Geophysical Research Abstracts
Vol. 13, EGU2011-13816, 2011
EGU General Assembly 2011

Community Structure in Soil Porous System

Antonio Santiago (1,2), Juan Pablo Cárdenas (1,2), Juan Carlos Losada (1), Rosa Maria Benito (1), Ana Maria Tarquis (3), and Francisco Borondo (4)

(1) Grupo de Sistemas Complejos. Universidad Politécnica de Madrid (rosamaria.benito@upm.es), (2) Instituto de Sistemas Complejos de Valparaiso (Chile), (3) CEIGRAM, E.T.S.I. Agrónomos, Universidad Politecnica de Madrid, Madrid, Spain (anamaria.tarquis@upm.es), (4) Dept. Química and Instituto Mixto de Ciencias Matemáticas CSIC-UAM-UC3M-UCM, Universidad Autónoma de Madrid

Diffusion controls the gaseous transport process in soils when advective transport is almost null. Knowledge of the soil structure and pore connectivity are critical issues to understand and modelling soil aeration, sequestration or emission of greenhouse gasses, volatilization of volatile organic chemicals among other phenomena. In the last decades these issues increased our attention as scientist have realize that soil is one of the most complex materials on the earth, within which many biological, physical and chemical processes that support life and affect climate change take place.

A quantitative and explicit characterization of soil structure is difficult because of the complexity of the pore space. This is the main reason why most theoretical approaches to soil porosity are idealizations to simplify this system. In this work, we proposed a more realistic attempt to capture the complexity of the system developing a model that considers the size and location of pores in order to relate them into a network. In the model we interpret porous soils as heterogeneous networks where pores are represented by nodes, characterized by their size and spatial location, and the links representing flows between them.

In this work we perform an analysis of the community structure of porous media of soils represented as networks. For different real soils samples, modelled as heterogeneous complex networks, spatial communities of pores have been detected depending on the values of the parameters of the porous soil model used. These types of models are named as Heterogeneous Preferential Attachment (HPA). Developing an exhaustive analysis of the model, analytical solutions are obtained for the degree densities and degree distribution of the pore networks generated by the model in the thermodynamic limit and shown that the networks exhibit similar properties to those observed in other complex networks.
With the aim to study in more detail topological properties of these networks, the presence of soil pore community structures is studied. The detection of communities of pores, as groups densely connected with only sparser connections between groups, could contribute to understand the mechanisms of the diffusion phenomena in soils.