Geophysical Research Abstracts
Vol. 12, EGU2010-3594, 2010
EGU General Assembly 2010

Temporal changes of the structure of a loamy soil tilled layers as described by 2D Electrical Resistivity Tomography

Arlène Besson, Maud Seger, Guy Richard, Bernard Nicoullaud, Guillaume Giot, and Isabelle Cousin
INRA, Soil Science Unit, Orleans, France (arlene.besson@orleans.inra.fr)

The soil structure is complex, heterogeneous, space and time scale dependent, submitted to the climate, biological activity and human practices. For instance, in agricultural context, when soil management practices aim at developing desirable soil conditions for a seedbed and establishing specific surface configuration for planting, drainage or harvesting operations, they can also induce soil structural disturbances, as compaction resulting on in-field wheel traffic. These intense soil degradations have a drastic impact on soil functioning and plant growth but are not absolutely irreversible. Indeed, earthworm's activity, root growth and climate improve the soil structure by cracking, by developing voids, channels, by a progressive fragmentation and disaggregation of the initial dense matrix. Despite this natural structural resilience process of soils is well known, its empirical evidence at the macroscopic scale remains challenging. This requires a well detailed characterization of structural components in space and time.

The objective of this study was to monitor the structural changes of a loamy tilled layer initially compacted locally by wheel traffic.
In the field, two zones were analysed: (1) a bare soil in view of describing mainly the impact of the climate on the soil structure and (2) a cultivated soil in view of describing the cumulative effect of the climate and root growth on the soil structure. For both, the non destructive and exhaustive method of Electrical Resistivity Tomography (ERT) has been used to monitor the structural changes from April to August, i.e. during the complete growing season. In addition, the interpretation of ERT was comforted by several visual descriptions of soil structure, realized on soil pits dug at the same location than the ERT profiles and by bulk density measurements from soil samples. Due to their high impact on electrical resistivity, water content and soil temperature were also monitored during the experiment. The temperature effect was corrected with the Keller and Frischknecht equation (1966).

Our results enhanced clearly the location of compacted clods in the trafficked zone with small values of electrical resistivity (close to 15 ohm.m). During the dessication period, the electrical values increased progressively according to the changes in water content. However, very high values of electrical resistivity were observed (up to 250 ohm.m) in the cultivated zone: according to experiments conducted in laboratory, these high resistivity values could not be only related to the decrease of the water content but also, to the formation of cracks in the compacted and non-compacted zones. Due to the cumulative effects of evapotranspiration and root water uptake, soil cracking was more pronounced in the cropping system than in bare soil. These results were consistent with visual descriptions of soil pits.
We show then the adequacy of ERT to describe in space and time the structural resilience of the soil tilled layer and we discuss on the main influences of structural changes in space and time.

This work was part of the FP7-DIGISOIL project on "Integrated system of data collection technologies for mapping soil properties".