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Confidence interval estimation of hydraulic heads based on a simple stochastic model and geologic interpretations

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While several studies have focused on the statistical description of heterogeneity in geologic formations, its effect on the distribution of the absolute error in hydraulic head estimates at unobserved locations has received less attention. In this study, we use a pulse-based stochastic model to study how the scale of observed spatial heterogeneities in geologic formations and their intensity, affect the distribution of the absolute error of the estimated hydraulic heads. We do so for one dimensional confined aquifers, and study how the corresponding distributions depend on the standardized distance from the nearest measuring points, and several properly standardized large-scale characteristics of the aquifer. The latter can be inferred based on semi-quantitative interpretations from geologic maps. The obtained results show that the resulting distributions can encompass structural dependencies originating from different spatial scales, while exhibiting characteristics (bounds, multi-modal features etc.) that can be explained using simple geometric arguments. The obtained results are promising, pointing towards the direction of establishing design criteria based on large-scale geologic maps. Possible extensions of the presented analysis in two dimensions are also discussed.