EV07

Pedostructure and Pedoclimate: New Concepts in Soil Water Physics Leading Hydrostructural Pedology at the Heart of Agri-Environmental Disciplines

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Bridging the gap between the local scale of processes in soils and the mesoscopic field, watershed or ecosystem levels of description, becomes a major challenge nowadays particularly in addressing the questions of transdisciplinarity, transfer of scales, local to global change assessment, and empirical against physically-based characterization.

Hydrostructural Pedology recently proposed by Braudeau and Mohtar [2009], bridges the gap "between" Pedology and soil-water physics, combining the morphological and mineralogical description of soil organizations and their hydro-structural properties at different functional scale levels of the soil medium; distinctly different from hydropedology that deals with water at the soil surface and soil mapping. The new paradigm allows for a thermodynamic characterization of the structured soil medium with respect to soil water content, then for modeling the pedoclimate dynamic that is needed by all disciplinary models of the agro-environmental sciences today.

This approach has led to the development of a physically based computer model, Kamel® [2011], modeling and characterizing the pedon and its hydrostructural functioning at every scale of organization (primary peds, pedostructure, horizon, pedon, and primary soil map unit). This allows for i) a functional typology of pedostructures, then of soil mapping units that can be simulated in their hydrostructural dynamic according to the external climatic conditions ii) the dynamic and physical coupling of biological and geochemical soil processes with pedostructure and pedoclimate dynamics at depth in soil (related to external climate conditions), and iii) the physically-based transfer of information from the internal local scale of soil processes in soil to the external scale at soil surface.

We present this new discipline, Hydrostructural Pedology, focusing on the systemic and thermodynamic approaches of soil organization which is at the basis of its irreplaceable role in the biophysical multi-scale modeling of farming, ecological or environmental systems. Therefore, we think that mandate and missions of QEERI would be fulfilled with the creation of a specific laboratory dedicated to soils according to this new paradigm, for that they can be characterized and modeled like physical and organized media for biological life, and thus, be non empirically coupled with models of other environmental disciplines.