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Fractional Model for Solute Spreading in Randomly Heterogeneous Porous Media

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Classical experimental results show that spreading of passive tracers in very heterogeneous soils does not always obey Fourier's law. A fractional partial differential equation is proposed for spreading of matter in a saturated porous medium, starting from precise hypotheses concerning the medium itself. Solute is assumed to spread according to Fick's law in intertwisted tubes whose slope and cross-section are randomly distributed. Then, the averaged concentration evolves according to a modified heat equation, including a non local operator which is a time derivative of fractional order, combined with a space derivative. The fundamental solution of the fractional equation has a second moment which is not proportional to time.

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