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Relación entre vector y clima: No todo es culpa del cambio climático

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- El calentamiento promedio de la superficie del planeta. CALENTAMIENTO GLOBAL O CAMBIO CLIMATICO.
- HIPOTESIS 1: Adaptarse a la temperatura.
- HIPOTESIS 2: Lo urbano.
- Comentarios finales.

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Calentamiento global de 1880 a 2015

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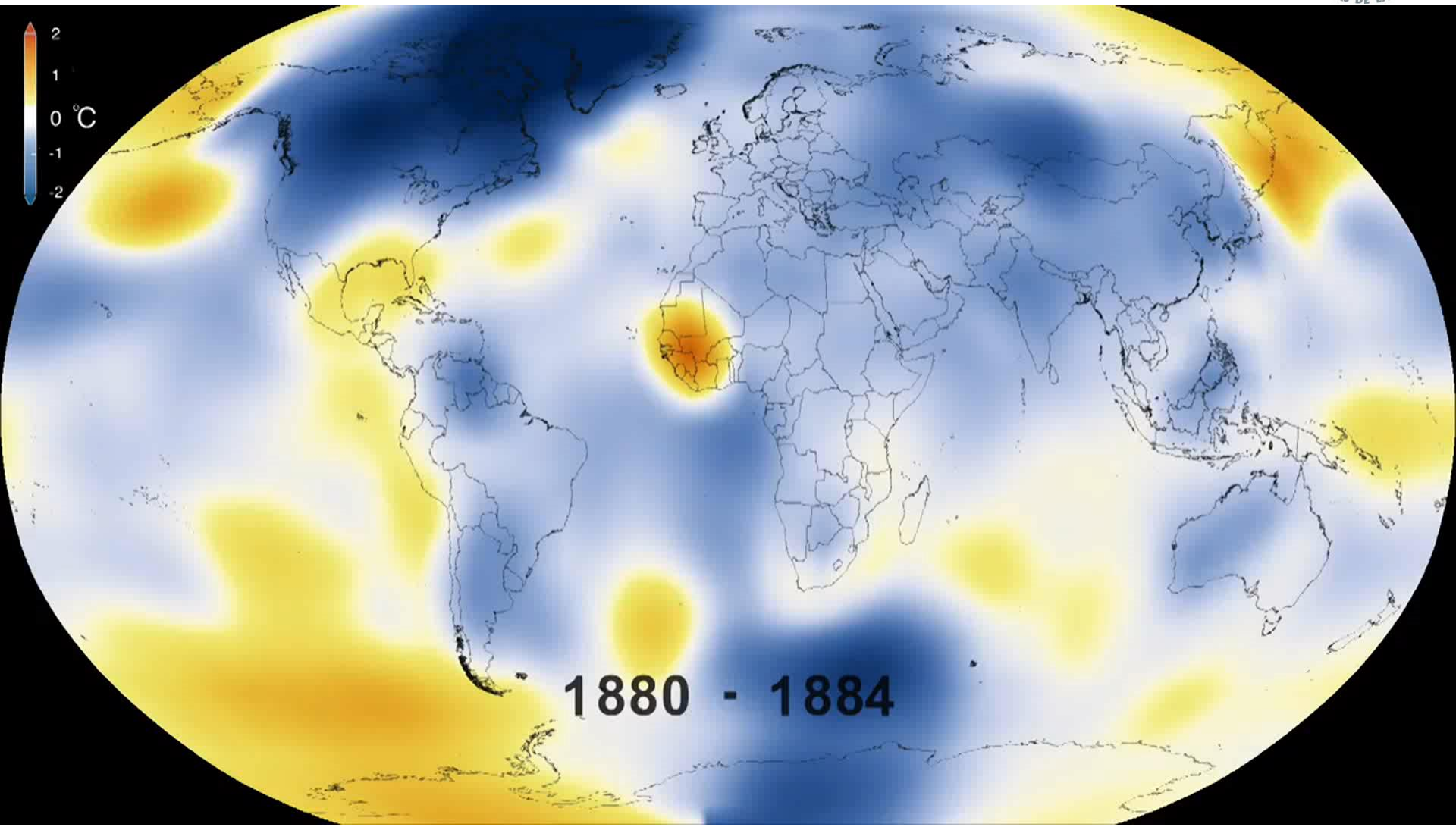

(NASA, 2016)

http://climate.nasa.gov/climate_resources/139/

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Adapt or not to adapt, That is the question!

