Second review of 'The non-hydrostatic global atmospheric model for CMIP6 HighResMIP simulations (NICAM16-S): experimental design, model description, and impacts of model updates'

I commend the authors for significant improvements to this manuscript relative to the initial submission. In particular, I find the naming convention for the simulations to be vastly improved, which makes it much easier to follow the sensitivity experiments and their impact when updating from NICAM12 to NICAM16. The deeper look into the impact of design choices is welcome. The manuscript also has fewer typographical errors and is a much more pleasant read for an English speaker.

I still have some minor comments that probably should be addressed, but following a response to these few points, I recommend publication in GMD. I anticipate this will be a useful reference for those who apply HighResMIP data to investigate the performance of current-generation Earth system models at high spatial resolution.

Minor comments

- Page 3, line 11. Would cite Skamarock et al. [2019].

- Page 4, line 6. Should 'interval' be something like 'time discretization' or 'timestep'?

- Section 3.5. This particular section is a bit weak. I hope a future goal of the team is to explore the response to this more thoroughly as it is a pretty robust change in boreal summer soil moisture from Fig. 10 and likely feeds back into surface enthalpy fluxes, etc.

- Page 11, line 13. Is the 15m a global constant? If so, add 'set to 15m globally.'

- Section 4. Am I interpreting it correctly that there is a large dynamics/GWD timestep sensitivity (DDT2M vs. DDT1M) in the model? If so, this is quite a surprising finding, as generally models are relatively insensitive to dynamical core resolution as long as the model is stable. Does this timestep also impact microphysics, convection, etc.? If so, then that is a more common source of timestep sensitivity. See Gross et al. [2018].

- Fig. 17. The text makes reference to an observational comparison ('The intense precipitation occurs more frequently in the model compared with GPCP.'). It is unclear if the authors meant to add this as a reference to this figure for comparison, but adding either TRMM or GPCP as a fourth line would be a helpful benchmark, especially since the precipitation response runs counter to some other HighResMIP models (where precipitation rate is generally higher as resolution increases, at least until $\Delta x =$O(10km).

- Figure 18. Include the node count for 9s and 7s simulations (looks like perhaps 160 and 10 based on the text?) as is done for the 8s runs.

- Page 15. 'Note that the... author.' This can be moved to the acknowledgements section as it isn't scientifically notable.

- Fig. 16. Add legend showing what the red, blue, and green dots represent on the figure (perhaps in the white space below 16f). While I understand the figure is similar to Fig. 5, it is still useful to include as much description as possible, particularly when the figures do not follow one another.

Typographical errors and grammar

This list is not meant to be exhaustive, but rather, a few obvious catches I noted while reading.

- Page 1, line 34. Would probably swap the order and say 'extreme weather, such as tropical cyclones.'

- Page 2, line 2. '... oscillations such as the Madden...'

- Page 2, line 21-23. This passage is a bit awkward. Might just say something like '... no fully coupled atm-ocn models are included in this manuscript as it is under development.' or something similar.

- Page 4, line 20. Formatting of 'SSP5-8.5'

- Page 8, line 3. 'versus synoptic systems'

- Page 12, line 10. '... of the bias, which may be due to factors such as the convective timescale.'

- Would check references that are either 'submitted' or 'accepted' as their treatment as citations in journals varies from publisher to publisher. Not sure what GMD's official stance on this currently is.

References

M. Gross, H. Wan, P. J. Rasch, P. M. Caldwell, D. L. Williamson, D. Klocke, C. Jablonowski, D. R. Thatcher, N. Wood, M. Cullen, et al. Physics–dynamics coupling in weather, climate, and earth system models: Challenges and recent progress. *Monthly Weather Review*, 146(11):3505–3544, 2018.

W. C. Skamarock, C. Snyder, J. B. Klemp, and S.-H. Park. Vertical resolution requirements in atmospheric simulation. *Monthly Weather Review*, 147(7):2641–2656, 2019.