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Spatio-temporal modeling of *Aedes albopictus* dispersal in Réunion Island. Application to the release of Sterile Insects.

This work is part of a project, called the SIT-project, that aims to develop biological control tools to prevent or stop a Chikungunya epidemic. Chikungunya is somehow a uncommon disease and before the huge epidemic in Réunion island and in India in 2006, our knowledges on this virus were small. Recently, in September 2010, a few cases of Chikungunya appeared in South of France, indicating that Chikungunya is not only a tropical disease but can potentially appear in Europe. The appearance of Chikungunya is strongly connected with the spreading of one of its principal vector, *Aedes albopictus*. This mosquito is now well established in the South of Europe. In [1] and [2], we were mainly concerned on the modeling of the epidemic and on the use of chemical vector control tools, like adulticides and larvicides, and mechanical control, which consists in reducing the breeding sites. Unfortunately, using chemical control tools, in Réunion Island is not really a good idea. First, because Réunion Island is a hot spot of endemicity, and second because mosquito can develop a resistance to insecticides. In a recent paper, we have developed a new model on the use of the Sterile Insect Technique (SIT) as an alternative to insecticides [3].

All published models are temporal models, i.e. they don't take into account the spatial component. Using the previous works, we began to fill this gap. Using mark-release-capture experiments, we have developed a system of partial differential equations (PDES) in order to model the spreading/displacement of an *Aedes albopictus* mosquito population. In a first approach, we have splitted the females in two biological stages: one representing the female looking for breeding sites, and the other representing females looking for blood meal. This led to a system of two coupled partial differential equations. Then, we have considered a full model with more compartments including the aquatic stage, imature females, female looking for blood meals, female looking for breeding sites, and males, for mating. These led to a system of coupled advection-reaction-diffusion PDES. Taking into account entomological knowledges, we have included biological facts into the equations in order to be as realistic as possible. We developed appropriate numerical methods in order to get realistic numerical simulations to be able to compare with "experiments" in the fields.

The main application of this work is to optimize vector control, using releases of sterile males combined with mechanical control.

References

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[3] Y. Dumont and J.M. Tchuenche, Mathematical studies on the Sterile Insect Technique for the Chikungunya Disease and *Aedes albopictus*, submitted.