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New method for uncertainty analysis of computationally expensive models with application to groundwater contamination

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We present a new method for uncertainty analysis for computationally expensive environmental models and compare the results to the widely used method GLUE. The goal for both methods is to characterize the uncertainty in model predictions based on the uncertainty in model parameter values. Numerical results for both methods are applied to a complex model of engineered bioremediation of chlorinated ethenes in groundwater. The new method utilizes a new global optimization method for computationally expensive functions that uses radial basis functions to create a function approximation of the expensive simulation model. A cell declustering algorithm is used to remove the bias in the sampling of the function approximation optimization in order to obtain a good uncertainty estimate. The results show that the new method obtains more acceptable (behavioral) samples in 200 simulation evaluations than GLUE obtains in 2000 simulation evaluations for some cases. Given that the simulation times for expensive models can takes hours for one run, these differences are very significant.