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Assessing the Risks to Human Health in Heterogeneous Aquifers under Uncertainty

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Reliable quantification of human health risk from toxic chemicals present in groundwater is a challenging task. The main difficulty relies on the fact that many of the components that constitute human health risk assessment are uncertain and requires interdisciplinary knowledge. Understanding the impact from each of these components in risk estimation can provide guidance for decision makers to manage contaminated sites and best allocate resources towards minimal prediction uncertainty. This presentation will focus on the impact of aquifer heterogeneity in human health risk. Spatial heterogeneity of the hydrogeological properties can lead to the formation of preferential flow channels which control the plume spreading rates and travel time statistics, both which are critical in assessing the risk level. By making use of an integrated hydrogeological-health stochastic framework, the significance of characteristic length scales (e.g. characterizing flow, transport and sampling devices) in both controlling the uncertainty of health risk and determining data needs is highlighted. Through a series of examples, we show how fundamental knowledge on the main physical mechanisms affecting solute pathways are necessary to understand the human health response to varying drivers.