

**Thesis Title:** Assessing Vulnerability to Dengue Fever in Mexico under Global Change

**Abstract:** We live in an era of global change where human impacts on the structure and function of the Earth system have reached unprecedented dimensions, threatening the Earth's life support systems upon which the health and survival of all Earth's species depend. A growing body of literature has shown that demographic and societal changes in the last three decades have had a major impact on the increasing distribution and emergence of infectious diseases. Despite advances in medicine, the trends in emerging infectious diseases are worrisome: not only are we seeing the emergence of new infectious agents, but also the rebound of those once thought to be controlled, such as dengue fever.

This three article dissertation is motivated by the urgent need to assess the impacts of global change on health, and particularly in the incidence and distribution of dengue fever. In particular, this research seeks to assess the trends of dengue fever in Mexico and to increase the understanding of the socio-economic and environmental factors shaping the differential vulnerability to dengue fever across space. To do so, this study adopts a global change vulnerability framework and integrates methodologies from GIScience, the climatic sciences and species distribution modeling.

The first paper is entitled "A robust nonparametric trend analysis of dengue fever in Mexico 1999-2006", and provides a spatially explicit assessment of the temporal trends of dengue fever at the municipal scale based on the Mann-Kendall statistic and Theil-Sen slope estimator. The results show a small but steady increase of dengue fever incidence in 74% of the 998 municipalities that reported at least one dengue fever case during the study period. Three states in southern Mexico concentrate the majority of the municipalities with stronger trends: Veracruz, Quintana Roo and Guerrero.

The second paper is entitled "Mapping the potential risk to dengue fever in Mexico from aggregated data". This study demonstrates an approach to map dengue fever risk from aggregated data based on species distribution modeling, and examines the relative contribution of socio-economic vs. climatic variables to the spatial distribution of dengue fever risk. Several models of dengue fever risk are compared using different variable selection methods. The patterns of dengue fever are consistent across models, showing higher levels of risk in the low elevation coastal areas. At the scale of analysis of this study the climatic variables (specifically the minimum temperature of the coldest month, annual precipitation and mean temperature of the wettest quarter) are more important than the socio-economic variables for characterizing dengue fever risk in Mexico.

The third paper is entitled "Putting all together: An evaluation of the implications of composite index aggregation methods for decision making and vulnerability assessment". This paper examines commonly used methodologies used for creating vulnerability indices in the global change vulnerability literature and compares the results of applying four of them (Data Envelopment Analysis, Weighted Linear Combination, MIN and MAX operators) to construct an index of vulnerability to dengue fever in Mexico. The results highlight the implications of using each methodology in terms of the spatial

patterns of vulnerability, but also in terms of the degree of trade off among the measures being combined and the degree of risk involved in the decision making process.