On hysteresis reaction-diffusion systems and application in population dynamics

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We consider a general class of PDE-ODE reaction-diffusion systems, which exhibits a singular fast-reaction limit towards a reaction-diffusion equation coupled to a scalar hysteresis operator.

As applicational motivation, we present a PDE model for the growth of a population according to a given food supply coupled to an ODE for the turnover of a food stock. Under realistic conditions the stock turnover is much faster than the population growth yielding an intrinsic scaling parameter. We emphasise that the structural assumptions on the considered PDE-ODE models are quite general and that analogue systems might describe e.g. cell-biological buffer mechanisms, where proteins are stored and used at the same time.

Finally, we present a new kind of hysteresis-diffusion driven instability caused by the nonlinear coupling between a reaction-diffusion equation and a scalar generalised play operator. We discuss in detail how this coupling with a generalised play operator can lead to spatially inhomogeneous large-time behaviour or equilibration to a homogeneous state.