

## Interactive Discussion: Author Response to Referee #2

# Brief Communication: A new drought monitoring network in the state of Brandenburg (Germany) using cosmic-ray neutron sensing

D. Altdorff, M. Heistermann, T. Francke, M. Schrön, S. Attinger, A. Bauriegel, F. Beyrich, P. Biró, P. Dietrich, R. Eichstädt, P. M. Grosse, A. Markert, J. Terschlüsen, A. Walz, S. Zacharias, S. E. Oswald  
*NHESS Discussions*, doi:10.5194/egusphere-2024-3848

---

**RC:** *Reviewer Comment*, **AR:** *Author Response*,  Manuscript text

Dear madam or sir,

thank you very much for your referee report, and for the time and effort you spent to examine the manuscript.

We understand your concerns, and will try to address them in a revised version of the manuscript. In the same way as in our response to referee #1, though, we also hope that this response can contribute to a better understanding of the context and scope of our manuscript. Please find both your comments and our responses below in a point-by-point reply.

Thanks again for your feedback and your support of this process.

Kind regards,

Maik Heistermann (on behalf of the author team)

**RC:** *In this Brief Communication, the authors present a new initiative in Germany to establish an operational, long-term soil moisture monitoring system based on cosmic-ray neutron sensors (CRNS) for the state of Brandenburg. In general, this is a very positive development, as CRNS has established itself as a new standard method for the continuous determination of soil moisture at the field scale and the widespread deployment of these sensors is very helpful and highly welcome both for environmental research and for the support of water management. In terms of content, this article presents the status of the project as well as a comparison of the measured soil moisture with simulations of the agrohydrological model SWAP. The manuscript is well written [...]*

**AR:** We thank the referee for the positive feedback on the relevance of our initiative and the readability of the manuscript which are, in our view, important aspects of the evaluation.

**RC:** *[...] however, I have to agree with reviewer #1 that the paper reads more like a project report and does not fulfill the NHESS requirements for short communications, especially in terms of the length of the paper.*

**AR:** We also appreciate the critical appraisal. Since the referee explicitly refers to the arguments outlined in the report of referee #1, we would also like to explicitly refer to our response to referee #1 (link), and keep the response in this context a little bit shorter. Still, we would like to specify (and partly repeat) some aspects here, too:

- Regarding the statement that the paper "does not fulfill the NHESS requirements for short communications, especially in terms of the length of the paper", we would like to maintain that the length requirement for Brief Communications applies to the final, typeset version, which is significantly shorter than the preprint in terms of number of pages. With 10.5 pages, our preprint is even slightly below the average length of preprints for Brief Communications that were accepted for publication in NHESS over the past two years.
- Still, we are really willing to scrutinize, without reservation, the manuscript in order to find and remove details that might not be essential to our overall argument. The referee's specific comments (below) contain some helpful guidance as to where the text could be shortened (e.g. around ll. 54-71 of the preprint). As already pointed out to referee 1, we also see potential to shorten the section about the case study.
- We are not sure how to interpret the statement that the paper "reads more like a project report". Is this meant in the sense that project reports tend to be less concise – to report details that might not be considered as scientifically relevant? This interpretation would be consistent with the referee's assessment that the paper is too long for a Brief Communication (which we addressed in our above response above). We kindly ask for clarification if this comment was meant in a different way.

**RC:** *Also, it may be beneficial to complete the installation and subsequently measure soil moisture over a longer period of time. Once this has been achieved, the authors could publish the results as a data paper.*

**AR:** As mentioned before, the motivation of the brief communication is to raise awareness for this initiative among researchers and experts in the field of management of water-related risks in Brandenburg, and to use the opportunity to reach this audience, as presented by the very specific topical and regional scope of the special issue to which we submitted our manuscript (entitled "Current and future water-related risks in the Berlin–Brandenburg region", see [https://nhess.copernicus.org/articles/special\\_issue1295.html](https://nhess.copernicus.org/articles/special_issue1295.html)). As already pointed out to referee 1, we are convinced that a new initiative on soil moisture monitoring in Brandenburg which is rooted in both research and public administration is worth being reported in this special issue of NHESS (both referees, in their reports, explicitly welcomed and appreciated this development). We even think that it would be negligent *not* to report on this initiative in such a context. We are further convinced that a Brief Communication is exactly the format to bring across this message, and that our manuscript, as demonstrated above, meets the requirements of the Brief Communication format.

