Advanced Early Dengue Prediction and Exploration Service

aedesproject.org

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October 2019

Our Challenge

Living In Our World

The Earth is composed of complicated systems – land, water, air, living things, and the planet itself. Understanding how these systems work together is important. Challenges in this category will ask you to craft solutions using NASA data – a story, a game, a video, any product of your design – that capture what it's like to live on Earth.

Smash your SDGs!

Your challenge is to develop creative solutions that use Earth observations to address the United Nations' Sustainable Development Goals and foster sustainable development worldwide. Use NASA and other Earth observing satellites' data as well as information generated by crowd-sourcing and in-situ measurements to create practical applications that support environmental and societal policy across water, health, food security and/or land use domains.

The Problem: Philippines Dengue Epidemic

1,107
Deaths

271,000+
Cases

Source: Department of Health

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With manual reporting dengue data is delayed by 2-3 months.
Public Health sector resources are limited.
Need to move the emphasis from treatment to prevention.

Source: Department of Health

Capturing The Dengue Data Cycle

Data

Climate

Creates mosquito breeding environments

Mosquitoes

Get infected and spread cases of disease

Data

Searches

Triggered by public alarm and spread of cases and deaths

Deaths

Occur if cases are untreated

Data

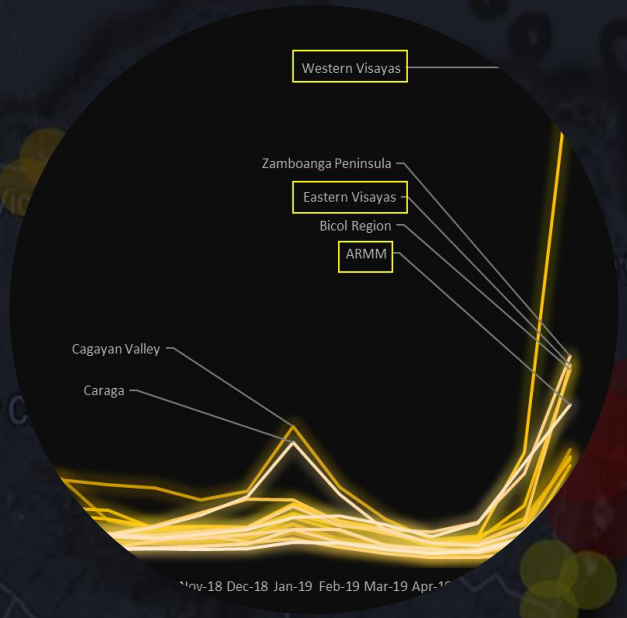
Reports

Cases and deaths are reported to Department of Health (2-3 months lag)

Solution: Advanced Dengue Prediction

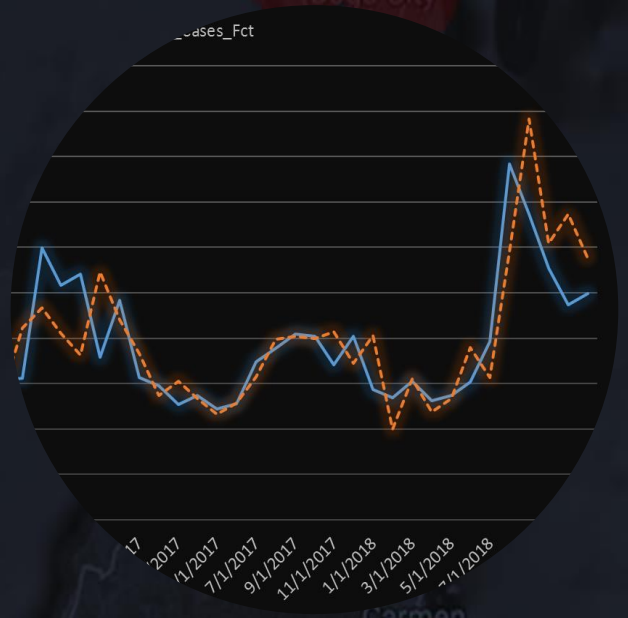
Correlate dengue cases and deaths with real-time data from climate, google searches, and satellite maps, giving an advance indicator of when dengue will emerge and potential dengue hotspot locations.

