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Soil resistivity over root area ratio, soil humidity, and bulk density: laboratory tests

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Knowledge about root system distribution covers an important role in slope shallow stability stud-ies, as this factor grants an increase in soil geotechnical properties (soil cohesion and friction an-gle) and determines a different underground water circulation. Published studies (Amato et al., 2008 and 2011; Censini et al., 2014) about in situ application of ERT (Electrical Resistivity Tomo-graphy) analysis show how the root presence affects the measurable soil resistivity values, confirm-ing the suitability to investigate the application of such technique, aiming to estimate root density in soil with an indirect and non-invasive method.
This study, laboratory-based and led on reconstructed samples in controlled condition, aim to find a correlation between the resistivity variations and the various factors that can affect them (humid-ity, bulk density, presence of foreign bodies, temperature).
The tests involved a clay-loam soil (USDA classification) taken from Quaracchi (Florence, Italy), in an experimental fir-wood (Picea abies) owned by the Department of Agricultural, Food and For-estry System, Florence University, a previously chosen site for field ERT applications. The row ma-terial has been dried out in a lab stove, grounded and sieved at 2 mm, and then placed in a lexan box (30 x 20 x 20 cm) without compaction.
Inside the sample have been inserted 3 series of 4 iron electrodes, insulated along the shaft and with the conductive end placed at three different depth: 2 cm from surface, in the middle of the sample and in contact with the bottom of the box; resistivity measures are conducted on the three levels using a Syscal R2 with electrodes connected in a dipole-dipole configuration.
Root presence is simulated inserting bamboo spits (simple geometry, replicable “R.A.R.”) in varying number from 0 to 16 in every area between two contiguous electrodes. The tests are repeated in time, monitoring the natural variations in humidity (evapotranspiration) and bulk density (compac-tion).
The first results show an increase of resistivity with the decrease of mean humidity that follows a potential trend; data measured in the spitted sample can be statistically considered as a different population in respect to the data from the bare earth sample, giving credit to the hypothesis that the wooden spit presence could be indirectly quantified from geoelectric data.

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