The Cryosphere
Discussions

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Interactive comment on "Calibration of a non-invasive cosmic-ray probe for wide area snow water equivalent measurement" *by* M. J. P. Sigouin and B. C. Si

Anonymous Referee #1

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General Comments

This work discusses the use of a non-invasive cosmic-ray sensor for measuring snow water equivalent (SWE) and provides a calibration function that applies to shallow snow packs. The technology is relatively new. The same type of sensor has been used for monitoring soil moisture in a number of countries, starting with the COSMOS network in the US, since around 2006. To my knowledge this is the first SWE calibration that has been submitted for publication. These results will enable the use of COSMOS data (and data from other networks) for monitoring winter SWE in addition to summer soil moisture. I believe this work to be highly valuable through its demonstration and advancement of new technology that will benefit snow hydrologists.

Specific Comments

Line 319-322: I am fairly sure that there is no density or porosity effect based on my knowledge of physical principles (and also modeling and empirical results). It's really the number of collisions that matter–i.e. the number of collisions that a neutron will experience as it passes through the snow pack. The distance between collisions will increase as density decreases, but the total effect is exactly the same. However, if you want to stick with this explanation I would suggest starting the sentence with "We speculate that..."

Line 591: (Figure 3) I don't see any value in the combined regression as it is done here, given the evidence for an offset. Hence in order to "combine" the two seasons of data, one season should be normalized to the other, and then the linear regression performed. Or the regression coefficients (slopes and intercepts) might simply be averaged between the two seasons. I am not sure which is better; but should not matter anyhow since the slopes are nearly the same.

Line 352-364: The first half of this paragraph is a bit awkward. I think the most relevant part is the last two sentences of the paragraph; before that the author seems caught in a circle. I think it can be explained like this: the author collected two seasons of calibration data, and the RMSE for each season was ___.

Technical Comments

Line 52: replace "measurement scale" with "spatial scale" (word measurement is redundant in this sentence)

Line 65: delete "very"

Line 86: insert "field survey" between "common" and "method" (I am not sure what is the most common method overall, but it seems uncontroversial that the snow tube is the most common method for campaign style surveys.)

Line 88: importantly, snow tubes are prone to systematic errors, the magnitude and

direction of which depends on snow conditions. At least that is what this reviewer has observed; I wish I had a better reference than that handy.

Line 110: cite Desilets et al. (2010) with regard to the potential to measure SWE.

Line 114: delete "the" at end of line.

Line 128: add "and the Pyrenees of Spain" after the word "France".

Line 141: delete everything after word "site". (These extra words are superfluous.)

Line 154: "increased accumulation of snow along the line" for clarity

Line 163: this is a good place to explain why you only analyze data from the mod tube. You could end the first sentence by saying something like "...following the practice established for soil moisture observations (Zreda et al., 2012)." Relationships between the bare tube counting rate and SWE are thought to be less straightforward.

Line 187: start sentence with "The raw neutron..." (i.e. delete everything before that)

Line 205: (1) For consistancy in units, convert g cm^-2 to hPa (130.24 * 0.9807 = 127.5 hPa). (2) Round to one decimal place or less (higher precision is not justified or needed).

Line 247: insert words "a first order" (or something with similar meaning) between "for" and "comparison".

Line 301: delete word "regression" which is redundant.

Lines 305-306: please clarify by saying that the intercepts of the regression lines match up more closely. (at least I think you mean the intercepts).

Line 324: instead of saying "and simple regression was completed" say something like "and fitted with a linear regression model"

Line 332: delete "simple" (superfluous)

Line 337: no need to show this equation both here and on Line 348.

Line 394: replace "fully" with "quantitatively"

Line 422: replace "regards" with "regard"