Mapping Dengue Vulnerability in Peru

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Problem and Motivation

Mosquito-borne illnesses such as Zika, West Nile, dengue, and malaria have the capacity to wreak havoc on populations with limited access to medical services. A key factor in the prevention and containment of these diseases is the efficient identification of communities susceptible to outbreaks. This would allow healthcare providers and policy-makers to efficiently deploy limited resources. In particular, they may predict optimal times and locations to spray for mosquitoes, distribute nets, or re-allocate medical services for maximal efficacy.

Data-driven analytical tools and visual aids may greatly facilitate this process. To this end, we sought to develop an interactive visualization tool that displays the incidence of dengue in Peru per month over the years 2010 to 2014. The interaction would allow a user to easily observe temporal and geographical trends. Our choice of visualization was primarily inspired by the tool developed by [2] for studying infectious diseases in Africa.

Approach and End-Use Goals

We partnered with researchers at the UW MetaCenter for Global Disease Preparedness who were the primary source of data for this project (see paper for additional sources). The data comprised the number of dengue cases reported in each administrative division of Peru per month over the years 2010 to 2014, along with climatic variables like mean temperature, precipitation and Enhanced Vegetation Index (EVI). The team also provided insight about possible end-use cases and target audiences. Following these discussions and initial exploration, we developed a final product targeting three main questions regarding dengue infection:

Why?

Research suggests that climatic factors affect the spread of dengue; for instance, [1] establishes a strong correlation between dengue infections and precipitation in Singapore. We hope to extend this correlation to the country of Peru.

When?

Predicting when outbreaks may occur is an important goal of research in this area. To this end, we display seasonal changes in the appearance of dengue both within Peru's individual regions and among the country as a whole.

Where?

With rainforests, the Andes and an expansive coastal region, the geography of Peru is incredibly diverse. Therefore, we look at how incidence varies geographically by region as well as a factor of the EVI.

Results and Design Details

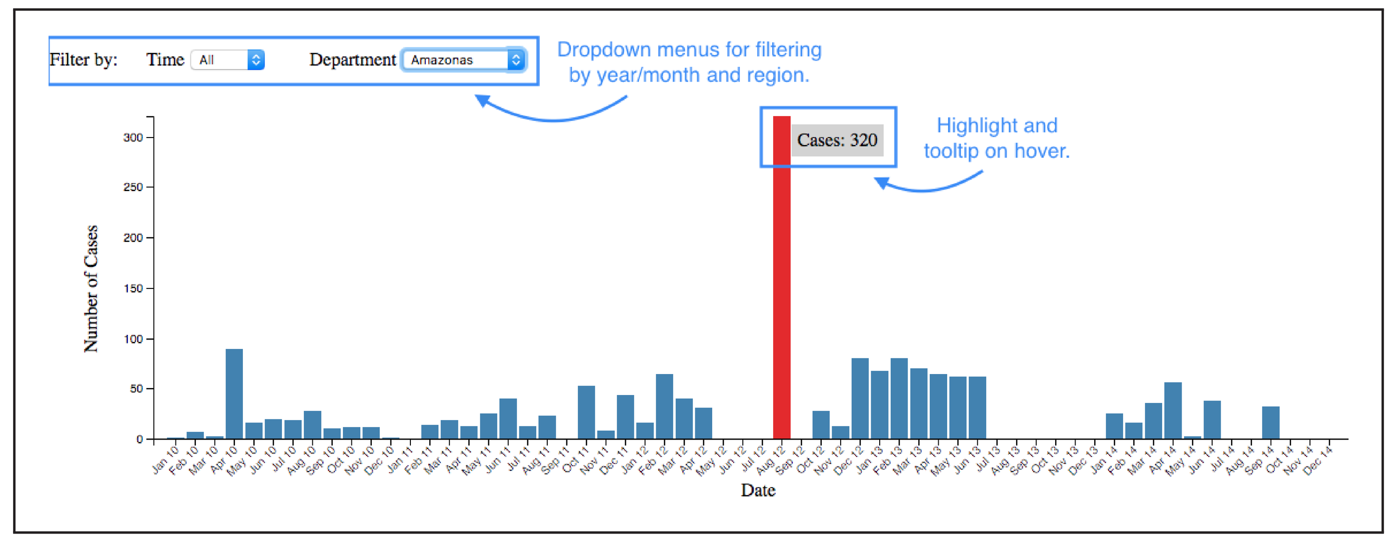

Figure 1: Incidence of dengue in Amazonas, Peru, from 2010 to 2014.