Data-Driven Dengue Portal



Descriptive

Surface and visualize existing dengue trends



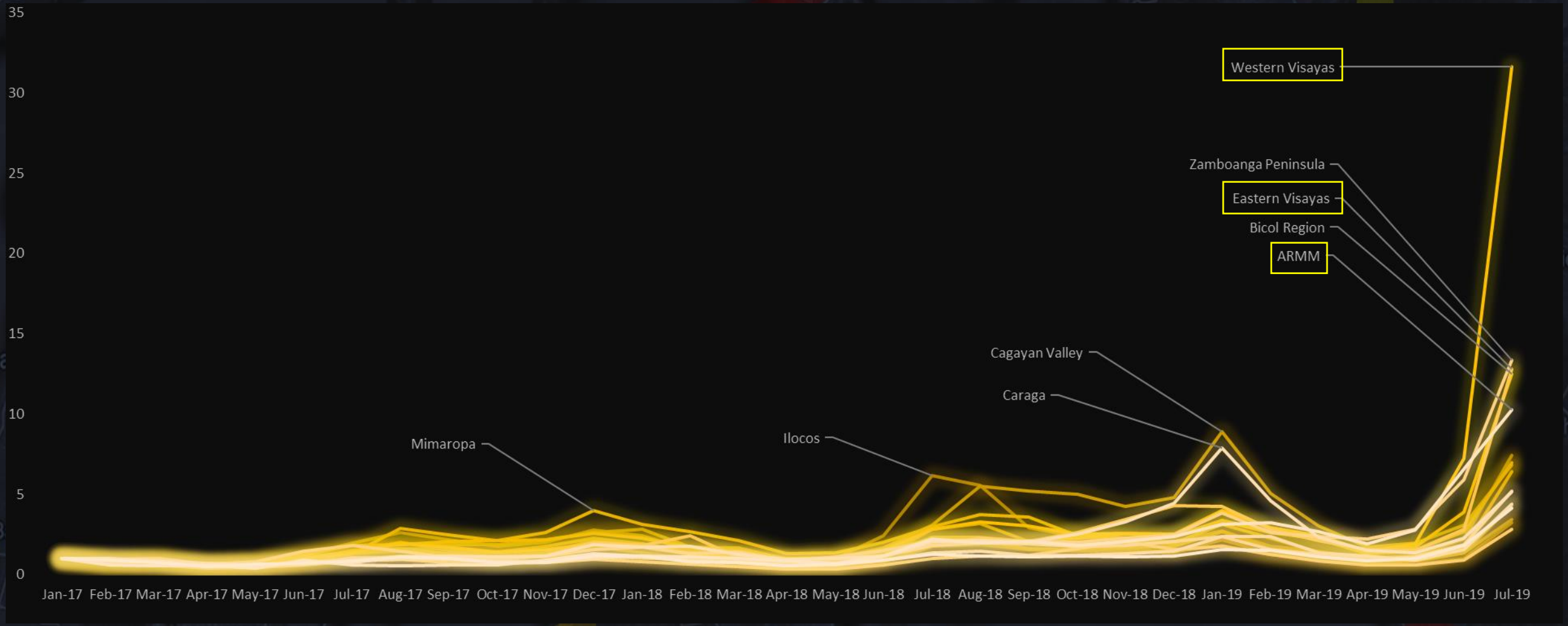
Predictive

Establish contributing factors and project likely dengue trends

Prescriptive

Provide guidance on areas to target for dengue mitigation

Searches for Dengue: Epidemic of Panic

