Authors' Response to Reviews of

Enhancing sea ice knowledge through assimilation of sea ice thickness from ENVISAT and CS2SMOS

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The Cryosphere,

RC: *Reviewers' Comment*,   AR: Authors' Response,   ☐ Manuscript Text

Dear Editor, Alison Delhasse, François Massonnet and Imke Sievers

Firstly, we would like to thank you all very much for the constructive comments and suggestions for the manuscript "Enhancing sea ice knowledge through assimilation of sea ice thickness from ENVISAT and CS2SMOS". Your insights are very useful in enhancing the quality of our work. Based on the comments and suggestions from the second revision stage, we have revised the manuscript.

Please find our detailed point-by-point responses to the second review stage comments in the following sections. Below, we list each comment (Reviewer Comment, **RC**) and insert our response (Authors' Response, **AR**) along with the corresponding revisions of the manuscript (inside the **black box**).

Sincerely,

Nicholas Williams
On behalf of all the authors

1. Second Reviewer Final Responses

RC: *137: prior what?*

AR: Apologies, it refers to the prior ensemble. We have change it to:

> The sea ice volume in each thickness category is changed proportionally so that the thickness of each thickness category remains identical to that of the prior ensemble (i.e., the multicategory hicen before assimilation).

RC: *156: could you add a reference explaining how anomaly-field assimilation works?*

Yes of course, we refer to Carrassi et al. (2014).

RC: *287-288: This is not inline with the figure text in figure 4*

AR: We have changed this text to be in agreement with figure caption text, as follows:

> To compare this data to our model monthly mean thickness, we first convert the sea ice draft into SIT using the method of Rothrock et al. (2008), and then average all the measurements over each month or year to convert to monthly or yearly averages respectively, which we can compare to the model. If there was missing data in a month, we discard the ULS data for that month for that mooring, if there were more than thirty days of missing continuous data in a year, we do not compute a yearly average for that year.

RC: *403: shown in ?*

AR: Apologies for the typographical errors, this section has now been corrected to as follows:

> Prediction skill and underlying mechanisms vary significantly by region (Bushuk et al., 2024). Our assessment spans both the pan-Arctic region and specific basins, following the approach of Bushuk et al. (2017). We use the same regions as defined in Bushuk et al. (2017), shown in Figure **??**. We compare the performance of CTRL and +SIT to highlight the role of SIT in improving predictability across different regions. We present the central Arctic, Beaufort Sea, Barents Sea, Bering Sea, and pan-Arctic regions, where the largest differences in SIE, SIT and IIEE skill between CTRL and +SIT are observed, but an assessment for other regions is also available in the supplementary material.

References

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