



Contribution ID: 281

Type: Oral Presentation

Effect of the connectivity of alluvial aquifers on groundwater flow and solute transport

Tuesday, 31 May 2022 11:45 (15 minutes)

The assumption that the heterogeneity of aquifers can be described with multilog-Gaussian distributions has been widely used (Law, 1944). However, the multilog-Gaussian assumption is inappropriate in alluvial aquifers (Zinn and Harvey, 2003). Alluvial aquifers, such as fluvial sediments containing paleochannels, present structures composed of interconnected bodies (Tidwell and Wilson, 1999). Alluvial aquifers can be described with binary distributions (Zinn and Harvey, 2003). Many authors have argued that the connectivity of alluvial aquifers is more important than the values of permeability K (Zappa et al., 2006). The connectivity of alluvial aquifers induces a channeling leading to significant increase in average flow rates and even more significant reduction of contaminant first arrival times (Molinari et al., 2019). Few works have performed three-dimensional detailed numerical simulations of groundwater flow and solute transport in binary distributions. In 2017, Jankovic et al. choose to study the effective permeability, the plume mean velocity, the BTC and the mass flux in multiLog-Gaussian, connected and disconnected K -fields introduced by Zinn and Harvey in 2003 (Jankovic et al., 2017). The bulk of the BTC was predicted quite accurately by the solution of the advection dispersion equation based on the first order approximation. In this work, the asymptotic value of the longitudinal dispersivity α_L is numerically estimated in three-dimensional multiLog-Gaussian, connected, intermediate and disconnected, K -fields from Monte Carlo parallel numerical simulations in advection-diffusion cases with a Peclet number $Pe = \langle u \rangle l_c / d_m = 100$ where $\langle u \rangle$ is the mean flow velocity, l_c is the correlation length of K -fields and d_m is the diffusion coefficient. The following figure shows that the evolution of α_L with respect to the deviation $p-p_c$ presents a mountainous form in all the tested cases. p and p_c are the volume fraction of low conductivity zones and the percolation threshold, respectively. The maximum value of α_L is obtained just after the percolation threshold p_c . A detailed analysis will be performed by comparing the numerical results with the first order approximation and the percolation theory (Sahimi et al., 1986 ; Rubin, 1995).

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Country

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Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

Online

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Session Classification: MS08

Track Classification: (MS08) Mixing, dispersion and reaction processes across scales in heterogeneous and fractured media