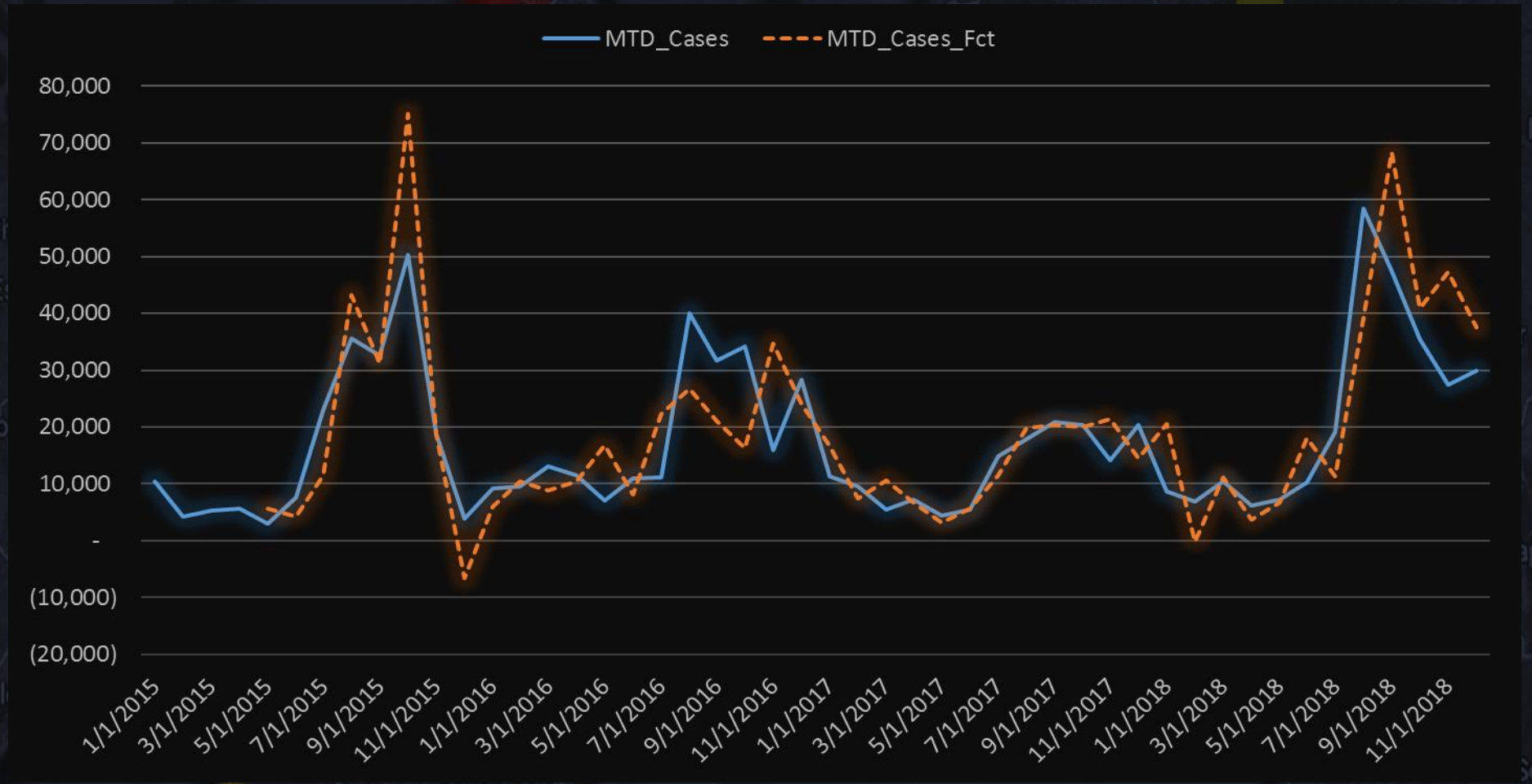


Source: Google Searches (% Growth, January 2017 = 1)

Predicting Dengue Cases

Factors:

- Average Monthly Regular Temperature
- Average Monthly Rainfall
- Google Searches for ‘dengue’, ‘dengue symptoms’, ‘dengue cure’, ‘dengue medicine’
- Lagged values for factors and cases
- R 0.82 / R2 0.67

