Hydrology and
Earth System
Sciences
Discussions

Interactive comment on "Investigating temporal field sampling strategies for site-specific calibration of three soil moisture – neutron intensity parameterisation methods" *by* J. Iwema et al.

J. Iwema et al.

ji13908@bristol.ac.uk

We thank the Referee (R. Schwartz) for his time and his positive feedback on the manuscript. We address all comments in detail below:

The authors have done a good job in collectively evaluating and discussing CRNS calibration results from three different sites. The results of the study provide some insight into the temporal soil moisture data required for calibration and a suitable model. I have a few comments and suggestions for improvement.

[1] When discussing results in the abstract, results and conclusion sections, it would be helpful for readers to provide some indication of the approximate error in the predicted weighted soil water contents (or range in weighted soil contents) from the specific model using CRNS neutron intensity counts. This will avoid ambiguous statements (e.g. "COSMIC performed relatively good at all three sites"; "sampling more than ten days would . . . improve the calibration results only a little"). Without these numerical values, it is impossible to evaluate and compare calibration strategies.

Response: We thank the reviewer for this important comment. We understand the importance of providing error estimates related to weighted soil moisture. We are currently analyzing the results to provide such estimates which will be included in the revised version of the manuscript.

[2] Methodology: Please identify the soil moisture sensors in each of the study sites. This is important with respect to interpretation of results (some sensors are inherently better than others are and less influenced by soil characteristics, even when calibrated).

Response: This is a good point made by the reviewer. We will include the information about the sensors in the new version of the manuscript:

"At SR 18 paired in-situ sensor profiles, with sensors (ACC-SEN-TDT, Acclima Inc., Meridian,ID,USA) at 5, 10, 20, 30, 50 and 70 cm depth, were installed with the spatial distribution as described by Franz et al. (2012), with all equal horizontal weights."

"The in-situ sensor network (SoilNet, Qu et al., 2013, 2014) consisted of 83 profiles with soil moisture sensors (SPADE soil water content probes, sceme.de GmbH i.G., Horn-Bad Meinberg, Germany; Hübner et al., 2009) installed at 5, 20, and 50 cm depth."

"150 profiles with in-situ soil moisture sensors (horizontally installed ECH2O sensors (EC-5 and 5TE, Decagon Devices Inc., Pullman, USA), SoilNet, Rosenbaum et al.

2012) at 5, 20, and 50 cm depth were installed."

"The same CRNS model (CRS-1000, Hydroinnova LLC, Albuquerque, NM, USA) was used at all sites."

[3] The observation that "specifically resolving individual soil layers with COS-MIC compared with depth-weighted soil moisture using the other methods led to better overall performance of the calibration" is important and should be included in the abstract if possible.

Response: We thank the reviewer for emphasizing this point. We will add a sentence in the abstract as suggested.

[4] Do the authors believe that the differing density and/or spatial (vertical horizontal) sampling of soil moisture measurements influenced the calibration performance? Should this be discussed?

Response: This is also an important point made by the reviewer and we thank him for that. We will add a sentence to the Results and Discussion section of the manuscript: *"It is important to notice that varying the density and/or spatial (vertical and horizontal) sampling of soil moisture measurements may influence the calibration performance. The analysis of the actual impact on performance are beyond the scope of this study which focuses on understanding the temporal sampling using typical spatial soil sampling approaches previously published in literature (Zreda et al., 2012; Desilets and Zreda, 2013; Bogena et al., 2013)."*

Citations

Bogena, H. R., Huisman, J. A., Baatz, R., Hendricks Franssen, H. J., and Vereecken, H.: Accuracy of the cosmic-ray soil water content probe in humid forest ecosystems: the worst case scenario, Water Resour. Res., 49, 5778–5791, doi:10.1002/wrcr.20463, 2013.

Desilets, D. and Zreda, M.: Footprint diameter for a cosmic-ray soil moisture

probe: theory and Monte Carlo simulations, Water Resour. Res., 49, 3566–3575, doi:10.1002/wrcr.20187, 2013.

Franz, T. E., Zreda, M., Rosolem, R., and Ferré, T. P. A.: Field validation of a cosmic-ray neutron sensor using a distributed sensor network, Vadose Zone J., 11, doi:10.2136/vzj2012.0046, 2012.

Hübner, C., Cardell-Oliver, R., Becker, R., Spohrer, K., Jotter, K., and Wagenknecht, T.: Wireless soil moisture sensor networks for environmental monitoring and vineyard irrigation: Helsinki University of Technology, no. 1, p 408-415, 2009.

Rosenbaum, U., Bogena, H. R., Herbst, M., Huisman, J. A., Peterson, T. J., Weuthen, A., Western, A. W., and Vereecken, H.: Seasonal and event dynamcs of spatial soil moisture patterns at the small catchment scale, Water Resour. Res., 48, W10544, doi:10.1029/2011WR011518, 2012.

Zreda, M., Shuttleworth, W. J., Zeng, X., Zweck, C., Desilets, D., Franz, T., and Rosolem, R.: COSMOS: the COsmic-ray Soil Moisture Observing System, Hydrol. Earth Syst. Sci., 16, 4079–4099, doi:10.5194/hess-16-4079-2012, 2012.