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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Soil water content evaluation considering time-invariant spatial pattern and space-variant temporal change" *by* W. Hu and B. C. Si

Anonymous Referee #3

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This article describes an interesting approach to decompose the soil moisture content into a time invariant spatial pattern, space invariant temporal changes and space and time dependent redistribution. Though the ideas and the results of the paper are in my opinion interesting I think the writing of the paper can be improved. In case you manage to improve the text and mainly convey your message well, I think this article will be interesting for many scientists studying spatio-temporal variations in soil moisture contents.

For example, some points to improve in the text: the reasoning behind the separation of the time varying component into the space invariant temporal change and the time

dependent redistribution should be explained more clearly in the materials and methods part 2.1., as this is the main idea of this paper. Furthermore I would recommend to move the study area and data collection description either to the beginning or to the end of the methods section, instead of in between the descriptions of the statistical analysis. And the results start with a paragraph of the correlation between the time-invariant spatial patterns and the environmental factors, where I would expect first a description of the different components of soil moisture content and how the new and the old method EOFs do for the prediction of SWC. Then the comparison of how the different environmental factors relate to the different SWC components might be interesting to learn more about the processes which influence the soil moisture change.

With the method used in this paper the strength and direction (positive / negative) of redistribution of the soil moisture depend completely on the spatial mean soil water content. I would think that the redistribution term also strongly depends on whether the system is drying or wetting as different processes determine the soil moisture change. Therefore I think it would be worthwhile to include this in the analysis, though that may be difficult as the dataset is not very large as it is, and this would mean to divide the data in even smaller sets for the calibration/ validation. So this might be an idea for future research into the factors influencing the different space and / or time- varying components of the soil water content.

p.12832, line 1-3: during evaporation period clay soils may lose more water than sandy soils, because there is more storage in clay soils? Normally the clay soils can also hold the water much stronger than the sandy soils due to capillary forces so it would depend on the time scale over which you would measure water loss. In general sandy soils lose water much more rapidly so I think the occurrence of a larger loss of water in clay soils depends on the initial water content and the time over which a soil can dry out.

Figure 1: the temporal mean soil moisture content has quite a high peak just past 100 m, going over 50 % and seeing the EOF and EC values, I estimate the redistribution

value for this location is generally even positive for conditions above approx. 28% spatial mean SWC. Is that realistic?

Figures 1 and 2: it is remarkable to see that at both extremes of the transect (i.e. from 0 to 100m and from approx. 420 m to the end) the temporally mean soil water content and the redistribution terms are much smoother and rather average values than in the stretch from 100 to 420 m. At a first glance both average SMC and redistribution terms seem to be strongly related to the elevation, except for these extreme stretches. Therefore I think it is interesting to relate these different components of soil moisture to different environmental factors to learn more about the processes which might influence the soil moisture redistribution at this scale.

Figure 2: here the two days selected are of course a very wet and a relatively dry day, which is a very logical choice but I would mention this in the caption, even though it should be clear by the opposite direction of the redistribution terms.

Figure 3: a cosine relationship between spatial mean soil water content and EC does make sense to me, but in the case of EC1 for the top soil layer, the relationship between EC and spatial mean SWC looks quite linear. Normally I would expect the variation in soil moisture content to decrease when the soil moisture approaches saturation. Does the fact that your EC1 does not decrease with higher soil moisture content mean that your soil has a rather high porosity and the spatial mean soil moisture content never comes near saturated conditions, even when your average soil water content is near 36 Vol %? Or is your spatial variation in porosity very high? Otherwise I would expect the EC values to become negative with high soil moisture contents in case the spatial variation in porosity is low, as the spatial variation which is evident in the temporally mean soil water content would have to be counteracted with the redistribution term to get a reduced spatial variability in the soil water content.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 12829, 2013.