Author Response to Referee #2

Technical Note: revisiting the general calibration of cosmic-ray neutron sensors to estimate soil water content

Maik Heistermann et al.
Hydrol. Earth Syst. Sc., doi:10.5194/hess-2023-169

RC: ***Referee Comment***, AR: *Author Response*, ☐ Manuscript text

Dear referee,

thank you very much for your positive response, and for the time and effort spent to examine the manuscript.

The comments are very useful and will be comprehensively considered in the revised version of the manuscript. Please find a point-by-point reply below.

Kind regards,
Maik Heistermann
(on behalf of the author team)

Comments and responses

RC: ***[...] Line 60: Sentence is a bit clunky - suggest reword to "This requires the user to account for the relative sensitivity of the neutron detector, the effects of other hydrogen pools in the sensor footprint, and the effects of geographic latitude, longitude, and altitude"***

AR: The suggestion will be implemented.

RC: ***Line 130: An alternative method for correcting for spatial and altitudinal variability has been published by McJannet and Desilets (2023) and it may be useful here as it will allow user to apply even more widely to areas outside of Europe.***

AR: This suggestion is in line with a comment made by referee #1, and we agree that McJannet and Desilets (2023) should be mentioned in the context of this study. The best opportunity to do this is, in our view, in the conclusions section after line 333 of the preprint. There, we already stated:

> While the PARMA model is well-established, other such models exist, and future research might explore the potential sensitivity of the neutron intensity scaling on the choice of the model.

In the context of this paragraph, we will more specifically refer to alternative approaches, including McJannet and Desilets (2023), but also e.g. Hawdon et al. (2014) and the scaling approach used in the original COSMOS

paper by Zreda et al. (2012). The latter was based on the method that had been presented by Desilets and Zreda (2003). Altogether, the above paragraph should become:

> While the PARMA model is well-established, its application in this study remains a subjective and exemplary choice. Other similar models exist (e.g. Desilets and Zreda, 2003; Hawdon et al., 2014; or McJannet and Desilets, 2023), and future research should aim to explore the potential sensitivity of the neutron intensity scaling to the choice of the model and the consistency of the resulting soil moisture estimates.

RC: ***Line 145 suggest changing to "For our reference detector we chose a so called…"***

AR: The suggestion will be implemented.

RC: ***Line 334: suggest "Altogether, we assume that we have considered the most relevant processes and variables…"***

AR: The suggestion will be implemented.

RC: ***Line 335: suggest "On average, the general calibration function fits the weighted average of locally measured SWC per CRNS footprint fairly well, specifically for the apparent gravimetric SWC".***

AR: The suggestion will be implemented.

RC: ***Line 340: suggest "Interestingly, though, we only become aware of these errors in the case where we apply a general calibration…"***

AR: The suggestion will be implemented.

RC: ***Line 344: suggest "Based on the results of this study, we recommend considering both calibration options, local and general, and weighing the relative uncertainty of the one against the other"***

AR: The suggestion will be implemented.

References

Desilets, D. and Zreda, M. (2003): Spatial and temporal distribution of secondary cosmic-ray nucleon intensities and applications to in-situ cosmogenic dating, Earth Planet. Sc. Lett., 206, 21–42.

Hawdon, A., McJannet D., Wallace J. (2014) Calibration and correction procedures for cosmic-ray neutron soil moisture probes located across Australia. Water Resources Research, 50(6), 5029–5043.

McJannet, D. L., Desilets D. (2023): Incoming Neutron Flux Corrections for Cosmic-Ray Soil and Snow Sensors Using the Global Neutron Monitor Network. Water Resources Research, 59(4), e2022WR033889.

Zreda, M., Shuttleworth, W. J., Zeng, X., Zweck, C., Desilets, D., Franz, T., and Rosolem, R. (2012): COSMOS: the COsmic-ray Soil Moisture Observing System, Hydrol. Earth Syst. Sci., 16, 4079–4099.