The Cryosphere

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Discussions

Interactive comment on "Sea ice diffusion in the Arctic ice pack: a comparison between observed buoy trajectories and the neXtSIM and TOPAZ-CICE sea ice models" *by* P. Rampal et al.

Anonymous Referee #3

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The study aims to evaluate the sea ice drift fields of two sea ice models with different ice rheology and coupling. They are mainly interested in sea ice diffusion accuracy of ice trajectory forecast as, e.g., needed for prediction of oil spill dispersion. In addition, the study derives useful metrics for ice diffusivity from buoy tracks.

In general, this is an interesting paper suitable for the Cryosphere. The model results and metrics derived from the buoys are, e.g., useful to guide future research on oil spill modeling in sea ice. The study provides, e.g., the time development of a potential oil spill search radius and which of the two model systems currently would be more suitable to predict the ice diffusivity more realistic.

The clear shortcoming of this article is that it is geared towards promoting the neXtSIM

model system, which would not be a problem if the judgment always would be fair. This is not always the case. For example, the TOPAZ mean drift is too fast while the neXtSIM mean drift is too slow. While the too fast TOPAZ drift is mentioned and exposed several times the too slow neXtSIM drift is only mentioned at the margins. The study cannot solve the question if the difference in mean drift and diffusion observed between TOPAZ and neXtSIM is intrinsic to the models, i.e., ice rheologies, or the different initial conditions and atmospheric forcings (TOPAS: thinner ice, lower resolution forcing -> can cause faster ice and less drift fluctuations as observed here). While mentioned in the study these points should be stated more clearly. In the end, however, it is clear and I agree that neXtSIM performs better in the current setup than TOPAZ.

Find more details comments below. After these points are improved I recommend the article for publication in the Cryosphere.

Page, line

1,1: I would suggest to add more information to the abstract about the buoy only results obtained in this study (e.g. p14, Fig.8), which are relevant for e.g. oil spill forecast. If possible this could also be reflected in the article title

3, 59: the sentence sounds as if you are using the same buoy dataset as in Rampal, 2008, 2009. But this cannot be the case as the time series is longer. Do you mean you are using the same pre-processing? Otherwise why not reference the original IABP data?

6, 142: what is an "off-line float tracking system"? Mention that this will be described below.

6, 164: slab ocean: this is a strong difference to TOPAZ and the differences should be discussed more.

7, 176-179: if you are initializing with the TOPAZ ice thickness, why don't you use that for the comparison of the two models? That would be much fairer. By increasing the

ice thickness in neXtSIM but not in TOPAZ it can be expected that the ice in TOPAZ is moving faster for the same forcing. If possible you should repeat the experiment with the original not adapted TOPAZ ice thickness. You are not interested in the accuracy of the total sea ice volume here; you are interested in differences in the motion fields. The initial conditions therefore should be as equal as possible for the two model setups in my opinion. While I can understand that nothing can be done about that one is a couple ice-ocean model and the other is a ice model only, I cannot understand why you are introducing this artificial ice thickness difference here, which naturally will favor neXtSIM (because the ice thickness is pulled towards more realistic ice thicknesses every year).

7, 185-189: Also here, why are you using different atmospheric forcing for the two model setups? The ASR is a newer and mostly believed better reanalysis for the Arctic than ERAi. As ice drift strongly depends on the quality of the atmospheric forcing different results can be expected even if the same sea ice model would be used.

8,217: apart -> away (?)

8,218: not a specialist on this but "steady and homogenous" sound like the wrong adjectives for a turbulent flow without mean flow to me.

8,227: you have not mentioned what tau is exactly so far.

9,263: what is k? The different buoys?

11,302-304: I actually cannot see that. I only see that for 2007. It is at least not as clear from the figures as you formulate it. Please adapt.

11, 308: How is the artificial thicker ice in neXtSIM affecting this behavior? Would the difference be similar if neXtSIM would have used the TOPAZ ice thickness for initialization?

12,337-345: Can you quantify these statements by numbers? I can see that TOPAZ is too fast. In e.g. 2007, however, it looks like neXtSIM is too slow and maybe also in

2008.

13,376: Maybe point out here that the majority of the IABP buoys are deployed on MYI.

13,395: This paragraph gives a good summary of possible causes for the observed differences, which I agree with and which should be summarized in the conclusions again. Your goal, however, is to separate the differences caused by the two ice rheologies. How can you achieve that goal if the forcings, thickness etc. are so different that they affect the results?

15,445: The last two paragraphs actually give interesting and useful information derived from the buoy dataset only. This information is independent from the model comparison. Maybe it would be easier to find for the reader if summarized in an extra sub-section. Also from the abstract I would not have expected to find such information here. Mentioning it could widen the readership.

16,472: Before you were always giving T in days

16,471-502: you should clarify that you are talking about the buoy results not models here.

17,508: The TOPAZ circulation pattern looks right just the magnitude is a bit off.

17,509: Yes, but mention again that neXtSIM is too slow and that these differences for the mean fields well can be due to the different forcing and ice thickness and not the models themselves.

17,520: Doesn't look to me that TOPOAZ was tuned the same way regarding the ice thickness as neXtSIM and using better atm. forcing also does not sound like finer tuning to me.

18,524: add a few more introductory sentences. After reading the paper it was not clear to me where the Appendix relates to the rest of the paper.

19, 572: Research Council?

25, Fig.4: I see three lines: thin black, thick black, red. You only describe two in the caption.

26, Fig.5: mention what L is in caption or shorten whole caption.

29, Fig. 8: Hard to see anything in the upper plot

31, Fig10: color scale and annotations impossible to read.