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Comment on hess-2021-564

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Community comment on "Technical note: A revised incoming neutron intensity correction factor for soil moisture monitoring using cosmic-ray neutron sensors" by Magdalena Szczykulska et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-564-CC1>, 2021

Based on data from the UK Cosmic-ray Soil Moisture Observing System network the authors found that the correction of incoming neutrons variations caused spurious trends in the soil moisture estimates, especially for a site in Scotland with high organic carbon content.

This is a timely topic, as more and more Cosmic-ray neutron sensors (CRNS) are installed world-wide. Correction for incoming neutron variability is essential for the application of CRNP since in addition to the short-term fluctuations, a strong positive trend in incoming neutrons was observed in 2016 and 2017 due to the solar cycle. Therefore, without appropriate correction, the CRNS data will show spurious trends in soil moisture.

For this purpose, data from neutron monitors are widely used in the CRNS community. However, neutron monitors show differences in the variations of incoming neutrons, mainly due to different cut-off rigidities. It is clear that these differences also propagate in soil moisture estimates from CRNS signals, which requires the necessity of trend adjustment of the neutron monitor data. Up to now, a dedicated study on this topic is missing. Therefore, this paper is of great interest for the growing community of CRNS users.

I have the following general comments:

The authors argue that the spurious trend becomes more obvious at site with high soil moisture values due the non-linear calibration function. But the COSMOS-UK site Sourhope (<https://cosmos.ceh.ac.uk/sites/SOURH>) only ~160 km away from Gensaugh also features high soil moisture values up to ~70 Vol.% due to high soil porosity (soil density is 0.65 g/cm³), but there is no spurious trend like Gensaugh.

Therefore, I think there is a need to test this method at several sites to exclude the possibility that the spurious trend is actually due to a local hydrological change at the Gensaugh site triggered by the extreme drought in 2018. Such decreasing trends after this drought can be observed also at other sites in Europe.

So far, the authors used only one COMOS-UK site (Glensaugh) for developing their method and another site (Bunny Park) to test it. The COMOS-UK network as well as the recent COSMOS-Europe data paper (Bogena et al., 2021) provide a perfect basis for a better testing of the method.

The proposed method for correcting influences of incoming neutron variations on CRNS readings has the following shortcomings, which should be discussed in more detail:

- 1) Although it uses standardised differences using the median, the correction factor derived from the relationship is still influenced by soil moisture dynamics (i.e. it would only perfectly work for a permanently wet site or a lake). I suggest excluding dry periods from the analysis to avoid dry bias.
- 2) The correction factor depends on the measurement period. It is unclear, how many years are need for achieving a reliable correction factor.