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A pore scale model of Soil Organic Matter (SOM) dynamics and microbial colonisation

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Soil is a complex environment and its biota is responsible for driving fundamental ecosystem processes such as nutrient cycling, the degradation of pollutants and crop production. Due to the opaque nature and complexity of soil, it has proven difficult to elucidate the physical, biological and chemical interactions comprising ecosystem processes. In part this is due to the lack of an experimental system that can capture the physical heterogeneity of soil in a fashion that can be replicated, and is amenable to spatially precise quantification of the biological and chemical components. We therefore turn to a theoretical analysis to produce hypotheses regarding the interactions amongst Soil Organic Matter (SOM), soil structure and fungal dynamics. X-ray CT is used to determine the microscale architecture of the pore network. This study formulates hypotheses relating to the interactions between fungal dynamics and SOM within a soil environment. Organic matter occurs initially in a particulate state (POM) represented as part of the soil structure. As it is exposed to enzymatic fungal activity, it decays and produces a diffusive substance i.e. dissolved organic carbon (DOC) and is readily available as an external resource for fungal uptake. Fungal dynamics is based on an existing model that demonstrates colony structure can be modelled as an emergent phenomenon resulting from the interplay between simple local processes governing uptake and remobilisation of internal resources, and macroscopic transport processes. This study will present the assumptions of SOM-Fungal dynamics and quantify how different POM distributions effect colony dynamics and colony spatial architecture.