The effect of landscape slope on soil organic carbon in domažlice district in the Czech Republic

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INTRODUCTION

Soil organic carbon (SOC) is one of the most important soil components as it significantly affects and improves soil chemical and physical properties as well as soil biological activities, biodiversity, and processes. However, the SOC pool can be influenced by natural processes, such as erosion, as well as anthropogenic activities. For erosion transport, rainfall intensity and slope gradient are the most important. SOC loss increases as the rainfall intensity increases. Topography, particularly the slope gradient, is the primary factor affecting the intensity and frequency of erosion and thus may impact SOC stock. Several studies have indicated that erosion and its intensity and frequency increases with increasing the slope andflow velocity (Reyna-Bowen et al. 2019). Original SOC content and erosion pattern are two important factors through which different soils can influence SOC loss (Li, Z., et al. 2016).

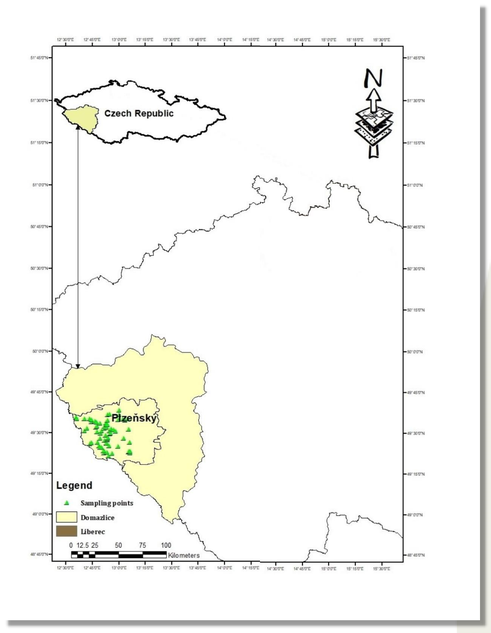

Fig. 1. Location of Domažlice district in the Czech Republic and sampling locations

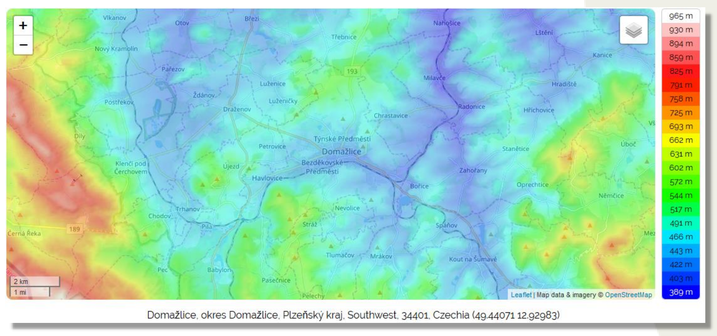

Fig. 2. Domažlice district topographic and elevation map.

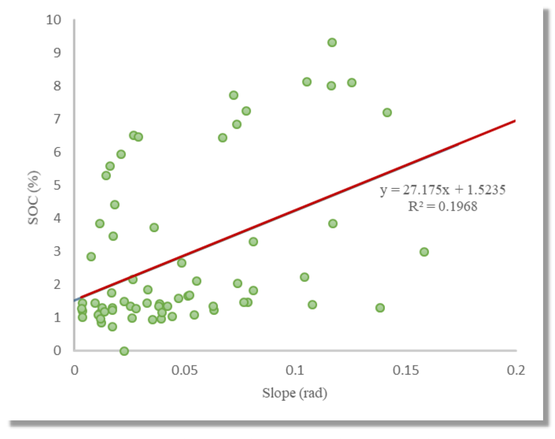

Fig. 3. Linear regression of the relationship between slope and SOC content in Domažlice district (all data)

MATERIALS AND METHODS

The study area is located at Domažlice district, in the south-west of the Czech Republic. Samples were randomly collected from the study area (67 samples) (Fig.1). The soils were sampled to the depth of 30 cm using a steel soil auger after removing plant debris at each sampling location. First, the whole datasets for each district were analyzed. Then the data were divided into three land-use categories, namely arable lands and forests and complex system and analyzed separately. To measure SOC, soil samples were air-dried. Subsequently, the SOC of each sample was determined through the oxidimetric modified Tyurin method. Slope data were calculated for the sampling sites using a digital elevation model (DEM). The Linear regression coefficients were calculated to describe the relationships between slope and SOC stock in R and SPSS software. The SPSS software was also used to determine the correlation matrix between selected variables. Linear regression analysis was used to test the correlations between slope and SOC.

