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Analysis of the joint impact of dose-response models and permeability heterogeneity on aquifer resilience loss due to Bisphenol A contamination

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In this work, we investigate the interplay between dose-response models and permeability heterogeneity on the resilience of an aquifer contaminated with emerging contaminants under uncertainty. We focus our attention to Bisphenol A (BPA) in groundwater which is known to cause endocrine-related effects on humans. Health risks are computed through two distinct BPA dose-response models. The first one is a non-monotonic dose-response (NMDR) model while the second one is a monotonic dose-response (MDR) model. Through the use of a Monte Carlo numerical framework, we simulate transport of BPA from a source to an environmentally sensitive target in a three-dimensional aquifer. Results indicate the importance of considering both hydrological and toxicological information in water resources management. The magnitude and the uncertainty associated with the resilience loss are strongly impacted by the functional shape of the dose-response model and the level of heterogeneity. Further analysis indicates that the role of the ratio of the volumetric flow rate passing through the source zone to the ambient groundwater flow rate in controlling the aquifer resilience loss.