Geophysical Research Abstracts
Vol. 12, EGU2010-993-1, 2010
EGU General Assembly 2010

Geomorphic processes and plant distribution

Marianne Chase (1,3), Edward Johnson (1,4), Yvonne Martin (2,5)

(1) Department of Biological Sciences and Biogeoscience Institute, University of Calgary, Calgary, Alberta, Canada, (2) Department of Geography and Biogeoscience Institute, University of Calgary, Calgary, Alberta, Canada, (3) mnchase@ucalgary.ca, (4) johnsone@ucalgary.ca, (5) ymartin@ucalgary.ca

Studies in plant ecology have tended to use statistics and patterns to describe the distribution of plants on landscapes. While descriptive studies are useful, they do not explain the cause of the distribution, nor do they allow one to predict the distribution of the plants on a different landscape. One tool commonly used by plant ecologists to describe the distribution of plants is a tolerance curve, a 1 dimensional curve that describes the abundance of a species along an environmental gradient. Tolerance curves are generally symmetrical and unimodal, however several studies have also found skewed and bimodal distributions and the shape of these curves has been a subject of some debate. Regardless of the discrepancy in the shape of the curve from one study to the next, gradient methods used to derive the curves often come to the same conclusion; soil moisture is the primary gradient. On a local scale soil moisture depends upon contributing area and slope. Climatic, tectonic, biotic, and geomorphic processes act in different combinations upon a landscape to give the landscape its characteristic form, and thus determine patterns of soil moisture. Our purpose is to show how a process-based geomorphic understanding of landforms can be used to understand the abundance and distribution of plants. A landscape evolution model that incorporates uplift and erosion is used to create landscapes such that the geomorphic processes acting upon each landscape are known and the relative strengths of these processes can be controlled. The landscapes created differ in that the first is a landscape in which the dominant process is soil creep, the second is similar to the first but also experiences pore pressure landsliding, and the dominant process of the third landscape is water runoff. A soil moisture index is then distributed across each landscape and patterns in soil moisture related to the geomorphic processes that created each landscape. Plants are then placed upon each landscape using hypothetical plant tolerance curves that relate plant abundance to the soil moisture index. Each landscape is subsequently sampled using a traditional direct gradient method where transects are laid from channel to ridgeline to obtain plant tolerance curves for each species that relate plant distribution to soil moisture, where distance from the channel is a proxy for soil moisture. Results indicate that different geomorphic processes and different strengths of geomorphic processes affect the distribution and abundance of plant species by altering the pattern of soil moisture. At points the same distance from the channel, but located on different transects, soil moisture may differ, as well as the rate of change of soil moisture along each of those transects because of variable contributing areas, local slopes, and degree of convergence and divergence. The variability in wetness values from one transect to another is reflected as variability in plant abundance, and thus the traditional direct gradient method of obtaining tolerance curves results in different shapes for the same species, explaining the differences observed in the literature. Therefore, the position on the slope must be considered when taking transects, soil moisture should be measured, and one must have an understanding of the geomorphic processes behind the evolution of the landscape.