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

Estefania Munoz<sup>1</sup>, María Arbela<br/>ez<sup>2</sup>, Lina Zuluaga<sup>2</sup>, Luis Martínez<sup>2</sup>, Iván Vélez<sup>2</sup>, and Víctor Villa<sup>2</sup>

<sup>1</sup>Universidad Nacional de Colombia; PECET - World Mosquito Program Colombia <sup>2</sup>PECET - World Mosquito Program Colombia

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#### Abstract

The El Niño-Southern Oscillation (ENSO) phenomenon is the main mechanism forcing climate variability in tropical South America in several timescales, impacting the life cycles of disease vectors and host/vector relationships. The dengue is a vectorborne disease with great socioeconomic impact in Colombia, being the arbovirus with the highest mortality. In this analysis, we related the records of Dengue cases registered in Colombia in the period 2007-2017 and the series of sea surface temperature anomalies in the Niño 3.4 region. Furthermore, we studied the effect of the ENSO on precipitation, relative humidity, maximum and minimum air temperature, and wind velocity in Colombia to understand the impact of the ENSO in the dengue incidence. The effect of the ENSO on climatic variables spatially varies. During the warm (cold) phase, i.e., El Niño (La Niña), the maximum and minimum air temperature increase (decrease) throughout the country, but in the Amazonian region, it is less likely to occur. During El Niño the mean rainfall decreases, except in the Orinoquía region where it can increase. In the Pacific and Caribbean regions, rainfall is more likely to decrease in this phase of the ENSO, while surface radiation increases in the Andean region. Wind speed increases in the Andean, Caribbean and Pacific regions, and decreases in the Orinoquía and Amazonian regions. El Niño phase intensifies the incidence rate of Dengue in the Andean, Caribbean, and Pacific regions (correlation between 0.3 and 0.8 with 95% of confidence for lags between 1 and 14 months approximately) and La Niña in the Amazonian and Orinoquía regions (correlation between 0.2 and 0.5 with 95% of confidence for lags between 10 and 20 months approximately). The above should be explained by the decreasing in rainfall and increasing on temperature and wind velocity (less relative humidity) in the Andean, Caribbean and Pacific regions, and the increase in radiation in the Andean region during El Niño. On the other hand, during La Niña, rainfall decreases in the Orinoquía region and decreases on the temperature are unlike in the Amazonian region.





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## . Introduction

Dengue virus (DENV) is the most important vector-borne viral disease, and is mainly transmitted by the Ae. Aegypti mosquito<sup>1,2</sup>. Its spread is attributed to anthropogenic and climate conditions, being particularly susceptible to El Niño Southern Oscillation (ENSO)<sup>2</sup>, 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<sub>max</sub>), 295 stations
- Minimum temperature (T<sub>min</sub>), 305 stations

### References

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

Estefanía Muñoz<sup>2</sup>, M. Patricia Arbeláez<sup>1,2</sup>, Iván D. Veléz<sup>1,2</sup>, Luis Martínez<sup>2</sup>,

Lina Zuluaga<sup>2</sup> & Víctor Villa<sup>2</sup>

<sup>1</sup>Universidad de Antioquia, <sup>2</sup>World Mosquito Program. e-mail: estefania.munoz@worldmosquito.org



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• El Niño is highly correlated ( $\rho \approx 0.7$ ) 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

Individual climate variables are not significantly correlated with the dengue incidence.

• El Niño (La Niña) increases (decreases) the number of dengue cases in the Amazon ( $\tau$ =2-3 months), Pacific ( $\rho$ =0months), and Andean ( $\tau$ =2-9 months) regions, and decreases (increases) it in the Caribbean (τ=16-20 months) and Orinoquia ( $\tau = 15-20$  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

• 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.

Positive correlations between ONI dengue and 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.

