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An Uncertainty Analysis for Predicting Soil Profile Salinity Using EM Induction Data

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Proximal soil sensing techniques such as electromagnetic (EM) induction have been used to identify and map the areal variation of average soil properties. However, soil varies with depth owing to the action of various soil forming factors (e.g., parent material and topography). In this work we collected EM data using an EM38 and EM34 meter along a 22-km transect in the Trangie District, Australia.We jointly inverted these data using EM4Soil software and compare our 2-dimensional model of true electrical conductivity (sigma – mS/m) with depth against measured electrical conductivity of a saturated soil-paste extract (ECe – dS/m) at depth of 0-16 m. Through the use of a linear regression (LR) model and by varying forward modelling algorithms (cumulative function and full solution), inversion algorithms (S1 and S2), and damping factor (lambda) we determined a suitable electromagnetic conductivity image (EMCI) which was optimal when using the full solution, S2 and lambda = 0.6. To evaluate uncertainty of the inversion process and the LR model, we conducted an uncertainty analysis. The distribution of the model misfit shows the largest uncertainty caused by inversion (mostly due to EM34-40) occurs at deeper profiles while the largest uncertainty of the LR model occurs where the soil profile is most saline. These uncertainty maps also illustrate us how the model accuracy can be improved in the future.