Geophysical Research Abstracts
Vol. 21, EGU2019-17871, 2019
EGU General Assembly 2019

Linking spatial analysis of low and high resolution grassland ecophysiological data

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Grasslands, such as other managed fields, release large quantities of greenhouse gases (GHG). Fluxes of GHG are highly variable spatio-temporally, which hampers the quantification of the yearly sum. Although actual spatial patterns of ecosystem functions (EF) are determined by the actual spatial distribution and intensity of background or driving variables, a potential "optimal" or persistent state can also be detected on the basis of long-term climatic, surface relief and soil conditions. Changing climate could alter these instant and long-term patterns through the modification of the drivers. Field studies and spatial analysis can help to reveal such temporal dynamics of spatial patterns and to understand the shifts in EF.

We used two ways of spatial analysis to study grassland EF. One way was the geostatistical analysis of low-resolution field-scale manual measurements on 10 $\times$ 10 m grids. Geostatistical data processing revealed that topographic differences, however small they might be, had primary importance in the generation of spatial patterns of both the soil nutrients and the microclimate due to the variability of the available soil moisture and fine shading effects of crests and depressions, both the patterns of the above-ground biomass, soil respiration, and nitrous oxide flux. We found that spatial patterns and spatial correlations between variable pairs were dynamically changing characteristics. A further controlling factor was the management of the grasslands, creating different levels of homogeneity/heterogeneity.

The other way in spatial analysis can be the use of a high-resolution data. We used a 0.2 $\times$ 0.2 m resolution digital elevation model (DEM) in the geostatistical analysis for external drift kriging. In many cases kriging with DEM gave us better result than ordinary kriging with the variable itself. However, a more important use of DEM could be the calculation of different topographic attributes (e.g., slope, aspect, topographic position index, surface rugosity), because these data can reveal more about the neighboring effects within a landscape. We hypothesized that not just DEM, but the calculation of different indices along a spatial series can help to have a more detailed insight into the effects of topography on the spatial patterns of e.g. erosion, soil nutrient horizontal heterogeneity, and also on the EF.