Referee comments in black, response in blue

Anonymous Referee #2: (https://doi.org/10.5194/egusphere-2022-1189-RC2)

Review of "Estimating the uncertainty of sea-ice area and sea-ice extent from satellite retrievals" by Wernecke et al.

Summary

This paper presents a method to estimate uncertainties in passive microwave-derives sea ice extent and area. It is derived from spatial and temporal errors in the gridded concentration fields. The approach yields estimates of uncertainty in daily and monthly extent and area values and the paper provides trend estimates with accompanying uncertainties.

General Comment

This is an excellent paper. It provides a logical, quantitative method to estimate extent and area uncertainties based on the characteristics of the gridded sea ice concentration fields. Such quantitative extent and area uncertainties have long been lacking, which is a significant limitation in the passive microwave products that are a key indicator of warming and climate change. The use of these extent and area uncertainties to derive uncertainties in trends is also highly valuable, particularly for the Antarctic where trends are near-zero and uncertainty is needed to assess if trends are significant. The paper is well-written and explains the methods and results well. I recommend publication after only minor revisions, noted below.

Thank you for the review and suggestions. We are very glad to hear your thoughts on the research topic, its significance and the presentation of this study.

Specific Comments (by line number):

79: "tie points" is used here, but not defined. It is defined later in the paper in lines 244-245. Readers may not be familiar with the term, so it should be defined here when it is initially used.

Agreed

83: "constant biases" – aren't biases by definition a constant? I think you mean here that the biases are consistent throughout the various product – i.e., a land difference is a constant offset – as opposed to differences between products due to methodologies (channels used, tie point values) that have mean biases but with variable differences depending on conditions. I think it would be fine to just remove "constant" and just say "biases" as the source of these biases are mentioned.

Agreed

115-116: This paper essentially uses the results from Kern (2021) and Kern (2021) as the basis for the whole approach. In light of that, I think a short summary of the method and data is warranted. Though the references obviously explain things in detail, I think having a brief explanation would be helpful to allow readers to have a sense of those papers without having to go to the external references. Again, it doesn't need to be detailed, but at least 2 or 3 sentences summarizing the data and method used for both the spatial correlation (2.1.1) and temporal correlation (2.1.2) would be a good foundation for the rest of the paper. It could also be done for both spatial and temporal in Section 2.1, as an introduction, before going to the two subsections.

In parts this might be a misunderstanding, potentially caused by an ambiguous formulation on our side (line 116 ‘In this study’ was intended to refer to Kern 2021, not the manuscript presented here). The majority of Section 2.1.1 (lines 115 to 144) is a summary and discussion of the Kern (2021) method and dataset. The spatial correlation length scale is based directly on the published data (Kern, 2022), the temporal correlation length scale is derived here, closely following the methods of Kern (2021). Both of these aspects have been made clearer and a few key results from Kern (2021) have been added.

221-229: It is most useful to have trend values with the quantitative uncertainties derived based on the spread of the ensemble members. This provides the trend uncertainties based on the uncertainty in the extent and area values. However, there is also the significance of the trend based on the “noise” in the linear trend fit – e.g., the trend standard deviation and/or the P-value of the trend (e.g., $P<0.05$); this assesses the confidence level in the trend based on the length of the timeseries and the year-to-year variability. This is the number often calculated and quoted with trends. But that is different than your estimate based on the ensemble members. I think it would be worth making this clear and perhaps it would warrant a short discussion (maybe in Section 4 or 5) of what this means for understanding the trend significance. This is particularly key for the Antarctic where trends have been near-zero, but have varied between small positive and small negative trends – are these changes really significant given what you have shown about the uncertainties as well as the trend standard deviation values?

While we have no answer to the significance of Antarctic trends for now, we do now discuss the different estimates in more detail and mention a limitation of the traditionally used standard error of the trend, namely its implicit assumption of independence.

We note that the current study focuses on Arctic sea ice and that an adaptation to the southern hemisphere is in preparation. In addition, the focus of this manuscript is to showcase our approach of propagating local SIC uncertainties to SIA and SIE uncertainties as well as to analyse the main sensitivities of this approach. We do not aim at providing a full analysis of the entire dataset in this study.