Referee comments in black, response in blue

Anonymous Referee #1: (https://doi.org/10.5194/egusphere-2022-1189-RC1)

This study retrieved the SIA/SIE uncertainties by taking into account the spatial and temporal error correlations of the underlying local sea ice concentration products. It shows that random SIC errors play a role in SIA uncertainties comparable to inter-SIC-product biases. This study also compiles the September SIA trend with an explicit representation of temporal error correlations from 2002 to 2017. Extending this research to regional studies would help to investigate the impact of the correlated SIC uncertainties on oceanic and atmospheric surface fluxes. I would suggest a minor revision before it can be published.

Thank you for the useful comments and suggestions.

Thank you also for the suggestion of regional studies. We decided not to include those in the current manuscript. 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. The results from 2015 and September are a proof of concept, and as such primarily meant to highlight the usefulness of our approach and to give a basic first idea of the resulting values. We do not aim at providing a full analysis of the entire dataset in this study. We are currently working on such analysis which we aim to publish, including regional aspects, separately once finished.

Investigating the impact of correlated SIC errors on surface fluxes, compared to independent noise, is another very interesting topic but would require modeling of convective processes in the atmosphere and ocean. It is also outside of the scope of this study.

(1) It would be better to use the exact values of SIE and SIA uncertainties in the abstract rather than showing an approximate value.

We intended to compress the information in the abstract to highlight the main findings by combining daily and weekly estimates as well as SIA and SIE estimates. However, we now provide the exact values as requested to put the reader into the position to assess the level of similarity themselves.

(2) Please indicate why you are focusing on CCI SIC product at 50km grid spacing product instead of that at 25km grid spacing.

The main difference between the 50km product and the 25km product are the used frequency channels (18.7 GHz and 37 GHz for 25km and 6.9 GHz and 37 GHz for 50km). The 6.9 GHz channel is less sensitive to some sources of uncertainty, such as atmospheric effects. Since we here are only interested in accumulated quantities (SIA and SIE), the higher spatial resolution is of limited use for this application. While we cannot say, or show here, that the 50km product is indeed more suited to derive SIA and SIE, these considerations let us focus on the 50km product for now. This product is also easier and faster to process.

(3) Please further demonstrate the advantages of using Monte Carlo approach in this study.

In general, the main advantage of MC approaches is their flexibility and user friendliness. This flexibility helps for example with the calculation of SIE uncertainty where traditional error propagation does not work well with discontinuities such as the application of thresholds.

For our purposes, however, the main reason for using an MC approach is that a traditional analytical approach is not feasible due to the size of the dataset. This is mainly because we allow temporal and spatial correlations at the same time. Therefore the number of data points handled at one time is very large, making it practically impossible to numerically define a covariance/correlation matrix (which has n^2 entries, where n is the number of data points). While there are approaches for sparse correlation matrices (as we have here), they are not always applicable, require additional assumptions and are only approximations.

We now discuss this impracticality of traditional analytical uncertainty propagation and the advantages of MC approaches in more detail.

(4) Why was 2015 chosen as a case to demonstrate the error correlation length scale and SIA/SIE standard deviation?

This choice was somewhat arbitrary, but was motivated by the fact that 2015 closely resembles the average SIE of the years 2011 to 2020 (https://nsidc.org/arcticseaicenews/charctic-interactive-sea-ice-graph/) and can thus be considered a “standard” year. Nevertheless, other years could have been chosen as case study since this choice only acts as an example.

(5) It would be better to add more figures to make the Results and Discussion sections more convincing and easier to understand, e.g., superimposing a graph of SIA trend and the linear regression of CCI product in Figure 5(b).

A figure has been added as suggested. In addition we added a panel with SIA and SIE anomalies to former Figure 4 and restructured the figures into one set (former Figure 4 and 5a) concerned with the 2015 time series and another set (a new figure with the September SIA plus regression and Figure 5b) concerned with the September trends. In this way we think that the result section has become more convincing and easier to follow.