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Differentiating between spatial and temporal effects by applying modern data analyzing techniques to measured soil moisture data

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Large data sets containing time series of soil hydrological variables exist due to extensive monitoring work in the last decades. The interplay of different processes and influencing factors cause spatial and temporal patterns which contribute to the total variance. That implies that monitoring data sets contain information about the most relevant processes. That information can be extracted using modern data analysis techniques. Our objectives were (i) to decompose the total variance of an example data set of measured soil moisture time series in independent components and (ii) relate them to specific influencing factors.
Soil moisture had been measured at 12 plots in an Albeluvisol located in Müncheberg, northeastern Germany, between May 1st, 2008 and July 1st, 2011. Each plot was equipped with FDR probes in 7 depths between 30 cm and 300 cm. Six plots were cultivated with winter rye and silage maize (Crop Rotation System I) and the other six with silage maize, winter rye/millet, triticale/lucerne and lucerne (Crop Rotation System II). We applied a principal component analysis to the soil moisture data set.
The first component described the mean behavior in time of all soil moisture time series. The second component reflected the impact of soil depth. Together they explained 80 % of the data set′s total variance. An analysis of the first two components confirmed that measured plots showed similar signal damping extend in each depth. The fourth component revealed the impact of the two different crop rotation systems which explained about 4 % of the total variance and 13 % of the spatial variance of soil moisture data. That is only a minor fraction compared to small scale soil texture heterogeneity effects. Principal component analysis has proven to be a useful tool to extract less apparent signals.