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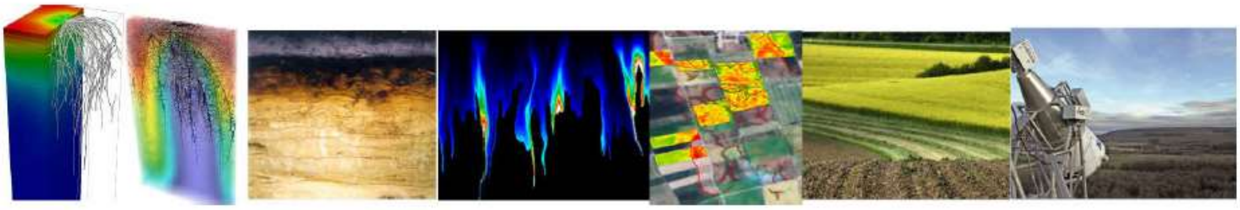

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A HETEROGENEOUS, 3D, MULTISCALE REPRESENTATION OF THE SOIL ARCHITECTURE TO MODEL MICROBIAL AND FAUNAL PROCESSES

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Biological and physical soil processes show a high degree of interactions across scales. For example, earthworm bioturbation at the soil profile scale acts on the abiotic conditions controlling microbial organic degradation at the pore scale. Bioturbation also influences the general characteristics of the profile like total organic matter content or water conductivity. Technically, Multi-Agents Systems (MAS) are particularly pertinent to reproduce global behavior by modeling autonomous system elements at a micro-level spatial scale. In a MAS paradigm, the soil architecture is considered as the environment with and in which biological and physical agents interact. By architecture, we consider here the spatial repartition of the soil's constituents like pores, minerals, or organic matters. The APSF (Agent Pore Solid Fractal) is a MAS environment that represents a heterogeneous, three-dimensional, and multiscale soil architecture at the profile extent. The APSF has been developed as an efficient and low-computation-cost spatial representation which is mass-balanced for the different considered soil fractions (e.g. mineral size fraction, organic fraction, pore volume). The APSF has been successfully used to simulate earthworm bioturbation and organic matter degradation by microbes in MAS, i.e. within the Sworm and Mior models as well as their coupling. However, the coherence of the APSF in term of pore and aggregate distribution, topology, or connectivity has not been yet assessed whereas their characteristics are crucial in biological and physical soil processes. The aim of this communication is to evaluate the ability of the APSF to realistically represent soil architecture by defining a method of sensitivity analysis to explore the effect of different input parameters on pore and solid spatial distribution. In the APSF, the spatial environment is described as a hierarchy of cubic voxels. For each hierarchical level, the spatial repartition of the different soil components (mineral matter, organic matter, pore) results from the replication of a unique pattern of voxels in a pseudo-fractal mode. The APSF input parameters are, for each level, the proportions of mineral, organic and porous voxels to be found in the construction pattern as well as a coordination index defining the number of neighboring pore voxels. We are currently implementing in the APSF code new chosen output variables to describe the topology of pores and aggregates like connectivity index, autocorrelation function, or chord distribution. We implemented an original method of multidimensional sensitivity analysis to take into account the strong dependence in the input parameters as the sum of voxel proportions strictly equals 1 at a given level. Those proportions are represented as a Dirichlet distribution. The sensitivity analysis has been successfully performed on global non topological outputs like size distribution. The results show that the behavior of the APSF is coherent with its algorithm: the variables of the larger scale levels are the most influent inputs. We still have to explore the sensitivity of the new topological outputs and to compare it with data issued from measurements on real soils.