We decided to separate our design into three distinct parts. On the Home page, we focus almost entirely on the question of "**when**" by displaying incidences per month over a five-year span throughout the country as a whole in a bar chart. This allows the user to clearly see broad seasonal trends. A drop-down menu also allows for viewing aggregates by month or year, while another menu filters by region. Hovering over a bar highlights it and opens a tooltip.

On the Maps page, we focus on spatial patterns in the spread of dengue primarily to provide answers to the questions of "**where**" and "**why**".

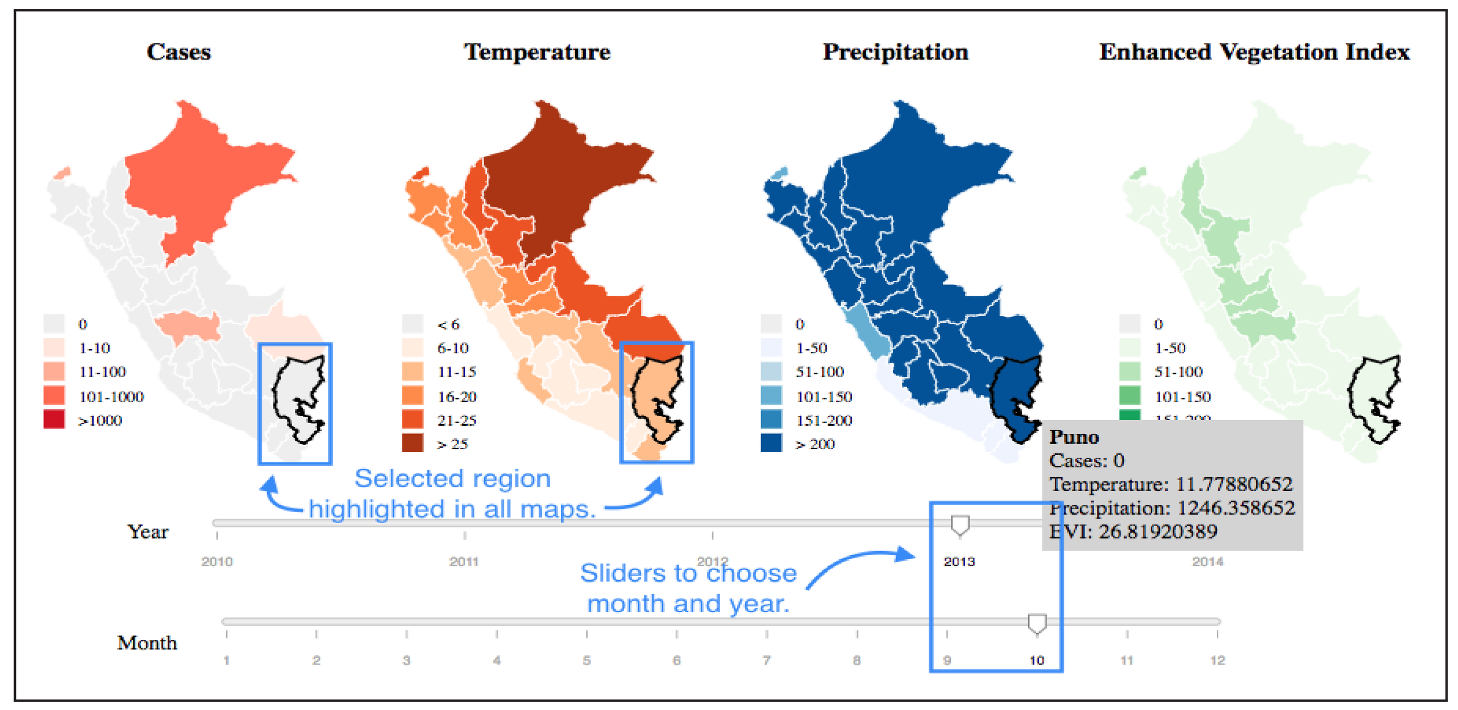

Figure 2: Maps showing dengue cases, mean temperature, precipitation and Enhanced Vegetation Index for Peru for October, 2013.