- Proceso a escala global y local:
  - ¿A qué se enfrentan las especies?
    - Impactos ante eventos extremos
    - Modificación de la Temperatura
    - Modificación en la Precipitación
    - Incremento del nivel del mar

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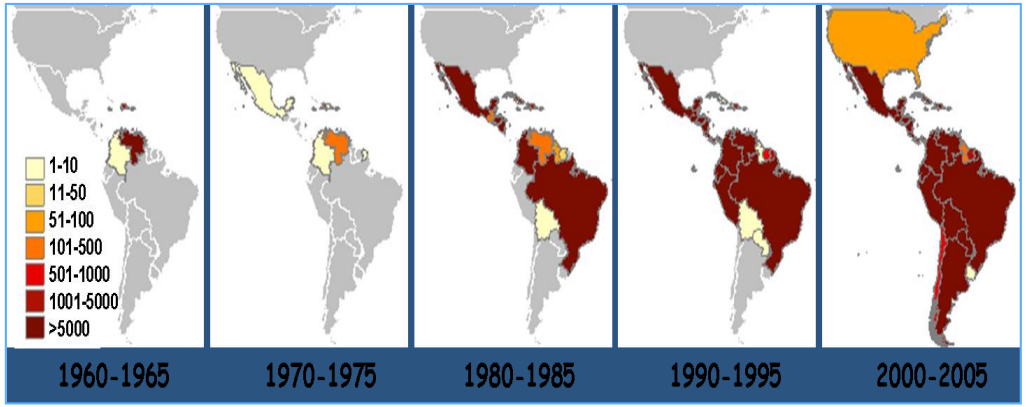
Dengue Fever

- Dengue Fever and Dengue Hemorrhagic Fever are caused by dengue viruses transmitted by *Aedes* mosquitoes
- Annually, more than 100 million people contract dengue worldwide
  - 500,000 people develop severe dengue hemorrhagic fever every year
  - No vaccine available
  - Increasing number and severity of cases in the Americas…



Source: WHO DengueNet

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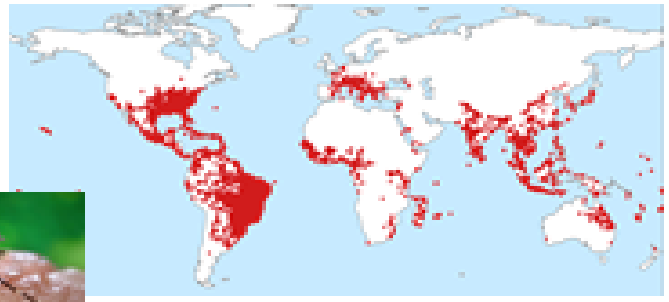
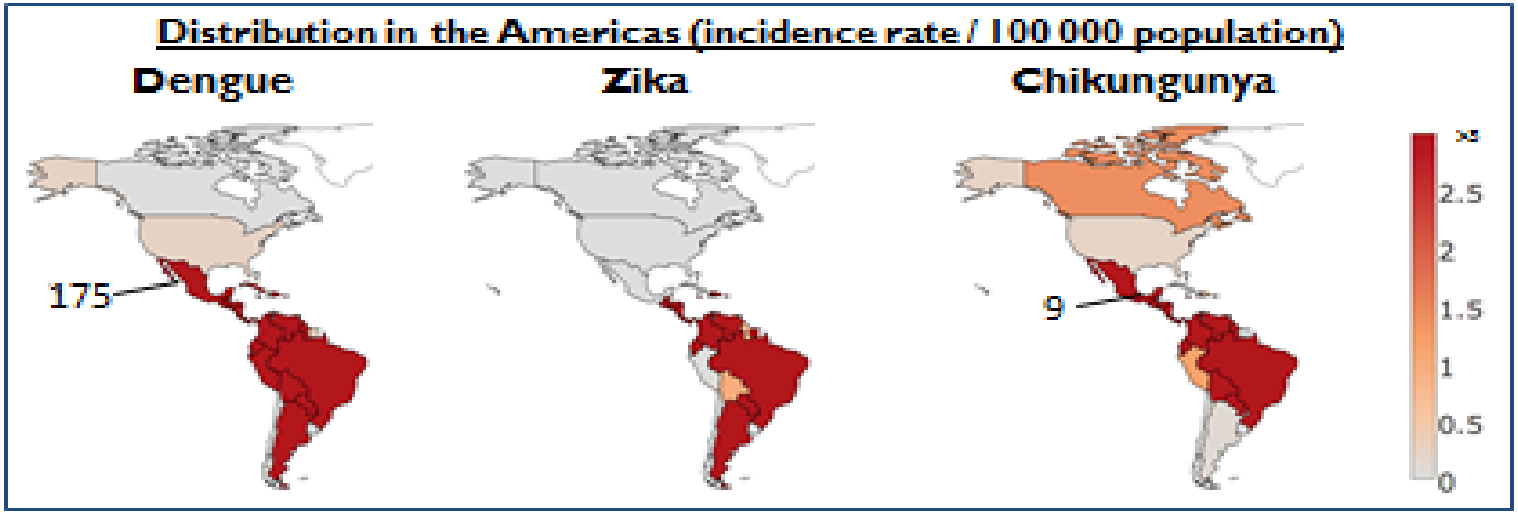
MOSQUITO-BORNE VIRUSES

