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

ŽÍŽALA Daniel, MINAŘÍK Robert

Research Institute for Soil and Water Conservation, Prague, Czech Republic

zizala.daniel@vumop.cz

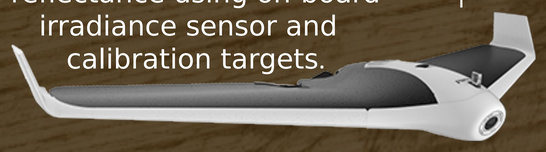
Photography encouraged

Introduction

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.

Materials & Methods

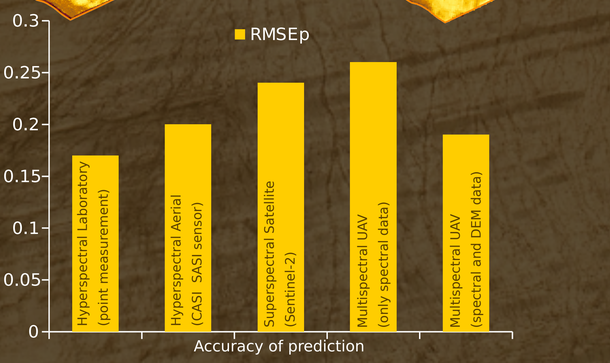
- Local study (area 100 ha) in the chernozems region of South Moravia - dissected relief strongly affected by all soil erosion forms (water, tillage, wind).
- Multispectral data were collected using a Parrot SEQUOIA camera - mounted on a fixed wing drone Parrot Disco-Pro AG.
- Data were processed into 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, laboratory analysis and derivatives of the digital terrain model were used for the prediction mapping of soil properties.
The principles of digital soil mapping were used - random forest and support vector machine.
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 and Sentinel-2 data.

Results

Prediction of soil properties



Classification results

Soil erosion classes

- Accumulated soils
- Non-eroded soils
- Moderately eroded soils
- Strongly eroded soils

		Observed					
		AC	ME	NE	SE	Classification overall	Producer accuracy (%)
Predicted	AC	**4**	0	0	0	4	100
	ME	0	**0**	0	0	0	0
	NE	0	2	**7**	1	10	70
	SE	1	1	1	**12**	15	80
Truth overall		5	3	8	13	29	
User Accuracy (%)		80	0	88	92		
Overall accuracy (%) = 79.3 **Kappa = 0.68**							

In comparison with Aerial hyperspectral data acurracy decreased from 82% to 79%. Moreover UAV multispectral data are not able to correctly identify transitional classes as moderetaly eroded soils.

Results show that the pattern of different erosion classes is very complex due to joint action of multiple erosion factors (water, tillage, wind) at test sites. There were classified only 22.0% of the area in flat and nearly flat relief as non-eroded soils. 29.1% represent strongly eroded soils and 28.2% of the area represent moderately eroded soil. Accumulated soils were found in the terrain concavities and side valleys and cover 20.7% of the 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.

The research has been supported by the project no. QK1820389 "Production of actual detailed maps of soil properties in the Czech Republic based on database of Large-scale Mapping of Agricultural Soils in Czechoslovakia and application of digital soil mapping" funding by Ministry of Agriculture of the Czech Republic.