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Use of aerial photographs for assessment of soil organic carbon and delineation of agricultural management zones.

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For quantitative estimation of soil properties by means of remote sensing, often hyperspectral data are used. But these data are scarce and expensive, which prohibits wider implementation of the developed techniques in agricultural management. For precision agriculture, observations at a high spatial resolution are required. Colour aerial photographs at this scale are widely available, and can be acquired at no of very low costs. Therefore, we investigated whether publically available aerial photographs can be used to a) automatically delineate management zones and b) estimate levels of organic carbon spatially.
We selected three study areas within the Netherlands that cover a large variance in soil type (peat, sand, and clay). For the fields of interest, RGB aerial photographs with a spatial resolution of 50 cm were extracted from a publically available data provider. Further pre-processing exists of geo-referencing only. Since the images originate from different sources and are potentially acquired under unknown illumination conditions, the exact radiometric properties of the data are unknown. Therefore, we used spectral indices to emphasize the differences in reflectance and normalize for differences in radiometry.

To delineate management zones we used image segmentation techniques, using the derived indices as input. Comparison with management zone maps as used by the farmers shows that there is good correspondence.

Regression analysis between a number of soil properties and the derived indices shows that organic carbon is the major explanatory variable for differences in index values within the fields. However, relations do not hold for large regions, indicating that local models will have to be used, which is a problem that is also still relevant for hyperspectral remote sensing data.

With this research, we show that low-cost aerial photographs can be a valuable tool for quantitative analysis of organic carbon and automatic delineation of management zones. Since a lot of data are publically available this offers great possibilities for implementing remote sensing techniques in agricultural management.