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# Quasi-3D mapping of soil moisture for agriculture using electric conductivity sensing

**Hira Shaukat**, Ken Flower, and Matthias Leopold
UWA School of Agriculture and Environment, The University of Western Australia, Perth, Australia
(hira.shaukat@research.uwa.edu.au)

Knowledge of real time spatial distribution of soil moisture has great potential to improve yield and profit in agricultural systems. Rapid and precise quantification of water in crop fields is challenging due to the influence of highly variable soil properties such as texture and porosity. Recent advances in non-invasive electromagnetic induction (EMI) techniques have created an opportunity to determine soil moisture content with high-resolution and minimal soil intrusion. So far, EMI has mainly been validated for homogenous soils, which are not common in agriculture. This study from a field site in Western Australia converts time series apparent electrical conductivity data recorded with a Dualem 1Hs EM-meter into spatiotemporal domains. A least square inversion algorithm was used to determine electric conductivities for individual soil layers (0-50cm, 50-80 cm and 80-160 cm) for two EMI surveys at a trial site, with different crop rotations and varying moisture conditions. A laboratory experiment under controlled conditions developed electric conductivity vs volumetric water content relations with power law functions for each layer with $R^2$ values between 0.98 and 0.99. Subsequently, EMI data were converted to volumetric water contents for each layer and predictions were spatially displayed. These EMI soil moisture predictions were compared with neutron moisture meter measurements, with $R^2$ values between 0.95 and 0.74 for the two surveys. The method is robust and offers a comparatively fast method to estimate the soil moisture status in fields and to subsequently make informed management decisions.