



EGUsphere, referee comment RC2
<https://doi.org/10.5194/egusphere-2022-982-RC2>, 2022
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Comment on egusphere-2022-982

Anonymous Referee #2

Referee comment on "The effects of assimilating a sub-grid-scale sea ice thickness distribution in a new Arctic sea ice data assimilation system" by Nicholas Williams et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-982-RC2>, 2022

The paper describes assimilation of monthly mean sea ice thickness, monthly mean sea ice thickness distribution from Cryosat-2 and sea ice concentration from passive microwave observations in CICE Arctic sea ice model. The best result was achieved when all three data sources are assimilated. For the first time, a sub-grid scale sea ice thickness distribution was assimilated. This led to a significant improvement in estimation of the thickness of the thickest ice category. The paper can be published once the following comments are addressed.

General Comment:

My major concern is that the only data source used for model verification was Cryosat-2 ice thicknesses that were not assimilated. In general, the fact that the modelled ice thickness becomes closer to Cryosat-2 observations indicate that the assimilation of Cryosat-2 ice thicknesses has been performed correctly. However, in order to further assess if the data assimilation brings the model closer to the reality, it is important to do a comparison against additional sea ice thickness observations. I suggest that the authors conduct verification of the model results against the available independent sea ice thickness observations including (1) NASA's IceBridge, (2) Beaufort Gyre Exploration Project upper-looking sonars (ULS), and (3) Airborne EM observations ("EM-bird"). I think that such additional verification analysis will substantially increase the quality of the paper.

Specific Minor Comments:

I noticed some minor inaccuracies throughout the paper:

Line 16 and throughout the paper. "Canadian Archipelago" à "Canadian Arctic Archipelago". Abbreviation "CAA" can be also used.

Fig. 1 In Y-axis title please add ")". X-axis title should be "Month"?

Line 58. Term "Optimal Interpolation" has been already introduced above.

Line 170. Please define "(?)".

Line 190-191. Words "using", "use", "using" are part of the same sentence. Please rephrase.

Line 214. Word "key" could be removed.

Line 217. "MYI", "FYI" were not defined.

Line 218. "radiances" -> "brightness temperatures".

Line 226. "team" -> "Team".

Line 279. Please rephrase "Ice thinner than 0.5 is not assimilated..." -> "Ice thicknesses lower than 0.5 are not assimilated..."

Lines 399-401. "because" is used twice in the sentence.

Legend font on Fig. 5 is very small.

Table 3. Add dimension to RMSE.

Figure 8, y-axis title. Add dimension.

Line 513. Should it be Fig. 13 instead of Fig. 12?