

Hydrol. Earth Syst. Sci. Discuss., referee comment RC4
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Comment on hess-2021-202

Anonymous Referee #4

Referee comment on "Towards disentangling heterogeneous soil moisture patterns in Cosmic-Ray Neutron Sensor footprints" by Daniel Rasche et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-202-RC4>, 2021

Overall, I believe this to be a well written report and a valuable area of research within the scope of HESS. The authors have tackled an important aspect of CRNS measurements that defines potential uncertainties of the sensor and suggests ways to improve its accuracy.

Fig 8 is powerful in demonstrating how this ratio between epithermal and thermal neutrons can change at sites with known heterogeneous soil moisture dynamics. I can see this being a useful metric to describe CRNS site heterogeneity in a simple way that can help a user understand possible site-specific impacts on soil moisture dynamics. I wonder if we should reconsider sensor footprint size once the Spearman rank correlation coefficient falls below a certain value?

Overall a good piece of work – comments below.

Moderate Comments:

L55: The authors rightly point out here that there are methods using the ratio of epithermal and thermal neutrons to estimate biomass in the sensor footprint (e.g. Tian et al., 2016). The site description seems to suggest that there is a uniform (spatial) biomass at the test site, it would be better to explicitly state this if true. The literature has shown the ratio of thermal and epithermal neutrons can be influenced by biomass changes (although research tends to be looking at this temporally rather than spatially), so knowing that biomass is spatially uniform at the site would be beneficial. On this point I feel a bit more discussion on possible impacts of spatially diverse biomass would make the paper more robust, considering research has shown biomass to impact neutron ratios too. The limitations are touched upon (L586) but an expansion on this (hypothesis of influence, future research ideas?) would benefit the paper.

L141: Three simplifications in the model are outlined here. A brief expansion on the impact the authors predict this may have on the simulation would be a benefit to the reader.

Minor Comments:

L60: Needs re-wording as it sounds a bit confusing currently: perhaps something like "However, the integration radius of thermal neutrons at the CRNS sensor can be expected

to be much smaller (a footprint of approx. 35m)”

L109: Write the actual value for the material density of quartz next to the description.