Analyzing climate variations at multiple timescales can guide Zika virus response measures

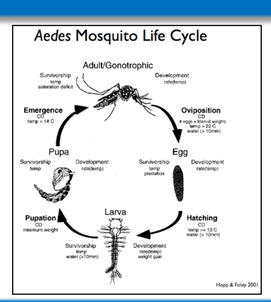
Á.G. Muñoz[1,2,3], M.C. Thomson[2,4,5], L. Goddard[2], S. Aldighieri[6]

[1]Atmospheric and Oceanic Sciences (AOS)/Geophysical Fluid Dynamics Laboratory (GFDL). Princeton University. New Jersey. United States of America. [2]International Research Institute for Climate and Society (IRI). Earth Institute. Columbia University. New York. United States of America. [3]Latin American Observatory for Climate Events (OLE2). Centro de Modelado Científico (CMC). Universidad del Zulia. Venezuela. [4] Mailman School of Public Health Department of Environmental Health Sciences. Columbia University. New York. United States of America. [5] WHO Collaborating Centre (US 306) on Early Warning Systems for Malaria and other Climate Sensitive Diseases. United States of America. [6] IHR, Epidemic Alert and Response, and Water Borne Diseases. Communicable Diseases and Health Analysis. Pan American Health Organization (PAHO)/World Health Organization (WHO). Washington DC. United States of America.

agms@princeton.edu

Motivation

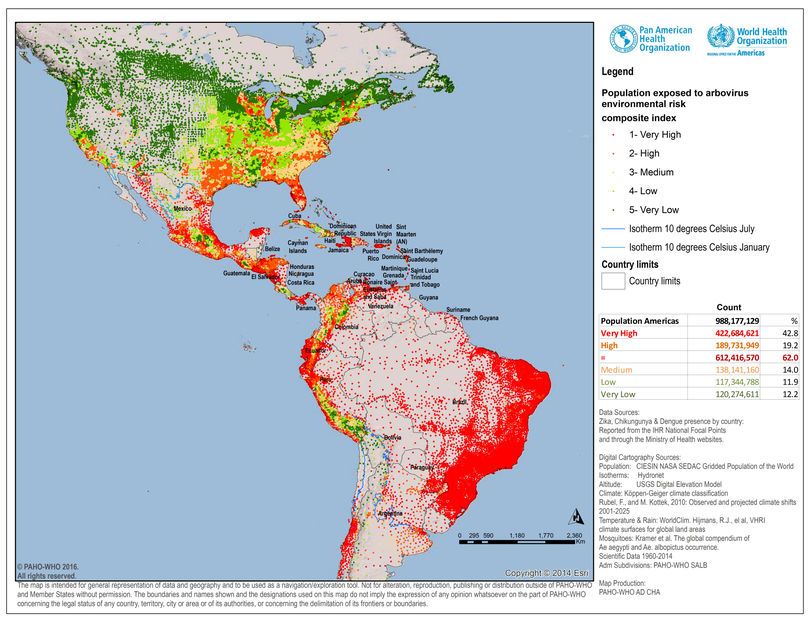
Zika virus (ZIKV) is a major threat, with potentially more than 2 billion people at risk of infection [Messina *et al*., 2016]. <u>*Both the ZIKV and mosquito vectors are sensitive to climate*</u> [Muñoz *et al.,* 2016c].



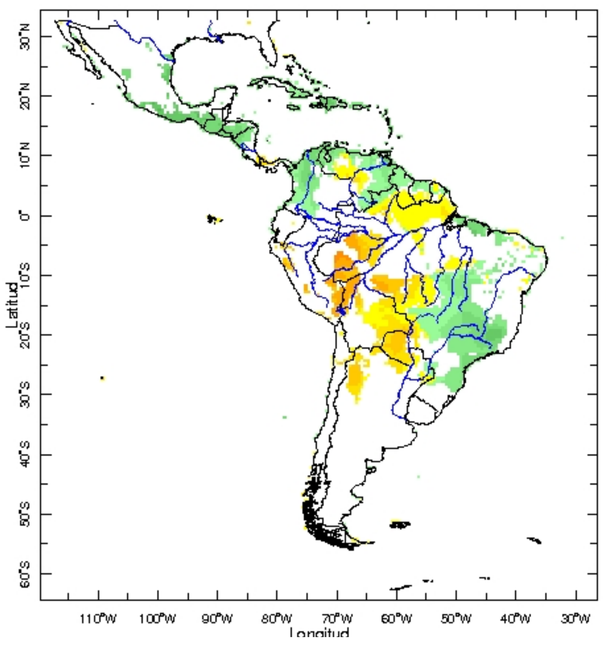
Goals

To provide timely, tailored and action-oriented health and climate services to decision-makers in Latin America and the Caribbean (e.g., monthly-updated ZIKV potential risk maps as the ones shown below). In order to achieve that goal, first we need to understand what particular climate signals are in play during the present ZIKV epidemic.

