The Lefever-Lejeune nonlinear lattice: convergence dynamics and the structure of equilibrium states

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We consider the Lefever-Lejeune nonlinear lattice, a spatially discrete propagation-inhibition model
describing the growth of vegetation densities in dry-lands. We analytically identify parametric regimes distinguishing between decay (associated with spatial extinction of vegetation patches) and potentially non-trivial time-asymptotics. To gain insight on the convergence dynamics, a stability analysis of spatially uniform states is performed, revealing the existence of a threshold for the discretization parameter which depends on the lattice parameters, below which their destabilization occurs and spatially non-uniform equilibrium states may emerge. Direct numerical simulations justified that the analytical stability criteria and parametric thresholds effectively describe the above transition dynamics and revealed the rich structure of the equilibrium set. Connections with the continuous sibling Lefever-Lejeune partial differential equation are also discussed.

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