Geophysical Research Abstracts
Vol. 18, EGU2016-5862, 2016
EGU General Assembly 2016

Estimation of tree root distribution using electrical resistivity tomography

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Trees influence soil-mantled slopes mechanically by anchoring in the soil with coarse roots. Forest-stands play an important role in mechanical reinforcement to reduce the susceptibility to slope failures. However, the effect of stabilisation of roots is connected with the distribution of roots in the ground. The architecture and distribution of tree roots is diverse and strongly dependent on species, plant age, stand density, relief, nutrient supply as well as climatic and pedologic conditions. Particularly trees growing on inclined slopes show shape-shifting root systems. Geophysical techniques are commonly used to non-invasively study hydrological and geomorphological subsurface properties, by imaging contrasting physical properties of the ground. This also poses the challenge for geophysical imaging of root systems, as properties, such as electrical resistivity, of dry and wet roots fall within the range of soils. The objective of this study is whether electrical resistivity tomography (ERT) allows a reliable reproduction of root systems of alone-standing trees on diverse inclined slopes. In this regard, we set the focus on the branching of secondary roots of two common walnut trees (*Juglans regia* L.) that were not disturbed in the adjacencies and thus expected to develop their root systems unhindered. Walnuts show a taproot-cordate root system with a strong tap-root in juvenile age and a rising cordate rooting with increasing age. Hence, mature walnuts can exhibit a root system that appears to be deformed or shifted respectively when growing at hillslope locations. We employed 3D ERT centred on the tree stem, comprising dipole-dipole measurements on a 12-by-41 electrode grid with 0.5 m and 1.0m electrode spacing in x- and y-direction respectively. Data were inverted using a 3D smoothness constrained non-linear least-squares algorithm. First results show that the general root distribution can be estimated from the resistivity models and that shape-shifting effects of secondary roots of the two *Juglans regia* in differently inclined ambiences can be imaged using 3D ERT. The results of this study can yield a grasp about the dimension of root architecture of single trees by using non-invasive geophysical techniques and give evidence about how roots influence the soil mantle mechanically and hydrologically according to the spatial distribution of their coarse roots.