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Heterogeneous carrying capacities and global extinction in metapopulations

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The lattice Nagumo equation (reaction-diffusion equation with bistable nonlinearity) may serve as a model of neuron transmissions, image processing or spatial population growth. This equation is well known for its rich structure of bounded stationary patterns and traveling wavefront.

In this talk we consider a simple two-patch Nagumo system with heterogeneous capacities. Two-patch models may serve as the simplest case of discrete-space models and reveal new phenomena. Moreover, they are directly connected to the construction of periodic solutions of lattice equations.

In contrast to the Nagumo two-patch system with the same capacities, which naturally provides two asymptotically stable and one nonstable stationary solutions for any combination of diffusion and reaction rates, we show that heterogeneous capacities may cause the disappearance of all nonzero equilibria. Zero solution is then the unique stationary solution and straightforwardly corresponds to the extinction of populations. We give a simple condition for capacities parameters which establishes that global extinction does not occur. On the other hand, we prove a sufficient condition for existence of the unique zero solution. Consequently, we obtain a nonexistence of traveling wave for Nagumo equation on periodic lattices.