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An in-situ soil structure characterization methodology for measuring soil compaction

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The agricultural cultivation has several direct and indirect effects on the soil properties, among which the soil structure degradation is the best known and most detectable one. Soil structure degradation leads to several water and nutrient management problems, which reduce the efficiency of agricultural production. There are several innovative technological approaches aiming to reduce these negative impacts on the soil structure. The tests, validation and optimization of these methods require an adequate technology to measure the impacts on the complex soil system.

This study aims to develop an in-situ soil structure and root development testing methodology, which can be used in field experiments and which allows one to follow the real time changes in the soil structure - evolution / degradation and its quantitative characterization. The method is adapted from remote sensing image processing technology. A specifically transformed A/4 size scanner is placed into the soil into a safe depth that cannot be reached by the agrotechnical treatments. Only the scanner USB cable comes to the surface to allow the image acquisition without any soil disturbance. Several images from the same place can be taken throughout the vegetation season to follow the soil consolidation and structure development after the last tillage treatment for the seedbed preparation. The scanned image of the soil profile is classified using supervised image classification, namely the maximum likelihood classification algorithm. The resulting image has two principal classes, soil matrix and pore space and other complementary classes to cover the occurring thematic classes, like roots, stones. The calculated data is calibrated with filed sampled porosity data. As the scanner is buried under the soil with no changes in light conditions, the image processing can be automated for better temporal comparison. Besides the total porosity each pore size fractions and their distributions can be calculated for every soil profile. The main advantage of this method is the ability to follow the temporal development, as the scanner is buried in the soil at the beginning of the measurement series and stays undisturbed for the entire period. The procedure was successfully applied in both arable-and horticultural crops.