

Review of the paper: Exploring hydrological similarity during soil moisture recession periods using time dependent variograms by Mälicke et al.

The manuscript presents an experimental study of the underlying mechanism (i.e., rainfall, radiation, soil characteristics, topography etc...) governing the spatial variability of soil moisture in time. In particular, the focus is the demonstration that during dry periods soil moisture spatial variability organizes itself in a stable configuration which is altered during rainfall events. This has profound implications on interpolation techniques like kriging as the covariance structure associated with the measurements is not time invariant and violates the underlying assumptions of the statistical interpolation methods.

The analysis is carried out by using a clustering approach called Mean Shift and the observations are collected from the CAOS research unit in Luxembourg.

The manuscript fits perfectly with the journal and is potentially very interesting. Overall it is well structured and well written but I believe is a bit cryptic and difficult to understand for readers not familiar with clustering theories (like myself). As the topic has significant implications I think the authors should give an effort to make it more accessible especially in section 3.3 (the part describing the Mean Shift technique and the similarity between variograms). Many terms are (i.e., bandwidth, density and so on) should be introduced and described to facilitate the understanding. Maybe a conceptual scheme explaining the main steps of the procedure and its difference with classical methods would help.

The description of the experimental area and the soil moisture measurements must be improved. It is not clear how many stations are finally used for the analysis and if the analysis period is only 2013. Why not showing soil moisture time series of relevant stations?

The choice of the mean shift clustering procedure is overall justified but its superior performance with respect to more classical techniques is not demonstrated in the study perspective. In practice, this is done in a simple synthetic case study (Figure 3). Why this is not done with the data used in the study?

I found a bit challenging understanding Figure 5 in terms of physical connection between analytical results and what happens in reality. For example, how the sudden changes observed in the experimental variograms are interpreted? Are they the effect of rainfall? If true it would be nice to have a timeseries of rainfall or averaged rainfall maps for relevant clustering periods to cross check this behavior. How does the influence of vegetation or soil characteristics play a role? Why not including also a soil map for the study area?

Why 2015 and 2016 results are not discussed in the manuscript and related with those of 2013? Indeed, it is written that *"The same type of analysis for the other years and another plot (SA-SB-SC-SI) are provided in the supplementary material"* however, however how they relate with 2013 and if their behavior is common to the one observed in 2013 should be included and discussed in the manuscript.

Overall, I believe this is an interesting manuscript and deserves publication on HESS journal but it must be more understandable in order to reach a broader audience and an effort should be made for describing connection between what physically happens in the field and the results.

I have other few minor comments which are included in the attached file.