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Disturbance and ecosystems response- A theoretical framework

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Ecosystem properties such as stability, resilience and resistance are key factors in determining the system's response to disturbances. We propose a theoretical framework that attempts to predict ecosystem function following disturbance in relation to the system's complexity and energy flow in time and space. System complexity is defined by the physical heterogeneity which is measured in different scales. The spatial arrangement of landscape units, the degree of contrast among them, and their size are key determinants of complexity. These properties may be measured for different ecosystem components such as soil properties, topography, vegetation composition and structure. In relation to geomorphological processes, the response variables which could be used to characterize ecosystem function are runoff and erosion rates. Since vegetation cover plays a key role in determining the behaviour these two factors solar energy flux and precipitation must be considered in determining ecosystem function. We suggest that complex systems are less prone to disturbances, i.e., demonstrate higher resistance. For example grasslands in Mediterranean regions are much more prone to fires compared to Maquis forests, which exhibit a higher degree of structural complexity. Ecosystems characterized by low precipitation values or low energy flux will exhibit lower resilience. Studies demonstrate that grasslands in Mediterranean systems recover much faster compared to grasslands in tundra regions.

Within this framework we suggest that complexity is scale dependent in space, and that the elements that contribute to the degree of complexity may change in time. For example, following a disturbance event which results in the decay or consumption of vegetation, runoff will initially depend primarily on soil properties, while in later stages it will depend on vegetation cover. Similarly, when considering runoff at small scales, micro-topography may be a key determinant of runoff processes, while at larger scales the total vegetation cover may the dominant element.