

## ***Interactive comment on “On the time and length scales of the Arctic sea ice thickness anomalies: a study based on fourteen reanalyses” by Leandro Ponsoni et al.***

### **Anonymous Referee #1**

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The article of “On the time and length scales of the Arctic sea ice thickness anomalies: a study based on fourteen reanalyses” aims at the Arctic sea ice thickness (SIT) which contains considerable uncertainty in the popular 14 reanalyses. They evaluate the reproduced SITs from the reanalyses, and then investigate the e-folding time and length scales of the SIT anomalies. Clearly, these topic and the consequent findings are helpful to deep understanding the SIT and the concerned variability.

1) Undoubtedly, one conclusion is “reanalyses built with sea ice data assimilation present shorter time and length scales”. However, all the reanalyses were only assimilation of sea ice concentration, and the inferred conclusion is not based on the

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direct comparison of with and without assimilation in a same system frame. The more proofs based on the sea ice concentration will be helpful to increase the rationality on physics. So the counterpart analysis on sea ice concentration shown in Fig. 2 and Fig. 3 will be robust.

2) Section 3.2 illustrates the intercomparison of the reanalyses. The current main features shown by Fig. 5 is not meaningful enough: some reanalyses are very close. . . In this section, more other information about SIT and its anomaly need to be added.

Firstly, the ensemble mean SITs based on with and without assimilation will be useful (P 15 Line 10: “This suggests that higher length scales are associated with thicker ice”). Furthermore, it will be complementary of the previous knowns in Uotila et al. (2018) and Johnson et al. (2012).

Johnson, M., Proshutinsky A., Aksenov Y., Nguyen A. T., Lindsay R., Haas C., Zhang J., Diansky N., Kwok R., et al.: Evaluation of Arctic sea ice thickness simulated by Arctic Ocean Model Intercomparison Project models. J. Geophys. Res., 117(C8), C00D31, doi:10.1029/2011JC007257, 2012.

Secondly, the standard deviations of the two ensembled SIT anomalies were not shown before and would be interested to the reader to know the variabilities or the distinguishes about the SIT anomaly in the reanalyses and even considering with and without assimilation.

3) Figure 2 clearly shows the time scale has been extended from less than 3 months to around 4 months, which is convert with the main finding (P1, Line 9: . . . data assimilation present shorter time and length scales).

4) The previously compared studies show atmospheric forcing fields essentially drive the results of sea ice simulations (Gerdes and Köberle, 2007; Hunke and Holland, 2007). Can you add some comment or analysis about the impact of the forcing resolutions on the SIT time and length scales?

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Gerdes, R., and C. Köberle: Comparison of Arctic sea ice thickness variability in IPCC Climate of the 20th century experiments and in ocean–sea ice hindcasts, *J. Geophys. Res.*, 112, C04S13, doi:10.1029/2006JC003616, 2007.

Hunke, E., and M. Holland: Global atmospheric forcing data for Arctic ice-ocean modeling, *J. Geophys. Res.*, 112, C04S14, doi:10.1029/2006JC003640, 2007.

5) The ice draft measurements from submarine have been identified an overall overestimation of +0.29 m (Rothrock and Wensnahan (2007)). This dataset also is used in this study. Can you add some comments about these kinds of bias corrections (also to other related observational data) applied here or not.

Technical issues: 1) As a basic index calculated by the SIT, it still is not clear how to deal with the conflicts of seawater and ice cover at each grid. For example in Fig. 2, when the observed sea ice is larger 0.1m, but the reanalyses are not all covered by sea ice. It is also not clear at P 15 Line 13 when to calculate the correlation between the two points: how to ensure the same lengths of the SIT time series.

2) P3, Line 20: “The original horizontal grids range from 0.25 to 1”. It is not correct because the reanalysis of TP4 is regional product with the resolution of 12-16km (also see Xie et al. (2017)).

Xie, J., Bertino, L., Counillon, F., Lisæter, K., and Sakov, P.: Quality assessment of the TOPAZ4 reanalysis in the Arctic over the period 1991-2013, *Ocean Sci.*, 13(1), 123-144, doi:10.5194/os-13-123-2017, 2017.

3) P3, Line 27: “... in details by Chevallier et al. (2017) (their Table 1) and Balmaseda et al. (2015)”. It is not correct because they did not include the TP4 product as least so recommend of the reference: Xie et al. (2017) or Uotila et al. (2018).

4) P4, Line 27: “the linear relationship between both parameters given by the hydrostatic equation”. It is better if clear to state the used equation or give a reference used.

5) Figure 1 adds the grid lines or labels the year on each panel. It is more convenient

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to match the statement. So P 11, Line 13 “for instance from 2001 to 2004” looks not suitable, and can be replaced by “for instance from 2002 to 2004”.

6) P 15 Line 10: “This suggests that higher length scales are associated with thicker ice” looks not so precis. It more likes around the North pole.

7) P 18 Line3: “.. scales of the sea ice thickness” replaced by “...scales of the sea ice thickness anomaly.”

8) Figure 11 adds a panel to show the difference so that details would be more clear.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2018-133>, 2018.