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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

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I am really happy to see work on high priority Copernicus polar mission candidates to come out - especially work pointing out synergies between different candidates. In short, the paper presents a novel way to derive the thickness of snow on sea ice – a parameter that is one of the key uncertainty contributors to sea ice thickness altimeter retrievals. Passive microwave based snow product from CIMR could complement the snow thickness estimate the dual frequency altimeter product of CRISTAL, latter being of superior resolution but worse coverage. For single frequency altimeters like Cryosat-2 and Sentinel 3 the impact of a novel PMW snow estimate, like the one presented in

this paper, would be much larger than for CRISTAL.

Whenever a new snow product emerges, it is tested against the Warren 1999 (W99) climatology, as this manuscript has done. However, I feel that there are significant shortcomings in the way W99 is handled in this paper.

Most importantly, instead of the original W99, the authors should use the modified W99 which accounts for thinner snow on FYI. All of the current CS2 SIT products use the modified W99. Reason for this is that as authors point out, original W99 has been shown to give too thick snow over the FYI areas covered by OIB by Kurtz et al. A comparison of CS-2 SIT using modified W99 and OIB SIT can be found in for example in Tilling et al 2018 (https://doi.org/10.1016/j.asr.2017.10.051) where the two agree within 0.5 cm. This is in stark contrast with the 24 cm bias in table 3.

Key point of the manuscript is that the new snow product is better than the original W99. Real question is, however, if the novel snow product is better than the modified W99 currently used for the CS-2 SIT retrievals. The authors should, in my opinion, add this comparison in the next version.

Furthermore, the authors begin their SIT processing from a freeboard product in the Cryosat-2 GDR. It is reasonably hard to find the details of the processor, but the freeboard is most likely already corrected for the propagation speed of radar pulse in snow. For this, a snow estimate has been required. Authors should remove the propagation speed correction and calculate another with their own snow estimate. Or if there is no propagation speed correction in the GDR freeboard estimate, one must be applied before FB to SIT conversion.

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