

Interactive comment on “Soil moisture: variable in space but redundant in time” by Mirko Mälicke et al.

Anonymous Referee #1

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OVERVIEW

The study investigates soil moisture spatial-temporal variability at hillslope and catchment scale through detailed in situ measurements for an experimental basin in Luxembourg. A new measure to capture the spatial dissimilarity is introduced. The variability of such measure in time and at different depths is computed and discussed.

GENERAL COMMENTS

The paper is mostly well written and clear. The topic of the paper is interesting for the readership of HESS as I believe that new statistical tools for analyzing soil moisture spatial-temporal variability are useful. Moreover, the analysis of new experimental measurements is always useful for advancing our knowledge on soil moisture variabil-

C1

ity.

However, as highlighted by Ryan Teuling (I couldn't resist to read his comments), a large number of scientific studies introducing the concept underlined in the paper, i.e., few measurements of soil moisture can be used to characterize its temporal variability at large scale (temporal stability), have been already published. I fully agree that the paper should consider such studies more in details, it should be better located in the context of scientific literature on the topic. Therefore, several sentences and parts need to be revised.

Moreover, I believe the paper should try to add some new results for advancing our knowledge. The introduction of the new dissimilarity measure is one point but something more can be added (see my comments below).

On this basis, I believe the paper needs major to moderate changes before the publication; I have listed below my comments with the indication of their relevance.

1) MAJOR: Throughout the paper I have found several times only qualitative assessments, particularly in the discussion. As mentioned above, a large body of literature on soil moisture spatial-temporal variability has been published. Therefore, I believe new papers should add quantitative information that should be compared with previous studies to highlight similarities and differences. For instance, it reads that rainfall is the responsible of changes in the clustering. How much rainfall is needed to have a change in a different cluster? What is a “strong” rainfall event causing the changes? Is it rainfall amount or frequency that is important? What is the quantitative difference in spatial dissimilarities between clusters during raining periods? How it varies with sampling distance? How long are cluster periods in different conditions? How do they vary with depth? Some of these results can be extracted from the figures, but I believe they should be synthesized by the authors and compared (quantitatively) with results of previous studies. It is an experimental study, therefore a table highlighting the quantitative results of previous studies might be highly useful for such a comparison.

C2

2) MODERATE: An important information that is currently missing is the “typical size of the hillslopes”. Is the size of the different hillslopes similar? Can the authors add a figure with a typical configuration in 2/3 hillslopes? Moreover, what is the size of the basin?

3) MAJOR: The paper is too long in many parts (at least for me), e.g., in the description of the methods and the discussion of the results. I strongly believe the paper may benefit from a reduction of the text by focusing on the main (quantitative) results that have been obtained from the analysis of the soil moisture data. Some descriptions of the methodology can be moved in the appendix. The current version of the paper is not easy to follow.

4) MODERATE: It's not clear to me how the authors have aggregated the data for the different hillslopes. How are measurements from different hillslopes aggregated? How to address the differences in land use and topography? The problem is underlined at page 6 but not addressed in the paper.

5) MODERATE: In the discussion two “periods” are highlighted, drying and wetting. However, in the paper 3 to 4 clusters have been identified. Why? The authors should add a clear explanation for that, I believe that we do not have only drying and wetting periods, but it depends on when they occur with respect to vegetation cycle. Is it a possible explanation?

6) MODERATE: Throughout the text, some small formatting and typo corrections are needed. Please carefully check the text for such errors.

SPECIFIC COMMENT (P: page, L: line or lines)

P1, L10: The extent of the hillslopes and of the basins should be specified in the abstract.

P1, L14-17: The concept of “redundancy” and “compression” are clear only by reading the full paper. It is not clear by reading the abstract what is communicated here in

C3

these sentences. Please revise.

P2, L10-11: “Soil moisture at the headwater. . .” This sentence should be revised, and also the paragraph L13-17.

P3, L19: The concept of “redundancy” should be clarified here in the introduction. Otherwise, it is hard to understand what the authors mean here.

P3, L28-. . .: The hypotheses to be tested are too specific. The authors have written such hypotheses after knowing the results (I guess). I suggest reformulating them to be less specific.

RECOMMENDATION

Based on the above comments, I suggest a major revision before the possible publication on Hydrology and Earth System Sciences.

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C4