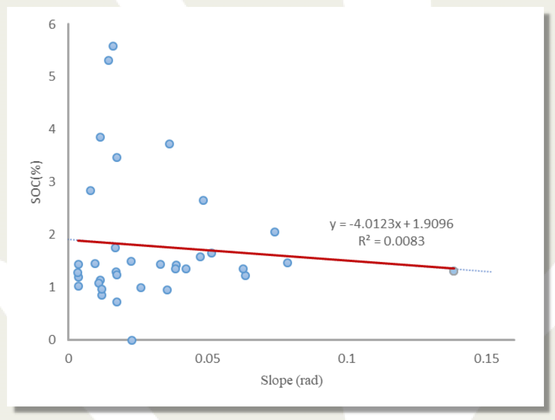

Fig. 4. Linear regression of the relationship between slope and SOC in arable lands in Domažlice district

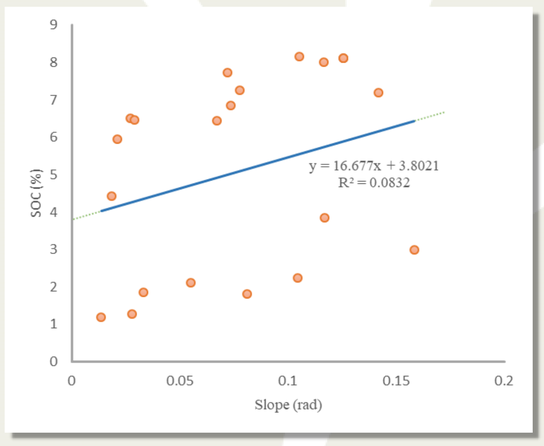

Fig. 5. Linear regression of the relationship between slope and SOC in forest areas in Domažlice district

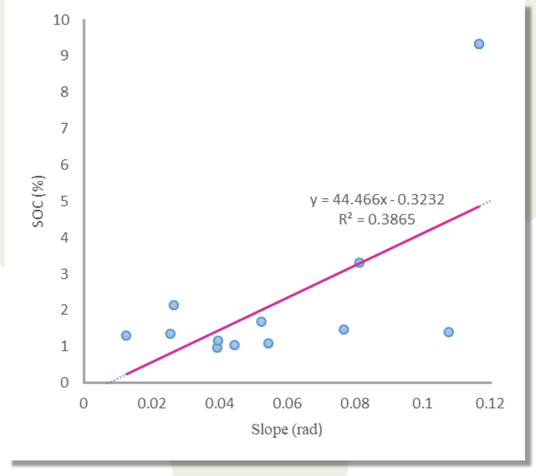

Fig. 6. Linear regression of the relationship between slope and SOC in complex systems in Domažlice district

MAIN RESULTS

The correlation matrices were performed to determine various relationships between selected variables. The relationship of SOC and slope was positive though relatively weak (R^2 = 0.19, $p \leq 0.05$). Since the results of the relationship between SOC and slope were very weak, we divided the region's data by land-use. The arable land relationship of SOC and slope in the Domažlice district was negative and very weak (R^2 = 0.008 for 35 samples), for the complex systems it was positive stronger than others (R^2 = 0.386 for 12 samples), and for the forests it was positive, but also very weak (R^2 = 0.083 for 20 samples) (Fig. 3-6) This study found that there was a positive correlation between slope and SOC (R = 0.444; P<0.01) (Fig.7) for Domažlice region. The data separation increased correlations between SOC and slope.

Table 1. Correlation matrix (Pearson) for Domažlice district

	RSP	LS Factor	TWI	Slope	Clay	SOC
RSP	1.000					
LS Factor	0.549**	1.000				
TWI	-0.588**	-0.532**	1.000			
Slope	0.652**	0.962**	-0.685**	1.000		
Clay	-0.160	-0.316	0.143	-0.344	1.000	
SOC	0.556**	0.398**	-0.347	0.444**	-0.108	1.000

**. Correlation is significant at the 0.01 level (2-tailed).
*,**,*** for P < 0.05,0.01,0.001 respectively

TWI: Topographic wetness index. LSF: LS Factor. RSP: Relative position of the slope

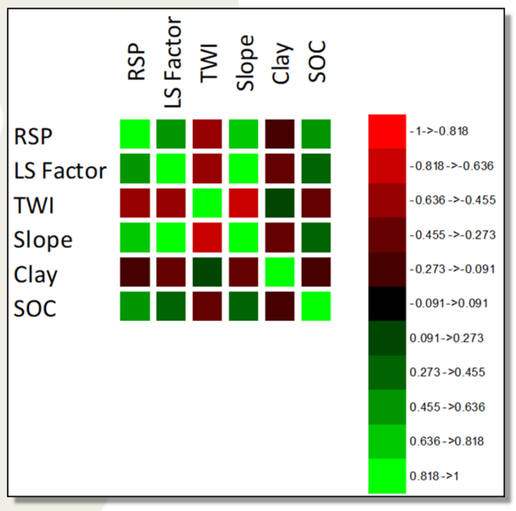

Fig. 7. Correlation matrix (Pearson) for Domažlice district

In summary, the studied district showed a positive and weak linear relationship between SOC and slope in forests and complex system. However, increasing slope may also decrease soil SOC (arable land). Thus, this study suggested that slope can be used as a general predictor of SOC. The separating of the data had a positive effect and increased R^2 results in the estimation of the relationship between SOC and slope. Also, results showed how much land-use affected the relationship between SOC and slope and how much it affects the distribution of SOC.