Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/hess-2021-202-RC1, 2021

reviewer comments

Anonymous Referee #1

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-RC1, 2021

The authors present a compelling study and a timely article on the challenge of using thermal neutron detectors for environmental research. The authors show both extensive modeling results and field observations. Some limitations of the study are acknowledged as a lack of field soil moisture data in the peatland but do not greatly impact the main results and conclusions. The authors also discuss and seem to solve some of the long-standing questions in the CRNS community about how best to estimate the coefficient(s) in the calibration function. The manuscript is well written and suitable for HESS. I have some moderate comments and minor edits needed before publication.

Moderate Comments

- The figure legends and axis labels are too small. Please enlarge before publication.
- L444. The authors argue that the thermal neutron footprint may be significantly deeper than the epithermal range of ~30-40 cm. If this is indeed the case additional profile sampling of soil chemistry is needed by the community in order to understand the distribution of trace elements (e.g. Gd and B) that may greatly impact the thermal neutrons. In particular, as the neutrons interact with more soil horizons (beyond the O and A typical for epithermal) soil chemistry may play a greater role. The authors point this out a little but should highlight the need by the community to sample more soil horizons for relevant epithermal and thermal neutron soil chemistry. Avery et al. 2016 and others have presented a nice lattice water dataset for the top 30 cm but it seems the community needs to expand this effort across CRNS sites and more soil horizons.
- L475. The authors show the heteroscedasticity effect from local and far-field soil moisture changes on the thermal and epithermal scatterplots nicely in Fig 8A. Without the soil moisture data in the peatlands, the conclusion is somewhat more speculative based on GW depth but still compelling. However, additional CRNS sites with large-

scale irrigation (60 ha) from center pivots may confirm this effect (CRNS sites exist in NE, KS, and IA in the USA with center pivots). As the center pivots water in pie slices over 48-72 hours they will create this near and far-field effect, particularly when compared against a rainfall event on-site. The authors could mention this experiment as future work needed by the CRNS community to help confirm the conclusions here.

Minor Comments

L 263. Need space “time seriesNET”

Figure 3. check legend and data time series in panel B? No red squares etc.

L538. Also, watch out for overfitting if only calibration data is available on campaign days. The CRNS community has found ~3 calibration dates are needed for robust N0 estimation. For 4 parameters you may need 12 or more calibration sampling days. That is a lot of digging :). It is already challenging to calibrate on multiple days if you have several CRNS sites.