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Reducing uncertainty of modeled results in aquifers and in low permeability layers by co-conditional stochastic simulations

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Stochastic simulation of aquifer heterogeneity is useful in order to provide a confidence interval of the modeled results for flow and solute transport problems. The few available measurements of the main parameters (hard data) can be supplemented by several secondary properties of the media as indirect data (soft data). Within the stochastic simulation, the additional conditioning obtained from the use of these secondary data allows to reduce the uncertainty of the results.

Examples of application are given considering both kinds of media. In aquifers, most of the solute spreading is governed by the hydraulic conductivity (K) spatial variability, which is generally considered as the main uncertain parameter. In very low permeability media, diffusion can be considered as the dominant transport mechanism, so that the diffusion parameters can be considered as influencing mainly the uncertainty of the results.

In aquifers, a stochastic approach integrating hydraulic conductivity measurements (hard data), head observations and shallow electrical resistivity tomography (soft data) is discussed in terms of uncertainty of computed well capture zones.

In low permeability layers, stochastic sequential simulations are proposed involving diffusion parameters as ‘hard data’, and hydraulic conductivity, grain size measurements, electrical resistivity log, gamma ray log and a description of the lithology variation as ‘soft data’. Results are discussed in terms of 1D vertical output solute transport fluxes at the boundaries of a clay layer, from a given contamination source

located within the layer.

The heterogeneity is probably always more complex than assumed by stochastic variations based on measurements of a single parameter. Additional conditioning obtained by the use of various secondary data improves the confidence of model results.