

The Cryosphere Discuss., referee comment RC1  
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## Comment on tc-2021-38

Emma Dodd (Referee)

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Referee comment on "Deriving Arctic 2□m air temperatures over snow and ice from satellite surface temperature measurements" by Pia Nielsen-Englyst et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-38-RC1>, 2021

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### General Comments

Overall, this interesting and valuable paper is generally well written. There is some additional discussion needed in places and some tightening of prose, particularly in the second half of the introduction and in the discussion/conclusion. Yet the research itself is comprehensive and the science is good.

### Specific Comments

- After Page 2 Line 30 the introduction needs a bit of attention to retain the good quality of previous paragraphs. It felt like the flow of the narrative was lost around here and there is a bit of repetition.
- For the satellite data please give an explanation for the choice of a 0.25 by 0.25 degrees regular geographical grid. This seems quite a coarse resolution given the input data, is this to correspond to T2m datasets from other sources or model grids?
- Page 7 Lines 5-7:
  - It took a couple of reads to figure out that the ISTskin\_L3 is the daily version of the L3 not the 3 hourly (assuming I understand correctly). I think changing the text to something like "Here, we have aggregated the AASTI ISTskin\_L2 observations into 3 hourly and daily, gridded 5 Level 3 (L3) averages of ISTskin\_L2 on a fixed 0.25 by 0.25 degrees regular geographical grid. The daily gridded averages (ISTskin\_L3) are calculated by averaging" might make this clearer.
- Page 8 Line 26:
  - You mention the distances but not temporal matching. I guess from the data this is a daily average comparison, but this might be worth mentioning explicitly here.
- Page 14 28-29:
  - This sentence reads as though only the random uncertainties are provided for each pixel and the others are provided as one value for the whole dataset. Is this correct?
  - Surely given the inclusion of a sampling uncertainty in the synoptic component and

separate equations for land ice and sea ice there should be a value for each pixel? This is the case for synoptic uncertainties for similar satellite products such as from e.g. Ghent et al (2017).

- Page 15 Line 1-4:
  - This sentence makes it sound like only ice over sea is included; ice shelf (land ice) and sea ice. But Figure 6 and previous figures show data over the Greenland ice sheet. Is the Greenland ice sheet included in the dataset?
- Results:
  - I would like to see a few more citations and additional discussion of the results here as I was often left wondering how the results compared with previous research or observations that might back up your results. For example:
    - "The monthly mean air temperature typically reaches 20 a maximum of -4°C during July and a minimum of about -28°C during winter." Does this correspond to previous research and/or observations? Perhaps the GrIS in situ observations could be added to Figure 12 to show how close the T2m\_sat is?
    - It seems that the results from comparisons of ERA-Interim (and ERA-5) suggest that the long standing warm bias in these reanalyses for the Arctic still exists, which deserves some comment here and perhaps citation of previous studies on this. I also don't know if ERA-5 has been compared to in situ T2m over the Arctic in other research yet so this could be an interesting result given the warm bias may still be a feature of this dataset series. Again, if so this is worth noting.
    - Page 17 Lines 5-9, I believe your statements about Arctic cloud cover are correct, but I think a citation would be useful to back this statement up.
  - Discussion:
    - This section was more like a list of additional things to note that did not fit in the rest of the paper rather than a coherent discussion. I felt it didn't really tell the story of the research in the way it deserves.
    - I think this needs a bit of work to restructure and possibly a short summary of results relevant to each point made. For example:
      - Page 22 Lines 11-18 seem to refer to the fact that "The satellite 10 derived air temperatures are about 0.3°C warmer than measured in situ air temperature for both land ice and sea ice." which is probably due to the influence of the linear regression? It would be nice to include the context for these sorts of statements in the discussion.
      - Will the surface temperature dataset be extended to seasonal snow and ice?

## Technical Corrections

- Page 2 Line 19: Satellite not Satellites
- Page 2 Line 23: Either un-capitalise The or remove
- Figure 3, 4: might be a big ask depending on the software used, but is there any chance of removing the sliver of white from the plots?
- Page 8 Line 22: I think a subheading for this validation section would be useful to the reader.
- Page 16 Line 8: there is not there are
- Page 23 Line 17: MODIS not Modis (acronym of sensor)
- Page 15 Line 2: could you expand the acronym ETOPO1 or provide a very brief

indication in text of what this is? Perhaps "ETOPO1 global relief model" or similar?

- Conclusion section: a bit long and should be distilled down to the major points.