Geophysical Research Abstracts
Vol. 12, EGU2010-5769, 2010
EGU General Assembly 2010

A simulation method for the stability analysis of landscape scenarios by using a NetLogo application in GIS environment

Federica Gobattoni (1), Giuliana Lauro (2), Antonio Leone (1), Roberto Monaco (3), and Raffaele Pelorosso (1)

(1) University of Tuscia, DAF Department of Environment and Forestry, Viterbo, Italy (f.gobattoni@unitus.it, +39 0761 357250), (2) Architecture Faculty, Second University of Naples, 81031 Aversa, (Italy), (3) Department of Mathematics, Politecnico di Torino, Torino (Italy)

Landscape continually evolves under the influence of a complex and broad range of natural processes, directly or indirectly determined by land use, but also under the impact of anthropic actions of planning and territorial management. While processes such as earthquakes, landslides, and so on, are manifestations of this evolutionary process, human decisions concerning land government (cropping, urbanization etc.) may affect dramatically the landscape evolution in a complex mechanism of cause-and-effect leading to accelerated erosion phenomena, hydro-geological instability and flood events. To better understand landscape evolution and change in time, several numerical and empirical models have been developed and implemented with the aim to explore and explain such complex processes; reproducing landscape evolution through models and schematic representation of reality could be a powerful and reliable tool for natural resources planning and decision making in land management.
Even understanding interactions and relations between the involved variables, predicting how the system will react to external inputs such as political, social or economic constraints, could be strongly difficult. Decision support systems could help in choosing among possible alternatives by integrating different sources of information and "What if" scenarios could be developed as possible future states of the world that represent alternative plausible conditions under different assumptions (Mahmoud M. wt al., 2009). Modelling approaches can be successfully applied to describe and assess both the natural spatial environmental variability and the anthropic impacts at different temporal and spatial scales even if they usually takes into account each aspect of the environmental system separately and without looking directly at landscape as a unique system and without understanding its intrinsic evolution mechanisms (H. Siegrist, 2002, S. Demberel, 2003, A. Brenner, 2005). GIS-based models which could be able to predict the response of the landscape working as a unique system, are expected to advance through a development of sustainable planning strategies and to evaluate the equilibrium-non equilibrium status of landscape evolution and the availability of vital resources in space and time. In this context mathematical models adapted in GIS environment may really give an heavy contribution in such a complex problem- solving, providing a real and concrete Decision System Support. An integrated GIS (Geographic Information System)-based approach was developed (G. Lauro, R. Monaco, 2008) combining an ecological graph model for the analysis of the relationship between spatial pattern and ecological flows and a mathematical model, based on a system of two nonlinear differential equations, that studies meta-stability and bifurcation phenomena. These equations are mainly based on a balance law between a logistic growth of bio-energy and its reduction due to limiting factors coming from environmental constraints. The energy exchange among them will be more or less strong depending on the degree of permeability of the barriers which can obstruct the energy passage from each "landscape unit" to the other. Through NetLogo, a cross-platform multi-agent programmable modelling environment, a completely automatic GIS-based mathematical model, based on the ecological graph and on the cited two differential equations, is presented and discussed here. A study case in Central Italy is analysed to better underline the importance of such a user friendly model in GIS environment.