

Interactive comment on “The Norwegian Earth System Model, NorESM2 – Evaluation of the CMIP6 DECK and historical simulations” by Øyvind Seland et al.

Anonymous Referee #2

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The paper is a high-level description of development, tuning, and key CMIP6 simulations of NorESM2. That includes a discussion of climate sensitivity and several aspects of the climatological state of the model.

The paper is half-way between an overview paper and an evaluation paper. It works well as an overview, covering the main development activities, simulations and results. I like the openness of the description of tuning strategies. Sharing components with CESM2 brings the interesting aspect of the impact of ocean/etc. on different on key metrics like sensitivity, which may provide interesting opportunities for new insights.

The paper does not work as an evaluation paper. The evaluation mostly looks at phys-

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ical aspects (radiation, clouds, ocean state, sea ice, ENSO) and the more “Earth system” components are not evaluated at all. My suggestion is to focus on the overview, delegating the evaluation of specific components to companion papers. The present paper should then be re-titled and reframed, with minimal effort, as an overview paper only. This reframing would be a good opportunity to make section 5 more balanced in terms of text-to-figure ratio: many figures are only briefly mentioned in the text, so could go.

1 Specific comments

- Caption of Figure 1: The information given in parentheses could more efficiently be put in the boxes directly.
- Line 64: I'm curious to know how those modifications were chosen. In response to perceived deficiencies in CESM2? Different scientific priorities? Ad-hoc developments that happened to be ready?
- Line 99: That paragraph would be a good place to say what the time step of the different models is.
- Line 99: That paragraph could be organised more efficiently. Related statements should be grouped together, for example all statements related to emissions; then chemistry; then volcanic forcing; then optical properties. Bullet points would work well here.
- Lines 123-124: What do you mean? The model should not cool in such simulations... Do you mean improve the radiative balance of the model?
- Line 128: Kirkevåg 2018 is unclear as to what particles acted as coagulation sink in the previous version. It should be clarified here.

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- Line 129: “a more realistic rate” What was the previous value? How big is the change?
- Line 139: How is the mean cloud-free relative humidity calculated? Assuming 100% RH in the cloudy part?
- Line 254: Need to clarify your secondary tuning target. Was it absolute temperature of the preindustrial state, the present-day state, or present-day temperature anomalies? The latter two imply a tuning of the response.
- Paragraphs starting lines 270 and 275: Those two paragraphs are confusing. Which changes made it and which didn't?
- Line 272: “the final parameter values” – might as well give those values here.
- Line 281: That statement looks incomplete.
- Lines 366-367: Is that drift related to the ocean temperature drift?
- Lines 379: Should cite the examples of long equilibrium studies.
- Lines 389-391: It would be useful to show that 500-year simulation on Fig 3. Is there a change in warming rate at some point in time, or is it just a question of time to equilibrium?
- Line 396: I suppose that the slower warming in NorESM2 means that its TCR is lower than that of CESM2?
- Line 417: Is that really the explanation? Isn't it normally a good thing to have a low climate sensitivity when having a strong forcing?
- Line 418: Perhaps say that this is the effective radiative forcing

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- Line 425: A good way to summarise the numbers in that paragraph is that the absolute temperature simulated by MM is almost 1 degree warmer than LM throughout the 1850-2100 period, but anomalies are similar.
- Line 468: Although I do not have specific comments on section 5, that section needs to focus on main results only, clearly summarising which model/model and model/obs differences are understood, which are not, and which differences affect the model response to forcing.
- Paragraphs starting lines 436 and 444 and Figures 6-7: SSP126 looks like an outlier in a couple of these timeseries. Is that just variability among ensemble, or is there something more than that?
- Figure 15 should be re-numbered, as it is used after Figure 19.

2 Technical comments

- Line 15: Satisfactorily -> satisfactory
- Line 47: Delete “Also”
- Line 793: Typo “properties”

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2019-378>, 2020.

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