Geophysical Research Abstracts
Vol. 19, EGU2017-3368-1, 2017
EGU General Assembly 2017

The stochastic dynamics of intermittent porescale particle motion

Marco Dentz (1), Veronica Morales (2), Alexandre Puyguiraud (1,3), Philippe Gouze (3), Matthias Willmann (4), and Markus Holzner (4)

(1) Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Spanish National Research Council (CSIC), Barcelona, Spain (marco.dentz@csic.es), (2) Department of Civil and Environmental Engineering, University of California Davis, (3) Geoscience Montpellier, Université de Montpellier, Montpellier, France, (4) Institute of Environmental Engineering, ETH Zurich, Zurich, Switzerland

Numerical and experimental data for porescale particle dynamics show intermittent patterns in Lagrangian velocities and accelerations, which manifest in long time intervals of low and short durations of high velocities [1, 2]. This phenomenon is due to the spatial persistence of particle velocities on characteristic heterogeneity length scales. In order to systematically quantify these behaviors and extract the stochastic dynamics of particle motion, we focus on the analysis of Lagrangian velocities sampled equidistantly along trajectories [3]. This method removes the intermittency observed under isochrone sampling. The space-Lagrangian velocity series can be quantified by a Markov process that is continuous in distance along streamline. It is fully parameterized in terms of the flux-weighted Eulerian velocity PDF and the characteristic pore-length. The resulting stochastic particle motion describes a continuous time random walk (CTRW). This approach allows for the process based interpretation of experimental and numerical porescale velocity, acceleration and displacement data. It provides a framework for the characterization and upscaling of particle transport and dispersion from the pore to the Darcy-scale based on the medium geometry and Eulerian flow attributes.

[1] P. De Anna, T. Le Borgne, M. Dentz, A.M. Tartakovsky, D. Bolster, and P. Davy, “Flow intermittency, dispersion, and correlated continuous time random walks in porous media,” Phys. Rev. Lett. 110, 184502 (2013).
[2] M. Holzner, V. L. Morales, M. Willmann, and M. Dentz, “Intermittent Lagrangian velocities and accelerations in three- dimensional porous medium flow,” Phys. Rev. E 92, 013015 (2015).
[3] M. Dentz, P. K. Kang, A. Comolli, T. Le Borgne, and D. R. Lester, “Continuous time random walks for the evolution of Lagrangian velocities,” Phys. Rev. Fluids (2016).