- 3.8 billion people in endemic areas
- 128 countries
  - Dengue (390 M cases/year)
  - Zika (0.4-1.3 M cases in Brazil alone in 2015)
  - Chikungunya (0.5-6 M cases/year)

Distribution of Aedes Aegypti and Aedes Albopictus



Distribution in the Americas (incidence rate / 100 000 population)



Kraemer MUG, et al. Dryad Digital Repository.
Weaver SC, et al. Expert review of vaccines. 2012;11(9).
WHO, PAHO data repositories

Dengue, Zika and Chikungunya co-circulate and share the same vector

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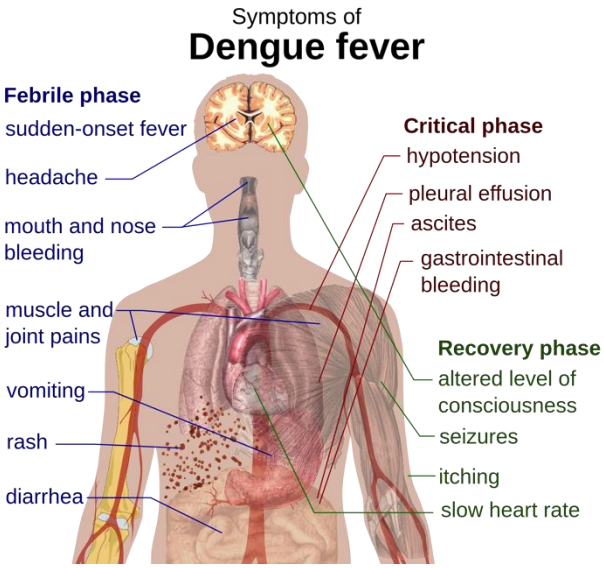
Symptoms	Zika	Dengue	Chikungunya
Fever	++	+++	+++
Rash	+++	+	++
Conjunctivitis	++	-	-
Athralgia	++	+	+++
Myalgia	+	++	+
Headache	+	++	++
Mouth/nose bleeding	-	++	-
~% asymptomatic	80	75	3-28
Incubation period	2-7 days	5-7 days	3-7 days

Clinical complications	Zika	Dengue	Chikungunya
Hemorrhagic fever	-	++	-
Shock	-	++	+
Guillian-Barré	++	-	+
Microcephaly	++	-	-
Disabling joint pain	-	-	++
Arthritis	-	-	++

