Response to Reviewer 2

This paper describes an open-source python tool called crspy that is designed to facilitate the processing of raw CRNS data into soil moisture estimates in an easy and harmonized way. Although the tool I think is useful, more explanations about the data inputs and data fusion methods and the applications and comparisons with other existing models are needed. Please see my comments below:

We thank the reviewer for taking the time to review our manuscript. The comments and suggestions provided will help us to improve it in the next iteration. Our replies to your specific comments are below.

The spatial mismatch between the ERA-5 land and the CRNS datasets is quite large (0.6 km vs 9 km). Before applying the ERA-5 data directly into your modelling, has the data been evaluated against the in-situ data first? For users/readers, it's useful to know this information.

We have not directly evaluated the ERA5-Land data with in-situ data in this study. We will make this clear in the updated manuscript.

Can you explain more about how the ERA-5 data are used for filling in the data gap? Which data fusion method is used in your tool? How did you tackle the spatial mismatching issue?

The main reason behind introducing this routine was due to the fact many of the earliest CRNS sensors do not include external sensors to measure standard meteorological variables such as air temperature and humidity. We now know that such additional measurements are essential to account for the influence of atmospheric water vapour dynamics on the neutron count rate (e.g., US COSMOS). We have previously found that neglecting to apply the water vapor correction can lead to soil moisture errors on the order of 30%-50% for sites where high atmospheric water vapor seasonality is observed (Rosolem et al. 2013). We selected ERA5-Land as a replacement for those external data in a similar way to, for example, synthesis datasets from the Fluxnet network uses the ERA-Interim dataset. Notice however that in our case, the sites will not necessarily have local data to be used for downscaling. We will discuss this further in the revised version of the manuscript highlighting the advantages and disadvantages.

Rosolem, R., Shuttleworth, W. J., Zreda, M., Franz, T. E., Zeng, X., & Kurc, S. A. (2013). The effect of atmospheric water vapor on neutron count in the cosmic-ray soil moisture observing system. Journal of Hydrometeorology, 14(5), 1659–1671. https://doi.org/10.1175/JHM-D-12-0120.1

It is stressed by the authors that the intention of the work is not to identify which method is better or worse than the other. This is a bit confusing as if we (users) don't know the comparative performance, how can we be confident in choosing your model. They can choose a more accurate model which I think is as important as the harmonized step.

We consider it outside the scope of this paper to rank the different networks on performance with regards to the chosen processing steps. We believe that all networks have significant contribution to the wider community in providing soil moisture data from this recent technology. As discussed in our reply to Reviewer#1, a community driven best practice method is probably the best outcome for a global network of such sensors, and crspy can facilitate the steps towards achieving such goals. We will discuss the future direction of crspy in the updated manuscript, which includes maintaining it with the most current methods based on our developing understanding of the CRNS method.

Pg 10-11. "The data required for the calibration step includes the date of …. volumetric soil moisture of the sample." Where are the sensor's calibration data from? Are these the information already available with all the existing Cosmic-Ray sensors around the world?

We thank the reviewer for raising this point which is likely due to lack of clarity. The calibration data is providing directly by the user typically from many soil samples taken at the site. Notice that some of the networks provide this freely and we will make this clearer in the updated manuscript.

We once again thank the reviewer for providing us with valuable feedback.