Geophysical Research Abstracts
Vol. 13, EGU2011-4220, 2011
EGU General Assembly 2011

Data needs for identification of more realistic parameterisations of hillslope hydrology and transport at different scales.

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The scale-dependent parameterisation of the complex processes of hillslope hydrology has been described as the "Holy Grail" of hydrological science (Beven, HESS, 2009). It is fundamental to providing better models, or closure schemes for models, of hydrograph responses and non-stationary residence time distributions. Such a parameterisation would need to reflect the expected difference in hillslope water velocities and celerities, the effects of soil heterogeneities and preferential flows, the effects of vegetation on both the pattern of inputs and extraction from storage. Such effects are expected to lead to hysteresis in the storage-discharge relationship that will vary with antecedent conditions and the length scale and form of the hillslope. In this work, these relationships are explored using the random particle tracking formulation of the Multiple Interacting Pathways (MIPs) model that allows for the complexities of hillslope processes in a straightforward way. The data required to identify the non-stationary characteristics of hillslope scale parameterisations are explored using an emulator of the detailed simulations.