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Travelling waves with forced speed

This talk is concerned with reaction-diffusion equations for population dynamics of the KPP type in inhomogeneous media. Specifically, the reaction term involves a bounded "favourable zone" which is travelling with a forced speed. We first studied such a model in a joint work with O. Diekman, K. Nagelkerke and P. Zegeling, in dimension 1 to describe the dynamics of a biological population facing a climate shift. In this context, global warming is interpreted as a Northward shift of the favorable zone for a given species. The goal is to understand whether a given species is able to keep pace with the climate change and how the latter affects the population size and distribution. For the extensions to higher dimensions and more general geometries, I report on joint works with Luca Rossi. First, we establish necessary and sufficient conditions to characterize the existence of travelling waves with the same speed in all of space or in cylinder like domains. This allows one to derive the asymptotic behavior of solutions of the evolution equation in various geometrical settings. Then, we describe problems which involve two different forcing speeds or periodic time dependence. There, one is led to pulsating travelling fronts and the dynamics is related to principal periodic eigenvalues of parabolic operators. Lastly, I will also mention different properties when the Allee effect is taken into account for which the geometry plays an important role.