

The Cryosphere Discuss., referee comment RC1  
<https://doi.org/10.5194/tc-2021-124-RC1>, 2021  
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## **Comment on tc-2021-124**

Anonymous Referee #1

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Referee comment on "Snow water equivalent measurement in the Arctic based on cosmic ray neutron attenuation" by Anton Jitnikovitch et al., The Cryosphere Discuss.,  
<https://doi.org/10.5194/tc-2021-124-RC1>, 2021

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### **General Comments**

The paper describes the usage of buried Cosmic Ray Neutron probes for monitoring SWE in Arctic environments. The application of a transect of probes to measure snow drifts is a new application of the Cosmic Ray Neutron Sensing method and opens a new method for monitoring these hydrologically and ecologically important snow accumulations.

Much space is dedicated to linear regression analysis. Given the fact that the principle relationship between neutron counts and SWE is highly non-linear, currently it is not clear why this analysis is performed and what is the added value as compared to the standard conversion function that takes the non-linearity into account. However, it could be used to demonstrate the changes due to soil water conditions between different years concluding that at the monitored sites the soil water storage is rather similar and that therefore the functions are well transferable in time (including eq. 4).

For comparing the accuracy of the neutron sensing derived SWE values, it would be better to compare SWE (from buried CRNS) with SWE (from manual surveys).

### **Specific Comments**

L 19, L 21, L 68: I would recommend to write "buried CRNS" instead of "in-situ" as both systems are in-situ, depending on definition.

L 21 and throughout the manuscript: CRNS is often associated with the non-invasive

application. I would thus use a different acronym like bCRNS for “buried CRNS” or similar.

L 51: add a reference for gamma attenuation as Koch et al is only about GNSS not gamma ray.

L 65: Name the main technique, LiDAR (airborne and terrestrial) and its main obstacle: it is a campaign based measurement.

L 75ff: There is at least one more manufacturer of commercial CRNS systems (Geonor). But maybe it would be better to focus on the scientific usage of the measurement principle: Japan (Kodama), France (EDF), glaciers (Howat and Guguerli). Also this type of instruments has been used in the USSR in the 1980ies. I miss one recent application for shallow snow packs in the UK (<https://onlinelibrary.wiley.com/doi/full/10.1002/hyp.14048>) where they also found that adaptation of parameters is necessary.

L 86: As CRS-1000 and SF are commercial names I would rather refer to the measurement principle (above-snow, buried).

Chapter 3.1 and 3.4: I would recommend merging these two into one chapter, or alternatively switching 3.3 and 3.4 to not confuse the reader.

Chapter 4.1: What can we learn from these regressions? It would be necessary to discuss the added value and the implications of this analysis.

Chapter 4.3: This is a very interesting part of the paper and it should be more pronounced, especially as compared to the linear regression analysis, as it comprises the main novelty of the paper.

L 431: Please write more clearly where the influence of the top soil profile was found, and also add it more clearly in the discussion section.