Geophysical Research Abstracts
Vol. 15, EGU2013-6590, 2013
EGU General Assembly 2013

Integrating connectivity, power law, and alternative stable state paradigms of dryland ecosystem structure and dynamics

Gregory Okin (1) and Paolo D'Odorico (2)

(1) University of California, Los Angeles, United States (okin@ucla.edu), (2) University of Virginia, Charlottesville, United States (paolo@virginia.edu)

Drylands are important ecosystems that cover about 40% of the Earth's land surface and provide goods and services for about 30% of the Earth's inhabitants. Dryland vegetation is almost universally patchy reflecting the resource limitation endemic to these areas and this patchiness unquestionably results from some type of self-organization. Understanding the function of these ecosystems is critical for their effective management and for understanding how they will be affected by changes in climate and land use as well as by invasion of non-native species. There are three main paradigms that have emerged in the literature to explain dryland ecosystem structure and dynamics. The connectivity paradigm posits that spatiotemporal patterns of vegetation observed in drylands are a result of the lateral movement of resources and disturbance along connected pathways. Other authors have examined the impact of local-scale interactions that give rise to large-scale patterns in the form of power law distributions of vegetation patches. Deviation from power law distributions as a sign of imminent, catastrophic change has been a common thread in this line of research. The sudden and often irreversible change observed in dryland ecosystems has led others to emphasize the importance of feedbacks that lead to the existence of alternative stable states and hysteresis in drylands. This latter view is closely aligned with the state-and-transition model approach. Here we show, through a series of conceptual and mathematical model arguments, that these three approaches - connectivity, power law distributions, and alternative stable states - can in many circumstances be considered equivalent. They are, in essence, different facets of a common set underlying processes. This transdisciplinary, integrated perspective should help understand how spatial processes interact to create pattern and patchiness in dryalnds as well as other ecosystems worldwide.