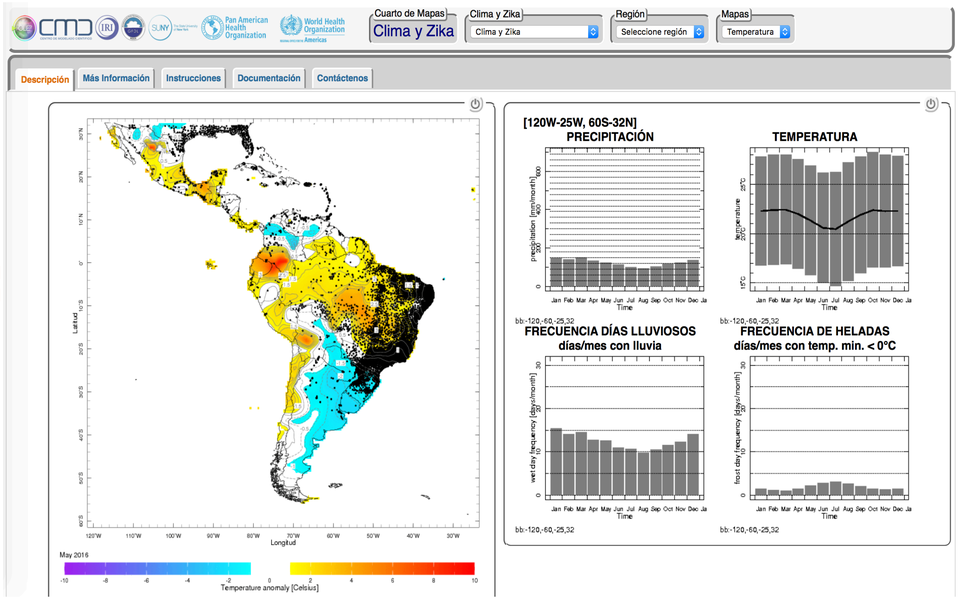
Health & Entoepidemiology Info



Climate Information

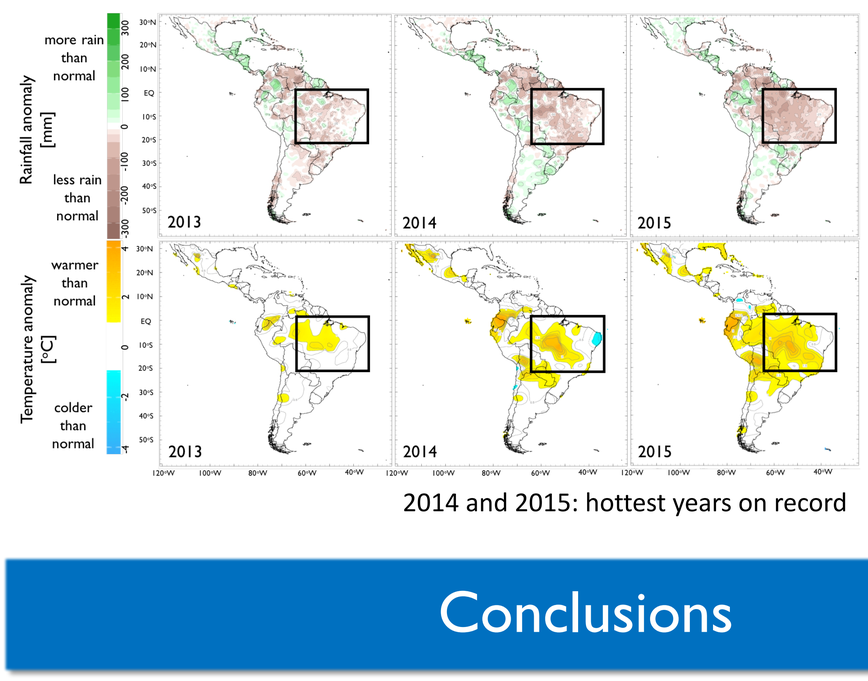


Health Service: Dynamic Risk Maps



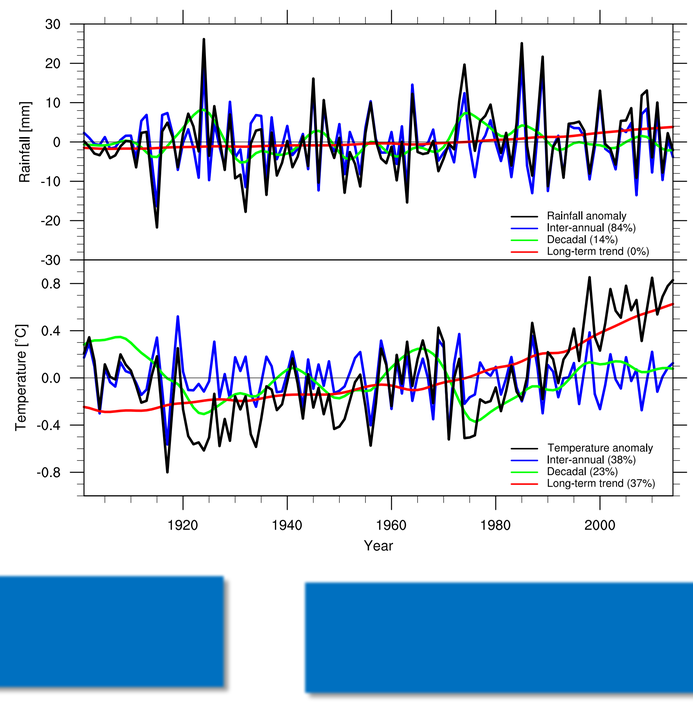
Muñoz *et al* 2016b; Muñoz *et al* (in prep.)

