My research
I am pursuing my doctoral research with Dr. Alex Perkins on the effects and optimal use of spatial repellents (SR) for the control of dengue. Spatial repellents are products sub-lethal to mosquitoes that prevent mosquitoes from entering human-occupied spaces, thereby reducing the risk of pathogen transmission in a way that is more sustainable in light of insecticide resistance. There are various manifestations of these products, including coils, candles and impregnated strips. With the development of an individual-based model informed by both entomological and epidemiological data, I am investigating the optimal distribution of spatial repellents in preventative and reactive control efforts.

Dengue and the need for new control tools
With a 30-fold increase in incidence over the last five decades, dengue poses an increasing threat to about half of the world’s population. In the absence of effective antiviral drugs or vaccines, control efforts currently rely fully on the control of the mosquito vector, *Ae. aegypti*: a costly and cumbersome endeavor with limited effectiveness. Consequently, there is an urgent need for the development of new, innovative vector control products. Spatial repellents (SRs) constitute such a new paradigm.

Implementing New Control Tools: A Multifaceted Problem

Entomology
Before a new tool can be implemented, extensive studies are needed to study the effects of SR on a variety of factors, such as the mosquito’s biting behavior, mortality, movement and reproduction.

Epidemiology
Epidemiological trials are needed to assess whether the tools indeed have an effect on the occurrence of the disease and its transmission.

Policy
The implementation of a new tool comes with many logistic challenges concerning the costs and distribution of the product as well as the local acceptance, amongst others.

Mathematical Modeling as a Tool to Bridge the Disciplines

Modeling the optimal use of spatial repellents
I work on the implementation of the many facets of spatial repellents in a modeling framework that simulates the spread of dengue in the city of Iquitos, Peru. With this model, I will perform experiments to predict the impact of SRs on dengue transmission. My work includes analyzing entomological and epidemiological studies, implementing these findings into the model, validating the model against field data and running experiments to gain insights on the optimal use SRs as a public health intervention.

Figures
Top-left: Representation of the possible modes of action of spatial repellents (Graphic by Kristina Davis)
Mid-right: Graphic of the different disciplines I combine to study the impact of spatial repellents on dengue transmission
Low-left: Snapshot of the modeled abundance of adult mosquitoes across the city of Iquitos, with red signifying high abundance and blue signifying low abundance. (Graphic by Alex Perkins and Robert Reiner Jr.)
Low-right: Snapshot of simulated dengue cases in the city of Iquitos, Peru (Graphic by Robert Reiner Jr.)