Monitoring Soil Moisture and Soil Cracking in Irrigated Fields

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OBJECTIVE

Improving irrigation efficiency by developing an electrical resistivity based method to monitor depth of soil cracking and soil moisture changes in 3D resolution.

BACKGROUND

Cracking soils are prevalent in agricultural irrigation areas in Australia. Not only do soil cracks hamper conventional methods for soil moisture measurement, crack formation also increases the adverse consequences of suboptimal irrigation scheduling.
Accurate moisture measurement and determination of cracking depth is crucial for efficient irrigation management.

METHOD

Borehole resistivity probes were designed and built, resistivity protocols to measure the electrical resistivity between the boreholes were optimised and programmed. The instrumental setup was tested in the lab in a sand and soil filled lysimeter, as well as in the field during two irrigation seasons.

Fig.1a: hand augering holes for resistivity probes Fig.1b: flood irrigation of cracked soil Fig.1c: irrigation water at pump outlet Fig.1d: Resistivity probe before installation in the field Fig.1e: ABEM resistivity meter for electrical resistivity tomography Fig.1f: Tracer application on soil column during resistivity tomography measurements

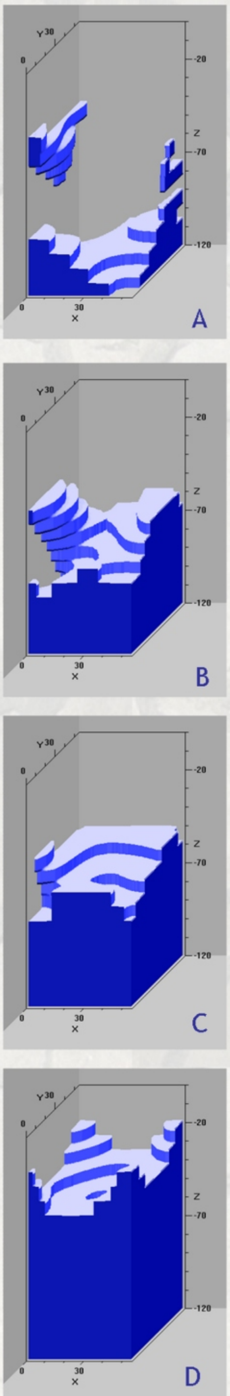

Fig.2a-2d:Time lapse images of a cracked soil during irrigation. The soil cracks provide a pathway for the water, resulting in the profile to be filled from the bottom upwards.

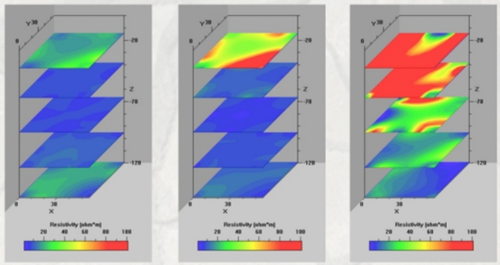

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Fig.3: Soil resistivity at different soil moisture stages in a Sorghum field. Blue indicates moist soil with low resistance to electrical current flow, red indicates dry soil with higher resistance to electrical current flow.

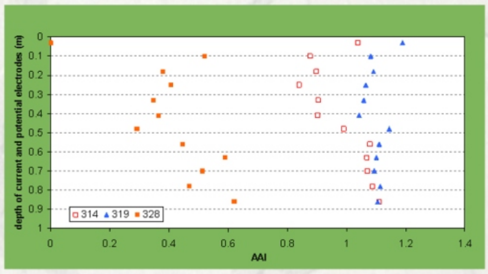

Fig.4: Directional dependence of current flow expressed by the apparent anisotropy index (AAI) for the different moisture stages shown in in fig. 3. The AAI can be used as a measure for cracking depth and crack dynamics. A homogenous soil profile has an AAI of 1, the larger the divergence from 1, the larger the inhomogeneity. Changes in homogeneity can be accounted to crack opening or closing.

IMPLICATIONS

The study will provide knowledge and tools for the farmer and policy maker to sustainably manage irrigation. The present results allow us to monitor qualitative moisture changes with small scale resistivity tomography as well as cracking depth and crack dynamics with the directional dependence of current flow. Presently we are working on calibrating the resistivity-soil moisture relationship to provide quantitative results.

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MORE INFORMATION

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