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Using multispectral UAV data and digital soil mapping methods for mapping actual soil erosion on plot scale

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Information on actual degradation level of soils affected by erosion is currently often based only on field investigation, numerical and empirical erosion models or expert knowledge. These methods are relatively time consuming to collect and process the data, therefore there is an opportunity to use newly developed tools and methods for accurate soil condition mapping. Remote sensing methods, including UAVs, and digital soil mapping methods can be a good means of achieving this goal. The aim of this study is to analyse the possibilities of spectral data and predictive modelling for accurate spatial delimitation of the degree of soil degradation.

The study was conducted on a local level (100 ha) in the chernozems region of South Moravia with dissected relief strongly affected by all soil erosion forms (water, tillage, wind). Multispectral data were obtained using a Parrot SEQUOIA camera mounted on a fixed wing drone Parrot Disco-Pro AG. Data was processed into an orthomosaic using Agisoft PhotoScan software including calibration to surface reflectance using on-board irradiance sensor and calibration targets. The ground truth data from soil sampling and laboratory analysis (50 samples) and derivatives of the digital terrain model were used for the prediction mapping of soil properties (SOC, carbonates, clay content, A horizon thickness). The principles of digital soil mapping were used for prediction random forest and support vector machine multivariate methods. Predicted Soil properties were used as erosion indicators. Erosion and accumulation classes were determined. The mapping results were confronted with previous results using aerial hyperspectral data.

Results show that at test sites the pattern of different erosion classes is very complex due to joint action of multiple erosion factors (water, tillage, wind). Only 22.0% of area in flat and nearly flat relief was classified as non-eroded soils. 29.1% represent strongly eroded soils and 28.2% moderately eroded soil. Accumulated soils founded in the terrain concavities and side valleys cover 20.7% of area. The resulting spatial pattern of the distribution of eroded soils has shown that the site is heavily affected by various types of erosion. Based on the results it is possible to model in detail the influence of individual erosion factors and propose anti-erosion measures and conservation management.

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