Geophysical Research Abstracts
Vol. 13, EGU2011-9733, 2011
EGU General Assembly 2011

Scaling in ecosystems: linkage of macroecological laws, spatial effects on species persistence, implications for biodiversity

Andrea Rinaldo
Laboratory of Ecohydrology, School ENAC, Ecole Polytechnique Federale de Lausanne (EPFL) , Lausanne, Switzerland (andrea.rinaldo@epfl.ch)

Scaling provides a powerful framework for understanding power-law behavior and deducing relationships between critical exponents. Scaling theory is employed to develop a mathematical framework for the analysis of diverse empirical macroecological relationships traditionally treated as independent. In particolar, a mathematical argument is discussed that predicts the link between the species-area relationship, relative species abundance and community size spectra. Moving from this premise, it is observed that natural ecosystems are characterized by striking diversity of form and functions and yet exhibit deep symmetries emerging across scales of space, time and organizational complexity. Species-area relationships and species-abundance distributions are examples of emerging patterns irrespective of the details of the underlying ecosystem functions. Empirical and theoretical evidence is presented for a new macroecological pattern related to the distributions of local species presistence, defined as the timespans between local colonizations and extinctions in a given geographic region. Empirical distributions, analyzed accounting for the finiteness of the observational period, exhibit power-law scaling limited by a cut-off determined by the rate of emergence of new species. In spite of the differences between the taxa studied, and the spatial scales of analysis, the scaling exponents are statistically indistinguishable and significantly different from those predicted by existing theoretical models. A theoretical investigation will be shown on how the scaling features depend on the structure of the spatial interaction network, regardless of the details of the ecological interactions. Thus fractal ecological corridors would provide predictive differences with respect to isotropic environmental matrices, highlighted by exact mean-field or directional dispersal models. I conclude that the inherent coherence obtained between spatial and temporal macroecological patterns points at a seemingly general feature of the dinamical evolution of ecosystems best highlighted in a scaling framework, a fitting tribute to Mandelbrot's vision.