Geophysical Research Abstracts, Vol. 7, 00028, 2005
SRef-ID: 1607-7962/gra/EGU05-A-00028

Direct integration of ERT measurements in inverse hydrologic analysis

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As part of an effort to improve interpretation of geophysical methods for hydrologic applications, we examine the optimal use of ERT measurements to characterize one-dimensional infiltration. Standard application of ERT would use independent inversions of ERT measurements to infer water content as a function of location and time. These water content measurements would be used to constrain a hydrologic model. This approach does not make full use of the hydrologic interpretation in inverting the ERT measurements. We develop a coupled hydrologic-ERT model. In our approach, each iteration of the hydrologic model, during inversion, is used to predict the ERT responses through time for the arrays used. These predicted ERT responses are compared with the measurements and the hydraulic properties are adjusted to improve this fit. We show that this approach automatically accounts for the effects of spatially variable electrical conductivities in the sample volume of each ERT measurement, which leads to errors in independent ERT inversions. This translates to improved accuracy of the hydrologic inversion based on the geophysical data.