Introduction

Since the re-introduction of the Aedes aegypti mosquito to Brazil and the first case in the 1980s, (Montrubio et al., 2009), Dengue Fever has become a major public health issue in Brazil.

Dengue is transmitted by the bite of the vector mosquito, and has a four day incubation period, before an infected person will develop a fever and rash, which he or she will recover from in approximately five days. Dengue Fever, itself, does not have a high mortality rate, but Dengue Hemorrhagic Fever (5% mortality rate), with an extra symptom of vascular permeability, blood loss, and Dengue Shock Syndrome (up to 40% mortality rate), where there is the loss of too much blood, resulting in hypotension, are where the majority of the Dengue deaths come from.

Due to the fact that the Aedes aegypti mosquito prefers areas with temperatures over 68° F (20° C), Nahapatan, "An Information value..." 2005), areas in Tropical and Subtropical climate regions have the highest volume of the vector mosquito. Brazil's location relative to the equator makes it a "hot spot" for the vector mosquito and in effect Dengue.

The health concerns of Dengue, has caused health officials to track the disease as well as the development of models to help track the number of occurrences and spreads, in order to understand the disease's patterns and facilitate the optimization of resources in the eradication of the disease. Looking at different factors of the mosquito and human components of the disease, should be helpful in finding areas of risk for Dengue.

Certain factors that are important to these components are, seasonality, population, transportation methods, and the different biomes and climate zones. Seasonality is important because in many areas of Brazil the different seasons bring hotter and colder temperatures to an region where mosquitoes live, if a temperature falls below the Aedes aegypti desired temperature they will not be found in that region. The population of a region is important feature because where population density is higher there are more potential targets in an infected mosquito's life span, causing greater spread of Dengue. Transportation methods are important for both humans and mosquitoes, for humans, the movement of the disease from an infected region to an uninfected region, as well as the density of mosquitoes in an area. Finally the different biome and climate regions are important to the mosquitoes habitation and seasonal patterns.

Methods

Using information on the number of cases in 2007 of Dengue Fever by region, from Brazil's Ministry of Health, along with information on population, biomes and climates from the Brazilian Institute of Geography & Statistics, to view how different types of physical and demographical (population) features cause the occurrences and spread of Dengue. Dengue occurrences and spreads are incredibly complex, to help simplify the correlation factors, a breakdown of the some of the physical and demographic factors was used after using ArcGIS to visually display and edit the Shapefile data, Microsoft Excel was used to create graphics and different factors (seasonal population, proximity to roads, lakes, and river, and biome & climate areas) and the number of cases in different regions.

Maps

Seasonal Spread

One of the biggest factors in the spread of Dengue is the season. In many parts of Brazil, seasonal conditions affect the climate. In the summer it is hotter and more humid, then in winter, when it is cooler and drier. Winter is not a good time for the vector mosquito, it is very susceptible to the heat and humidity, during the cold winter months there would be fewer Aedes aegypti mosquitoes (in areas where there is snow, especially in the south regions) then in the summer months. Finally, due to the decrease in the amount of mosquitoes there are less cases in the winter than the summer.

Results

After examining the maps and graphs to see the correlation between the spread and occurrences of Dengue and different physical and demographic properties of Brazil; this correlation is shown below.

### Conclusions

The correlations between the factors and Dengue occurrence and spread, show high risk areas for Dengue. Some of these areas have higher number of cases. This could be for many reasons, such as immunity, isolation of groups of people, or better use of mosquito control. By looking at these areas, public health officials could bring techniques used these areas into areas of high risk with higher number of cases of Dengue Fever. A more comprehensive study could also be done using smaller time periods and more accurate, if not exact, data on the location of cases, to track the spread more accurately, as well as getting more quantitatively accurate results.