Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06079, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06079
EGU General Assembly 2008

River networks as ecological corridors for biodiversity, populations and water-borne disease

A. Rinaldo(1,2), R. Muneepeerakul (3), E. Bertuzzo (1), I.Rodriguez-Iturbe (3)

(1) Laboratory of Ecohydrology, Faculté ENAC, EPF Lausanne (CH), (2) Dpt. IMAGE, Università di Padova, Italy, (3) Dept of Civil and Environmental Engineering, Princeton University, Princeton (NJ,USA) (rinaldo@idra.unipd.it)

In this Lecture we speculate about the noteworthy scientific and academic perspectives provided by ecohydrological studies of river basins, seen as a natural laboratory for establishing a complex system perspective integrating hydrologic, ecological and geomorphological dynamics. The Lecture first focuses on subtle similarities and departures among dendritic geometries observed in Nature over a wide range of scales, from biological networks like pulmonary systems or trails of foraging ants to vascular plants, to physical systems like the river basin as a whole. Essential processes to sustain human life and societies take place along dendritic structures. For instance, population migrations and human settlements historically proceeded along river networks to follow water supply routes – and this precisely defines the limit of the speed of their migratory processes. Riparian systems, the critically important ecosystems positioned along streams and rivers, are quintessential dendritic networks. They play many crucial roles in their respective watersheds, including nutrient filtering and biogeochemical processing, shade and resource provisioning, and stream bank stabilization. Devastating water-borne diseases, such as cholera, spread through water bodies linked by dendritic river networks and hydrologic controls are known to exist on epidemics. Yet, our full understanding of the linkages between the dendritic characteristics and these dynamics and patterns is still far from adequate. Although the dynamics of all mentioned systems has been extensively studied, existing approaches were mostly within the framework of so-called mean-field or two-dimensional landscapes that afford mathematically convenient simplifications. Just as knowledge of all the parts is

not sufficient to understand the emergent properties of a complex system, knowledge of the systems and the transport in the landscape will not guarantee understanding of emergent properties of complex systems operating in the landscape. How does connectivity within a a river network affect the emergent spreading of water-borne infections? Does the river basin act as a template for biodiversity? Can we predict the effects of ecosystem fragmentation? We propose a few answers through the study of apparently dissimilar topics, from biodiversity in river basins (fish and riparian vegetation) to disease dynamics in river networks, from a complex system perspective. Because of their origin, river networks and the transport processes that take place in them provide a natural integrating framework for hydrologic, ecologic and geomorphologic dynamics. The profound similarities existing among all types of river basins and their drainage networks, together with the key role that their dendritic structures play in all the above dynamics, suggest that general statistical signatures, characteristic of the organization of a complex system, will be present in a variety of phenomena. This proves of crucial interest for understanding the functioning of river basins as a whole, including its ecosystem structure and function. In the process, we suggest a redefinition of the boundaries of eco-hydrology.