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Title:

Mathematical modelling for pattern formation

Abstract:

The study of vegetation spatial patterns (VSP) and self-organization in plants has garnered significant interest due to the diverse and challenging-to-simulate underlying mechanisms, giving rise to various explanatory hypotheses.

Moreover vegetation spatial patterns may be interpreted as ecological indicators and may be used to prevent the degradation of the ecosystem. VSP appear in different forms depending on the type of terrain and environment conditions: spots, gaps, and labyrinths on flat grounds, while stripes and arced bands on sloped terrains.

Mathematical models, particularly reaction-diffusion systems leading to Turing instabilities, have been employed to depict the emergence of vegetation patterns in different environmental conditions. Hybrid modeling, integrating diverse approaches into a unified framework, is a key aspect, combining differential equations (ODE and/or PDE) with individual-based models (IBM) to provide complementary perspectives on systems.

This work presents multiple modeling approaches to investigate vegetation pattern emergence, ranging from partial differential equations to hybrid models based on the System Dynamics (SD) and Individual-Based (IB) modeling approach.

This is a joint work with Fabrizio Cartenì, Annalisa Iuorio and Gerardo Toraldo