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Spatial analysis of subsoil compaction on cultivated land by means of penetrometry, electrical resistence tomography and X-ray computed tomography

David Zumr, Markéta Vláčilová, Tomáš Dostál, Jakub Jeřábek, Martina Sobotková, and Michal Sněhota
Czech Technical University in Prague, Faculty of civil engeneering, Prague 6, Czech Republic (david.zumr@fsv.cvut.cz)

Soil compaction is a well recognized phenomena in the agricultural land. Various effects can alter the degree of the compaction in the field. The topsoil is regularly loosened due to agrotechnical operations, but the subsoil remains usually compacted. Various studies show increasing bulk density and decreasing saturated hydraulic conductivity in the plough pan, even though some authors argue that it does not have to be always the case due to presence of bio-macropores. Hence the structural properties of the subsoil and the spatial distribution of the compacted layer depth within the cultivated fields are important factors influencing soil water regime, nutrients regime and runoff generation.
The aim of the contribution is to present the results of the monitoring of the plough pan depth spatial distribution at the experimental catchment Nucice (Central Bohemia, Czech Republic). The soils are classified as Luvisols and Cambisols with a loamy Ap horizon (0.1 – 0.2 m deep) underlined by a silty and silty-clay B horizon. The content of clay particles in the topsoil is around 8%. The soil has low inner aggregate (soil matrix) hydraulic conductivity, with measured values of approximately 0.1 – 2 cm d-1. The bulk topsoil saturated hydraulic conductivity (Ks) is significantly higher and varies depending on the season.
To observe the divide between topsoil and subsoil layers in detail and to be able to compare the soil structure and pore networks of both layers we inspected undisturbed soil samples with X-ray computed tomography. The divide between the conservatively tilled topsoil and the subsoil is clearly observable also on terrain. To identify its exact position we implemented a combination of penetrometry, soil sampling and electrical resistance tomography (ERT). The penetration tests accompanied by soil probing were done in an irregular network across the whole catchment based on the slopes and distance to the stream. Several 2D ERT measurements were done locally on a plot of approximately 10 x 50 m. Dipole-dipole scheme with electrode span of 10 cm was used. The results obtained by different techniques are in a good agreement with observed plough pan position.
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