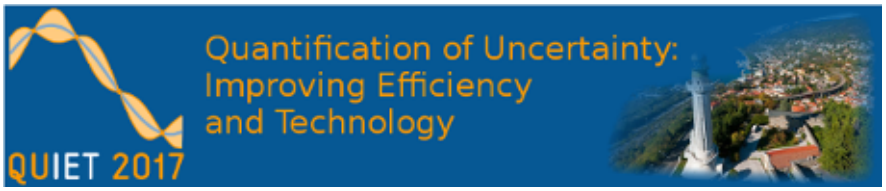

It's Really Dark Down There: UQ in Groundwater Hydrology

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In this talk I will briefly survey the history of UQ in groundwater hydrology, review some current methods for carrying it out, and identify research opportunities for applied mathematicians. Uncertainty about the states of groundwater systems arises primarily from lack of knowledge of system parameters, which in turn is usually due to the combined effects of sparse sampling and the high degrees of heterogeneity found on multiple scales. Since the most common UQ models used to resolve uncertainty in groundwater hydrology are based on stochastic partial differential equations (SPDEs) in some way, I will focus my review on SPDE methods ranging from naive Monte Carlo simulations of large parameter systems to direct estimates of the forms of probability density function of system states. I will also survey models of reduced complexity like continuous time random walks and other Markov-type models based on SPDEs. Topics will include stochastic representations of uncertain distributions of system parameters in space and time, methods to reduce uncertainty about the specific forms of models, and the so-called "scaling problem" that arises mostly from the mismatch in scales of measurements (the laboratory and field) and scales of application (aquifers and regions). The need for UQ will be motivated by the effects of anomalous transport of groundwater contaminants and their potential impacts on human health.