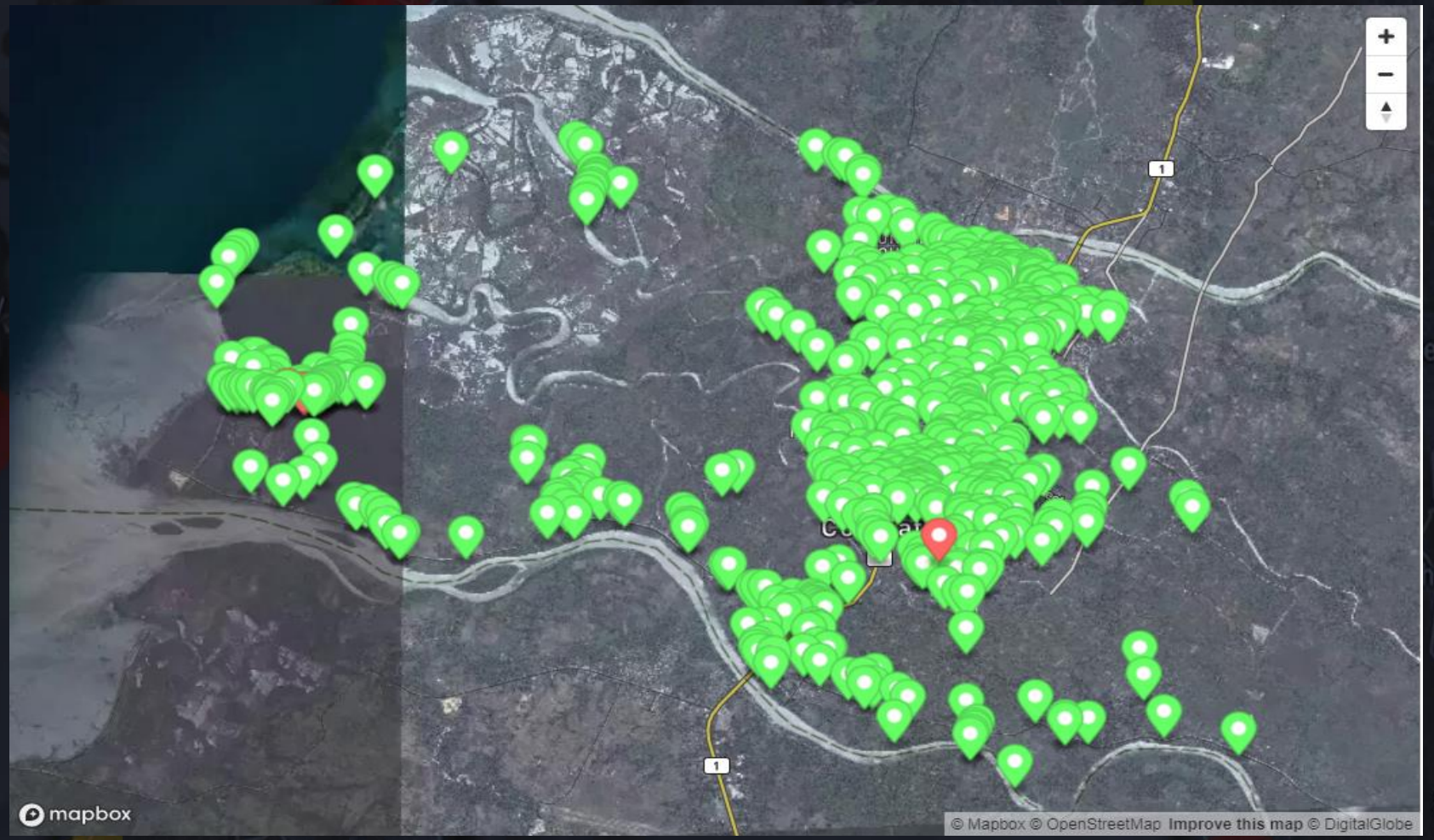


Sources: DOST-PAGASA Climate Data, Google Search Trends, DOH Dengue Monitoring Reports