We would like to emphasize that our paper is *not* intended to serve as a kind of replacement for a data paper, although we provide all means to access and use both the raw measurement data and the soil moisture products already at the current stage (see also response to referee 1, and the section on data availability in the preprint). We appreciate the suggestion that a longer time series could be published as a data publication in the future, but it should also be noted that data publications refer to a closed set of data with a fixed DOI which is not what we intend in terms of continuous long-term monitoring.

**RC:** *Finally, we don't learn much from the case study and the context of the comparison of CRNS data with simulation is unclear (see also specific comment further below).*

**AR:** We appreciate the critical appraisal of the case study. What we take from this comment is that we need to better explain – also in paper – why we think the presentation of this comparison is helpful. At the same time, the section about the case study is quite long, compared to the other sections of the manuscript. Given our aforementioned willingness to shorten this section, the challenge for a revision of the manuscript will be to better justify the case study while dropping some technical detail.

As for justification, we would already like to provide some explanations here: Hydrological models (of which SWAP is merely an example) are the most promising option to solve three issues which an instrumental monitoring of soil moisture alone cannot solve: a) the derivation of water fluxes (such as groundwater recharge, which cannot be directly derived from soil moisture time series), b) the upscaling of soil moisture and fluxes to unmonitored locations, and c) to allow for the comparison of model and observations in order to reveal (and ideally address) errors or uncertainties in either. While this challenge is at the heart of our initiative, solving it is obviously beyond the scope of our Brief Communication.

What we can provide, though, is a glimpse – a demonstration of perspective. The consistency between our model implementation and the observations obtained so far is that kind of glimpse. We find this approach much more concrete than just pointing to the theoretical perspective of bringing together data and model.

All this information is essentially already contained in section 4. Yet, we suggest the following changes in order to clarify the motivation and still shorten the section:

- to revise the first paragraph (ll. 86-88) in order to clarify the aforementioned motivation.
- to remove technical details provided along ll. 89-100.
- some content from the description/discussion of Fig. 2 (ll. 101-124) could be shortened and moved to the figure caption, some aspects might be dropped, and the remaining main text could be further condensed.

**RC:** *L38: Why mention only national networks?*

AR: In the light of the next referee comment (reg. l. 44), we agree that the CRNS-based soil moisture monitoring network in the context of the ADAPTER project should be mentioned here, too. We will add a corresponding sentence which will also refer to Ney et al. (2021).

**RC:** *L44: Such an initiative is not unique in Germany, see e.g. Ney et al. (2021).*

AR: Given our response to the previous comment, we agree that it is difficult to maintain that our effort is unique. We would, however, like to explain the reasons why we maybe not adequately acknowledged the ADAPTER project before: Our notion was that the focus of the ADAPTER project was exclusively on agricultural areas while our initiative aims to cover forest and grassland sites, too. Furthermore, we consider the close involvement of various state agencies along the entire process as a distinct feature of our initiative. However, we agree that the notion of "uniqueness" is probably unnecessarily bold, maybe even misleading. We will hence change the sentence to

In a recent effort, five institutions have combined their resources to establish [...].
---

**RC:** *Figure 1: The small maps are hardly recognizable and the situation at the measuring stations is not readable. Also, this this information is already available in table 1. Therefore, I suggest removing the small maps.*

AR: We thank the referee for the suggestion. The motivation of the maps (including the smaller ones) was *not* to show the landscape attributes at the monitoring locations. This information is, as the referee correctly pointed out, provided in Tab. 1. The idea of the small maps was rather to give an impression of the overall spatial distribution of important landscape attributes in Brandenburg. We would still prefer to show this information

as it – although implicitly – relates to the important issues of regionalisation and representativeness. In order to avoid the misunderstanding that the maps should show the attributes at the monitoring locations, we suggest that, in a revised version, we simply remove the location markers from the small maps.

**RC:** *L54-71: This sounds very much like an interim report.*

AR: As already pointed out above, we find it difficult to assess what this statement is supposed to imply. Our guess is that the referee considers this part as not sufficiently concise or relevant. If the statement was meant otherwise, we kindly ask for further guidance.

While we think that an objective documentation and justification of criteria for site selection is quite relevant, we also understand that this might be the kind of information that is not crucial to bring across our main points. We hence agree to shorten this part in a revised version of the manuscript.

