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Interactive comment on "Incorporation of globally available datasets into the cosmic-ray neutron probe method for estimating field scale soil water content" *by* W. A. Avery et al.

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The mobile monitoring of cosmic-ray neutrons using cosmic rovers is a promising way to non-invasively measure soil moisture at larger scales. However, for the processing of cosmic rover data ancillary information is needed (e.g. soil and vegetation properties). This paper describes and tests methods to provide this information using commonly available data sets. The manuscript is well written, however it contains some unclear or incomplete scientific reasoning that need to be amended (see comments below).

General comments:

This study investigates relationships between vegetation indices from optical remote sensing and above ground biomass. However, there is already a vast amount of literature on this topic, see e.g. Kumar et al. (2015) and Duncan et al. (2016) for recent reviews on this topic. Thus, the findings of this study should be discussed also in the light of results from existing literature. For instance, already established relationships could be compared with those from this study or could be used to extend the presented method to other vegetation types.

The usefulness of the derived soil properties from the GSDE data for CNRP rover applications needs to be better documented. At the moment, I am not fully convinced that the GSDE data is actually useful for CNRP rover applications. First, it is recommended to determine these parameters from in-situ soil samples anyway (L503-505). For instance, Franz et al. (2015) simply used the average values of these parameters derived from in-situ soil samples to successfully determine soil moisture for an area of 12 *12 km using the CNRP rover. A 12 *12 km area already seems to be the maximum area achievable by CNRP rover applications due to the speed limitation dictated by the CNRP sensitivity. Secondly, given the very low spatial resolution of the GSDE soil data, it will most likely not provide any useful spatial information for such a small area. Thirdly, the substantial uncertainties of relationships between the GSDE data and CNRP calibration parameters may lead to very uncertain calibration results (see also my specific comment L329). Thus, regional soil data bases like SSURGO in the USA or the soil information system FISBo in Germany would be more promising for CNRP rover applications.

The error propagation method is useful to derive first guess estimates of the uncertainties involved in the proposed method. However, a stronger test would be the application of the method using data from existing CRNP rover applications (e.g. Christman et al. (2013), Dong et al. (2014), Franz et al. (2015).

This study excludes below ground biomass, which can be a significant hydrogen pool depending on vegetation type (e.g. Bogena et al., 2013, Franz et al., 2013). Thus, the presented method should be extended by this factor. For instance, the plant specific root-shoot ratio could be used to calculate below ground biomass from above ground biomass (see e.g. Peichl et al., 2012).

Specific comments:

L60-61: This is not entirely true. In fact in-situ measurements of soil moisture have certain correlation lengths that can be used to infer larger scale information (e.g. Korres et al., 2015).

L70: A more recent review on non-invasive sensing of soil moisture dynamics from field to catchment scale is given by Bogena et al. (2015).

L78: According to Köhli et al. (2015) the footprint diameter ranges between 160 and 210 m.

L91: Baatz et al. (2014) is more appropriate here. This paper deals with CRNP calibration, whereas Baatz et al. (2015) describes a method for biomass correction of CRNP count rates.

L94: Add a citation, e.g. Baatz et al. (2015)

L96: “exploit” instead of “harness”

L103: “instead” instead of “in lieu”

L109: CONUS was explained in the abstract, but it would be good to explain it here again because of readers ignoring the abstract.

L133: “Köhli”

L144: see comment L78

L147: “Köhli”

L147-148: Köhli et al. also investigated effects of vegetation and SWC.

L152: Change into “Baatz et al. (2014)”

L170: The geomagnetic latitude is not a factor for the neutron counts correction. It is only used for the scaling of neutron counts to a specific location.

L212-213: To solve the calibration function, information on depth-weighted average soil water content is needed as well. In addition, the depth-weighted average of mentioned parameters should be used to account for the decreasing sensitivity of the CRNP with depth (see e.g. Köhli et al., 2015). Furthermore, below ground biomass can be an important hydrogen pool for certain vegetation types especially during dry conditions, e.g. sugar beet, spruce forest etc. (see Bogena et al., 2013).

L217: “Köhli”

L237: “Global Soil Dataset”

L249: This step needs a better explanation.

L258-259: In which cases “taking mean values” were preferred over “taking linear relationships”?

L268: Actually, only one vegetation index is presented here.

L271 “. . . 65 ha large.”

L288-289: This information is not needed.

L329: This is not the point. The problem actually is that the slope of the correlation strongly deviates from the 1:1 line in both cases. The error for soil organic carbon is larger than the organic carbon content of most of the samples. This questions the reliability of the GSDE data set for local applications like the cosmic-ray rover.

L348: add an adjective like e.g. reasonably

L362: “the” instead of “these”

L428-430: Better data sets are not only needed for higher resolution applications, but also to increase the reliability of the calibration function.

L434-435: The impact of soil organic carbon (SOC) on the calibration strongly depends on the total SOC amount and on the vertical distribution. For arable land SOC are relatively low and homogeneously distributed in the A-horizon due to land management activities. However, in grassland and forest sites, high SOC amounts and strong SOC gradients typically exist in the top soil (e.g. Bogena et al., 2013).

L463-465: Actually, this is an argument for adding more vegetation types in the analysis to increase the relevance of the paper.

L501-517: This section is not a conclusion and thus should be moved to the discussion section.

Literature

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