Response to review comments (Round 2)

We very much appreciate the review comments from Dr. Bogena and thank him for the effort and attention to our manuscript. It has certainly been improved as a result. We have addressed all of the comments and present our responses below.

Our responses to the comments are indented and in italics.

Referee #1 (H. Bogena)

What is important is the height of the EC sensors above canopy, which is only about 12 m in the case of Graf et al. (2014).

> *We agree, but in this and our particular case, the argument still stands that the footprint of an EC sensor depends on the height of the tower as well as certain prevailing meteorological considerations. For a 2 m tower height in a pasture (with low vegetation height), a fetch of around 200 m is a very reasonable estimate.*

An increasing number of existing large scale sensor networks make their data freely available to the science community (e.g. SCAN, ICOS). In addition, a number a measurement techniques are emerging that make use of existing networks that formally were installed for other reasons (e.g. Bogena et al., 2015) and thus will provide a much better coverage of soil moisture observation in the near future beyond the observatories.

> *We absolutely agree that CZO's and sensor networks are invaluable in providing data to understand the underlying processes behind hydrologic (and other related) variables and states – which we had stated in the text. However, while the number and coverage of such networks is increasing, it still remains impractical to have in-situ sensors at fine intervals of a few meters (or even hundred meters) to cover every area of interest. For example, intensively instrumenting an agricultural field would either create a hindrance to the farmer in his operations, or, on the other hand, result in the sensors being damaged or uprooted during tilling and other farming practices. We believe we have covered both aspects of this important area in our manuscript.*

I am still very much more in favor for adding this information. Why should the reader gather all this papers himself to get a basic overview of the models and their differences? Presenting this information makes the paper much more comprehensible and also better explains why the three models were used instead of only one.

> *As noted, we provided a basic overview of the models in the original manuscript. The premise (and common practice) of referencing to previously published technical articles is to avoid 1) inflating the length of the manuscript; 2) unnecessary duplication and 3) burdening the reader with material that can easily be obtained elsewhere (given the wide application of the chosen models).*

However, we respect the reviewer's opinion and will provide some additional details regarding the models in a revised manuscript, while still maintaining references where the reader can obtain the more detailed model information.

Actually, the CRNP validity was not tested in this paper in a strict sense. This could not be done with a single TDR profile anyway, since a network of point measurements within the CRNP footprint would be needed to do this (see e.g. Bogena et al., 2013).

Our intention was only to use the TDR measurements to assess the CRNP retrievals i.e. they were not compared at a point-to-point level, but more from a general behavioral perspective, to ensure that there were no unreasonable patterns in the time series. We have changed the term validate to evaluate to reflect this more qualitative assessment.

It is true that it was not implied that the observations were less accurate than the model results. The impression arises, because the focus was led on the comparison of soil moisture with model results.

The objective of the study was to query the relationship between the CRNP-measured soil moisture and the modeled evaporation estimates. We will review the paper once again to ensure that any implication of relative accuracy is removed from the revised manuscript.

