

## ***Interactive comment on “Spatial variability and its scale dependency of observed and modeled soil moisture under different climate conditions” by B. Li and M. Rodell***

**Anonymous Referee #1**

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### **Overview**

The study investigates spatial and temporal variability of in situ, modelled and satellite-derived soil moisture data at large extent scale ( $> 100 \text{ km}^2$ ) over three different climatic regions in US in a warm season (198 days). The relation between the spatial moments (standard deviation and skewness) and the mean soil moisture is firstly analyzed obtaining results in accordance with previous studies carried at smaller spatial scales. Moreover, thanks to the unique dataset collected for the study, the relation between spatial variability (expressed in terms of standard deviation) and the extent scale is an-

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alyzed. The results are provided for the three different data sets (in situ, modelled and satellite) and compared among them.

### **General Comments**

The paper is very well written, well structured and clear; the language is fluent and precise. The title clearly describes the contents of the paper. The abstract provides a concise and complete summary and the reference list is appropriate. The content of the paper is of great interest for the reader of HESS as the analysis of soil moisture spatial-temporal variability at large scale has a direct impact for many scientific and operational applications (e.g. flood and landslide forecasting, numerical weather prediction, ...). Specifically, I really enjoyed reading the paper as the unique dataset that the authors have collected for this study allows them to analyze soil moisture variability across different climatic regions and for a very large area in US. I also appreciate the citing, in the conclusions, to the analysis on soil moisture anomalies made by Mittelbach and Seneviratne (2012). Indeed, the very large scale investigated in this study can be significantly influenced by the respective contributions of time varying (e.g. anomalies) and time invariant (e.g. mean) components of soil moisture. In these conditions, I suspect that the statistical results might be largely different if the anomalies are analyzed. Anyhow, I only have some minor suggestions that, in my opinion, could further improve the quality of the paper.

1) In the cross-correlation analysis among the three different data sets it is clearly shown that the AMSR-E soil moisture product is not well correlated with in situ observations at SCAN sites (and likely also with modelled data from Noah). The average correlation in the East area is only 0.19. This result, besides the expected lower accuracy of satellite observations, can be mainly attributed to the different depth of investigation of AMSR-E ( $< 2 \text{ cm}$ ) with respect to Noah (10 cm) and in situ (5 cm) observations. Therefore, it is very likely that most of the statistical differences observed in the paper between AMSR-E and SCAN/Noah data can be linked to this issue.

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2) I would prefer the analysis reported in Figure 7 to be changed as it was done in Figure 6. Specifically, it will be clearer (at least for me) if the standard deviation at SCAN sites and at all grid points is compared as it was made for the mean values (Figure 6). Moreover, it is not clear to me if the data plotted in Figures 2, 3 and 5 for Noah and AMSR-E data refers to all grid points or only the points containing the SCAN sites. Please specify better.

On this basis, I feel that the paper might deserve to be published after a minor revision.

**Specific Comments/ Technical Corrections (P: page, L: line or lines)**

P10254, L18-21: I would like to note that in Brocca et al. (2007, JoH) it was shown in Figure 1 exactly the same result. Indeed, Brocca et al. (2007) analyzed several studies in contrasting climatic regions obtaining that in dry areas the soil moisture variance increases with mean soil moisture and in wet areas the opposite occurs.

P10262, L14: Please change "anomalous soil moisture" with "soil moisture anomalies"

Figure captions: I note that, in the figures, soil moisture is expressed in volumetric terms ( $\text{m}^3/\text{m}^3$ ) and not in volumetric percentage (see also page 10253, line 5). Please correct.

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