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Hydrogeological model selection with complex spatial priors

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We aim to rank conceptual models describing aquifer heterogeneity. As a test case, we consider a small-scale tracer test at the heterogeneous Macrodispersion Experiment (MADE) site in Mississippi (USA). Initially, we consider (i) widely used but not always sufficiently adequate multi-Gaussian models and (ii) geologically more realistic models built from complex spatial priors using training images and concepts from multiple point statistics (MPS). The evidence and subsequent Bayes factors used for model selection are derived using the thermodynamic integration method with an underlying Markov chain Monte Carlo (MCMC) inversion based on a sequential Gibbs algorithm. Thermodynamic integration has the advantage over most other MCMC-based methods for Bayesian model selection of working together with MPS-based inversion approaches. The flow and transport simulations are presently 2-D, but future work will account for modeling errors caused by the 2-D approximation.