Identifying key properties for mapping stable soil management zones

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Novel advances in data capturing technology allow to obtain a wealth of information on soil properties relevant for the agricultural and environmental management of land. However, this information often contains a large degree of cross correlation. So the challenge is to select those properties which are essential for the faced problem, the so called key properties, and use these to create stable soil management zones serving the decision making for different types of land use, including precision agriculture. Vitharana et al. (2008, Geoderma 143:206-215) made a first effort to address this issue in a specific situation: the European loess belt. They concluded that out of 12 soil and topographic properties three could be considered as essential: pH, apparent electrical conductivity (ECa) and elevation. Our aim was to extend this study in terms of properties considered and in a different soil-landscape. Therefore, we selected a 4.2 ha agricultural field in the sandy area of northern Belgium, which is part of the greater sandy plain of northern Europe. The information which we collected was: 1) detailed ECa measurements using a mobile electromagnetic induction sensor (EM38-MK2) with two intercoil distances (0.5 and 1 m) in both horizontal and vertical orientations; 2) measurements obtained with a Gamma-ray sensor (the Mole by The Soil Company) of U, K, Th, Cs radiations of the top-soil; 3) detailed elevation data obtained by an airborne LIDAR scan; and 4) analytical data of 30 samples of top- (0-30 cm) and sub-soil (30-60 cm): sand, pH and organic carbon content. These 15 variables were subjected to a principal component analysis which identified three components explaining 72.5 % of the total variability. These three components were best represented by ECa (coil distance 0.5 m in horizontal orientation), elevation and top-soil pH. Surprisingly, these were the same variables as identified by Vitharana et al. (2008).

A fuzzy k-means classification of maps of the identified key variables was used to delineate two management zones and an extragrade class. An independent performance validation using wheat yield data from a yield monitor confirmed the significance of the differences between the management zones.

It is concluded that top-soil ECa, pH and elevation are the best candidates for generic key properties to delineate potential management zones in central European landscapes.