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The Cryosphere Discussions

Interactive comment on "Sensitivity of ice production estimates in Laptev Sea polynyas to the parameterization of subgrid-scale sea-ice inhomogeneities in COSMO-CLM" *by* O. Gutjahr et al.

Anonymous Referee #1

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This paper describes a range of different set-ups for a high resolution atmospheric model simulating polynyas in the Laptev Sea. The set-up involves the use of "tiles" which are sub-grid scale parametrization of thin sea ice. The quality of the model appears fine, and the number of simulations are impressive. Citations given are generally fine, and the technical quality of the figures are OK. Polynyas are important regions with substantial ice production and very high heat fluxes, and are thus an important part of the Cryosphere.

With the above in place one would expect that the paper would be in fairly good shape,

but I am sorry to state that this is not the case. The attention to detail is totally overwhelming, and there is almost nothing learned in terms of physics. The use of abbreviations also has no end, and is a clear sign that at this level the text is more like a data report intended for those that may apply the same model system in a future study. One look at Table 3 should say it all.

For the main conclusion not much has been learned about the atmospheric boundary layer, where the model actually should resolve processes in a better way than earlier model attempts. That the overall heat loss increases along with the total ice production when areas of thinner ice is added as a new lower boundary condition is indeed what is expected and does not contribute to an increased scientific understanding.

The text is also written only from a modellers perspective, without even the most basic understanding of processes in a polynya in nature. Moving downwind from the beach there is CONTINOUS change from open water to thicker and thicker sea ice, much like the MODIS observations plotted in Figure 13. In essence resolving the heat fluxes and the ice thickness inside a polynya is a coupled problem. Such coupling has been done albeit in a very simple way starting with Pease (1987). I'm not saying that you should invent a new downwind thickness parametrization for thickness, but rather state that you have made your choices, and then how this is simplified from nature.

A statement like "open water areas particularly produce new ice and are hence rarely free of ice" (Page 6, line 10) is not correct at all. Polynyas stay open for many hours during strong wind events that effectively transport sea ice (frazil, grease, pancake, solid ice) downwind (Morales-Maqueda et al 2004, Fig. 17). An open polynya length along the wind direction between 10 – 30 km is not uncommon.

The most interesting part of this study is the response of the atmospheric boundary layer, as shown in Figure 7. But here two plots should be shown, the "best" case and the similar without the tiles (C05nt – perhaps, it is just a total misuse of abbreviations here). This should be the case also for Figure 5, Figure 6, and Figure 11. All the tables

should only compare values between your “best” model simulation and the one without the tiles. The details are not interesting, unless you have some way of evaluating the model performance.

The paper needs to be totally rewritten if it is to be published as a scientific article. First – make your choice on the “best” model simulations, and present all relevant results to this one case first. Then compare to existing simulations without the tiles. At the end you can include some sensitivities to some of the different choices made, like the different thin ice thickness’ inside the polynya.

This reviewer has not been convinced that new scientific understanding has been achieved here, but I’m willing to review a new version of a totally rewritten paper if that is submitted.

Sorry to be so negative, but this version can be saved as a technical report for researchers that will work on the same model in the future. No one else would have the interest to read about all these details, and you have not done the important scientific job it is to extract the new understanding based on your model simulations.

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New Citations:

Pease, C.H. 1987. The size of wind-driven coastal polynyas. J. Geophys. Res., 92(C7), 7049–7059.

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