Mosquito Hotspots From Satellite Images

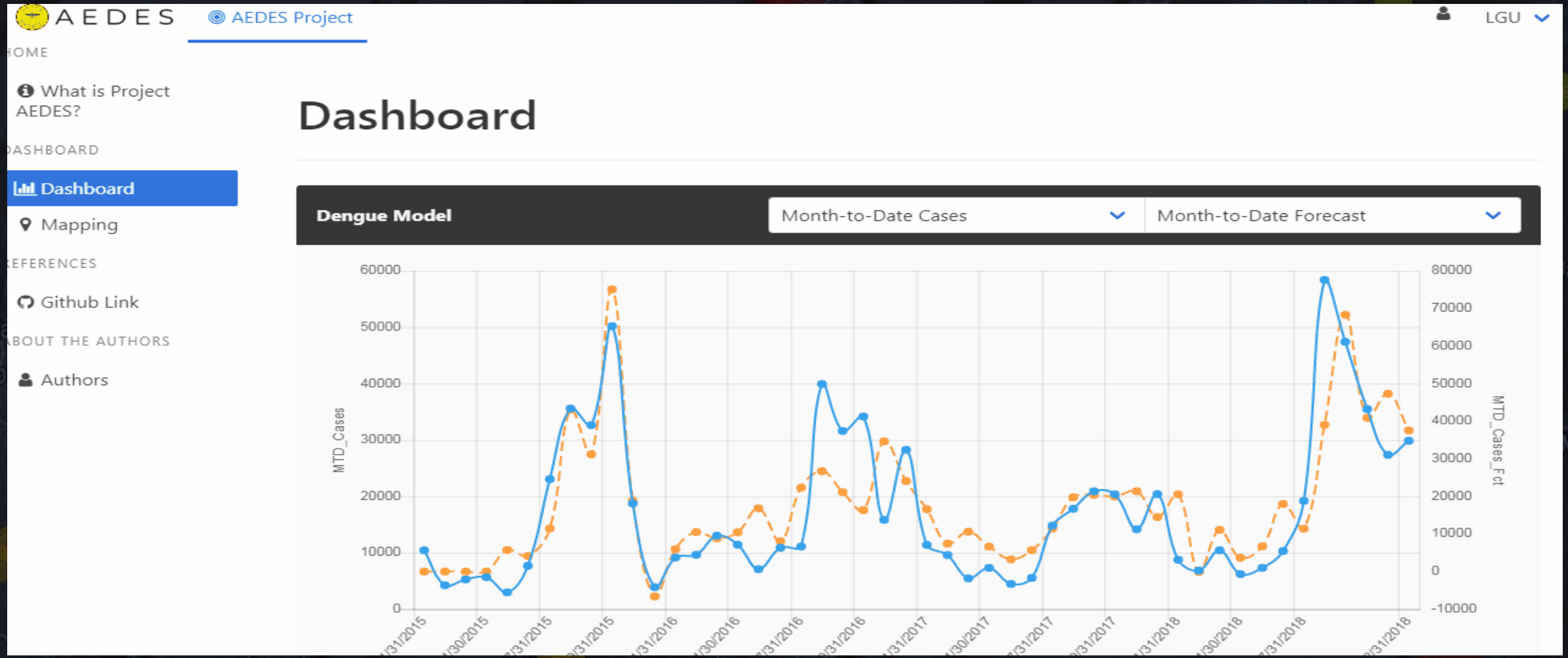
Factors:

- Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) to identify areas with vegetation.
- Normalized Difference Water Index (NDWI) to identify areas with water.



Sources: Copernicus Sentinel Data Hub, QGIS, OpenStreetMap, Mapbox

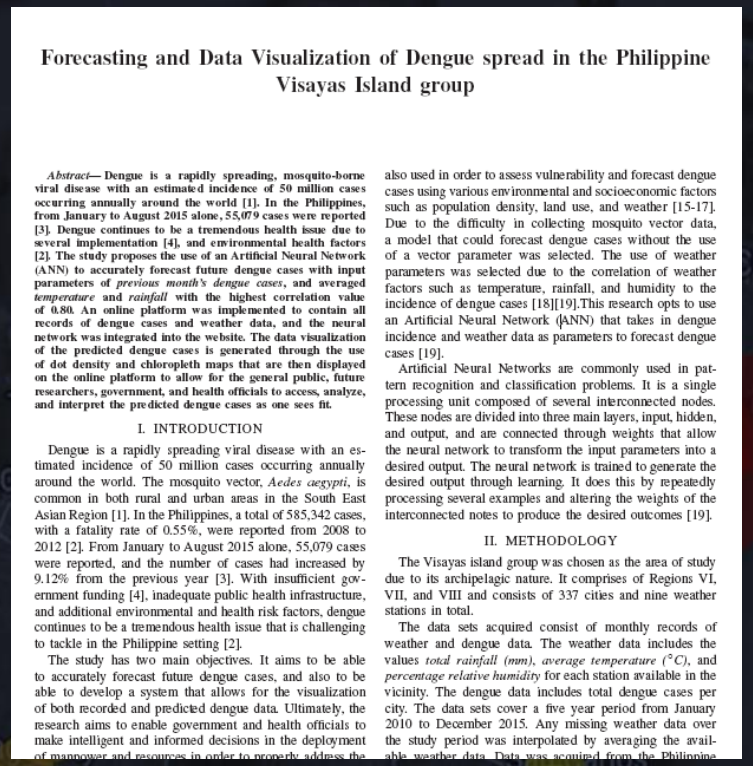
AEDES Project: Making Dengue Data Accessible



Target Beneficiaries

- Free to access dashboard for public use
- Target user: National and Local Government Health Departments
- Use it to generate localized dengue alerts and also target areas for interventions such as fumigation, misting, inoculations and medical supplies.

