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Using electromagnetic conductivity imaging to generate time-lapse soil moisture estimates.

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Irrigated agriculture is crucial to the agricultural productivity of the Moreno valley. To maintain profitability, more will need to be done by irrigators with less water, owing to competing demands from rapidly expanding urbanisation in southern California. In this regard, irrigators need to understand the spatial and temporal variation of soil moisture to discern inefficiencies. However, soil moisture is difficult to measure and monitor, unless a large bank of soil sensors are installed and at various depths in the profile. In order to value add to the limited amount of information, geophysical techniques, such as direct current resisivity (DCR) arrays are used to develop electrical resistivity images (ERI). Whilst successful the approach is time consuming and labour intensive. In this research we describe how equivalent data can be collected using a proximal sensing electromagnetic (EM) induction instrument (i.e. DUALEM-421) and inversion software (EM4Soil) to generate EM conductivity images (EMCI). Figure 1 shows the EMCI generated from DUALEM-421 data acquired at various days of a time-lapse experiment and including; day a) 0, b) 1, c) 2, d) 3, e) 5, f) 7 and g) 11. We calibrate the estimates of true electrical conductivity (sigma – mS/m) with volumetric moisture content and show with good accuracy the spatial and temporal variation of soil moisture status and over 12 day period. The results show clearly that the pivot sprinkler irrigation system is effective at providing sufficient amounts of water to the top 0.5 m of a Lucerne crop (i.e. red shaded areas of high sigma). However, in some places faulty sprinklers are evident owing to the lack of wetting (i.e. blue shaded areas of low sigma). In addition, and over time, our approach shows clearly the effect the Lucerne crop has in drying the soil profile and using the soil moisture.