

EGU24-6157, updated on 20 May 2024

<https://doi.org/10.5194/egusphere-egu24-6157>

EGU General Assembly 2024

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Analyzing Groundwater Hazards with Sequential Monte Carlo

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Analyzing groundwater hazards frequently involves utilizing Bayesian inversions and estimating probabilities associated with rare events. A concrete example concerns the potential contamination of an aquifer, a process influenced by the unknown hydraulic properties of the subsurface. In this context, the emphasis shifts from the posterior distribution of model parameters to the distribution of a particular quantity of interest dependent on these parameters. To tackle the methodological hurdles at hand, we propose a Sequential Monte Carlo approach in two stages. The initial phase involves generating particles to approximate the posterior distribution, while the subsequent phase utilizes subset sampling techniques to evaluate the probability of the specific rare event of interest. Exploring a two-dimensional flow and transport example, we demonstrate the efficiency and accuracy of the developed PostRisk-SMC method in estimating rare event probabilities associated with groundwater hazards.