Vegetation patterns without facilitative mechanisms.

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Regular patterns and spatial organization of vegetation have been observed in many arid and semiarid ecosystems worldwide, covering a diverse range of plant taxa and soil types. A key common ingredient in these systems is that plant growth is severely limited by water availability, and thus plants likely compete strongly for water. The study of such patterns is especially interesting because their features may reveal much about the underlying physical and biological processes that generated them in addition to giving information on the characteristics of the ecosystem. It is possible, for instance, to infer their resilience against anthropogenic disturbances or climatic changes that could cause abrupt shifts in the sys- tem and lead it to a desert state.

Therefore much research has focused on identifying the underlying mechanisms that can produce spatial patterning in water-limited systems[1]. They are believed to arise from the interplay between long-range competition and facilitation processes acting at smaller distances[2]. This combination of mechanisms is justified by arguing that water percolates more readily through the soil in vegetated areas (short range), and that plants compete for water resources over greater distances via long lateral roots (long range). However, recent studies have shown that even in the limit of local facilitation patterns may still appear[3].

In this work[4], we show that, under rather general conditions, long- range competition alone may be enough to shape gapped and stripped vegetation patterns patterns typical of models that also account for facilitation in addition to competition. To this end we propose a simple, general model for the dynamics of vegetation, which includes only long- range competition between plants. Competition is introduced through a nonlocal term, where the kernel function quantifies the intensity of the interaction. When the finite range of the competitive interaction is considered, and thus there is a kernel function whose Fourier transform may have negative values, patterns emerge in the system. This is a rather general condition if we consider the finite length of the roots, responsible of long-range competition for water. Therefore, our findings support the notion that, under fairly broad conditions, only competition is required for patterns to occur and suggest that the role of short-range facilitation mechanisms may not be as fundamental to pattern formation as has previously been thought.

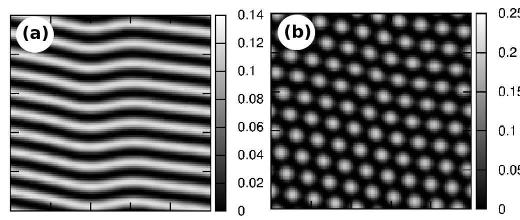

FIG. 1. Stripped (a) and gapped (b) patterns obtained with the model.

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