A collection of Jupyter Notebooks for coupled hydrogeophysical inversion of geophysical monitoring data

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Geophysical monitoring data are increasingly being used for calibration of hydrological models. In a coupled hydrogeophysical inversion approach, the geophysical data are not inverted in a traditional manner. Instead, the geophysical data and realizations of a hydrological model are combined in an optimization process for calibration of the hydrological model parameters. In a coupled approach, this process minimizes the misfit between the observed geophysical data and geophysical data computed from the hydrological realizations using petro-physical relations.

Here, we present a series of flexible Jupyter Notebooks that can be used for coupled hydrogeophysical inversion. A flexible optimization scheme allows the user to combine different geophysical modalities (electric resistivity, TEM, and FEM data) and hydrological modelling software (e.g. HYDRUS, SUTRA, and MODFLOW) in order to adapt the notebooks for calibration of a specific hydrogeophysical problem.

In two examples, we present the calibration of a 1D infiltration problem (see Figure) and a 3D tracer test, where 1D and 3D electric resistivity monitoring data, respectively, have been used to determine the hydraulic conductivity of the models. We use the Jupyter Notebooks to compare different survey setups and the use of other complementary geophysical methods to assess their sensitivity and value in coupled hydrogeophysical inversions.

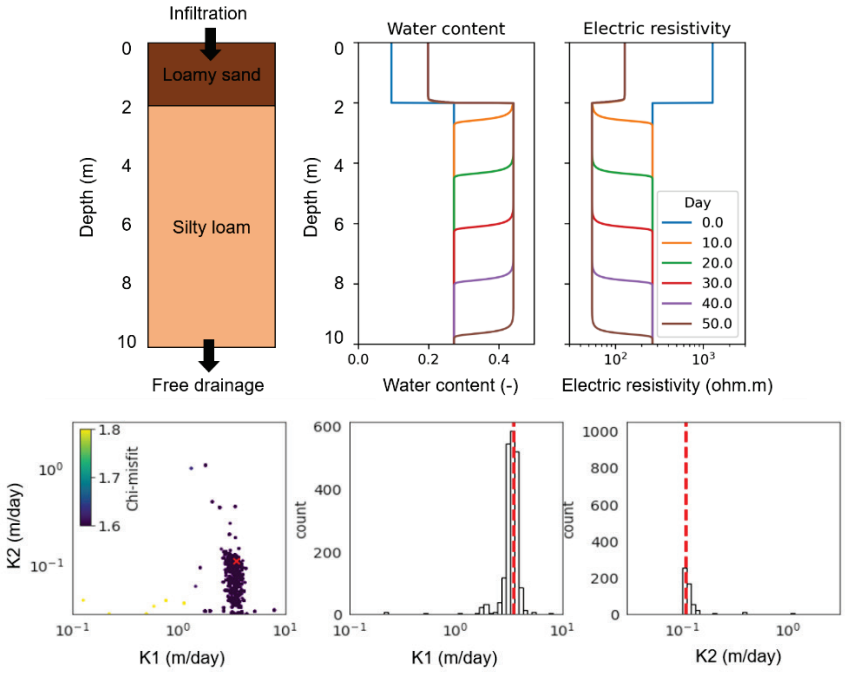

Figure:
Top panel: The two-layer hydrological model of an infiltration experiment, the resulting water content and the equivalent electric resistivity profile.
Bottom panel: calibration results of the hydraulic conductivity in the two layers (K1 and K2) using synthetic 1D resistivity monitoring data. The dashed red line is the true model.