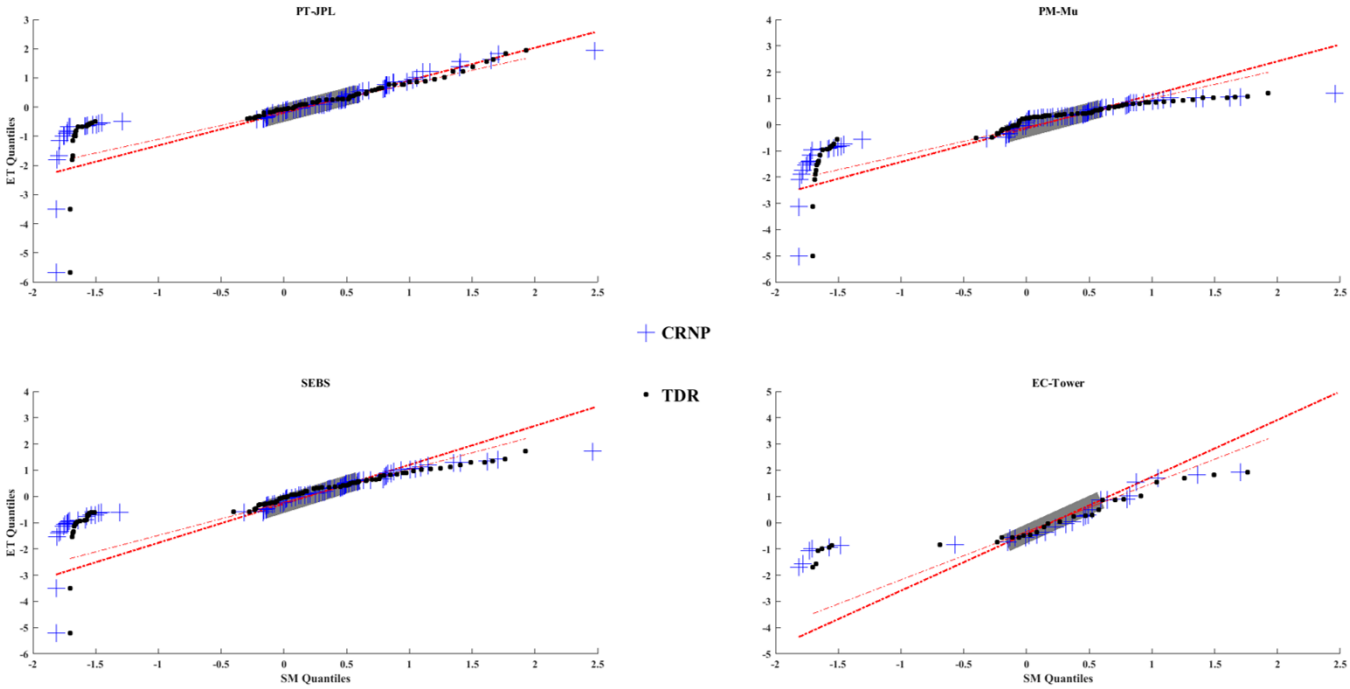
First, I have to repeat again that the term "evaporation" is confusing. I guess you are referring to evapotranspiration because it is related to root zone (i.e. evaporation from bare soil and intercepted water is not related to root water uptake in the root zone). So again, please improve the terminology in the paper. What I was trying to point out is that the existence of similar distributions alone is not adequate for this deduction, because processes at the soil-vegetation-atmosphere interface tend to be very complex. For instance, the process of evaporation from canopy is completely independent from soil moisture, but it might be an important part of total evapotranspiration at this location. Therefore, the distributions of both quantities might be similar because the CRNP measurements are also influenced by water intercepted on the canopy (see e.g. Bogena et al., 2013). In addition, the CRNP typically does not cover the whole root zone, because for intermediate soil moisture ranges the penetration depth is restricted to 20-30 cm. In addition, the CNRS is much more sensible to soil moisture of the first centimeters. In this sense the TDR measurements might even better represent root zone soil moisture at this site. Thus, the Q-Q analysis should also be done with the TDR data to test the assumption soil moisture is driven by the evapotranspiration process.

We are following the terminology established by Kalma et al., (2008), and employed widely elsewhere, wherein the term "evaporation" encompasses all processes resulting in transfer of water from the soil or vegetation to the atmosphere. As such, land surface evaporation consists of evaporation from the soil and canopy, and transpiration from the plant.

With regard to the Q-Q analysis, we agree that in some locations the CRNP can measure intercepted water, which could be a significant portion of the composite evaporation. It is worth noting that canopy interception is likely to represent an insignificant component of total evaporation in this semi-arid grassland environment.

However, as suggested, we performed a Q-Q analysis with the TDR measurements (see the plot below for the results). The blue + markers represent the analysis with the CRNP measurements, while the black dots represent the average of the three TDR probes. As can be seen, there is very little difference between the two plots for any of the model evaporation estimates.

We hope that this result satisfies the reviewer that our argument that the root zone soil moisture (RZSM) is still driving the evaporation process is valid. We have included text in the manuscript to reflect the logic put forth by the reviewer regarding TDR measurements perhaps being more representative of the RZSM, and that there was no significant difference in the Q-Q analyses with either CRNP or TDR measurements.



I am sorry for my ignorance concerning the models used in this study. Clearly, a better description of the models will help the readers to be better following the reasoning presented in the paper. If soil moisture is not a model variable this should be explicitly mentioned in the paper. Otherwise the modelled soil moisture should be compared with the measured soil moisture to demonstrate the validity of the model.

As mentioned in our earlier response, we will provide additional details about the models and have also revised the text to emphasize that soil moisture is not an input to any of the models evaluated in this study.