**NASA DEVELOP National Program**

****Jet Propulsion Laboratory (Pasadena, CA)

**Spring 2014**

**Brazil Health and Air Quality II**

*Utilizing NASA Earth Observations for Forecasting Dengue Vector-Borne Disease Outbreaks in Brazil*

**Team Lead:** Lorena Lopez (California State University, Northridge), lorena.lopez.47@my.csun.edu

**Team Members:**

Scott Barron, Young Professional (University of California, Los Angeles)

Elise Lorenzana (University of California, Los Angeles)

**Advisors & Mentors:**

Ben Holt (Jet Propulsion Laboratory)

Erika Podest (Jet Propulsion Laboratory)

Darren Drewry (Jet Propulsion Laboratory)

**Past or Other Contributors:**

Brazil Health and Air Quality I, Fall 2013

**Applied Sciences National Applications Addressed:**

Health and Air Quality

**Study Area:** Brazil

**Study Period:** January 2000 – December 2013

**Community Concerns**

* Vector-borne diseases (VBD) claim hundreds of thousands of lives annually, particularly impacting underdeveloped and developing countries.
* Globally, dengue is the fastest growing vector-borne disease.
* The World Health Organization now considers dengue to be the most important mosquito-borne viral disease in the world, with pandemic potential.
* In the last 50 years, dengue incidence has increased 30-fold, infecting up to 100 million people annually according to the World Health Organization (WHO).
* This virus causes approximately 50 million cases of dengue fever each year, 500,000 cases of dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS), and results in approximately 12,500 fatalities annually.

**Word Blurb**

The incidence of DHF/DSS has increased due to increase in human population, uncontrolled urbanization and international travel. The most important vector for dengue is the mosquito *Aedes aegypti*, which thrives in stagnant water. Lack of reliable piped water services and garbage disposal systems provide mosquitos with ideal development conditions. No commercially available vaccine for dengue currently exists, leaving vector control as the only viable option for dengue prevention. Effectively combatting vector-borne diseases depends on the ability to monitor, predict, and map mosquito breeding habitats and vector prevalence.

**Abstract**

Vector-borne diseases claim millions of lives annually, particularly impacting children in underdeveloped and developing countries. According to the World Health Organization (WHO), dengue fever, along with dengue hemorrhagic fever (DHF), is the world’s fastest growing vector-borne disease. The ability to predict and mitigate the effects of dengue outbreaks has become increasingly difficult, as global climate change requires a complex understanding of shifts in local environmental systems. In order to reduce the impact of vector-borne diseases, including dengue, it is imperative to institute surveillance protocols to enhance timely mitigation in regions with limited resources.

Geographic information systems and remote sensing techniques can be utilized to characterize mosquito-breeding habitats and, thus, forecast vector-borne disease risks.  This project aimed to provide an understanding of the potential locations prone to the spread of mosquito populations by utilizing satellite remote sensing data to obtain information regarding vegetation, temperature, humidity, surface inundation, and precipitation. This project focused on the efficiency of vector-borne disease transmission by investigating the mean number of potential contacts infected by a mosquito population per infectious person per unit time (epidemic potential) of *Aedes aegypti* (primary vector for dengue) using temperature, humidity, precipitation, and surface inundation data along with human population density to identify areas of risk.

**Partners/Collaborators**

Centers for Disease Control (CDC): Captain Stephen H. Waterman

**Current Management Practices & Policies**

Field surveys are the predominant source of data collection to assess the number of dengue cases for a given location. On-the-ground data collection methods are often time-consuming and costly. The under-reporting of mild and non-symptomatic cases of dengue fever further complicates these methods as compulsory notification most often only identifies cases of dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS). Current approaches provide static maps of incidence.

**Benefit to End-User:**

* This information can be used by public health agencies to strategically plan their surveys and control efforts more effectively and to provide initial indications of disease outbreak risk for public health planning.
* This project will foster collaboration between NASA’s Jet Propulsion Laboratory (JPL), DEVELOP, and Centers for Disease Control Office of Infectious Diseases National Center for Emerging and Zoonotic Infectious Diseases (CCID/OID/NCEZID).

**Decision Support Tools**

* Epidemic potential model - describes the capacity of a disease to remain in a population as a function of vector life cycle, mortality and the required incubation period of the disease

**Earth Observations & Parameters**

TRMM, Precipitation Radar (PR), Microwave Imager (TMI) - precipitation

Aqua, Atmospheric Infrared Sounder (AIRS) – air temperature & humidity

QuikSCAT scattterometer and Aqua AMSR-E – surface inundation

**Future Applicable NASA Missions**

The Soil Moisture Active Passive (SMAP) mission

**Models Utilized**

Epidemic potential model described above

**Ancillary Datasets Utilized**

Dengue outbreak data for Brazil from 2001-2013 (Brazilian Ministry of Health)

Population data set for Brazil for 2010 (Center for International Earth Science Information Network)

**Software Utilized**

Esri ArcMap Desktop 10.1 – raster images and calculations

MATLAB – data modeling

Microsoft Access – database

SyStat – statistical analysis

**References**

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