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Cost-efficient saltwater monitoring of a shallow aquifer using long-electrode ERT

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Saltwater intrusion is a threat to local groundwater resources in coastal regions but it appears increasingly inland as a result of natural or man-made changes in the hydraulic system. ERT is a well suited technique for monitoring saltwater but on a larger, three-dimensional scale significant effort is needed. Our recently finished research project used an approach that utilizes steel-cased boreholes as long electrodes to cover scales of a few hundred metres to kilometres. The effect of the casings is accounted for by the Shunt Electrode Model (SEM). Synthetic studies and sensitivity analyses show that typical intrusions can be resolved if differently long boreholes can be used and target-adapted parameterization and regularization are applied (Ronczka et al., 2015a).
We present monitoring data from a 500x300m sized test field in Eastern Brandenburg. Thirteen boreholes and 6 surface electrodes have been permanently cabled. An optimum array layout was measured every 3 months over a period of 2 years along with in-situ fluid conductivity measurements that enable a conversion of bulk resistivity into fluid salinity. The inversion result of a reference time step agrees well with the geology, with classic 2D ERT data and with the fluid samples that prove the existence of a saltwater body at the bottom of the aquifer. Furthermore, the temporal behaviour of the fluid salinity, i.e. a slight dilution of the intrusion, is reproduced even though the changes are very small (Ronczka et al., 2015b).

References:

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