Quantifying the Influence of Scaling Metrics and Hydrogeological Data in the Statistical Characterization of Model Predictions in Well-Catchment Regions

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In this work, we evaluate the value of hydrogeological information on the assessment of the risk of contamination of a pumping well operating in a heterogeneous aquifer. Our aim is to statistically characterize the mass fraction of the contaminant recovered at the well and its corresponding arrival time. We do so by investigating the role of the key length scales that characterize and control the well region of influence and its probabilistic delineation with respect to the contaminant source location. The impact of augmenting hydrogeological data on the reduction of uncertainty associated with the environmental scenario is also analyzed. Results show that the way of obtaining a robust characterization of the target predictions depends on the length scale considered. For the sampling scheme considered in our simulations, the relevance of conditioning on the probability distributions of the solute mass fraction recovered at the well and the associated travel times is affected by the location of the contaminant source zone within the probabilistic well catchment. With respect to the statistical characterization of the travel time associated with the recovery of a given mass fraction, the worth of augmenting the hydrogeological data tends to diminish with decreasing solute residence time within the well catchment.