The Cryosphere Discussions

The Cryosphere Discuss., author comment AC1
https://doi.org/10.5194/tc-2021-124-AC1, 2021

Reply on RC1

Anton Jitnikovitch et al.

Author 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-AC1, 2021

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.

Author reply: The terminology of the instrument setup was considered throughout the formulation of the paper, including using the term 'buried CRNS'. In Kodama et al. (1979), Howat et al. (2018), and Wallbank et al., (2021) the sensor was physically buried a few centimetres below the ground surface – however, in our experiments, the sensors are placed on the ground surface and the snow accumulates on top of them. We acknowledge that the terminology can be refined, however, 'buried CRNS' is not a wholly accurate representation of the set-up in this works. For this reason, we originally decided to use in-situ.

In the following submission, we will refer to this type of sensor as a 'grounded in-situ sensor' – as the sensor is always in contact with the soil-interface – this terminology builds upon similar wording proposed by Gugerli et al. (2019). We will also clarify that our approach did not bury the sensor.

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.

Author reply: Thank you, same reply as to the comment on L19, 21, 68.

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

Author reply: Thank you. We will add the reference: Kirkham et al., 2019 (Kirkham, D., Koch, I., Saloranta, T., Litt, M., Stigter, E., Møen, K., Thapa, A., Kjetil, M., amd Immerzeel, W.: Near Real-Time Measurement of Snow Water Equivalent in the Nepal Himalayas, Front. Earth Sci. 7: 177. Doi: 10.3389/feart.2019.00177.

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

Author reply: We will update the text to include this suggestion in the following revision.

Thank you.

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.

Author reply: We will revise the text to consider including these manufacturers in the following submission. We will also include the paper by Wallbank et al., 2021 and clarify that although they used a different type of CRNS system, they also found it necessary to adjust the parameters. Thank you.

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

Author reply: Thank you. We will adjust the text and refer to this type of sensor as a 'grounded-in-situ sensor' – as the sensor is always in contact with the soil-interface – this terminology builds upon similar wording proposed by Gugerli et al. (2019).

We do feel there is value in clarifying the specific type of sensor (SnowFox™) as this is a modern instrument that has only limited testing.

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.

Author reply: Thank you. We will consider this.

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.

Author reply: We will clarify the potential benefit of the regressions. We will clarify how the regression equations could be used to demonstrate the changes due to soil water conditions between different years and will note that at the monitored sites the soil water storage is fairly similar and that therefore the functions are well transferable in time. We will also consider applying the regression approach to demonstrate that at certain sites, the regression approach may be used to predict future SWE – until now, this approach has only been utilized using an above-ground CRNS.

We will also shorten this section.

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.

Author reply: We will expand this section. Thank you.

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.

Author reply: We will clarify the influence of the top soil profile in this works. Unfortunately, our field observation data on this is limited, which is why some assumptions had to be made.