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Spatial 2D and 3D distribution of moisture content in irrigated soils

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Information on space and time distribution of moisture content in irrigated soils of cultivated land may be significant for at least the following reasons:
- the availability of water for irrigation and its costs;
- the variable depths where roots are developed for different types of plants;
- soil salinization due to excessive irrigation works of cultivated land.
The main geophysical techniques utilized in our study to assess the moisture content in agricultural soils are:
- Electric Conductivity mapping for areal surveys;
- Electric Resistivity Tomography for depth imaging of 2D and 3D resistivity distributions.
In areas with irrigated land the electric parameters of soil (electric conductivity and electric resistivity) may be mostly related to the moisture content, as suggested by recent observations (Ioane et al. 2010).
The electromagnetic measurements (EM) were carried out with an EM38B (Geonics) conductivity meter, in order to obtain the areal distribution of electric conductivity and magnetic susceptibility in soils till 1.5 m maximum depth. Mapping of electric conductivity over large areas offer rapidly information on the moisture content, especially in irrigated zones.
The electric resistivity tomography measurements (ERT) were performed with a SuperSting (AGI) multi-electrode device in order to get in-depth distribution of electric resistivity. The multi-electrode resistivity measurements may offer more detailed information on the vertical variation of electric resistivity / soil moisture as 2D or 3D spatial models.
Recent investigations using electric resistivity tomography (ERT) measurements on irrigated cultivated land of the Buzau county (Romania) aimed at displaying the in-depth penetration and accumulation of irrigation water. There were employed special acquisition systems, with electrode intervals of 0.5 m, for a very detailed investigation of soil shallow levels located between the surface and 1.0 m depth. The inversion of apparent resistivity data was done using three different optimization methods, the best electric model (real resistivity and depth values) being obtained with the robust inversion algorithm. The obtained distributions of electric parameters (resistivity and conductivity) were represented as 2D and 3D models for depths of 1.5 to 2.0 m and interpreted as shallow variations of moisture content. As a consequence of the particular irrigation drip-system utilized in the studied area, the sectors of high moisture content are developed at each irrigated row (1.0 m interval) with breaks of lower moisture content corresponding to non-irrigated intervals. In the 3D model, the direct irrigated sectors develop as half-spheres of low resistivity (high moisture) beneath the drip location.

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