Similar initial symptoms
Different disease outcomes



CDC, WHO

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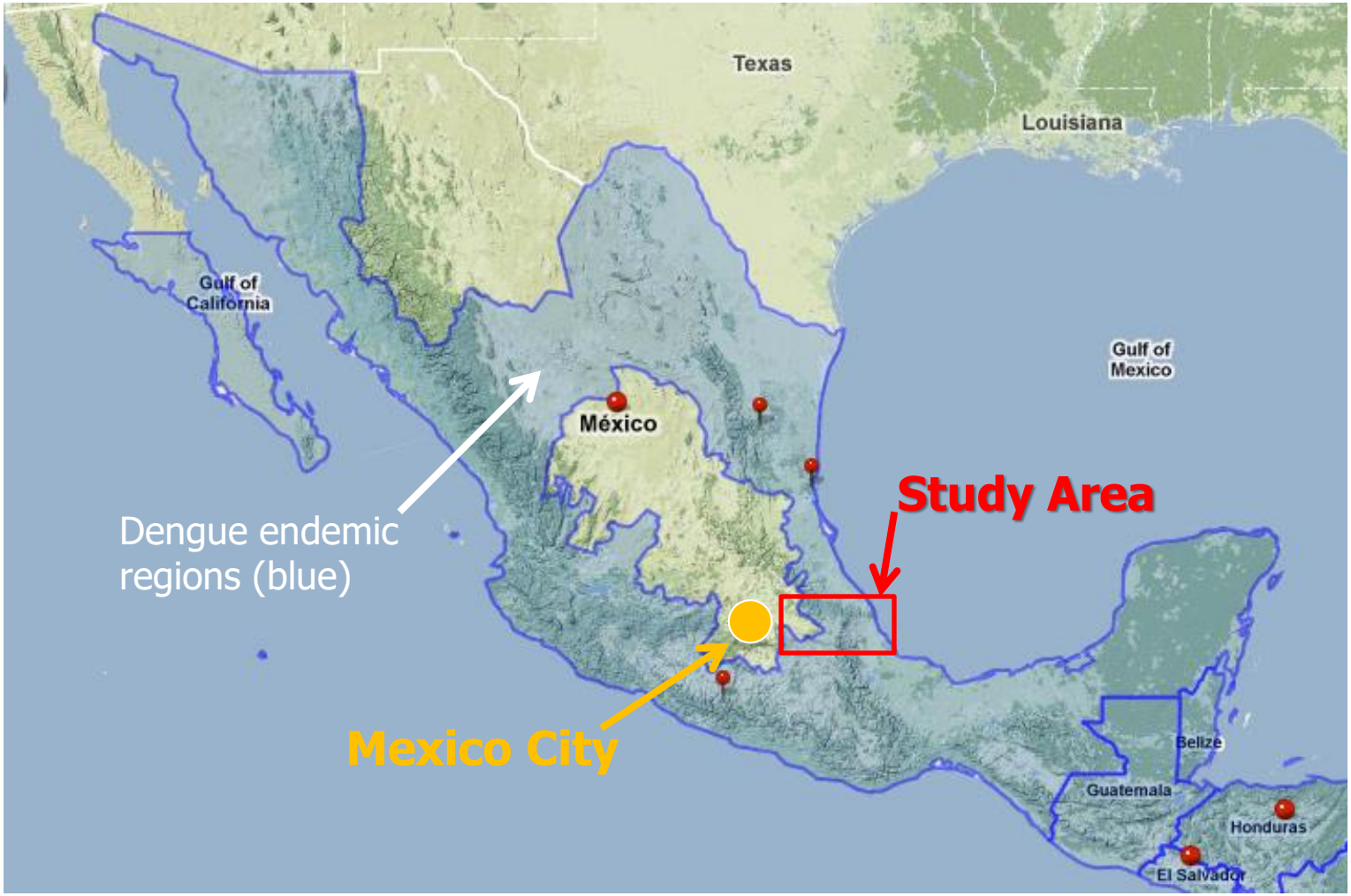
