Call for Papers

Journal of Hydrology Special issue on ***Soil Architecture and Preferential Flow across Scales***

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I. Publication Timeline

- Deadline for submission of manuscripts: **May 1, 2009**
- Deadline for review process and paper selection: June 30, 2009
- Deadline for submission of final manuscripts: August 30, 2009
- Publication of the special issue: December 2009 (or Jan.-Feb. 2010)

II. Synopsis

Revolutionaries in science often root in the understanding of fundamental structure of natural systems (e.g., DNA for biology, atoms for physics, and elements for chemistry). The same is true for the study of soils and landscapes (e.g., molecular structure for water properties, mineral structure for clay behaviors, and landforms for geomorphic processes). A new era of soils research needs to be "structure-oriented," passing the stage of "texture-focused." While considerable knowledge on soil structure has been amassed over decades, a comprehensive theory and an effective means of quantifying soil structure across scales is still lacking. To propel the field forward and out of the stagnation, thinking outside "the box" is needed to embrace the broadest sense of soil structure (termed "soil architecture," reflecting hierarchical levels of soil structural complexity from the molecular level to the landscape scale) and to encompass pedality (aggregation), pore space (networks of openings), and their interfaces (including surface features of peds and various macropore-matrix like interfaces) and biological modifying factors (e.g., roots and worm holes). We also need to go beyond the traditional scale of soil aggregates to include soil profile architecture (e.g., water-restricting soil horizons) and landscape architecture (e.g., landforms and stratigraphy), especially in view of the growing interests in landscape and watershed processes. To represent soil architecture in a manner that can be coupled into models of flow, scaling, and rate processes, noninvasive quantification (e.g., computing tomography and geophysical tools) and continuous mapping (e.g., spectroscopy and remote sensing) of soil architectural patterns across multiple scales are essential. Such advances would allow more realistic and integrated studies of physical, chemical, biological, and anthropogenic forcing on soils in the landscape context. In addition, interfaces are among the critical controls in understanding the landscape-soil-water-ecosystem dynamics, including macropore-matrix interface, soil horizon interface, ped interface, water-air interface, soil-root interface, microbe-aggregate interface, soil-bedrock interface, soil-atmosphere interface, and soil-water table interface. Such interfaces are often triggers of various preferential flows and are linked to the validity of upscaling or downscaling.

On the other hand, numerous studies over the past decades have demonstrated that preferential flow can occur in just about any natural soils and hillslopes. However, continued neglect or inadequacy in addressing preferential flow in field soils and landscapes remain a challenge in soil science and hydrology communities. Many studies have demonstrated that preferential flow severely limits the applicability of standard models for flow and transport that are mostly based on homogeneous domain theory (such as the Richards' equation and the convection-dispersion equation). Among the challenged assumptions is a big unknown: the boundary conditions or the flow configuration. A possible paradigm shift from a "continuum" based approach to a "networked and hierarchical structure" may be needed for better understanding, modeling, and predicting flow and transport in field soils and landscapes. Traditionally, hydrologic processes are generally conceptualized within the field domain (e.g., the Navier-Stokes' equation and the Darcy's law). Classical hydrology and soil physics have applied findings from fluid mechanics, together with the necessary constitutive relations to develop sets of governing equations, much the same as atmospheric and ocean sciences have done. However, heterogeneities in porous geomedia, hierarchical structures of soils, surface roughness and vegetative covers, and channel geometries make the land surface and subsurface different from the continuous field assumption. Arguably, field vs. object distinction would provide a useful framework for further debates on flow dynamics in the real-world subsurface. It becomes increasingly apparent that solid earth is not a continuous fluid; rather, it poses hierarchical heterogeneities with discrete flow networks embedded in both the surface and the subsurface. Complex networks in the subsurface and preferential flow dynamics in the variably-saturated soil zone pose a number of challenges to the *status quo*. For example, how do subsurface network structures translate climatic forcing, through its nonlinear responses and feedbacks, to watershed outputs (including water quantity and quality)? The answer to this question will depend on our adequate understanding of subsurface network structure's formation, evolution, and function.

This special issue calls for discussions and demonstrations of the above points using various examples. Of particular interest are the quantification of natural soil architecture and preferential flow across space and time, as well as their quantitative relationships. We invite original contributions to the following topical areas, broadly defined:

- Conceptualization and representation of soil structure/architecture across scales
- Quantification and modeling of soil structure/architecture across scales
- Genesis/formation and dynamics/evolution of soil structure/architecture across scales
- Quantitative relationships between soil structure/architecture and degree/likelihood of preferential flow
- Types of preferential flow (including water, chemicals, gases, microbes, organics, and solids/erosion) in different structured (aggregated, macroporous, fractured, or layered) natural soils, hillslopes, and watersheds
- Mechanisms, indices, and quantification of preferential flow in real-world soils across scales
- Conceptualization, modeling, and prediction of preferential flow velocity, pathways, and patterns at different scales
- Advanced techniques for visualizing, mapping, or monitoring soil structure/architecture and preferential flow in the lab or in the field
- Detection, modeling, and prediction of subsurface flow networks
- Perspectives and future directions in advancing the studies of soil structure/architecture and preferential flow across spatial-temporal scales

The special issue is open to all researchers. Interested researchers are welcome to contact the guest editors if they are interested in submitting a manuscript. **All submissions will be subject to the standard *Journal of Hydrology* peer review processes.**

There is a good possibility that this special issue may be spun off into a book. The special issue is expected to stimulate new research developments and to promote interdisciplinary studies including the emerging fields of hydropedology and ecohydrology.