Geophysical Research Abstracts
Vol. 13, EGU2011-1992, 2011
EGU General Assembly 2011

An Empirical Equation for Effective Conductivity

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We discuss a new approach to scaling up hydraulic conductivity in highly heterogeneous porous media. The media are composed of multiple disjoint volumes of different materials at intermediate scales, and we seek an effective conductivity for the whole domain. The method results in an empirical equation for approximating effective conductivity at large scales on the basis of the geometry, topology and material properties of the different included volumes. The up-scaling methodology depends on a non-Darcian representation of flow at small scales that is of interest in its own right. After posing the problem in terms of the random composite domain model of heterogeneity, we will discuss the non-Darcian representation of flow and give some computational examples of typical flow fields. Then we will derive the up-scaling equation empirically and analyze some preliminary results.