GH33B-1196

# Evidence of coupling between El Niño-Southern Oscillation and Dengue incidence in Colombia

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AGU 100 FALL MEETING San Francisco, CA | 9–13 December 2019

## 1. Introduction

Dengue virus (DENV) is the most important vector-borne viral disease, and is mainly transmitted by the *Ae. Aegypti* mosquito[1,2]. Its spread is attributed to anthropogenic and climate conditions, being particularly susceptible to El Niño Southern Oscillation (ENSO)[2], since it can modify precipitation and temperature dynamics.

**Objective: estimate the degree of linear association between dengue incidence and ENSO in Colombia, analyzing the climate variables affected by the ENSO.**

## 2. Data

**Dengue incidence**
- SIVIGILA (INS)
- From 2007 to 2017

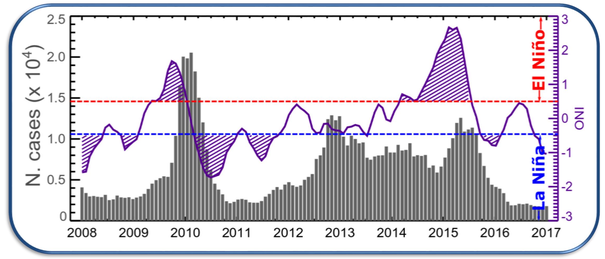
**ENSO**
- ONI (NOAA)

**Climate variables**
- IDEAM
- Daily resolution

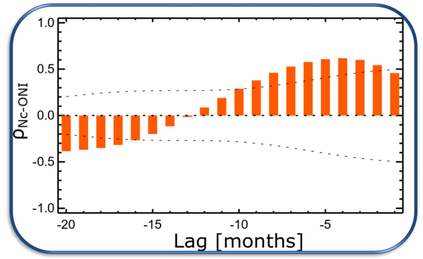
- Rainfall (P), 1595 stations
- Maximum temperature ($T_{max}$), 295 stations
- Minimum temperature ($T_{min}$), 305 stations

## 3. Results

**National scale**




Time series N. cases of DENV and ONI.




Correlogram N. cases and ONI

**Regional scale**

| Zone | P | $T_{max}$ | $T_{min}$ |
|---|---|---|---|
| Amazon | - | + | + |
| Andean | - | + | + |
| Caribbean | * | + | + |
| Orinoquia | * | + | + |
| Pacific | - | + | + |
| Colombia | - | + | + |

Correlation ONI and climate variables.

| Zone | P | $T_{max}$ | $T_{min}$ |
|---|---|---|---|
| Amazon | + | * | - |
| Andean | * | + | + |
| Caribbean | + | + | + |
| Orinoquia | * | * | + |
| Pacific | - | + | + |
| Colombia | * | * | * |

Correlation climate variables and N. cases of DENV.

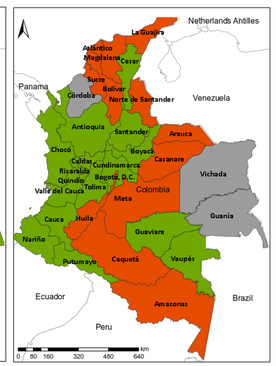
| Zone | DENV |
|---|---|
| Amazon | + |
| Andean | + |
| Caribbean | - |
| Orinoquia | - |
| Pacific | + |
| Colombia | + |

Correlation ONI and N. cases of DENV.

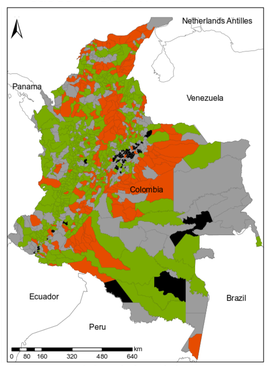
+ Positive correlation
- Negative correlation
* Not-significant correlation
nd Not enough data

**Department and local scale**


Regions




Departments




Municipalities

**Correlation sign between ONI and dengue incidence**

- Positive correlation
- Negative correlation
- Not-significant correlation
- Not enough data

## 4. Conclusions

**National scale**
- El Niño is highly correlated (ρ≈0.7) with the number of dengue cases for lags around 3 and 6 months.
- Total rainfall decreases (increases) with El Niño (La Niña), while the maximum and the minimum temperatures increase (decrease).
- Individual climate variables are not significantly correlated with the dengue incidence.

**Regional scale**
- El Niño (La Niña) increases (decreases) the number of dengue cases in the Amazon (τ=2-3 months), Pacific (ρ=0-7 months), and Andean (τ=2-9 months) regions, and decreases (increases) it in the Caribbean (τ=16-20 months) and Orinoquia (τ =15-20 months).
- El Niño (La Niña) decreases (increases) rainfall in the Amazon, Andean, and Pacific regions, and does not have a significan correlation with P in the Caribbean and Orinoquia.
- As the Caribbean is the driest region in Colombia, an increase in rainfall results in more cases of dengue. In the other regions, rainfall is not a limiting variable.

**Department and local scale**
- Positive correlations between ONI and dengue incidence are found in the zones with higher altitudes (see the map of departmental correlations).
- The higher correlations between ONI and dengue are in Antioquia, Boyacá, Cundinamarca, and Valle del Cauca departments, all of them on the Andes mountain ranges, and with positive correlations.
- Local conditions influence DENV's response to the ENSO macroclimate phenomenon.

## References

1. Lambrechts L, Scott TW, Gubler DJ. Consequences of the expanding global distribution of aedes albopictus for dengue virus transmission. PLoS Neglected Tropical Diseases. 2010;4(5).
2. Hopp MJ, Foley JA. Global-Scale Relationships between Climate and the Dengue Fever Vector, Aedes Aegypti. Climate Change. 2001;48:441–463.

## Acknowledgments

The authors thank the Programa de estudio y control de enfermedades tropicales – PECET, the Universidad Nacional de Colombia, the Instituto de Hidrología, Meteorología y Estudios Ambientales – IDEAM, and the Instituto Nacional de Salud de Colombia – INS.