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Quantifying the sensitivity of electrical geophysical methods to root traits of winter wheat

Guillaume Blanchy (1), Andrew Binley (1), Richard Whalley (2), and Malcolm Hawkesford (2)

(1) Lancaster University, Lancaster Environment Center, United Kingdom (g.blanchy@lancaster.ac.uk), (2) Rothamsted Research, Harpenden, United Kingdom

To ensure food security and face some of the challenges of climate change, we need to select more resilient crops whilst maintaining high yield. In this race, assessment of the root characteristic of different genotypes is a bottleneck despite abundant above ground phenotyping methods. Geophysical methods, such as electrical resistivity tomography (ERT) and electromagnetic induction (EMI), may help to overcome this issue by providing high spatial and temporal resolution at the field scale. Although these methods are unable to image roots directly, they have the potential to assess soil water uptake, which is directly linked to root function. Time lapse geophysical surveys can be carried out and conductivity can be linked to soil moisture using petrophysical relationships. Hence, geophysically derived changes in soil water content can be linked to root water uptake and then root parameters. However, this link is not straightforward and geophysical methods have their limitations. In this study, we quantify the sensitivity of both ERT and EM to different root distributions of winter wheat. We also estimate how the type of soil influences the geophysical measurements and the conclusions we can draw from them. The results should help us understand what quantitative results can be expected from ERT/EMI and what are their limitations for field-scale root phenotyping.