Response

Dear Editors and Reviewers:

We would like to thank our reviewers and editors for this opportunity. We gratefully acknowledge the helpful suggestions and careful checking of our manuscript. The content of this manuscript could only have been improved with their contributions.

For the specific technical suggestions, we will respond to them below and revise the corresponding context in the manuscript. A track-change version and the revised manuscript will be provided.

Further suggestions for a minor technical revision:

1. Which band of Sentinel-2 is shown in the figures? Probably band 3 (560 nm) as written in the text but this is not clear from the caption.

***Response**: We used images from the Sentinel-2 band 3 (560 nm), as mentioned in Section 2.2. As suggested, we have also added this in the caption of Fig. 8.*

2. Not very relevant for this study but regarding the emissivity I wonder if there is a better citable source than the ATBD of Hall et al. (2001) which refers to Jeff Key, written communication, 1996?

***Response**: Thanks for this suggestion. We will refer to other literature on the differences in IST retrieval due to surface emissivities in lead areas.*

Fan et al. (2020) assessed the accuracy of different methods of ice surface temperature retrieval based on Landsat-8 thermal infrared imagery at 100 m resolution. They first discriminated between different types of surfaces, snow/ice surface and water surface (e.g., open water areas, ice-free leads, or flooded ice surfaces), and used different emissivities for them. Their results show that in the lead scene, the Landsat-8 retrieved surface temperatures are higher for lead areas than MODIS results, as the coarser resolution of MODIS tends to underestimate lead areas. This is essentially the same as an explanation by Hall et al. (2001) that the different emissivities due to the mixed pixel effect in thermal infrared remote sensing ultimately results in a difference in the retrieved temperature.

A more quantitative description of the result of this temperature difference can refer to Jiménez-Muñoz (et al., 2014). They note that part of the error in the surface temperature retrieval by the split-window algorithm arises partly from the uncertainty in the surface emissivity, which can contribute to a difference of 1.4 K.

Jiménez-Muñoz, J. C., Sobrino, J. A., Skoković, D., Mattar, C., and Cristobal, J.: Land

surface temperature retrieval methods from Landsat-8 thermal infrared sensor data, IEEE Geoscience and remote sensing letters, 11, 1840-1843, 2014.

We included this literature in the revised version to better clarify our idea: "Essentially, IST data, which are usually retrieved using the split-window technique (Key et al., 1997), has challenges in sea ice scenarios with the presence of melt ponds and leads. This is partly due to the lower emissivity (0.96 compared to 0.99) of water compared to sea ice, causing a difference in the retrieved temperature (Jiménez-Muñoz et al., 2014; Fan et al., 2020), especially with mixed pixel effects (Hall et al., 2001)."

3. The link between improved detection of leads and the support of actual climate action (SDG 13) is in my opinion very weak. Maybe drop this half-sentence and the following appraisal of the satellite in the SDG context? It is certainly a great satellite mission, but the discussion of SDG indicators is beyond the scope of this journal. The sentence "Combining this data with diverse datasets of sea ice, we aim to provide insights into the contribution of leads to Arctic sea ice dynamics" would be a good closing.

***Response**: Thanks for this suggestion. As suggested, we have removed the last paragraph. However, research related to Arctic warming and sea ice dynamics is also a significant concern of SDG13: climate action, which aims to "take urgent action to combat climate change and its impact," so we would like to retain at least this content. The manuscript will end with the following:*

"Combining this data with diverse datasets of sea ice, we aim to provide insights into the contribution of sea ice leads to Arctic sea ice dynamics, in an effort to combat climate change and its impacts as support a key towards SDG 13: climate action.".