

Interactive comment on “Arctic Mission Benefit Analysis: Impact of Sea Ice Thickness, Freeboard, and Snow Depth Products on Sea Ice Forecast Performance” by Thomas Kaminski et al.

Anonymous Referee #1

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Paper Review “Arctic Mission benefit Analysis: Impact of Sea Ice Thickness, Freeboard, and Snow Depth Products on Sea Ice Forecast Performance”, The Cryosphere Discussions

This is a well written and detailed paper in which CryoSat-2-derived ice freeboard, sea ice thickness and snow depth products are used to assess a coupled ice-ocean model’s forecast performance for a region that includes the East Siberian Sea, Outer New Siberian islands and the West Laptev Sea. A comprehensive list of control variables ranging from atmospheric forcing, initialization fields and physical processes (e.g., density of sea ice) are used. The paper presents a very thorough description

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of the Quantitative Network Design (QND) and how it is used to assess the observational impact of remotely sensed ice freeboard on the uncertainty reduction on sea ice volume and snow volume. The substance of the study is highlighted in Figure 16 which shows the uncertainty reduction in the three areas for sea ice volume and snow volume when evaluating quantities such as sea ice thickness, radar freeboard, and lidar freeboard. General Comments: There is a wealth of information provided to the reader in terms of detailed tables and figures. The paper title is somewhat misleading as only the last day of the model forecast (May 28, 2015) is used in the evaluation. I expected a much longer period of analysis (e.g., weeks to months). Figures 14 and 15 (see comments below) are too difficult to read in their present format. The manuscript appears to include all relevant references.

Specific Comments:

The paper title implies that the use of sea ice thickness, freeboard, and snow depth products will be used to assess sea ice forecast performance. However, I only see an evaluation of the model forecast on May 28, 2015. Could an extended period (entire month of May 2015) be evaluated? The Northern Sea Route is mentioned many times in the text. The maritime transport industry should have interest in how ArcMBA and the QND approach could be used to predict the ice conditions for June, July and possibly August as well. Could this work be extended in this manner for a future study? Page 6 (line 9-10): The paper states “We perform these predictions for May 28, 2015, a point where there is still sufficient snow cover for our prediction to be relevant”. However, on page 12 (lines 23-24) the paper states “Note that on May 28 parts of the target regions are almost snow free already”. How does this impact the first statement about “sufficient snow cover”? Also in this paragraph, to make sure I understand; the model was spun up for a period beginning January 1, 1979. A restart file from March 31, 2015 was used to initialize MPIOM and the modeling system was run with data assimilation through April 30, 2015. The 4-week model forecasts begin May 1, 2015 and I assume are forced with the ERA-Interim reanalysis, but without any ocean/ice data assimila-

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tion? Is this correct? Please provide a more detailed caption for Figure 2 and provide some additional text about the trajectories (notional) depicted in this figure. Page 12 (lines 17-18). Fig. 8c depicts the mean April 2015 misfit of the modeled SIT to AWI CryoSat-2 ice thickness. How does the April 2015 AWI CryoSat-2 data compare to NASA OIB for this period? Please provide an additional plot showing the NASA OIB data overlaid on the 2015 mean CryoSat-2 SIT. How does OIB compare with the AWI data?

Page 12 (line 22): There is mention of “modified Warren climatology”, but no explanation on how the modified snowcover was used in the CryoSat-2 ice freeboard retrievals. Please explain and provide specific details. Table 3 shows significant reduction in the uncertainties for SIV and SNV. I am surprised there is very little mention of these results in the text. Please expand on this in the text. Page 28: Graphs in Figure 14 are very difficult to read (too small). Perhaps graphs for Reg 1, 2, 3, 4, 5, 7, 8, 9 can be removed and the remaining graphs could be enlarged. Page 29: Figure 15 is a little easier to read than Fig 14, but still a challenge to read the individual plots. Although mentioned briefly in the Summary and Conclusions, it would be of value to assess the impact from this study on the ice drift. Are there ice drift observations available in May 2015 to perform an analysis?

Technical Corrections:

Page 2 (line 1): Spell out EO as this is first time referenced.

Page 2 (line 12): Don't spell out EO here

Page 2 (line 14): Is there a better term for “rawer”? Also “rawer” is used in several instances through page 9.

Page 2 (line 21): I suggest deleting phrase “products of further”

Page 2 (lines 22-23). Add comma after approach, and delete QND on line 23 to make 1 sentence.

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Page 3 (line 3): LFB has already been defined

Page 4: Figure 1 caption should read “Oval boxes”, not “Ovals boxes”

Page 6: Figure 2 caption should read “presentation” (lower case p).

Page 7: Fig. 3 blue background is too dark. Please modify for better clarity?

Page 8 (line 10): Can a reference be given for “Gent and McWilliams style”?

Page 9 (line 15): Replace “will be” to “are”

Page 9 (line 21): How do you come up with 34 years? Jan 1 1979 – March 31, 2015 should be ~36 years

Page 9 (line 24): Spell out OSI SAF

Page 9 (line 28): delete “by” and put Lindsay and Schweiger (2015) in parenthesis.

Page 10 (line 5): typo. . . should be “regions”

Page 13 (line 4) remove “could”

Page 21 (line 5): spell out EASE.

Page 22 (line 5): should be “For later use “it” also lists. . .”

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2017-249>, 2017.

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