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Potential SOC saturation of typical native soils of the Carpathian Basin

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Soil organic carbon (SOC) content is a crucial property of each soil since it determines most of their physical and chemical behavior. It is responsible for aggregation, hydrological properties, cation exchange and buffer capacity. Moreover, fertility is also in a close connection with SOC content. Nowadays soil is taken into consideration as one of the largest unsaturated carbon pool that can be loaded applying natural and passive processes (e.g. conservation tillage). Increase of SOC content amends soil properties and in a global context it can also mitigate climate change by pumping carbon from the atmosphere to the soil. This process is limited by the carbon storage capacity of mineral soils, which is presumed to be the balance among i.) input quality and quantity of carbon; ii.) mineralization by microorganisms; iii.) particle size distribution and aggregation of the soil. Moreover, climatic conditions, mineral composition and hydrology should be taken into account in order to predict actual carbon holding capacity. However, many papers report results about numerical context on SOC storage capacity no generally accepted model was found yet. Most researchers agree that chemically and biologically resistant carbon is associated with the finest mineral particles of the soil, even though the upper limit of this fraction varies (20 μ, 50 μ or 63 μ). Therefore, long term SOC holding capacity is presumed to be a function of particle size distribution. In this study 20 μ was used as a threshold for the fine fraction.

Present study aims to compare theoretical SOC holding capacity of four native soils of a subhumid temperate zone. In order to minimize climatic effects soils were chosen within five kilometer distance from each other. Elevation differences among the profiles are less than three meters. The uppermost potentially cultivated layer of a Phaeozem, Chernozem, Cambisol and a Solonetz was sampled. SOC content was measured using dry combustion at 900°C, while particle size distribution was determined by laser diffraction.

Results suggest that the Chernozem and the Cambisol layers are slightly oversaturated, whereas the Phaeozem and the Solonetz layer have a saturation deficit of 9.6 and 6.8 %, respectively according to the Hassink (1997) model. On the other hand, the fine fraction associated SOC takes the half of total SOC in each soils except for the Phaeozem, where this ratio is more than 70%. Comparing these findings to other results of native forest soils from the Carpathian Basin it is clear that most forest topsoils are considerably oversaturated. Moreover, within this country-wide database a strong linear connection is found between SOC content of the fine fraction and the SOC content of the bulk soil, which refers to the limitations of the Hassink (1997) model.

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