

Hydrol. Earth Syst. Sci. Discuss., referee comment RC3
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Comment on hess-2022-123

Anonymous Referee #3

Referee comment on "On soil bulk density and its influence to soil moisture estimation with cosmic-ray neutrons" by Mandy Kasner et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-123-RC3>, 2022

The manuscript reports a numerical and experimental study of the effect of soil bulk density on cosmic ray sensing (CRNS). Such an impact is important if the land surface is subject to farming practices and for applications of the CRNS method for mapping soil moisture across heterogeneous landscapes.

I believe that the impact of soil bulk density is an impact factor that needs to be considered at least for some applications when converting neutron counts into soil moisture and as such, the study is highly relevant and important and ultimately warrants publication. However, the manuscript is not ready for publication in its present form as far as the analysis, presentation and language are concerned. The authors need to make a thorough effort in improving the text and make it consistent both internally and in relation to the presented figures. During my reading of the manuscript, I noted language issues at several places but I will only mention some of them below.

Comments:

I. 50: Perhaps a bit unusual to start out with the hypothesis that that neutron intensity is unaffected by soil bulk density. The whole idea of the manuscript is to document that the opposite is the case, so it would be more intuitively to state that the objective of the work is to analyze and quantify the impact of soil bulk density on neutron counts and how to take this impact into consideration to obtain reliable estimates of soil moisture.

Section 2.4 Experimental concept: I believe that the reported experiments are very interesting in order to gain experimental evidence of the impact of soil bulk density. The experiments are indeed a comprehensive endeavor and I would like to know a bit more details on the setup perhaps by an accompanying figure, which also shows the position of the CRNS detector.

I anticipate that the packings were done with dry sands. How did you then add water afterwards to obtain uniform moisture contents in the packings?

Could there be environmental factors affecting the results?

l. 142: I suppose this should be for the loose experiment?

l. 155: In line 126 it is stated that the grain density in the simulations is 2.86 g/cm^3 but now a value of 2.65 g/cm^3 is assumed? Any inconsistency here?

Figure 1: In my printout, water and air have the same signature. Please make the two phases mutually discernable.

l. 164: It is 4 units of soil and 1 unit of water giving a ratio of 4. Please be consistent how you refer to this ratio throughout the manuscript.

l. 165: equal 20 vol% porosity?

l. 177: This sentence is contradictory to Figure 2. Intuitively I would think the sentence is right.

l. 183: I am not sure I see a flat slope in Figure 3.

l. 186: Again, I would not call it a flat curve.

Figure 3b: In Figure 3a the counts become higher for lower soil moisture contents but the opposite is the case in Figure 3b, which does not make sense.

Section 3.3 Evidence in the sand box experiment: There are some conflicting statements in this section regarding counts. Do the counts increase significantly (l. 193) or are they the same (l. 205)? What is the learning from the experiments given that some the controlling parameters are not constant?

l. 284-300: Please revise these lines as well as the figures. There are conflicting figure numbers and porosity numbers and some of the referred numbers of counts and soil moisture I do not see.

l. 315: Impressive perhaps a bit exaggerated.

l. 324-325: This is an important statement which perhaps should be emphasized even more.