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Hydrology and Earth System Sciences Discussions

Interactive comment on "Analysis of surface soil moisture patterns in agricultural landscapes using empirical orthogonal functions" *by* W. Korres et al.

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Response to Anonymous Referee #3:

We would like to thank referee #3 for the comments to our manuscript. According to the comments we revised our manuscript. The main changes and also the reply to the comments can be found below:

"1. The soil moisture data used are for the top 6 cm soil layer. Physically, this layer mainly responses to daily atmospheric processes. How much meaningful is it to use this data to analyze soil moisture connections at monthly and longer scales?"

In general, our data set resulted from a number of field campaigns carried out to derive

ground truth data to validate soil moisture retrievals from satellite-based radar systems (ENVISAT; ALOS). Because of the small penetration depth of the radar, only the top soil layer (6 cm) was measured during the field campaigns. This restricts our analysis to surface soil moisture patterns but as such data is potentially also available for large areas (as remote sensing products), it seems to be reasonable to analyze the driving parameters behind such patterns.

The measuring dates were predetermined by satellite overpasses and regarding soil moisture status it can be assumed that these dates are more or less randomly distributed in time. The only exception is that no measurements were carried out if rainfall occurred on the date of satellite overpass.

We fully agree with the referee, that no soil moisture connections in time (representing continuous soil moisture dynamics or seasonality) can be derived from our data set which only contains 'snapshots' in time. However, it is not our intention to analyze the soil moisture seasonality, but to identify the main drivers of soil moisture patterns at different soil moisture states. This is complemented in the revised manuscript.

"2. Moisture measurements of top soil layer at one day during a month or longer period does not reflects much about soil moisture condition for the period; Instead, it could be easily affected by rainfall on and/or shortly before the measuring day. Thus, evidence is needed to indicate that the measured patterns of a specific date is not a random ones."

As stated above, our soil moisture measurements are snapshots in time, which can be affected by random processes, e.g. rainfall shortly before measuring. While single soil moisture patterns might by affected by random processes, the significant EOFs represent the stable patterns of a dataset and are by definition not random. This is the main reason, why we applied an EOF analysis to our dataset. The existing degree of randomness of a single soil moisture pattern is reflected by the associated EC, since the EC value represents the proportion of the significant EOF pattern in the soil mois-

ture pattern of each date. In consequence, we do not use single soil moisture patterns (which might be random) but the EOF patterns for the subsequent correlation analysis. To be explicit regarding the interpretation of our overall data set using EOFs and the possible randomness of single soil moisture patterns we introduced a paragraph in section 4.1 of the revised manuscript.

"3. The soil moisture differences from the average over times at a location do not remove seasonal cycle, which can be seen in the original measurements though it looks weaker than that in many other geographic areas. As a result, the time coefficient series for major EOF patterns for both sites mainly reflects this temporal variability."

We fully agree with the referee. As expected, the time coefficient series (or ECs) of the temporal analysis perfectly reflect the dry and wet states in our soil moisture data set. This is described in section 6.2 of the manuscript (p.5585). The intention to carry out this analysis was to identify locations with high temporal variability (shown in the related EOF) which subsequently could be related to locations of specific soil characteristics (percentage of SOC at the grassland test site and soil porosity at the arable land test site, respectively). For clarification we introduced some more information in the methods section (section 4).

"4. As little as 8 samplings in time domain is used. This number is considered to be too small for a temporal correction calculation in the EOF analysis."

If we understand the referee correctly this comment points to the correction of the temporal autocorrelation in the temporal significance analysis. As already mentioned in the reply to referee #1 we recalculated the significance of the temporal EOFs (instead of 8 degrees of freedom to calculate the sig.-levels more conservatively 6 degrees of freedom are used yet). The correction for the effects of the autocorrelation in the temporal analysis results in the same number of significant EOFs compared to the calculation without the correction (one significant EOF for each test site). This is incorporated in section 4.2 in the revised version of the manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 5565, 2009.