Ben-Gurion University of the Negev
Blaustein Institutes for Desert Research
The Swiss Institute for Dryland Environmental and Energy Research
Alexandre Yersin Department of Solar Energy and Environmental Physics

Title:

Modeling porous media hydrodynamics at different spatial scales

Speaker:

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Abstract:

Spatial averaging over a Representative Elementary Volume (REV) of intensive quantities product leads to concurrent PDE's, describing macroscopic balance equations of the phase extensive quantity at the REV spatial scale and the one associated with the deviation from that extensive quantity at a much smaller scale. The hydrodynamic characteristics at the smaller scale are governed by pure hyperbolic PDE's (Sorek et al. (2005); Sorek et al. (2010); Sorek and Ohana, 2015). Field observations of condensed colloidal parcels motion (Ronen et al., 1992) under natural gradient flow validate the suggestion of hyperbolic PDE's addressing the fluid momentum and components mass balance at the smaller spatial scale.

At the REV scale, Sorek et al. (2005) obtain extended forms of the macroscopic Navier-Stokes (NS) equation. These can vary from inertia fluxes in the form of a nonlinear wave equation, Forchheimer's law expressing the microscopic NS fluid inertia transmitted to the solid matrix through the solid-fluid interface (Sorek et al. (1992);Sorek et al. (1992);Levy et al (1995);Levy et al., (1999)), or conform to Darcy's law when friction at that interface is dominant.

Controlled experiments supplemented by numerical predication of the primary and secondary macroscopic balance PDEs are needed to study the hydrodynamic interrelation between these two adjacent spatial scales.

References

Levy, A., et al. (1995), Transport in Porous Media, 21, 241-268, 1995.
Levy, A. et al. (1999), J. MultiPhase Flow, 25, 683-704, 1999.
Ronen, D. et al. (1992), Water Resources Research, 28, 1279-1291, 1992.
Sorek, S. et al. (1992), Transport in Porous Media, 9, 3-13, 1992.
Sorek, S. et al. (2005), Transport in Porous Media, 61, 215-233, 2005.
Sorek, S. et al. (2010), Transport in Porous Media, 81, 1, 61-72, 2010.
Sorek, S. and Ohana, Y. (2015), Austin J Hydrol., 2, 1, 1-9, 2015.

Tuesday, November 1, 2016, 11:00
Lecture room, Physics Building (ground floor)