The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC1
https://doi.org/10.5194/tc-2021-351-RC1, 2021

Comment on tc-2021-351

Anonymous Referee #1

Referee comment on "Understanding model spread in sea ice volume by attribution of model differences in seasonal ice growth and melt" by Alex West et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-351-RC1, 2021

The authors analyse how differences in three climate models contribute to difference in the modelled sea ice. They apply the ISF method to break out contributions of individual components to drivers of melt and freeze throughout the year. Overall the manuscript is well written, clear, and has sound methodology. Well done! My concerns are primarily related to clarification and minor in scope.

Specific comments

- Line 110, remove "and" after Wang et al.
- Line 197: I would recommend rewording "thicker ice in HadGEM3-GC3.1-LL and UKESM1.0-LL causing a colder surface temperature, and less heat loss to space, than is the case in HadGEM2-ES" to: "compared to HadGEM2-ES, the two CMIP6 models have thicker ice which leads to a colder surface due to reduced heat conduction through the ice, and the colder surface results in less longwave radiative loss to space."
- Line 216: You haven't cited or mentioned CICE yet. You may want to expand a bit about why or how the ice models are different.
- Figure 3:
  - Could you plot surface albedo differences to show the net spatial impacts of all components?
  - It might be nice to compare with observations here, where appropriate. The different models have hugely different ice fractions and melt pond fractions. Which are most reasonable given observations?
- Equation 2: instead of MODEL it says MODE. Same two lines above.
- Equation 5: At first it is nearly impossible to tell the difference between a for area and alpha for albedo. Could Area be changed to A_i or bolded to make this clearer? Same for lines below.
- Line 282: Please clarify how bare ice fraction is found.
- Line 285: If this equation is relevant, may want to number it. Also, please define the albedo of the ocean. Is the albedo over different surface types output directly?
- Line 304-306: Did you verify that the answer is similar by using either/both CMIP6

models and comparing ensemble mean to the individual ensemble members?

- Figures 4,5,6:
  - These figures are really nice and clear, but I had a lot of trouble with the colors. Please modify the colors to improve readability, change dash patterns, or bold particular lines of relevance.
  - I think monthly mean figures of the spatial difference contributions might be useful as a supplementary figure to see which components dominate in different regions.
- Line 328: Why is the snow thickness so different between these models?
- Line 379: I would recommend rewording "differences in the thicker categories contribute much more towards the total" to: "contributions across all thickness categories are similar rather than being dominated by very thin ice as was found in the previous comparison."