Related Literature



Forecasting and Data Visualization of Dengue spread in the Philippine Visayas Island group

Abstract— **Dengue is a rapidly spreading, mosquito-borne viral disease with an estimated incidence of 50 million cases occurring annually around the world [1]. In the Philippines, from January to August 2015 alone, 55,079 cases were reported [3]. Dengue continues to be a tremendous health issue due to several implementation [4], and environmental health factors [2]. The study proposes the use of an Artificial Neural Network (ANN) to accurately forecast future dengue cases with input parameters of *previous month's dengue cases*, and averaged *temperature* and *rainfall* with the highest correlation value of 0.80. An online platform was implemented to contain all records of dengue cases and weather data, and the neural network was integrated into the website. The data visualization of the predicted dengue cases is generated through the use of dot density and chloropleth maps that are then displayed on the online platform to allow for the general public, future researchers, government, and health officials to access, analyze, and interpret the predicted dengue cases as one sees fit.**

I. INTRODUCTION

Dengue is a rapidly spreading viral disease with an estimated incidence of 50 million cases occurring annually around the world. The mosquito vector, *Aedes caegypti*, is common in both rural and urban areas in the South East Asian Region [1]. In the Philippines, a total of 585,342 cases, with a fatality rate of 0.55%, were reported from 2008 to 2012 [2]. From January to August 2015 alone, 55,079 cases were reported, and the number of cases had increased by 9.12% from the previous year [3]. With insufficient government funding [4], inadequate public health infrastructure, and additional environmental and health risk factors, dengue continues to be a tremendous health issue that is challenging to tackle in the Philippine setting [2].

The study has two main objectives. It aims to be able to accurately forecast future dengue cases, and also to be able to develop a system that allows for the visualization of both recorded and predicted dengue data. Ultimately, the research aims to enable government and health officials to make intelligent and informed decisions in the deployment of manpower and resources in order to properly address the also used in order to assess vulnerability and forecast dengue cases using various environmental and socioeconomic factors such as population density, land use, and weather [15-17]. Due to the difficulty in collecting mosquito vector data, a model that could forecast dengue cases without the use of a vector parameter was selected. The use of weather parameters was selected due to the correlation of weather factors such as temperature, rainfall, and humidity to the incidence of dengue cases [18][19].This research opts to use an Artificial Neural Network (ANN) that takes in dengue incidence and weather data as parameters to forecast dengue cases [19].

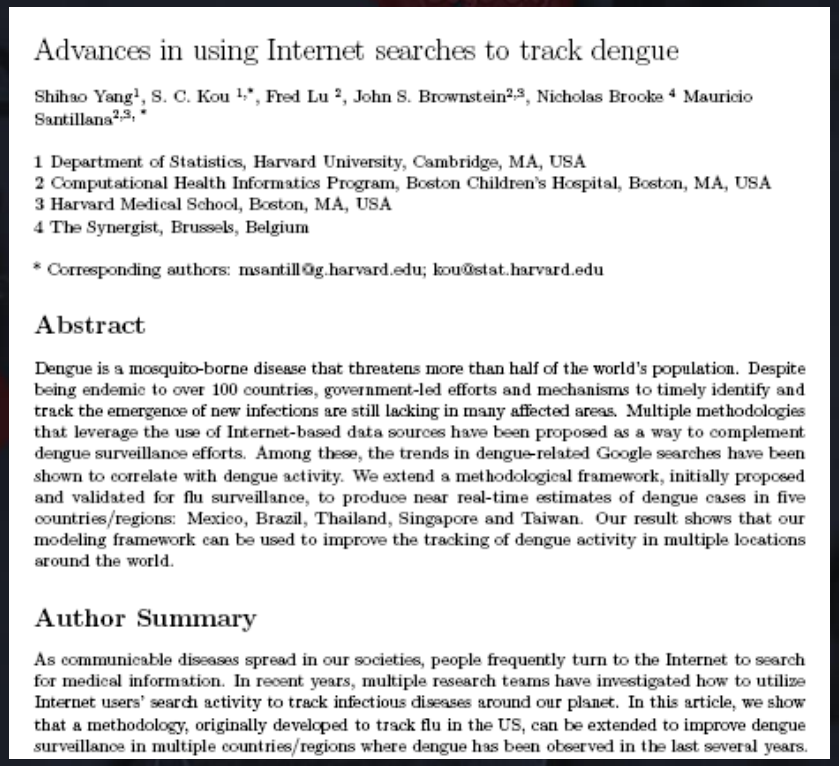
Artificial Neural Networks are commonly used in pattern recognition and classification problems. It is a single processing unit composed of several interconnected nodes. These nodes are divided into three main layers, input, hidden, and output, and are connected through weights that allow the neural network to transform the input parameters into a desired output. The neural network is trained to generate the desired output through learning. It does this by repeatedly processing several examples and altering the weights of the interconnected notes to produce the desired outcomes [19].

