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# Estimation of uncertainty in bulk soil electrical conductivity derived by Electrical Resistivity Tomography

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When applying Electrical Resistivity Tomography (ERT) to monitor the bulk soil electrical conductivity, sb, attention must be paid to the different sources of error. Noise is mainly related to systematic errors (such as bad electrode contact) and to random errors (caused by the measurement device), respectively. This noise is considered in the inversion process by means of an appropriate error model. If the noise level is chosen too high, information will be lost and the sb image will be too smooth. If the noise level is underestimated, the data will be overfitted leading to artefacts in the distribution of sb. In this study, we derived the error model from a statistical analysis of "normal" and "reciprocal" ERT measurements, which theoretically should be identical. In order to check the quality of the inversion results, we compared ERT derived distributions of sb with Time Domain Reflectometry (TDR) data. A time series of ERT measurements was inverted, and comparing the results with TDR data revealed a high variability in ERT derived sb time series. To clarify the effect of the measurement error on the uncertainty of ERT derived sb, synthetic datasets were produced and the sb uncertainty was estimated using a Monte Carlo approach. The synthetic ERT datasets were derived using forward simulations in two layered sb profiles, which were based on TDR measurements. One was taken during a dry spell and one after long-lasting rainfall events. Noise was added to the simulated datasets according to a realistic error model and the produced datasets were subsequently inverted. The noise model was based on analyses of the "normal-reciprocal" measurement errors, which were found to be related to the geometry of the electrode pairs. Using the synthetic study, the effect of the different error sources on the uncertainty of ERT derived sb values could be quantified.