

Bright patches on chernozems - from space to surface and soil properties

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The bright patches on chernozems can be easily visually distinguished in the aerial images, due to their bright colour contrasting with the dark colour of the surrounding chernozems. They present a typical feature of the loess hilly lands in the Danube Lowland. They refer predominantly to the areas where (i) the soil substrate – loess is tilled, (ii) the transitional AC horizon of chernozems is tilled, (iii) or one of them, or both are mixed into the plough layer during tillage. They are usually categorized as eroded chernozems or regosols. To the lower extent, the accumulation patches might occur, if the loess material redeposited from upper part of the slope in the colluvium is tilled. This study focuses on uncovering the soil properties of bright patches, identified on different scales – spatial and temporal, combining three methods – the remote sensing, morphometric analysis and soil mapping. In the area of 31 km² (located in the Trnavská pahorkatina Hilly Land, south of Trnava), the bright patches were identified using visual analysis of georeferenced aerial images from 1949 and 2004, representing two types of landscape structure characteristic for the 20th Century. In 1949 small, in one direction elongated fields, with mean size 0.008 km² prevailed, while in 2004 the mean size of a field was 0.28 km². The morphometric analysis was performed based on DEM derived from topographical maps (scale 1:10 000). Soil sampling in the first phase of the project was performed in a subset of the patches in small agriculture catchment (0.28 km²), situated in one single field (in 2004). The percussion drilling or hand augering (with undisturbed structure) were used in order to describe the depth of the soil horizons and the soil properties. Together 365 bright patches covering 3.2% of the study area (31 km²) were identified in 1949; while it was twice more in 2004 (776 patches), when they covered approximately 12% of the same area. The bright patches were predominantly located in areas with slope gradient between 3 and 6°, which is considered as the higher slope in this part of the hilly land. In 1949 the distribution of bright patches was more strongly related to higher slope gradient, the convex forms of profile curvature, and upslope position than in 2004. In the studied catchment, 34 soil profiles were described in the bright patches (identified in 2004), and 73% of them were situated on the convex forms of profile curvature. The most of the profiles were eroded (88%), the mean soil loss was 0.36 m (in the comparison with the reference soil profile), and in 55% of described soil profiles the entire mollic horizon was removed. The typical surface horizon contained 2.3% of humus and 21% of carbonates. The soil profiles were further compared with those situated in the areas neighbouring with the bright patches, and soil profiles on two valley cross-sections, in order to understand the soil redistribution in the catchment, and describe the differences between the bright and black patches in the chernozem landscape. This work was supported by the Slovak Research and Development Agency under the contract ESF-EC-0006-07 and APVV-0625-11; Anna Smetanová has received the support of the AgreenSkills fellowship (under grant agreement n°267196).