Observation of hydrologic influences on transient EM-38 response at local and watershed scales

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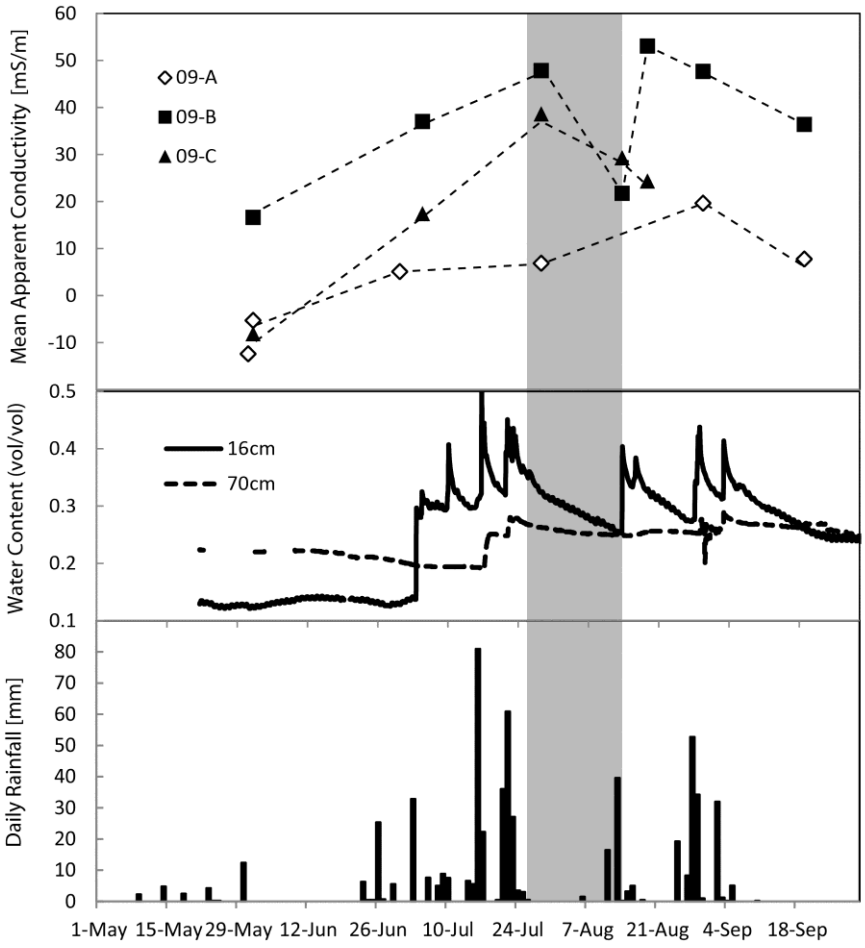
We used electromagnetic induction (EMI) to evaluate whether changes in the apparent electrical conductivity (σ_a) of agricultural fields can be related to hydrologic processes acting over timescales representative of individual storm events and seasonal variations for a watershed located near the village of Salri, Madhya Pradesh, India. We found that seasonal changes in water content are closely related to wetting and drying cycles in the watershed. Importantly, however, we also found that the specific way that apparent conductivity changes through time is dependent on location and is influenced by the distinct hydrologic processes occurring at the survey location. Subsequent studies were conducted for two individual rainfall events to evaluate whether daily changes in apparent conductivity can provide insights into the variability of hydraulic conductivity at the scale of individual agricultural fields. For one of the fields investigated, we found that σ_a and changes in σ_a over time both produced similar spatial patterns with distinct regions that had different hydraulic conductivity values. In contrast, a second field showed that σ_a and changes in σ_a produced significantly different spatial patterns. In this case, changes in σ_a were found to produce a better relationship with hydraulic conductivity in the field than was obtained using σ_a directly. This study shows that transient EMI mapping can be a useful tool for identifying changes in apparent electrical conductivity that are associated with variations in soil hydrology at scales ranging from individual fields to watersheds.



Gross effects of the 2009 monsoonal rainfall on water content observed in field 09-B and the apparent conductivity of field 09-A, 09-B, and 09-C; the three fields are located in distinctly different parts of the watershed. The shaded region indicates a period of no rainfall when the field dried out significantly.