Spatial analysis of agro-ecological data: Detection of spatial patterns combining three different methical approaches

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Processes in natural systems and the resulting patterns occur in ecological space and time. To study natural structures and to understand the functional processes it is necessary to identify the relevant spatial and temporal space at which these all occur; or with other words to isolate spatial and temporal patterns. In this contribution we will concentrate on the spatial aspects of agro-ecological data analysis. Data were derived from two agricultural plots, each of about 5 hectares, in the area of Newel, located in Western Palatinate, Germany. The plots had been conventionally cultivated with a crop rotation of winter rape, winter wheat and spring barley. Data about physical and chemical soil properties, vegetation and topography were i) collected by measurements in the field during three vegetation periods (2005-2008) and/or ii) derived from hyperspectral image data, acquired by a HyMap airborne imaging sensor (2005).

To detect spatial variability within the plots, we applied three different approaches that examine and describe relationships among data. First, we used variography to get an overview of the data. A comparison of the experimental variograms facilitated to distinguish variables, which seemed to occur in related or dissimilar spatial space. Second, based on data available in raster-format basic cell statistics were conducted, using a geographic information system. Here we could make advantage of the powerful classification and visualization tool, which supported the spatial distribution of patterns. Third, we used an approach that is being used for visualization of complex highly dimensional environmental data, the Kohonen self-organizing map. The self-organizing map (SOM) uses multidimensional data that gets further reduced in dimensionality (2-D) to detect similarities in data sets and correlation between single variables. One of SOM's advantages is its powerful visualization capability.

The combination of the three approaches leads to comprehensive and reasonable results, which will be presented in detail. It can be concluded, that the chosen strategy made it possible to complement preliminary findings, to validate the results of a single approach and to clearly delineate spatial patterns.