Large-scale stochastic optimization using non-stationary geostatistics for uncertainty assessment of groundwater flow and solute transport, in the framework of a near surface radioactive waste disposal

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Uncertainty quantification is very much needed to support decision making related to *e.g.* environmental impact assessment for waste disposal sites. A probabilistic result provides a much stronger basis for decision making compared to a single deterministic outcome. Accurate posterior exploration of high-dimensional and CPU-intensive models, which are often used for environmental impact assessment, is however a challenging task. To quantify the uncertainty associated with solute transport in the framework of a near surface radioactive waste disposal in Mol/Dessel, Belgium, we investigate combining the adaptive Metropolis (AM) McMC algorithm for updating the global model parameters, and adaptive spatial resampling (ASR) for updating of the spatially distributed model parameters, by block sampling. The forward model used is a groundwater flow model conditioned on borehole and direct push data, that accounts for non-stationary heterogeneity in hydraulic conductivity. The obtained flow solutions are used for solute transport simulations, and the results are compared with a different groundwater flow model parameterization, that makes use of homogeneous hydrogeological layers. Moreover, a number of simulations is performed to assess the effect of realistic dispersivity, which is derived from outcrop investigations. The obtained results indicate that the combination of AM and ASR using block sampling seems not to be very efficient for McMC sampling with the forward model used in this study. However, using the algorithm in optimization mode seems to work fine, and provides an alternate way for exploring the parameter space and the prediction uncertainty.