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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Quantifying mesoscale soil moisture with the cosmic-ray rover" *by* B. Chrisman and M. Zreda

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Review of "Quantifying mesoscale soil moisture with the cosmic-ray rover" by Chrisman and Zreda

General comments

The cosmic-ray rover is a promising instrument to close the gap between point and remote sensing measurements of soil moisture. This paper describes a feasibility study in which the cosmic-ray rover is used for the first time to generate soil moisture maps. Challenges as well as possible hydrological applications are presented.

The manuscript is well written and the data are of good quality. The results are in-

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teresting and useful. Scientists interested in using the cosmic-ray rover for hydrology applications will find the paper useful. It is a good paper and it deserves publication in HESS.

However, some assumptions which have been made to upscale soil moisture information are problematic and need attention (see specific comments).

Specific comments

L27 “soil moisture data products” instead of “campaigns”

L34 “At the...”

L64 “The study area is situated. . .”

L64 What do you mean with “extended basin”?

L67 Provide the mean annual precipitation amount

L76 delete “a Sonoran”

L96-112 Since this paper is kind of a feasibility study these aspects (e.g. uncertainty, footprint, resolution) should be discussed in detail in the results section.

L159 Please, do not write theta as a function of N

L161-163 This is not true for vegetation due to its temporal dynamic content of hydrogen.

L167 “Gravimetric sampling” is an improper formulation; better: “soil sampling with subsequent gravimetric soil water content determination”

L175 Could you also indicate the vegetation influence in terms of neutron counts or soil eater content (e.g. <5% N/h for average wetness conditions)

L178 explain “wt. %”

L191-192 Could you also indicate the soil organic carbon influence in terms of neutron

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counts or soil eater content (e.g. <5% N/h for average wetness conditions)

L200 Wouldn't it be better to use the in-situ soil water content measurements of the TDT sensor network to calibrate the cosmic-ray rover?

L241 Please provide also the experimental variogram as well as the variogram model.

L252-257 I do not understand these statements. From Fig. 2 only a seasonal change of soil water content can be seen. Please explain in more detail and provide statistics of the SWC maps (e.g. mean, variance) in a table.

L258 For a better understanding of the soil moisture pattern it would be helpful if you could include the landuse of the area in the left map of Fig. 1.

L263 "Agricultural wetness" is an improper formulation. How large is the influence of vegetation on neutron counts in these areas?

L285-304 This section discusses which temporal resolution is best suited to derive SWC maps from the data. Since you come to the conclusion that the 7 min data is the best compromise, it would be more logic to present this section before you are presenting the SWC maps.

L315 It would be helpful for the reader if you would include a short motivation for the temporal interpolation.

L324 It would be better if you would always refer to "study area" which is actually a rectangular box and not a true basin.

L335 The soil moisture range of the data set is not large enough to guaranty that the function of Famiglietti et al. (2008) is actually representing the standard deviation / mean soil moisture relationship. Numerous studies on soil moisture variability have shown different functional relationships.

L339-340 Please provide also the absolute difference to mean soil moisture maps of Fig. 2.

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L350-351 Which natural processes could that be? How will the water management and irrigation in the urban areas influence the correlation?

L367 Actually the cosmic-ray rover integrates between 0 and 76 cm. Is that considered correctly in the soil moisture profile calculation?

L368-370 What is the grid resolution of the used SMOS data? It would be helpful if you would also present the SMOS data (e.g. one representing low soil moisture and one representing high soil moisture).

L384-386 This a very strong assumption and can only be justified in case of homogeneous soil properties within the study area. Therefore you should provide some information on the soil properties (e.g. soil texture) within the study area and discuss possible uncertainties in upscaling.

L387 Change “leakage” into “percolation”

L393 Here you are correlating 0-5 cm data with 0-76 cm data. How is this justified?

L411-413 In hydrology the term “surface storage” denotes water that is stored on the surface (puddles, ponds, streams etc.). You should refer to “soil moisture storage” instead. In the equation the water storage change of the unsaturated zone between soil and groundwater is missing.

L419-429 Since the catchment area does not correspond to the study area and runoff is a negligible term of the water balance in this area this section should be omitted.

L465-466 In your data temporal stability of soil moisture is also a result of water management activities.

L480-481 I know that at least one Fluxnet-station is located in the study area. The data is freely available and should be used to validate the ET estimates.

Tables and Figures

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Figure 1: Obviously the study area is arbitrary rectangular box and only covers part of the actual basin. Thus it should be called simply study area throughout.

Figure 2: To what kind of smoothing are you referring to?

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