



Geophysical mapping of variations in soil moisture

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The geophysical investigation of soil characteristics is a matter of great actuality for agricultural, hydrogeological, geotechnical or archaeological purposes.

The geophysical mapping of soil quality is subject of a recently started scientific project in Romania: "Soil investigation and monitoring techniques – modern tools for implementing the precision agriculture in Romania – CNCSIS 998/2009".

One of the first studied soil parameter is moisture content, in irrigated or non-irrigated agricultural areas. The geophysical techniques employed in two areas located within the Romanian Plain, Prahova and Buzau counties, are the following:

- electromagnetic (EM), using the EM38B (Geonics) conductivity meter for getting areal distribution of electric conductivity and magnetic susceptibility;
- electric resistivity tomography (ERT), using the SuperSting (AGI) multi-electrode instrument for getting in-depth distribution of electric resistivity.

The electric conductivity mapping was carried out on irrigated cultivated land in a vegetable farm in the Buzau county, the distribution of conductivity being closely related to the soil water content due to irrigation works. The soil profile is represented by a chernozem with the following structure: Am (0 - 40 cm), Bt (40-150 cm), Bt/C (150-170 cm), C (starting at 170 cm).

The electromagnetic measurements showed large variations of this geophysical parameter within different cultivated sectors, ranging from 40 mS/m to 85 mS/m. The close association between conductivity and water content in this area is illustrated by such geophysical measurements on profiles situated at ca 50 m on non-irrigated land, displaying a mean value of 15 mS/m. This low conductivity is due to quite long time interval, of about three weeks, without precipitations.

The ERT measurements using multi-electrode acquisition systems for 2D and 3D results, showed by means of electric resistivity variations, the penetration of water along the cultivated rows from the drip system. The mean depth of water penetration is about 0.5 m, while the depth level where the irrigation water is accumulating in a continuous wet layer is about 0.7 m.

Magnetic susceptibility measurements performed on the soil profile in this area showed highest values on the Am layer, an important decrease within the Bt layer, followed by a weak increase toward the C layer.

Electric conductivity and magnetic susceptibility measurements were carried out on profiles crossing non-irrigated cultivated areas in the Prahova county. The variations of electric conductivity, ranging between 10 and 30 mS/m is considered to be related mainly to the moisture content. Highest values of electric conductivity, greater than 50 mS/m, correlated with anomalies of magnetic susceptibility, were recorded over buried metallic pipes of various sizes, the cultivated land being located between an oil refinery and green-houses.