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The Cryosphere Discussions
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Interactive comment on "Improving gridded snow water equivalent products in British Columbia, Canada: multi-source data fusion by neural network models" *by* Andrew Snauffer et al.

Anonymous Referee #2

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The authors of this paper seek to improve Snow Water Equivalent (SWE) estimates using an Artificial Neural Network (ANN) with six SWE products and six other inputs as predictor variables. They compare the results of the individual SWE products with the different configurations of predictor variables for the ANN as well as Multi-Linear Regression models (MLR) to measured SWE at different in situ stations. The given results are very relevant to the scientific community and fits the scope of The Cryosphere. The quality of the presentation is also excellent. Nonetheless, there are a few minor clarifications that need to be addressed before final publication since in its current state, I feel the authors blindly used an ANN without proper consideration.

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Discussion paper

C1: Though I understand ANNs to be very powerful machine learning algorithms, I would like the authors to clarify why they have chosen an ANN instead of other machine learning algorithms such as Support Vector Machines (SVM)? Some other methods are more computationally efficient and provide very similar results to ANNs as shown by Forman and Reichle (2014).

C2: In Table 1, please provide the names of the SWE products and there acronyms in the legend to make it easier for the reader to identify quickly the different products.

C3: In this study, only the Mean Absolute Error (MAE) is used to determine the performance of each product/method. Please provide reasoning for this or add other metrics such as bias. The bias potentially gives more information on the performance of the method by indicating if it over/underestimates the measurements. This could actually help understand why ANN3 outperforms ANN6.

C4: I understand that the authors have analysed in depth the six SWE products in Snauffer et al. (2016). Nonetheless, why only try different combinations of the 3 best SWE products with the ANN? Some other combination might actually prove better since the different SWE products don't all use the same inputs and modelling schemes to estimate SWE. Though this might be out of the scope of this current paper, I suggest the author provide a reasoning why they only tested combinations of the 3 best SWE products and I also suggest they test other combinations in a future study.

C5: I would also like more clarifications on the selection of the ANN parameterization. Since there are many parameters in an ANN, this would help understand the results. Even if the parameters are the default ones from a given algorithm, please provide them.

C6: The authors need to do a more thorough analysis of the predictor variables. Which predictor is more statistically significant? Are there correlated variables? Etc.

Figure 3: It would be useful to see an annually smooth curve for the SWE products and

the models to see if there are discontinuities in the models/products instead of only the outputs where there were measurements. This is also an important result of Machine Learning methods.

References:

Forman B. and Reichle R. H. 2014. Using a Support Vector Machine and a Land Surface Model to estimate Large-Scale Passive Microwave Brightness Temperatures Over Snow-Covered Land in North America. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 8 (9), pp.4431-4441.

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