Self-organization of vegetation patterns in aid- semi-arid ecosystems

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A spontaneous transition from a uniform cover of vegetation to a fragmented ecosystem constituted by a periodic spatial distribution of gaps, or patches is a comment feature of arid and semi-arid landscapes [1,2]. This process occurs either in water-limited resources and/or low nutrient territories. Large scale observations using remote-sensing have demonstrated that patterns morphologies (gaps, bands, spots) may display the change in wavelength under climate variations.

We present a generic non-local interaction-redistribution model [3] that focuses on plant-plant facilitative and the competitive interactions between individual plants that are responsible for the formation of periodic vegetation patterns. Besides, we study the effect of the Allometric factor that only relies on structural parameters [4] that can be measured with precision in the field. When the level of the aridity is increased, the uniformly vegetated cover undergoes isolated or randomly distributed vegetation gaps [2], this study shows that the vegetation patterns presented lies on the self-organization hypothesis that attributes their cause to interactions intrinsic to vegetation dynamics. Localized vegetation structures is a patterning phenomenon that occurs under the same condition as symmetry-breaking instability. However, for a moderate level of aridity, they tend to spread and to invade the whole space available in a given landscape. This bifurcation is referred to as curvature instability that deforms the circular shape of localized patches and provokes a self-replication phenomenon that can take place even in strictly isotropic environmental conditions [5,6] This curvature instability may lead to the formation of another type of morphologies, such as arcs and spiral-like vegetation patterns [7].

Keywords : vegetation patterns, arid and semi-arid landscapes, self-organization, desertification.

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