Geophysical Research Abstracts,
Vol. 11, EGU2009-9166, 2009
EGU General Assembly 2009

Application of the heterogeneous complex networks model to porous structure of soils

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We present a general formalism for models to study the evolution dynamics of complex networks [1]. It is an extension of the preferential attachment model to heterogeneous networks (HPA), which we define as those where nodes have intrinsic properties that bias their attachment probabilities to other nodes. We would like to emphasize that the proposed class of models is quite general and contains most of the previous heterogeneous network models available in the literature, including the fitness model, as particular cases. Also it should be mentioned that although there are some previous models that incorporate an internal property to nodes (e.g. hidden variables), none of them focuses on growing networks with such heterogeneity.

An analytical expression of the degree distribution has been derived for the general class of heterogeneous models presented [2]. It has been shown analytically that all the models in this class present power laws in the degree distribution with different exponents.

We have also carried out a numerical simulation of the degree distribution and clustering in the threshold model [1]. This is a particular case in the class of models proposed, where the attachment affinity is inversely related to the distance between node states as given by a space metric. This particular model is introduced in order to provide a benchmark for numerical simulation of heterogeneous networks, while loosing as little generality as possible in the choice. We think that the hypothesis of an inverse relationship between affinity and intrinsic distance (as given by a relevant metric) may be a reasonable proxy for many real networks where preferential attachment can be considered as the most relevant linking mechanism.

Finally we present an application of the HPA to quantify the structure of porous soils [3]. Under this perspective pores are represented by nodes and the space for the flow of fluids between them are represented by links. Pore properties such as position and size are described by fixed states in a metric space, while an affinity function is introduced to bias the attachment probabilities of links according to these properties.

References

[1] A. Santiago and R. M. Benito, “Emergence of multiscaling in heterogeneous complex networks”. Int. J. Mod. Phys. C 18, 1591 (2007).

[2] A. Santiago and R. M. Benito, “An extended formalism for preferential attachment in heterogeneous complex networks". Europhys. Lett. 82, 58004 (2008).

[3] A. Santiago, R. M. Benito, J. P. Cárdenas, J. C. Losada, A. M. Tarquis and F. Borondo, "Multiscaling of porous soils as heterogeneous complex networks". Nonl. Proc. Geophys. 15, 1-10 (2008).