Open Access | https://doi.org/10.62329/AETR1576

AGROGEO

Evaluating the contribution of spectral induced polarization to understand the geometry of the rhizosphere in agroforestry

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Abstract

Agroforestry, the practice of planting trees on agricultural land, is a sustainable form of agriculture. Trees not only protect the soil from wind erosion, but also improve the water supply, and increase the amount of nutrients and organic matter in the subsurface, which can lead to an increase in the yield. Yet, the impact on the rhizosphere, which are soils influenced by tree roots and associated processes, due to the expansion of the tree root system and their interaction is not fully understood.

In this study, we use the Spectral Induced Polarization (SIP) method, which provides the conductive (conductivity) and capacitive properties (polarization) of the subsurface, to delineate the expansion of tree roots on the edge of agricultural fields. SIP measurements were conducted in a frequency range between 0.1 and 75 Hz at four sites with fruit trees. We collected data with different 2D and 3D electrode configurations, e.g., a circular array and a star-shaped array, to investigate their resolving capabilities, as the detection of roots requires high spatial resolution.

The 2D and 3D inverse models show that the conductivity can be used to delineate the root zone and areas of high water content, while the polarization offers information about areas with high organic matter beneath the roots. Our study demonstrates that the SIP method is able to provide information about the expansion of tree roots and their interaction with soil, which is critical information for the application of agroforestry.

Keywords SIP, tree root system, soil oisture, organic matter, field experiment

Conference Talk

Published Feb 01, 2024

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