Geophysical Research Abstracts,
Vol. 11, EGU2009-7067, 2009
EGU General Assembly 2009

Detecting soil water use by Mediterranean vegetation on rocky soils using electrical resistivity tomography.

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Water availability is an important constraint on tree and shrub development in Mediterranean ecosystems. During prolonged periods of summer drought, water stored in the soil column is the only available water source. Some Mediterranean tree species are known to have extensive root system penetrating deeply into fractured bedrock. Accurate characterisation of the soil and the ability of trees to subtract water from the soil profile are crucial for the understanding of Mediterranean ecosystems and the modelling of primary production. However, with shallow soils on rocky substrate, it is hard to obtain soil moisture data at depths below 30-50 cm.

We explored the use of Electrical Resistivity Tomography (ERT) to detect vegetation water use trough the whole soil column. ERT provides spatial information on soil conditions and moisture content down to 5 m and deeper in a 2D cross-section. It uses a multi-electrode array that is connected to the soil through steel pins that are inserted in the ground. This method of installation allows measurements on rocky substrate.

We used ERT to detect spatial and temporal patterns of soil moisture in variable shallow soils and weathered bedrock of the Peyne area in Mediterranean southern France. The Peyne area has a sub-humid climate and is covered mainly in sclerophyllous trees and shrubs. ERT measurements were made for 13 sites in the study area which were all visited in June, at the onset of the dry season, and again in September, near the end of a three-month dry period. Our measurements show root penetration and water use by trees 5m and deeper, despite the shallow soils in the study area. We also show large short-scale spatial variability and the importance of the geological substrate in moisture processes. ERT is a useful new technique for the exploration of soil and ecosystem functioning, even with rocky soils, providing information on rooting depth and water use otherwise unavailable.