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Mapping regions of equifinality in the parameter space - A method to evaluate inverse estimates and to plan experimental boundary conditions

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Only the combination of physical models and experiments can elucidate the processes of reactive transport in porous media. Column scale percolation experiments offer a great opportunity to identify and quantify processes of reactive transport. In contrast to batch experiments, approximately natural flow dynamics can be realized. However, due to the complexity of interactions and wide range of parameters the experiment can be insensitive to the wanted process and misinterpretation of the results is likely. In the proposed talk we want to show how numerical tools can be applied for thorough planning and evaluation of experiments. The central tool are maps of regions of equifinality, which are gained by a thorough sensitivity analysis of the parameter space. This tool can help on the one hand to plan the experimental boundary conditions such that the results are sensitive to the wanted process. On the other hand, they provide information on the reliability of inversely gained parameters of flow and transport. In the proposed talk we want to show from all three phases of the method. In the first phase the equifinality maps are used to choose an appropriate boundary condition for the experiment. In the second phase, the according column experiments are conducted and simulated inversely. We show break-through curves from such experiments with materials from different soils, sites and materials (Coke oven sites, abandoned industrial sites, destruction debris, municipal waste incineration ash). The columns were subjected to multiple flow interruptions and different flow velocities and parameters of reactive transport were gained in inverse simulations. The third phase consisted of an evaluation of the reliability of the parameters applying again maps of equifinality. Some drawbacks of the model could be identified and gave valuable hints on the actual processes.