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Soil moisture dependence of electrical resistivity in soils of a lateric landscape in Western Australia

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Soil moisture changes in the field may be detected by changes in electrical resistivity. To assess the suitability of electrical resistivity measurement as a means of monitoring soil moisture at various scales, this study focuses on soil moisture - electrical resistivity relations obtain at the lab scale for soils from the jarrah forest in Western Australia. A small four-probe resistivity method was used in the laboratory on 21 repacked soils at various water contents. Soil electrical resistivity measured by the four-probe method was related to the volumetric water content by a power function consistent with Archie's law. Water retention was successfully described by the van Genuchten equation. The power parameter of Archie's law was well correlated to van Genuchten's alpha parameter and the residual water content. In the field, water balance assessment at a 100 m scale involved the use of electromagnetic induction (EM38) and electrical resistivity tomography (ERT) measurements during the dry and wet seasons. To assess whether the water content dependence of electrical resistivity is detectable in larger scale field measurements, EM38 and ERT measurements were evaluated by comparing the signal measured at different times during the dry and wet seasons with field data from soil pits. During the wet season, changes in resistivity measured by ERT decreased by 39%, and corresponding moisture changes increased by over 50%. However, ERT results were not closely related to the soil moisture contents suggesting that there may be a scaling problem with the ERT method. EM proved to be a good indicator for soil moisture change in particular for sandy sites, however, EM measurements were affected by electromagnetic susceptibility of the lateritic soils.