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Delineation of colluvial soils in different soil regions

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Colluvial soils are considered to be the direct result of accelerated soil erosion in agricultural landscape, resulting in accumulation of humus-rich soil material in terrain depressions and toe slopes. They represent an important soil cover element in landscapes influenced by soil erosion and form an important soil organic carbon (SOC) pool. Delineation of colluvial soils can identify areas with high sediment input and potential deep organic carbon storage and thus improve our knowledge on soil mass and SOC stock redistribution in dissected landscapes. Different prediction methods (ordinary kriging, multiple linear regression, supervised fuzzy classification, artificial neural network, support vector machines) for colluvial soils delineation have been tested in three different soil regions (Cambisol, Luvisol and Chernozem) at two scales (plot and watershed) in the Czech Republic. The approach is based on exploitation of relationship between soil and terrain units and assumes that colluvial soil can be defined by particular range of terrain attributes values. Terrain attributes derived from precise DEMs were used as predictors in applied models. The soil-terrain relationship was assessed using a large dataset of field investigations (300 cores at each plot and 100 cores at each watershed). Models were trained at plot scale (15-33 ha) and the best performing model was then calibrated and validated at watershed scale (25-55 km2). The study proved high potential of terrain variables as predictors in colluvial soil delineation. Support vector machines method was the best performing method for colluvial soil occurrence prediction at all the three sites. However, significant differences in performance have been identified among the studied plots. The best results were obtained in Luvisol region where both determination coefficient and prediction accuracy reached the highest values. The model performance was satisfactory also in Chernozem region. The model showed its limitations in the Cambisol region, where a high uncertainty and low prediction accuracy resulted from generally weak soil-terrain relationship given by low redistribution of the soil material. Different terrain attributes were applied as predictors in the models at each study region. In the Chernozem region, the colluvial area is defined by extreme values of slope and topographic position index. In Luvisol and Cambisol regions, colluvial soil area is related mostly to specific values of plan curvature and topographic wetness index. Role of colluvial soils given by theirs spatial extent differs in the studied sites. Colluvial soil in the Chernozem region represents an important soil cover part (13% from the total area). Moderate importance of colluvial soils was determined in the Luvisol region (8 %) and low in the Cambisol region (3%). Spatial extent of colluvial soils corresponds to the intensity of soil mass redistribution. At the three sites with similar environmental settings (terrain, land management, climate), it is mostly soil characteristics and profile development typical for each classification unit that resulted in different importance of colluvial soil in each study site.
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