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# Simplified spatiotemporal electromagnetic induction – salinity multi-field calibration

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Salinity-affected farmlands are common in arid and semi-arid regions. To assure long-term sustainability of farming practices in these areas, soil salinity ($EC_e$) should be routinely mapped and monitored. Salinity can be measured through soil sampling directed by geospatial measurements of apparent soil electrical conductivity ($EC_a$). We present a modeling approach that allows calibrating the $EC_a$-$EC_e$ relationship across the same geographical region. The calibration, which is essentially an analysis of covariance (ANOCOVA) between $EC_a$ and $EC_e$, can be extrapolated spatially and temporally to other fields in the same region by employing as few as three additional soil cores per new field/timing. Two case studies for California are presented showing how the ANOCOVA calibration approach can be used in a spatiotemporal framework to map and monitor soil salinity. For the spatial framework, we show an ANOCOVA calibration and (spatially unbiased) cross validation over a regional-scale database from 22 fields where $EC_a$ and $EC_e$ were measured at 267 locations. For the temporal framework, we show a temporal ANOCOVA calibration and (temporally unbiased) cross validation using data from a long-term (1999-2012) monitoring study at a 32.4-ha saline field where $EC_a$ and $EC_e$ were monitored over time at the same 40 locations. Our results suggest that this approach is reliable at low salinity values (i.e., where common crops can grow). The ANOCOVA approach is a significant step towards enabling the routine use of $EC_a$ mobile sensor technology for inexpensive soil salinity monitoring at high spatial and temporal resolutions.