP) and the Eastern North Atlantic (ENA)*
Why is that worth mentioning?

18 P5L19 *[. . .] associated with fast atmospheric physical processes.*
As mentioned above, a careful definition of fast and slow physics would be good.

19 P5L31 I'm not fully convinced here, that 5 years of simulation is really an appropriate time frame in terms of statistical significance. You also started your manuscript pin pointing to the climate aspect. While doing five years of simulation, the climate aspect is not covered what so ever. If you want to go more in the direction of the climate simulation, there is a need for a better discussion either why five years are really sufficient

or perform more simulations. Thinking about ensemble, timeslice or just longer time periods.

20 P6L1 No need for the wording “skilful” here.

21 P6L18 How did you do this selection? Please describe the criteria you’ve chosen.

22 P6L24 *model results are conservatively interpolated*
What do you mean by *conservatively*? Please add more details on the interpolation method.

23 P6L30 This sentence is way too self explanatory.

24 P7L10 Why does the land surface model behave so differently? Please comment on that and add more details to that finding.

25 P7L33 Please elaborate on the point of improved physical processes.

26 P10L16-21 I do miss numbers in this paragraph. Please provide additional information if you use the phrase *too strong* or *relatively small*.

27 P12L13 I’m missing additional information about the interpolation method.

28 P13L8 Do you have any strategies of tackling that problem, that the model is not able to represent the night time maximum?

29 P13L29 *other models* Any references? What other models do you mean?

30 P13L31 *efficient tool for parameterization testing* This is an interesting point. I’m strongly encouraging you in working on that aspect a bit more and provide more details.

31 P15L11 Do you really mean many, or just those two?

32 P15L25 I disagree that the only conclusion is to develop better scale aware parameterizations. There are also model developments were you end up having e.g. convection permitting simulations.

33 P15L28 I’m a bit confused about the phrase *detailed guidance*, could you please comment on that?

Technical comments

P1L12 Climate simulation => Plural please

P3L2 all => All Make it two sentences

P5L7 analysed vs. analyzed

P5L26 nudging => nudged

P5L31 considered *as* spin-up

P11L32 *overwhelming* is not a proper term here.

P14L32 analysed vs. analyzed

P20L18 Please check you bibliography => N/A N/A

P22L14 Please add a date of last access.

Figure 1, 12 and 13 should be enlarged.

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