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Electrical resistivity feasability to characterize structural heterogeneity of cultivated soils : from 1D to 3D.

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Soil structure, *i.e.* soil particles arrangement at various scale, is a key component of the physical quality of agricultural fields: it determines the mechanical and transfer properties which are involved in numerous aspects of soil physical degradation (poor rootability, aeration and water infiltration). Soil structure of agricultural fields is variable in space and time. One of the main problems is that actually characterization methods (such as bulk density, penetration resistance or visual morphological description) are destructive and cannot be used to obtain a direct spatial and temporal monitoring of the soil structural heterogeneity.

The aim of our study was to examine the feasibility of using a non invasive geophysical method, the electrical resistivity, to describe the structure of a cultivated loamy soil.

Preliminary in laboratory conditions, electrical resistivity results after soil temperature correction by the Frischknecht and Keller equation (1966) showed a significant 10 Ω.m difference between two soil blocks exhibiting different structures. Indeed, the resistivity values were significantly higher for the porous block than for the compacted block.

Based on these results, at a field profile scale, two-dimensional electrical resistivity tomography (ERT) in Wenner array with a weak electrodes spacing (0.1 m) perpendicular to traffic direction has been conducted. Comparison of ERT pattern obtained by Loke and Barker inversion (1996) with the visual morphological description showed the ability of electrical measurements to detect structural features such as plough pan and wheels tracks in the ploughed layer. Moreover, after soil temperature correction, these resistivity values obtained in field conditions were not significantly different from these obtained for the two structures in laboratory conditions.

This electrical method can then be considered as encouraging for non-destructive description of soil structure. Soil electrical resistivity is sensitive to bulk density: an increase in bulk density corresponds to a decrease of electrical resistivity. But the weak resistivity difference between structures obtained in these trials showed the necessity to accurately measure other soil parameters (such as temperature, water content, texture) susceptible of influencing resistvity values.

Three-dimensional electrical resitivity tomography for discussion of soil structure heterogeneity can be made as well. However, ERT method at the whole plot scale would be long and fastidious. A new technology, Automatic Resistivity Profiling (ARP), a multi-probes system tracted by a Quad bike developped by Geocarta Society permits to measure electrical resistivities at three depths every 0.2 m in real time. A resistivity map is rapidly obtained. Two electrical resistivity maps at field scale are discussed and wheel tracks perfectly localised.