Assimilation of recovered contaminant mass measurements to support the management of remediation systems under uncertain hydraulic conductivity and plume distributions

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Abstract. Combined simulation-optimization models may be used to assist the design of cost optimal and effective pump-and-treat (PAT) remediation systems. Since this process is typically carried out in an environment of uncertainties, the ability to determine cleanup policies that are cost optimal and reliable at the same time is in fact limited.
In this work, an optimization framework for assisting the adaptive management of PAT remediation systems is presented. The hydraulic conductivity distribution and the dissolved contaminant plume location are considered as the major sources of uncertainty. The framework stems from the subdivision of the remedial horizon in a sequence of stress periods over which the pumping policy is dynamically adjusted based on new data collected during the cleanup operations. In particular, measurements of the cumulative contaminant mass extracted from the installed recovery wells are here assimilated to generate conditional realizations of the hydraulic conductivity field, which, in turn, are used to probabilistically delineate the initial plume distribution. Based on this improved representation of the plume location, the design of the PAT system is thus modified for the remainder of the remedial process.
This study indicates that measurements of integrated contaminant mass may retain valuable information about the plume location and the spatial heterogeneity characterizing the hydraulic conductivity field when more recovery wells are available. On the other hand, such information proves quite soft, particularly in the instances where recovery wells are installed in regions with low contaminant concentration.

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