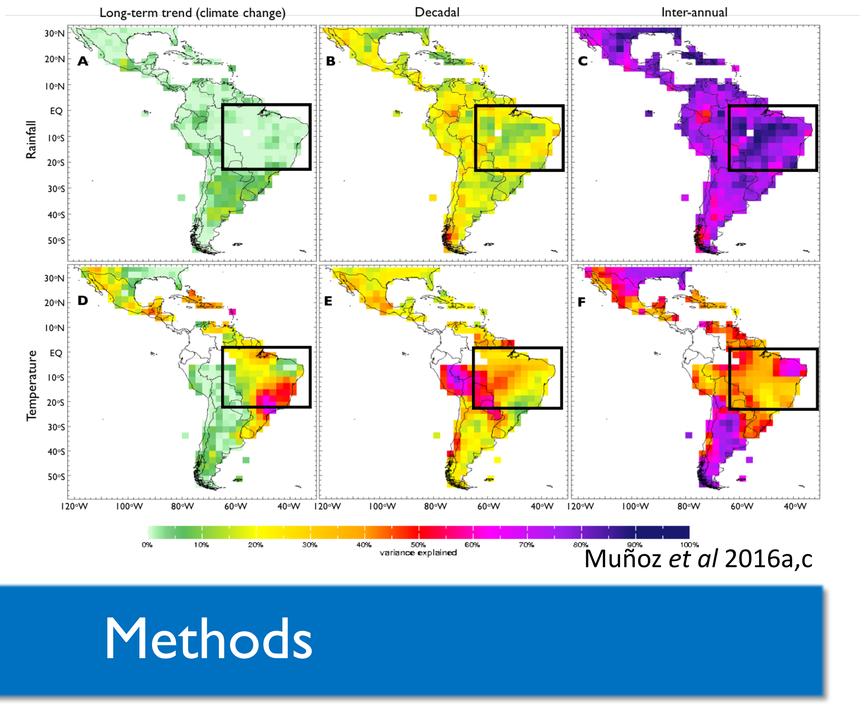
Recent climate



2014 and 2015: hottest years on record

Climate varies at multiple timescales





Muñoz *et al* 2016a,c

Conclusions

- Using a novel timescale-decomposition methodology, we demonstrate that the extreme climate anomalies observed in most parts of South America during the current epidemic are not caused exclusively by El Niño or climate change, but by a combination of climate signals acting at multiple timescales.
- In Brazil, the dry conditions present in 2013–2015 are primarily explained by year-to-year variability superimposed on decadal variability, but with little contribution of long-term trends.
- In contrast, the warm temperatures of 2014–2015 resulted from the compound effect of climate change, decadal and year-to-year climate variability.
- ZIKV response strategies made during Brazil's drought Brazil during El Niño 2015–2016, may require revision in light of the likely return of rainfall associated with the present La Niña event.
- Temperatures are likely to remain warm given the importance of long term and decadal-scale climate signals.

Methods

- individual gridbox values are first screened for filled data and for very dry seasons and regions;
- time-series are detrended via regression of the local time-series on multimodel global surface air temperature data from the Twentieth Century Climate in Coupled Models;
- order-five Butterworth filtering process with half-power at a period of 10 years, to separate high and low frequency components in the detrended data;
- inter-annual component is computed as the difference between resiudal from detrending step and decadal signal.

More info: Greene *et al.,* 2011; Muñoz *et al* 2016a,c

References

Greene, A., L. Goddard and R. Cousin, 2011: Web tool deconstructs variability in twentieth-century climate. EOS Trans Amer Geo Union. DOI: 10.1029/2011EO450001

Messina *et al*, 2016: Mapping global environmental suitability for Zika virus. DOI: 10.7554/eLife.15272

Muñoz, Thomson, Goddard and Aldighieri, 2016a: The Latin American and Caribbean Climate Landscape for ZIKV Transmission. IRI Tech Report 2016-01. DOI: 10.7916/D8X34XHV

Muñoz, Á.G., X. Chourio, M.C. Thomson, A. Stewart, P. Nájera, R. Cousin, 2016b: Towards a ZIKV Climate-Health Service at the Latin American Observatory. DOI: 10.13140/RG.2.1.1348.0560

Muñoz, Á.G., M.C. Thomson, L. Goddard and S. Aldighieri, 2016c. DOI 10.1186/s13742-016-0146-1