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A reaction-diffusion malaria model with incubation period in the vector population

Malaria is one of the most important parasitic infections in humans and more than two billion people are at risk every year. To understand how spatial heterogeneity and extrinsic incubation period (EIP) of the parasite within the mosquito affect the dynamics of malaria epidemiology, we propose a nonlocal and time-delayed reaction-diffusion model. We then define the basic reproduction ratio and show that it serves as a threshold parameter that predicts whether malaria will spread. Furthermore, a sufficient condition is obtained to guarantee that the disease will stabilize at a positive steady state eventually in the case where all the parameters are spatially independent. Numerically, we show that the use of the spatially averaged system may highly underestimate the malaria risk. The spatially heterogeneous framework in this work can be used to design the spatial allocation of control resources.

This talk is based on a joint work with Dr. Xiaoqiang Zhao.