Hydrol. Earth Syst. Sci. Discuss., 12, C950–C954, 2015
www.hydrol-earth-syst-sci-discuss.net/12/C950/2015/

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

Received and published: 10 April 2015

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

The authors present at interesting review of the three common calibration methods used for the cosmic-ray neutron sensor. The authors estimate statistically the required number of calibration datasets for the three different methods at three different study sites, providing some recommendations. The paper is well

written but does contain several locations where grammar needs to be improved. Following fairly minor re-visions (updating HMF coefficients, commenting on use for mobile applications), the paper would be suitable for publication and add to the growing CRNS literature.
As the main author of the HMF method, I would suggest a couple comments. First, the 4 derived coefficients were updated in the McJannet et al. 2014 WRR paper table 4. The updated coefficients should be used as they are more reflective of the 1 inch moderated tubes than a pure epithermal response (0.5 to 1000 eV). A weighted average of 30% thermals (0-0.5 eV) and 70% epithermals (0.5 to 1000eV) should be used by MCNPx simulations to be more representative of the actual detector response. I don't think this well have a drastic affect on the overall results but may improve on any systematic bias that may exist with the HMF or COSMIC methods.

Response: We thank the reviewer for making this important point. We have updated the coefficients as suggested by the reviewer and we observed an improvement in the performance of the HMF method, especially at the two temperate sites (Rollesbroich and Wüstebach). New figures and equations will be modified accordingly in the revised version of the manuscript.

[2] The HMF function contains only 1 free parameter as compared to 2 for COSMIC operator (2 here but 4 free parameters elsewhere) and 3 for modified N0. It seems that the performance of HMF given the less number of calibrated parameters should be taken into account for any cross comparisons of the methods. Did the authors consider any penalty factors for increased number of free parameters to calculate? Could this be considered with an AIC metric? The authors do point out the fewer number of parameters in several locations but I was just wondering if a penalty function was used.

Response: We thank the reviewer for his comment. Our original analysis did not include a penalty factor related to number of parameters as model complexity (i.e. related

to total number of parameters) was subjective assessed by the authors. We do recognize the importance of also taking into account the number of parameters calibrated when evaluating the model performance. Notice that the Akaike Information Criterion (AIC) was designed to find an optimum between number of parameters and model accuracy of linear black box models, and works best when comparing model structures of different complexity within the same class (for instance, linear regression as in the original works on AIC). In our case we deal with three nonlinear models with different structures and we hence argue the AIC might not be the most appropriate choice. As far as we know, no suitable alternative method, ready to use for the concerned type of models, is available. However, we agree the issue of model complexity is worth raising in the paper and therefore in the revised manuscript we will mention that:
"A model with fewer parameters but similar or slightly worse performance may be preferred to a more complex model." (Results and Discussion, Section 3.2, p2366 after line 5).

[3] Given the excitement for mobile CRNS surveys (Chrisman et al. 2013 and Dong et al. 2014), the authors may comment on the most appropriate method for use with mobile surveys. Perhaps in a few sentences in the discussion is all. Clearly calibrating each site 2-10 times is not a good option for mobile surveys.

Response: This is an important point raised by the reviewer in regards to calibration of mobile sensors. We will therefore add a few sentences to Section 3.2 (reproduced below).
"With the increased number of applications for mobile surveys (Chrisman et al., 2013; Dong et al., 2014), multiple calibration instances may be difficult. In regions where stationary CRNS are available, information from mobile surveys can be better translated/constrained by such sensors, and hence multiple-day calibration becomes even more important for stationary sensors. Alternatively, one may adopt a space-for-time approach such as those proposed for satellite remote sensing soil moisture applications (e.g., Reichle and Koster, 2004)."

[4] A few examples of grammatical errors and needed sentence changes. Authors should check rest of manuscript for consistency.

Response: We thank the reviewer for this comment and will correct grammatical errors throughout the manuscript.

[5] Pg 2353 L18: "because year long daily time series of soil moisture is usually unavailable." Equation 3. Please update coefficients using McJannet 2014 WRR Table 4.

Response: We will change p2353 L18 to:
"As a proxy for soil moisture samples, we used data from in-situ soil moisture sensor networks, because continuous soil moisture sampling measurements over a full year are usually not available."
We will update the coefficients of the HMF method using Mcjannet et al. (2014) Table 4. New figures and equations will be modified accordingly in the revised version of the manuscript.

[6] Pg 2366 L 22. :"understood by"

Response: We changed "understand by" to "understood by", as proposed by the reviewer

Citations

Chrisman, B., and Zreda, M.: Quantifying mesoscale soil moisture with the cosmic-ray rover, Hydrol. Earth Syst. Sci., 17, 5097–5108, doi:10.5194/hess-17-5097-2013, 2013.

Dong, J., Ochsner, T. E., Zreda, M., Cosh, M. H., and Zou, C. B.: Calibration and Validation of the COSMOS Rover for Surface Soil Moisture Measurement, Vadose Zone J., 13, doi: 10.2136/vzj2013.08.0148, 2014.

McJannet, D., Franz, T., Hawdon, A., Boadle, D., Baker, B., Almeida, A., Silberstein, R., Lambert, T., and Desilets, D.: Field testing of the universal calibration function for determination of soil moisture with cosmic-ray neutrons, Water Resour. Res, 50, 5235-

5248, doi:10.1002/2014WR015513, 2014.

Reichle, R. H. and Koster, R. D.: Bias reduction in short records of satellite soil moisture, Geophys. Res. Lett., 31, L19501, doi:10.1029/2004GL020938, 2004.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 2349, 2015.