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Dryland conservation as an interdisciplinary problem, or how to combine big data, simulation and mathematical models, and simple experiments to support ecosystem management.

Water-limited ecosystems are highly complex systems covering 40% of Earth's land surface, mostly in developing countries, and are home to 35% of the world's population. A paradigmatic property of these ecosystems is the spatial self-organization of vegetation, which leads to strikingly regular spatial distributions of plants. These self-organized spatial patterns have been suggested as important ecosystem health indicators. Specifically, pattern shapes may indicate the proximity of the ecosystem to undergo a desertification transition. Despite this potential ecological importance, the plant interactions that underlie pattern formation remain unclear. Without strong empirical evidence of how these patterns emerge, mathematical modeling has been crucial in formulating different hypotheses. However, models assuming different mechanistic origins reproduce the same series of patterns but predict contradicting ecological consequences for them. In this context, a new approach to understanding vegetation dynamics in water-limited ecosystems that focuses on unveiling how plants interact with each other and how those interactions scale to large population sizes to create emergent patterns is needed. In this presentation, I will discuss how to develop such a new approach. I will first present simple mathematical models for pairs of interacting plants that can be parameterized and tested using simple greenhouse experiments. Next, I will discuss how to scale these models to larger system sizes using intensive simulation methods and use them to make predictions about ecosystem-level properties that can be tested with satellite images and remotely sensed vegetation indicators.

References

Cabal, C., Martínez-García, R., de Castro Aguilar, A., Valladares, F., & Pacala, S. W. (2020). The exploitative segregation of plant roots. Science, 370(6521), 1197-1199; Cabal, C., Maciel, G. A., & Martinez-Garcia, R. (2023). The evolutionary stability of plant antagonistic facilitation across environmental gradients and its ecological consequences: soil resource engineering as a case study. bioRxiv, 2023-02; Martinez-Garcia, Ricardo, et al. "Integrating theory and experiments to link local mechanisms and ecosystem-level consequences of vegetation patterns in drylands." Chaos, Solitons & Fractals 166 (2023): 112881.

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