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Geoscientific Model Development Discussions
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Interactive comment on "Using Arctic ice mass balance buoys for evaluation of modelled ice energy fluxes" *by* Alex West et al.

Anonymous Referee #1

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General comments:

The authors present a thorough analysis of the well known dataset of ice mass buoys deployed covering the Central Arctic and Beaufort Gyre regions since 1993 to provide climatology seasonal estimates of the top and bottom ice conductive and melt and ocean fluxes over and under sea ice. The novelty of the method lies in the fine analysis of the data and in the physical processing applied to retrieve meaningful fluxes that can then be used to evaluate climate models such as the HadGEM2-ES Met Office model. I am supportive of this paper being accepted in this general as this dataset and methodology offers a useful tool to the modelling but also remote sensing and in-situ communities. Nevertheless one of the main strength of this paper is the (clean) dataset produced as well as the algorithm developed to analyse these dataset and I strongly

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encourage the authors to make these data available to the community. In addition, in this case, the nature of the product calls for more transparency and sharing the code and data will warrant easier reproducibility for the scientific community. Finally, a significant effort is needed to clarify the sensitivity of the analysis to the various constants and approximations made. I provide some detailed comments below on how this could be achieved.

Specific comments:

Abstract

1 Introduction

P1L23: add reference to Kwok, 2018

2 Calculating monthly-mean energy fluxes from the IMBs

P3L26: would a more advanced optimal interpolation scheme improve the results? P3L33: define z_srf and explain a little more (maybe in appendix or with figure 4 how zsrf and zint are sufficient to estimate both changes of surface and bottom sea ice. P4L2: King et al, 2018 and Mercouriadi et al, 2018 have shown that such snow ice formation is prevalent in some regions of the Arctic. Discuss. P4L13: couldn't you ask the data providers? P4L19: a link to the code would be very valuable here. P4L26: you can cite Alexandrov et al, 2010 for values of snow and ice density. Snow evolves throughout the season with values typically from ∼200 to 350 (i.e. Tilling et al, 2017) P4L34: not clear where this formula comes from and if it applies to the real snow on sea ice. At what depth? P5L9: this fixed thickness (say L) is a parameter of your analysis. Discuss how sensitive your results are to this choice. P5L29: similarly how does the uncertainty on these constants impact your results? Discuss. P6L1: These values come from where? Recent work Nandan et al 2018 show salinity at the snow ice interface to be larger than 1. There are more references buy Turner et al 2015 (model work on CICE) but also Notz etc... P6L5: equation is no readable P6L17-21:

where is that shown. Perform proper sensitivity analysis to all these parameters in your plots, discussion etc... P7L1: interesting. How would you inform the S value. Is it measured? Explain. What problem are you referring to here. P7L5: Tsamados et al, 2015 has implemented the three equation boundary conditions and discussed false bottom impact on sea ice - ocean bottom fluxes P7L13: Interesting. Can you see synoptic signal related to snow forcing (i.e. storms?). At what timescale are you resolving these? Monthly? Should you pre-process such erroneous signals before monthly averaging? Explain -> share code!

P3L28: Some have argued that power law is in the forcing? How sensitive are your results to the spatio-temporal lenghtscales of the atmo/ocean forcing? P4L8: we branch -> meaning? P4L13: justify this choice. Cite Landy et al, 2019 P4L19: bold not a good idea. i suggest run_ITD run_noITD

3 Deriving monthly-mean flux distributions from the IMBs

P7L27: why not two regions in the table 1 P7L28: why don't you discuss changes between decades I.e. 90s vs 00s vs 10s? P9L1: explain a bit more how these errors on the individual monthly scatter points are obtained. Are you performing an error propagation or are these simply a standard deviation?

4 Evaluatating modelled sea ice using the. IMB-derived fluxes

P9L21: not clear if you estimate the fluxes at the same location in time and space as the IMBs or average over the whole region for the whole month. You should both to test impact of IMB sampling on your results. P9L27: why didn't you perform your analysis on a more advanced model with more Ice thickness categories? P9L35: is it West 2018 or 2019. P10L4: again not clear if you perform comparison like for line (i.e. for same days and grid cells) or not. P10: here you list various fluxes but don't explain why you find these results. A bit too descriptive. P11L5: West 2018 or 2019? P11: discuss role of melt ponds (summer) and snow cover (winter) P12: I think a lot of your analysis is missing the link to melt pond coverage.

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