Response to RC1

The paper uses a brightness temperature satellite simulator to diagnose the timing of melt onset in model simulations, and compare this new metric to other metrics of melt onset. Overall, the paper is well written and worthy of publication subject to the minor corrections listed below:

We thank the referee very much for their positive assessment and their very constructive comments that will help us improve the manuscript. Responses to the minor corrections are below.

1. Line 49: Write out the ACR3O acronym here as this is its first use.
Thank you for noticing this, the acronym stands for “Arctic Ocean Observation Operator” and will be written out at first use.

2. Line 61: What method of regridding was used?
The nearest neighbor source-to-destination regridding method was used and this will be noted in the text.

3. Line 73: "Each .." Describe the method in slightly more detail - How does brightness temperature change as melt occurs?
Text will be added to this section to provide more detail on the Markus et al., 2009 methodology (used in the Steele et al., 2019 dataset).

4. Line 85: "Surface temperature" - clarify whether this is ice, snow or either surface temperature.
The surface temperature-based definition is based on the CESM model variable surface temperature, and is the sea ice temperature if no snow is present and the snow temperature if snow is present. This will be noted in the text.

5. Line 123: What is the justification for the step function as opposed to another functional form?
In the absence of an empirical function to describe snow wetness, we chose to prioritize the simplicity of the functional form in order to reduce the uncertainty introduced by this estimation. While other functional forms were not evaluated, we will include a brief addition to the text describing the sensitivity of the results to the step function thresholds.

6. Line 138: "So here" -> "Therefore" or another replacement.
We will replace "So here" with “Therefore”.

7. Line 141: "CICE provides..." I believe CICE can provide the number of layers specified so clarify this isn't the only choice possible. Maybe something like: "CICE was configured to provide"
We will make this change in the text as suggested.

8. Lines 140-150: Clarify what thermodynamic model CICE is used? Mushy layer? Bitz-Lipscomb 1999?
Here CICE5 was configured to use the default thermodynamic scheme within the CESM, which is the mushy-layer thermodynamics. This will be noted in the text.

9. Line 152: Lagrangian tracking - I am unfamiliar with this functionality in CICE - is it documented/referenced somewhere? There is a FY ice tracer, but it is not lagragian tracked, instead advected with the Eulerian transport scheme.
Thank you for this clarification. The phrase “Lagrangian tracking” does not apply, as we are utilizing the FY ice output variable. This will be corrected in the text.

10. Line 154: Clarify what the correlation length is.
The correlation length is a metric of the scatterer size. Although it is a variable that is quite well understood and quantifiable for snow (Mätzler, 2002; Proksch et al., 2015; Lemmetyinen et al., 2018), its quantification in sea ice is not clear and its values not well known. We therefore use values based on past experiments conducted by Rasmus T. Tonboe (Burgard et al., 2020a) and this will be noted in the text.

11. Line 159: "(greater than 30cm)(Fig. S2)" -> "(greater than 30cm; Fig. S2)"
We will correct this in the text.

12. Line 180-185: The two thresholds are presumably justified from a bimodal nature of the brightness temperatures. It would be useful to see histograms demonstrating this bimodal nature.
Thank you for this suggestion. We will create histograms of the brightness temperatures and assess if they can be well-integrated in the manuscript’s Supplement and discussion of results.

13. Line 185: "with boundary" -> "with the boundary"
We will correct this in the text.

14. Figures 1, 5, 6, 8: Add the field name and units to the colorbars.
Field names and units will be added to the colorbars.

15. Figures 3, 4, 7: Add markers to the map of the Arctic ocean showing exactly where the a,b,c,d points are.
Latitude and longitude markers will be added to the maps.

16. References: "SIMIP community ... 2020": This doesn't appear to be how to cite: https://agupubs.onlinelibrary.wiley.com/action/showCitFormats?doi=10.1029%2F2019GL086749
Thank you for raising this point. The citation of the SIMIP paper was changed at Wiley after the initial publication for purely administrative reasons related to the funding of the publishing charges being carried centrally by the Max-Planck-Society in Germany. As this change was implemented for purely administrative reasons, rather than reflecting the intended, agreed authorship of the paper, we would prefer to keep the reference as reading like the original authorship “SIMIP community, 2020” if journal guidelines allow.