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From local understanding to continuous parameter fields using concepts of hydropedology

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Soils are a critical key to understand water an matter fluxes in terrestrial systems. The hydraulic properties of soils especially within the first few decimeters below the soil surface are decisive for the partitioning of precipitation water into various components as storage, surface runoff, interflow, fast infiltration and slow seepage.
Generally, soil hydraulic properties and their spatial structure determine the residence time of water and dissolved solutes within the highly reactive top soils and herewith they also determine the amount of water available for plants and the chance of nutrients and also harmful substances to be recycled or decomposed instead of being flushed to surface waters or groundwater.

The notorious problem for modeling and predicting these processes is the omnipresent spatial heterogeneity of the material across many scales. At the scale of pedons an effective one-dimensional modeling approach is required including phenomena of non-equilibrium (i.e. preferential flow, dynamic wettability and hysteresis) which are the consequence of some sub-scale heterogeneity.
At the scale of hillslopes and beyond it is as well the structure of material properties at the sub-sacle, the spatial pattern of functional types of pedons, which determines the effective behavior.

In this contribution the potential of combining pedological knowledge about soil forming factors (like landscape morphology, parent material) with imaging techniques at various scales (tomography, geophysics, remote sensing) is discussed to come up with a realistic estimation of sub-scale heterogeneities at both, the peon scale and the landscape. This is suggested to be the key to derive the required model parameters which typically cannot be measured directly. This approach has started to sail under the flag of "hydropedology".