

Interactive comment on “COSMOS-UK: National soil moisture and hydrometeorology data for empowering UK environmental science” by Hollie M. Cooper et al.

Anonymous Referee #1

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The work describes the cosmic-ray soil moisture observation network of the United Kingdom, which has been built up over the past 7 years. As stated by the authors, the network is indeed the densest national network of such kind and offers in combination with its complementing climate observations a valuable data set for environmental research. In the paper the focus is mainly on the description of the network, its equipment and the local calibration to relate the neutron counts to volumetric soil moisture. I think, both, the data set and the data description paper are relevant and important to environmental modeling and help to improve our understanding of land-surface – atmosphere interactions. Nevertheless, the documentation needs some further clarifications and also the structure and content of the data set should be partially reworked. Therefore,

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I recommend the publication, after the consideration of the following comments:

In general, the manuscript is well structured but I see shortcomings in two respects:

1) I think the data description is missing information about and a discussion of possible errors within the CRNS method / data 2) some of the essential data processing steps are not explained with sufficient detail

More specifically my comments are:

1: (Title) "empowering UK environmental science" To me this formulation reads a bit "selfish". It may be UK-national soil moisture data, but it should be (and I believe it is) open to anyone who works in the field of environmental science, British or not. I think there are many global or continental models that include the UK and would likewise benefit from your data. So I suggest to change the title into something less "nationalistic".

35: Could you find another citation Moene and van Dam? I think there are plenty of papers out there that give a more specific introduction to the topic of soil moisture in the Earth System, e.g., by Seneviratne et al.

40: "measurement footprint" You may already specify it here to let the reader know what to expect. E.g. "the field scale measurement footprint"

57: 80cm -> blank missing

80-85: What's the reason for not having more stations in Scotland (only 2 stations in the east)? Also for Yorkshire and North-West England the network is more sparse.

Table 1: I think the table needs to be condensed. Since available in the metadata, you can skip the 2 columns for Easting and Northing and also End date can be moved to Start date like this: "Start(end) date" 26/11/2013(-01/10/2016)

The numbers for SAAR and Altitude should be right-adjusted. For the Soil type and land cover you should define abbreviations in the table header (e.g. MS for Mineral

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soil, IG for Improved grassland). and Soil type should go right of Altitude and SAAR. So finally one line could be a s short as: Cochno 23/08/2017 168 662 MS IG

and all stations could be overviewed at a glimpse one a single page.

120-122: not clear if all CRS1000B sensors have been removed from the network and CRS2000Bs are used now everywhere. If all had been changed, since when is the network pure CRS 2000B? Pls. be more specific.

125: Shortly explain what TDT sensors are.

127: What was the reason to remove the PICO profiles?

139: Why don't you use wind shields for the Pluvios? It's so often windy in Britain.

157: Pls. list the 8 sites with extra snow measurements

169: Is there any publication that shows the superiority of the SBS500, so that you want to use it as reference to check the quality of others (like the Pluvio)?

183-184: Why do you only consider 0-25 cm depth for calibration? Later in figure 7 you suggest much larger penetration depths.

183: Pls. provide model and manufacturer for the soil augers

189: Fig.3: You should also provide annuluses (25,75, 200m) for the older calibrations (e.g. by having 2 separate graphs side by side with one legend, or by additional annotation in brackets '5 (25) m')

205: Were the bulk densities also obtained with the weighting function?

206: Did you also consider the findings of Schroen et al. 2017 <https://hess.copernicus.org/articles/21/5009/2017/> for your weighting and calibration approach? The Sheepdrove data of COSMOS-UK was used in this work.

208-210: There should be a discussion about the magnitude of possible errors in the determination of the reference soil moisture. Is the 0.03 vol.% difference significant or

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may the error in sampling and thermo-gravimetry be even higher?

211: Tab. 5: Please give standard deviations for bulk density, lattice water, and soil organic carbon (add with \pm sign)

217-230: Please be more specific in the description of the derivation of the corrected neutron count signal. This important step should be reproducible by the data users. So you should provide the exact formulas and specify the constants used (e.g. for the reference pressure). Did you use the same reference pressure for all stations? Did you do or do you plan to do a cross-calibration for the different sites, to get an idea of the variations in sensitivity of the sensors?

224: I think it should be "Physikalisches Institut's, University of Bern, Jungfrauoch"

227: What are the implications of using a neutron monitor with such a large displacement and elevation difference. I assume a big difference in the cutoff rigidity between Jungfrauoch and your sites. Wouldn't the Kiel monitor be better suited? I think that this should also be discussed in the paper.

241: Are the fits for all the sites performing equally well? You may discuss and add some other cases too.

243: Fig. 4: Please add the formula for the synthetic curve including constants to the legend of the plot

264: Fig. 5: Please add panel IDs (a, b, c). What is the reason for the counts in a) being half of those in b)? Is it a different aggregation interval? X-axes text (date) should be removed for all but the lowermost panel. Then the margins between panels can be removed in favor of larger legend font sizes. Y-axis text for e) Precipitation is too small (smaller than for other panels). Legends (font sizes) for d) VWC are too small.

271: Fig. 6: Please add panel IDs. Resolution of figure needs to be improved. Since colors are rather hard to distinguish (especially with red-green blindness), I would recommend to use gray-scale (maybe with transparency) for the lines and symbols (point,

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cross, dot, ...) for the regions at the highlighted date.

289: "measurements" I wouldn't see this as a measurement but rather as a derived quantity. Something of "shows the assumed/computed/estimated D86..."

293: Fig. 7: Add panel IDs. All texts are by far too small. As for Fig. 5 I suggest to remove the x-axes annotation and to cut the margin between the sub-panels. How can the Euston VWC time-series reach 0? Was that reflected by the TDT sensors?

328: As you provided SnowFox derived SWE in the data set, its derivation should be documented more precisely (formula, calibration). At least provide it as supplementary material.

334: Fig. 8: Same as before (panel IDs and description in the caption), remove x-axes between sub-panels, increase font sizes and avoid red-green coloring in one graph.

353: Please explain what "gauge boards" are

361-386: The different data sub-products are clearly distinguished and organized in a logical structure. However, on top-level, the user doesn't want to find a 200 files long list to be downloadable click by click. So all the data should be organized as a single file archive (zip) download.

The user should be able to use the data set without considering the data-description paper just by making use of the metadata.

Thus, the information in table 7 should be provided within 4 additional metadata files (SH, SH...QC, Hourly, Daily). And the JSON format might be a better way to specify things. What's lacking in the metadata is the information how a certain measurement is derived does the timestamp 00 refer to the period 00-30 minutes or 30-00 minutes and has the value been obtained by averaging or as instantaneous value?

The timestamp in the data files need to be ISO 8601 compliant (e.g. 2018-01-01T12:00:00Z) so that also the time-zone information is contained.

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The site metadata should also contain the standard deviations for BD, SOC, and lattice water (which is btw. completely missing). For the easting and northing the projection needs to be specified.

Please provide also the hourly raw neutron counts (uncorrected) as well as the Snow-Fox raw and corrected counts as some people may be interested in using their own corrections.

387: Fig. 10: Change to color-blind safe palette (<https://knightlab.northwestern.edu/2016/07/18/three-tools-to-help-you-make-colorblind-friendly-graphics/>)

435-447: It would be nice to have also a short outlook. What are the perspectives for COSMOS-UK? Are there plans to extend the network (e.g., for Scotland)? How long is the projected lifetime of the project. How will the CRNS sensors degrade over time? Do you plan to upgrade the network with more sensitive detectors as they become available on the market?

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