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The Cryosphere Discussions

Interactive comment on "Estimating Snow Depth on Arctic Sea Ice using Satellite Microwave Radiometry and a Neural Network" *by* Anne Braakmann-Folgmann and Craig Donlon

Anonymous Referee #2

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The manuscript introduces the use of neural networks into the space of snow thickness retrieval on sea ice. The authors compare their results to previous methods including the most recent methods on this subject. In addition to the snow depth algorithm evaluations, the authors present the influence on an ice thickness estimate from CryoSat and compare it to the widely used Warren climatology. The authors also give an outlook towards the possibilities of the joint forces of the candidate missions CIMR and CRISTAL using their methods. The research is well conducted and the manuscript is well written and is suitable for publication after minor copy editing and addressing the following comments:

General:

1. The neural networks are trained using a small amount of data. According to the text, the data was split into train, validation and test data sets. Did you somehow ensure that that similar values of snow depth occur in all three splits? In best case the histogram of snow depth in each of the splits should be similar. Did you try different splits and compare the results?

2. It is unclear to me why the GRs and PRs are used as input. One would expect that the neural network would figure out the relations and adjusts the weights accordingly during the training process. Did you try higher complexity of the networks when you used brightness temperatures as input?

3. For comparisons with Models and also for the uncertainty values of ice thicknesses from CryoSat it is quite important to have uncertainty attached to each retrieved value. Can you think of a method estimating uncertainties for the neural network based snow thickness retrieval? It would be good to have a statement about this in the manuscript.

Specific:

P1. L.2: .....it is fundamental climate.... -> .... it is a fundamental climate....

P2. L.34: acts as -> behaves like

P11. L 23: A few words about sea ice drift as a source for ice thickness variability would be nice.

P15. L24: remove either "polar stereographic" or "EASE2". The EASE2 grid is actually not a polar stereographic projection but an equal area projection.

P16. Figure7: The AMSR2 and the AMSR2+SMOS neural networks produce very different spatial distribution of snowdepth and often by more than 20cm and even show inverse pattern (Canadian archipelago, East Greenland). To believe your statement that the combination of the two neural network would produce good results, a scatter

plot between these two networks might be insightful, especially over a longer time span.

Also P18 Figure 8 show partly anti pattern between the AMSR2 and the AMSR2+SMOS neural network. P23.

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