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Ising-like patterns of spatial synchrony in population biology[1]
ANDREW NOBLE, ALAN HASTINGS, University of California, Davis, JON MACHTA, University of Massachusetts Amherst — Systems of coupled dynamical oscillators can undergo a phase transition between synchronous and asynchronous phases. In the case of coupled map lattices, the spontaneous symmetry breaking of a temporal-phase order parameter is known to exhibit Ising-like critical behavior. Here, we investigate a noisy coupled map motivated by the study of spatial synchrony in ecological populations far from the extinction threshold. Ising-like patterns of criticality, as well as spinodal decomposition and homogeneous nucleation, emerge from the nonlinear interactions of environmental fluctuations in habitat quality, local density-dependence in reproduction, and dispersal. In the mean-field limit, the correspondence to the Ising model is exact: the fixed points of our dynamical system are given by the equation of state for Weiss mean-field theory under an appropriate mapping of parameters. We have strong evidence that a quantitative correspondence persists, both near and far from the critical point, in the presence of fluctuations. Our results provide a formal connection between equilibrium statistical physics and population biology.

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