UNCERTAINTY QUANTIFICATION: A CASE STUDY

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Geological studies of the groundwater system at the Columbus Air Force Base revealed that the system consists of several distinct facies, whose geometries and hydraulic properties are both uncertain. Modeling these two sources of uncertainty as separate random processes operating on two distinct scales provides a natural framework for quantifying predictive uncertainty of system states such as hydraulic heads and fluxes. Uncertainty is conveniently described by the corresponding second moments, i.e., (co)variances of the random system states. Our composite media theory allows us to investigate the relative importance of the two sources of uncertainty for uncertainty quantification. Our results make it clear that large-scale block variability can have a significant impact on predictive uncertainty. We compare the complete composite medium model to a widely used homogeneous approximation, which ignores large-scale heterogeneity entirely. Not surprisingly, accounting for structural data (e.g., soft geophysical information about internal geometry structure) reduces uncertainty in our predictions of hydraulic heads and fluxes.