**RC:** *L116-119: It is not clear to me how this comparison is to be analyzed in this project. What are the consequences if there are discrepancies? Do you then not trust the measurement data, even though the model certainly may have a much higher uncertainty?*

AR: We thank the referee for this remark. It is in fact difficult, for these lines, to find a balance between brevity and depth. First of all, we want to make the point that any discrepancy between model and observation is an opportunity to learn something (this may sound corny, but it is true). While this typically means that observations can help us to learn something about model errors (and how to address them), it could also be the other way around. In our context, inconsistencies between model and observations repeatedly helped us to detect sensor malfunctioning that did not produce obviously implausible observations. While this might be one of the "lessons learned" that referee 1 could be interested in, any detailed account of such cases would unnecessarily inflate the manuscript. However, we suggest to add, in the revised version, a similar sentence at the end of the paragraph in l. 119 in order to clarify the statement:

In fact, inconsistencies between model and observation repeatedly helped us to detect and fix sensor issues that might otherwise have remained hidden as they did not result into obviously implausible observations.
---

**RC:** *L126-129: Describing commitments should not be part of a scientific publication. It would make more sense to present the concrete implementation of a real-time data platform.*

AR: One of the aims of our paper is to invite institutions and people to engage in this initiative, e.g., as users of data, in the development of helpful data products, in the dissemination, in the provision of additional monitoring locations, or by informing us of their specific needs (e.g., with regard to locations, data, or presentation of results). That is why we consider it very important to emphasize these commitments, even if this may not be the sound of a research article – because this is not a research article (at the risk of excessive repetition: we deliberately preferred the format of a Brief Communication over a Research Article).

As for the presentation of a real-time data platform, the amount and complexity of the provided data and products does not yet call for the design of real-time data platforms which would deserve a comprehensive documentation in the context of a journal article. We made a clear statement on data availability in the main text, and, more specifically, in the section on data availability. There, we provide the link to a website that includes a public directory to download both, raw observations *and* soil moisture products. You can access and view that directory via a browser interface, but you can also obtain static https-links to each of the data files which can be directly used in any automatic data processing environment. The directory also contains station metadata in a dedicated table.

As pointed out to referee 1, this website was put on a hold for a few weeks; yet, we think that it well serves the intended purpose for the time being. As the diversity, complexity and lengths of observations and products may increase, we are certainly willing to adjust this approach. However, we do not think that a detailed account of that website will serve the paper well. However, since the availability of that website and the data might not have become clear enough from the preprint, we will extend the section of data availability further, and also add to the caption of Fig. 2 the information that similar time series and figures are available on the website in near real-time.

**RC: L139-140: Formulations such as “some validity” and “some transferability” are too vague.**

AR: We agree. In a revised version of the manuscript, we will rephrase as follows:

[...] the results of our case study demonstrate that the parameterisation of our model – as based on region-specific vegetation parameters, pedo-transfer functions in combination with regional maps of soil properties, and a map of groundwater depth – already allowed to capture soil water dynamics at the monitoring locations fairly well. This increases our confidence that the parameterisation concept could be transferred at least to similar locations, which needs to be further investigated in prospective research.

**RC: L142-145: This seems to be rather an alternative measurement approach instead of an upscaling approach for the presented CRNS network.**

AR: We agree that the description should be clarified in order to convey a better idea how the railborne CRNS roving could support the upscaling of soil moisture. We hence suggest to change, in a revised version, these lines as follows:

An emerging perspective for future research is rail-borne CRNS roving: several locomotives of the Havelländische Eisenbahn AG have recently been equipped with CRNS sensors in order to monitor spatio-temporal soil moisture patterns along selected railway tracks (see Fig. 1). While those of our network locations which are close to these railway tracks (Tab. 1) could be used to verify the spatiotemporal integrity of the railborne data products, the latter could, in turn, be used to validate or train other model-based or data-driven upscaling approaches.

We hope that the given explanations together with the proposed outlined changes help to better put the intention of the manuscript in context, and further convince the reviewers of its merit. We are looking forward to any fruitful discussion that may yet to come.

## References

Ney, P., Köhli, M., Bogena, H., Goergen, K. (2021). CRNS-based monitoring technologies for a weather and climate-resilient agriculture: Realization by the ADAPTER project. In 2021 IEEE International Workshop on Metrology for Agriculture and Forestry (MetroAgriFor) (pp. 203-208). IEEE.