II. METHODOLOGY

The Visayas island group was chosen as the area of study due to its archipelagic nature. It comprises of Regions VI, VII, and VIII and consists of 337 cities and nine weather stations in total.

The data sets acquired consist of monthly records of weather and dengue data. The weather data includes the values *total rainfall (mm)*, *average temperature (°C)*, and *percentage relative humidity* for each station available in the vicinity. The dengue data includes total dengue cases per city. The data sets cover a five year period from January 2010 to December 2015. Any missing weather data over the study period was interpolated by averaging the available weather data. Data was acquired from the Philippine

Caro, et. al. 2016



Advances in using Internet searches to track dengue

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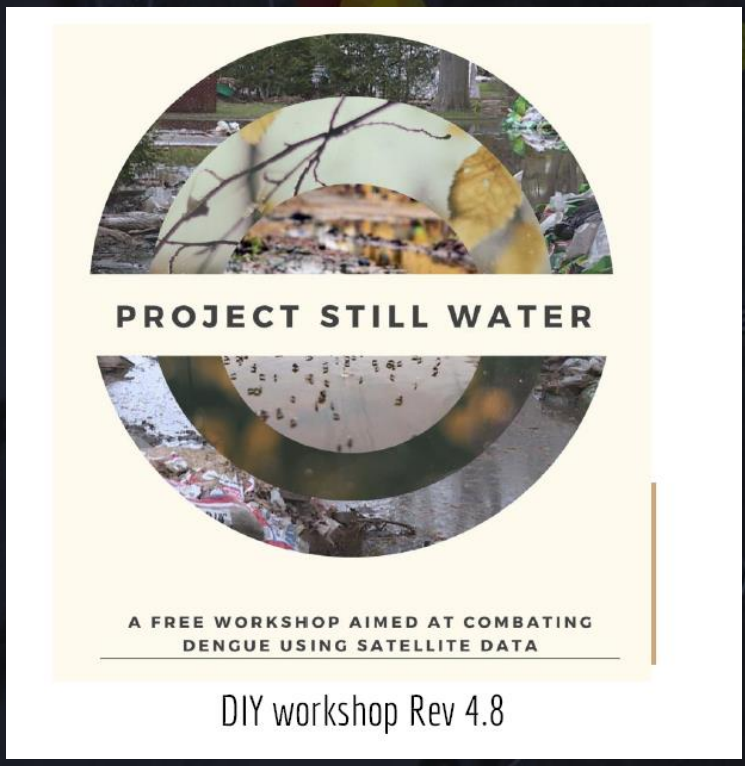
Abstract

Dengue is a mosquito-borne disease that threatens more than half of the world's population. Despite being endemic to over 100 countries, government-led efforts and mechanisms to timely identify and track the emergence of new infections are still lacking in many affected areas. Multiple methodologies that leverage the use of Internet-based data sources have been proposed as a way to complement dengue surveillance efforts. Among these, the trends in dengue-related Google searches have been shown to correlate with dengue activity. We extend a methodological framework, initially proposed and validated for flu surveillance, to produce near real-time estimates of dengue cases in five countries/regions: Mexico, Brazil, Thailand, Singapore and Taiwan. Our result shows that our modeling framework can be used to improve the tracking of dengue activity in multiple locations around the world.

Author Summary

As communicable diseases spread in our societies, people frequently turn to the Internet to search for medical information. In recent years, multiple research teams have investigated how to utilize Internet users' search activity to track infectious diseases around our planet. In this article, we show that a methodology, originally developed to track flu in the US, can be extended to improve dengue surveillance in multiple countries/regions where dengue has been observed in the last several years.

Yang, et. al. 2016



DIY workshop Rev 4.8

Chua et. al. 2018

Our Impact

For every single day we can reduce the lag in response time we save:

5
Lives

1,130
New Cases

Team AEDES

Dominic Ligot
Project Lead

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Statistical Models

Jansen Lopez
Geospatial Models

Mark Toledo
Software Engineer

Save Data. Save Lives.

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