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Estimation of geothermal reservoir properties using the Ensemble Kalman Filter

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Information about the distribution of permeability, temperature, and heat flow in the subsurface are of primary importance for the exploitation of geothermal reservoirs. The Ensemble Kalman Filter is a powerful tool to estimate these properties if temporal observations at a few drill holes in the reservoir are available. These observations can be temperature (BHT), hydraulic head during pumping tests, and chemical concentrations of tracer experiments. The Ensemble Kalman Filter is a recursive Bayesian method based on a Monte Carlo implementation to incorporate observations in an ensemble of reservoir simulations considering the probability of the model state and the likelihood of the observation. Assimilating data forces the simulation of the system to adjust the reservoir properties in the way to the match the data.
Here we demonstrate the application of the EnKF for estimating reservoir permeability for different combinations of observations and number of observation sites in a synthetic test case and apply the method to the tracer experiment of 2005 of the Soultz-sous-Forêts reservoir.