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Identification and simulation of contaminant source architecture

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Although contaminant source characteristics are crucial information for predicting subsurface contaminant transport, they are commonly paid too little attention. In absence of better knowledge or sufficient data, strong and unreflected assumptions on contaminant source architecture (CSA), such as geometry, intensity and location, are frequently accepted. Yet, such assumptions may cause severe prediction errors, since CSA dramatically controls downstream mass fluxes, mass release kinetics and source depletion times.

Therefore, this study performs extensive investigations of the uncertainty associated with contaminant source architecture. This work aims to conceptualize source zones as random space functions (RSF) which can be used in common transport models. The prime objectives are to identify the role of CSA in predictions, and CSA inference via stochastic inverse modeling. We choose a geostatistical approach in a Bayesian framework in order to cope with the issue of sparse data. Characteristics of CSA are inferred from all available downstream measurements of contaminant concentrations via stochastic inversion, using a reverse random walk particle tracking (RRWPT) approach. Thus we can update an a priori believe of CSAs by the likelihood of observed data.

With improved knowledge of CSA, better estimates and confidence intervals of contaminant mass flux, total mass, and source depletion times will be possible. In the current presentation we lay out the theory for inferring CSA via Bayesian updating, present an efficient reverse-inverse methodology and provide results from a series of synthetic test cases.