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Scale of soil horizontal heterogeneity and its effects on the spatial patterns of ecosystem processes in grasslands and crops

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Previous studies have found that spatial patterns of different ecosystem processes of grasslands are dynamic in time because the actual driving factors constantly change in intensity and spatial distribution, but also show a certain degree of persistence due to the surface micro-relief. On the other hand, a completely different setting is given in croplands where the soil surface is regularly tilled, removing micro-heterogeneity and moving/mixing high quantities of materials along soil cultivation, and plant canopy characteristics are also more homogeneous.
In our recent field work, we conducted spatial measurements in different crops at two study plots (plot C1: corn - 2014, bare soil – 2015; plot C3: sunflower - 2014, corn - 2015) on soil respiration (Rs) and different background factors, as soil water content (SWC), soil temperature (Ts), altitude (ALT) and soil carbon content (C). 8 measuring campaigns (2 by years and by crops at each site) has been conducted following grid-shape sampling schemes of 10 m resolution with a total of 75 sampling points. Data analysis was based on variography and kriging. The aim of the present study was to compare these observations with previous findings in grasslands to reveal how the scales of soil horizontal heterogeneity and spatial patterns differ in these ecosystems.
We found that spatial patterns were very various with weak spatial correlations between variable pairs in the crops due to the soil cultivation, irrespective of plot or plant type. This was the opposite to the findings in grasslands where spatial patterns followed more or less tightly the fine distribution of surface crests and depressions. Altitude was autocorrelated over distances of about 50 m in both plots, but we detected that neither SWC nor Ts showed consistent co-patterns with ALT or each other. SWC-ALT spatial correlation was mostly positive, while Ts-ALT correlation was negative, if they could be detected. These findings were also the opposite of the findings in grasslands. Autocorrelation lengths of Rs were 10 to 60 m, depending on crop type and measuring date, and we found that Rs was positively related to the greenness of the vegetation (VIGreen), the latter having autocorrelation lengths between 10 and 50 m. Description of the temporal variability of the spatial patterns of different ecosystem processes may increase our understanding about crop yield variability.