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Quantitative evaluation of macroscopic longitudinal dispersivity for one-dimensional flow

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Abstract Macroscopic dispersivity is the most important factor for analysing the convection–dispersion equation (CDE) at the field scale, and it is well known that macroscopic dispersivities vary with the scale of observation. In this study, artificial heterogeneous hydraulic conductivity fields were generated with the stochastic fractal model ($f^{\square}$ model). Macroscopic dispersivities were evaluated for two-dimensional stochastic isotropic and anisotropic fields by performing dimensionless CDE simulations. The results showed that macroscopic dispersivity depends on the length of the contaminant source and the travel distances, as well as on field characteristics such as variability of hydraulic conductivity for one-dimensional flow. We proposed simple models for quantitatively evaluating the average values of macroscopic longitudinal dispersivity by performing two-dimensional numerical experiments. Further, we showed that macroscopic longitudinal dispersivities calculated by these models generally corresponded with that obtained from the field study.

Key words macroscopic longitudinal dispersivity; stochastic fractal model; groundwater