Four maps displaying the number of reported cases, mean temperature, precipitation and EVI in a fixed month and year are juxtaposed for ease of comparison. Clear geographical trends in infections are immediately apparent from the first map, while the other three demonstrate a strong appearance of correlation between each of these variables and the incidence rate of dengue at a local scale.

On hovering over a map, the corresponding region in each figure gets highlighted and a tooltip with some contextual information appears. We also include sliders to filter the mapped data by month and year. The aim is to flesh out the temporal changes displayed on the main page, this time allowing the user to compare trends in dengue infections alongside the other measures displayed.

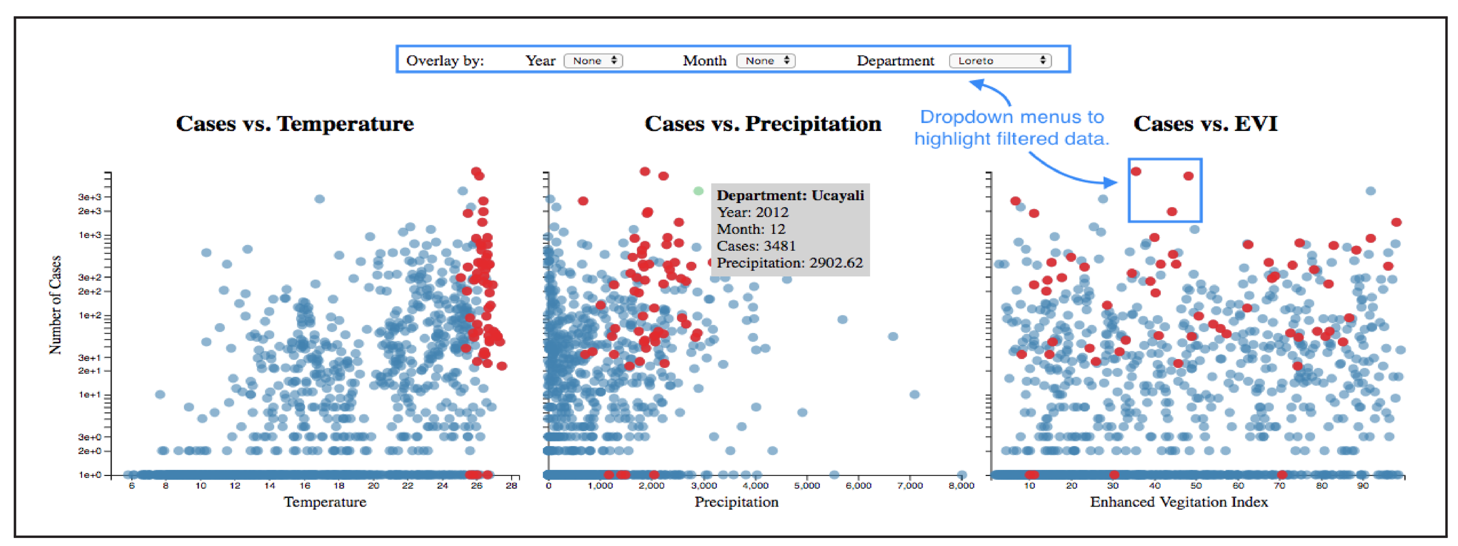

Figure 3: Cases of dengue (in log-scale) versus temperature, precipitation and EVI. The data-points corresponding to Loreto are highlighted.

Finally, the "**why**" question is further explored on the Correlations page. Small multiples are used; the visualization comprises three scatter plots showing the number of dengue infections against temperature, precipitation and EVI respectively. Data for all regions for all time periods is displayed. Selecting a particular region, month or year highlights the corresponding data points.

References

[1] Yien Ling Hii, Huaiping Zhu, Nawi Ng, Lee Ching Ng, and Joacim Rocklöv. Forecast of dengue incidence using temperature and rainfall. *PLOS Neglected Tropical Diseases*, 6(11):1–9, 11 2012.

[2] David M. Pigott et al. Local, national, and regional viral haemorrhagic fever pandemic potential in africa: a multistage analysis. *The Lancet*, 390(10113):2662–2672, December 2017.