ABSTRACT

During the last years, electrical methods were often used for the investigation of subsurface structures. Electrical resistivity tomography (ERT) has been reported to be a useful non-invasive and spatially integrative prospecting technique. The ERT method provides significant improvements, with the developments of new inversion algorithms, and the increasing efficiency of data collection techniques. Multichannel technology and powerful computers allow collecting and processing resistivity data within few hours. Application domains are numerous and varied: geology and hydrogeology, civil engineering and geotechnics, archaeology and environmental studies. In particular, electrical methods are commonly used in hydrological studies of the vadose zone.
The aim of this study was to develop a multichannel, automatic, non-invasive, reliable and inexpensive 3D monitoring system designed to follow electrical resistivity variations in soil during rainfall. Because of technical limitations and in order to not disturb the subsurface, the proposed measurement device uses a non-conventional electrode set-up, where all the current electrodes are located near the edges of the survey grid. Using numerical modelling, the most appropriate arrays were selected to detect vertical and lateral variations of the electrical resistivity in the framework of a permanent surveying installation system. The results show that a pole-dipole array has a better resolution than a pole-pole array and can successfully follow vertical and lateral resistivity variations despite the non-conventional electrode configuration used. Field data are then collected at a test site to assess the efficiency of the proposed monitoring technique. The system allows following the 3D infiltration processes during a rainfall event. A good correlation between the results of numerical modelling and field data results can be observed since the field pole-dipole data give a better resolution image than the pole-pole data. The new device and technique makes it possible to better characterize the zones of preferential flow and to quantify the role of lithology and pedology in floodgenerating
hydrological processes.
Key words: resistivity, monitoring, preferential flow, rainfall event, infiltration process, numerical modelling