

Interactive comment on “Assimilation of sea-ice concentration in a global climate model – physical and statistical aspects” by S. Tietsche et al.

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General comments

We are delighted to hear that the referee finds our manuscript well written and convincing. We will respond to his suggestion to shorten the manuscript by moving the description of the ice energy balance model (Sections 6.1 – 6.3) to Appendix A and dropping Appendix B.

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Specific comments

3.3, P.2413: The adjustment of sea-surface salinity that we apply in the Discussion version of the manuscript is in fact very simple: We demand that total salt content be conserved in the analysis update, i.e.

$$S^a = S^b,$$

with S^a the analysed salt content in the grid cell, and S^b the background. Total salt content is the sum of the salt in the ice, and salt in the ocean surface layer, so

$$S^{a/b} = h_i^{a/b} S_i + h_w^{a/b} S_w^{a/b}.$$

The sea-ice salinity S_i is assumed constant in the model. The thicknesses of ice $h_i^{a/b}$ and the thicknesses of water in the top ocean layer $h_w^{a/b}$ are known, as is the sea-surface salinity before the analysis, S_w^b . We can then easily solve the salt conservation equation

$$h_i^a S_i + h_w^a S_w^a = h_i^a S_i + h_w^a S_w^a$$

to obtain the analysed sea-surface salinity S_w^a . We do not account for any indirect salinity changes due to exchange with the atmosphere.

However, in a revised version of the manuscript we will discuss experiments *without* the adjustment of sea-surface salinity described above. This is in response to the comments by referee #1.

S.4.1, P.2414: The referee understands us correctly in that we have only perturbed the initial conditions slightly and run exactly the same model again (“identical-twin” experiment). The perturbation is a shift of the model state by one day. We will add clarification to the manuscript.

S.5.2, P.2418–2419: We revised Fig. 5 to show also the CAT and CMT assimilation runs. We also added the PIOMAS estimate of Arctic sea-ice volume for that period, as

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we feel that comparison with ICESat data alone is not conclusive. The revised figure is attached to this comment. For a discussion of the figure, please refer to our reply to referee #1.

Technical corrections

Eqs. 14 and 15: First, we agree that consistency with Eqs. 5 and 6 is desirable, and will rewrite the equations accordingly. Second, we thank the referee for spotting our typographical mistake: of course it should read $C^o - C$, we will correct that in the manuscript.

Interactive comment on Ocean Sci. Discuss., 9, 2403, 2012.

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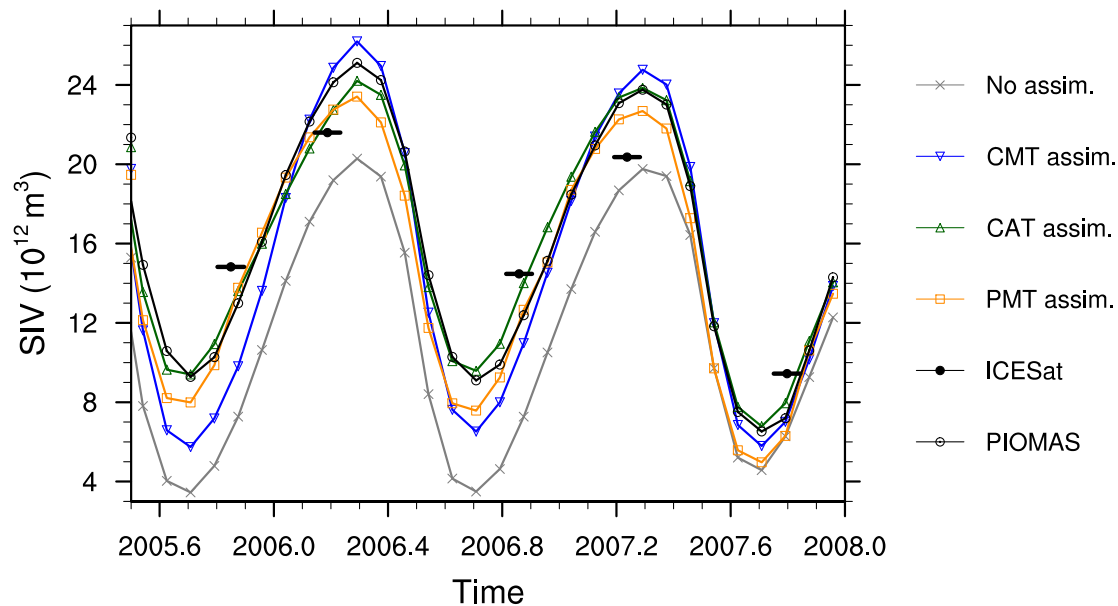
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Fig. 1. Comparison of northern-hemisphere sea-ice volume from our model runs with ICESat observational estimates and PIOMAS reanalysis estimates.

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