Geoscientific

Model Development

Discussions

[GMDD]

Interactive
comment

Interactive comment on "The Met Office Unified Model Global Atmosphere 7.0/7.1 and JULES Global Land 7.0 configurations" *by* David Walters et al.

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Wow, this is the best-written manuscript I've ever reviewed. I made some minor comments below which the authors should feel free to accept or reject.

Summary: this paper starts with a brief overview of the UKMO atmosphere model versions 7.0 and 7.1 and the JULES land model version 7.0. It then goes into detail about each change from version 6 to version 7. This is followed by a discussion of the model's tuning strategy. At this point, the model is evaluated briefly in climate and weather modes. Remaining problems are then discussed, particularly related to overly-strong aerosol indirect effect. Finally, modifications to improve the aerosol effect are

described. Improvements to the model have beneficial impact and make sense. I was struck by how methodical and focused the UKMO team is at getting the right answer for the right reasons.

Minor comments:

1. The thing that bugged me most in this paper was that the model timestep and target horizontal resolutions were never described or were described late in the paper in a tangential way. It would be nice to include target resolution info (as a table?) in the intro and timestep info in section 2.2.

2. p2 line 1-3: citations in this sentence seem like they're for v7 of the model, which is odd since this manuscript is the overview for this model version. Delete citations here?

3. section 2.1: I'm curious why UKMO continues to use a lat/lon grid instead of a cubed-sphere grid. Also, are polar filters used?

4. I'm curious about model performance. How many cores do you typically use and what is your typical throughput on the machine you use most? This might fit in section 2.2... or might be out-of-scope.

5. section 2.2: Using parallel splitting creates opportunities for water and aerosol species to go negative. How do you handle this and the resulting conservation errors?

6. page 4 line 13: When using the prognostic aerosol scheme, this is included..." is awkward. Replace with "The prognostic aerosol scheme is included..."?

7. page 7 line 12: "We also make use of..." sentence is awkward.

8. It seems odd to talk about Large-scale precipitation (sect 2.4) before large-scale cloud (sect 2.5) since the latter creates the condensate which the former acts on.

9. page 8, top: This is a research idea: combining CCA and CCW with PC2 cloud fraction and condensate before computing subcolumns seems like it would smear out differences between convective and stratiform cloud properties. Wouldn't it be better

to just reserve a subcolumn for convection?

10. section 2.8: if your PBL scheme is really a turbulence scheme, why not call the section and the parameterization "turbulence scheme" instead of PBL scheme?

11. p. 9 lines 16-22: I found this explanation to be unclear. Are you saying you're lifting parcels moist adiabatically by 1 grid cell and computing the TKE consumption required by that motion?

12. p. 9, line 28: "stable stability dependence": is stable stability redundant?

13. p. 9, line 29: what is the "sharp" function?

14. p. 10, line 9: "surface layer is conditionally unstable"?

15. p. 11, lines 28-end: I don't understand how you use the canopy model to simulate lake and urban surfaces. Reword?

16. p. 12, line 8: it seems like you'd only want to nudge to climatology for weather simulations, not climate change simulations? Also, how is albedo "further modified in the presence of snow"?

17. p. 12, line 10: does the canopy affect LW emission?

18. p. 12, line 22: how is "Excess water" defined?

19. p. 14 table and elsewhere: When you say "system dependent", I think of computer system (e.g. a particular intel KNL machine) but I think you mean "model configuration".

20. p. 16, line 10: This is a research idea: could you make solver tolerance a function of vertical level to get the best of both computational efficiency and accuracy where needed?

21. p. 17 line 2-3: I don't think there should be a paragraph break here.

22. p. 20 line 1: "by either" sounds awkward.

23. p. 20, lines 1-3: how is the fraction of autoconverting cloud different than the cloud fraction? It also seems awkward that you avoid advecting rain by doing something special when rain advects into a grid cell. . . how is rain advecting when you're avoiding advecting it? I think you mean you avoid horizontal advection by handling rain sedimenting into cells below by setting rain area fraction equal to the cloud fraction above it.

24. p. 21, line 19: "are scaled down before being combined. . ." How are they scaled down?

25. p. 22, line 29 or so: what fraction of the time is RHcrit at its max or min value?

26. p. 25 top: what is the % reduction in energy fixer magnitude from GA ticket #87?

27. p. 25 line 25: is enhanced thinning of stratocumulus a good thing in your model? In my experience models tend to thin Sc too much during the day.

28. p. 26-27: I must admit I still don't understand how convection interacts with the turbulence scheme after reading this section. I think turbulence acts as the trigger for convection and when convection acts the turbulence scheme ignores condensational heating (i.e. is a "dry turbulence" scheme) in order to avoid double-counting moist plumes? In any case, this could be explained better.

29. p. 30: the relationship between CAPE timescale and resolution would make a good topic for a standalone paper. What is written here is fine, but more details (in a follow-on paper) would be welcome.

30. p. 42 line 25: "own/independent analyses" this sounds awkward. Is a word missing?

31. section 3.11: I'm surprised there's no mention of land model tuning? Are there no tunable parameters in the land model? If so, you should mention that.

32. p. 45, line 14: Isn't it customary to include a table where it is first mentioned? Why

is Table 8 left to the end of the paper?

33. p. 45 line 15: in section 4.1-4.3 you only talk about N96 and N216. You should mention both of these and NOT mention N768 until section 4.4. Also, it would be nice to get the rough dx values in km here for N96 and N216.

34. p. 47 line 2: I think you mean "returning" rather than "retuning"

35. section 4.1-4.3: how long are the simulations you discuss in the climate section. The end of section 4.3 mentions 27 years... if this is the case, it should be mentioned at the beginning of section 4.1 because otherwise the reader is left wondering about statistical significance of the results you show...

36. Fig. 12: it's really hard to tell orange from red dots. Perhaps replace orange with yellow dots?

37. Fig 16 top left panel: why have OLR color levels start at 0 W/m2 so the plot basically just looks like a red box? I think some other figures could benefit from this change too.

38. Figure 21: 3rd from last line of caption: I think you mean blue instead of purple?

39. p. 57 line 7: I think you mean "OUR own analysis"?

40. section 4: I'm surprised you don't evaluate the land model skill at all. I know decent land model behavior is needed for reasonable atm metrics, but shouldn't you also evaluation soil moisture and temperature at each layer, river runoff, vegetation albedo, etc?

41. p. 59 end of line 9: "prep.b)" typo?

42. p. 60: differences between GA7.1 and 7.0 bullets 2-4: does CMIP6 specify these input datasets? More generally, you don't really say anywhere whether or not you follow the CMIP6 specifications for input dat

2017.

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