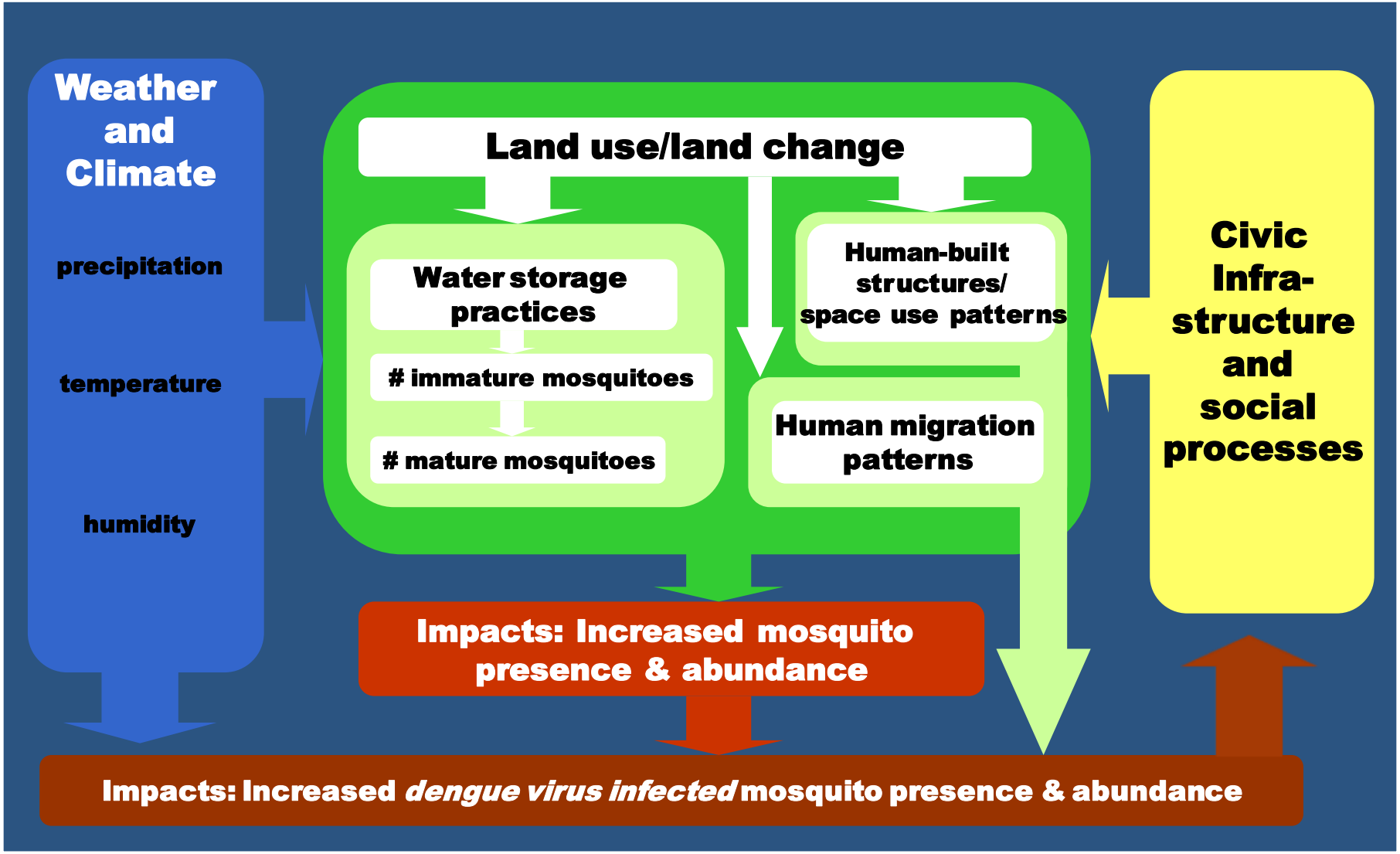
Vector presence at Mexico.



Source: DengueMap – a CDC-HealthMap collaboration)

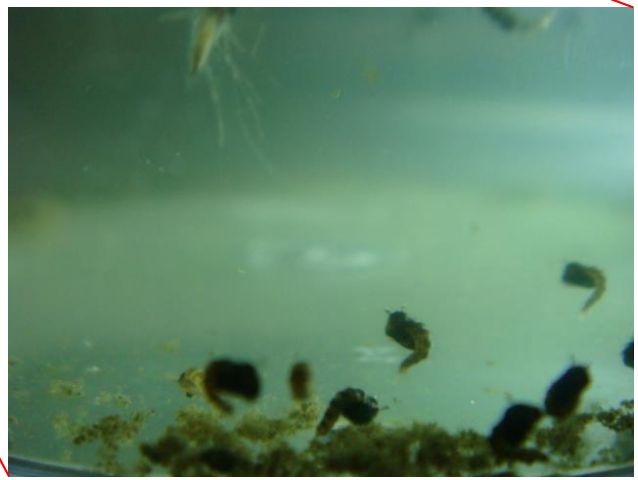
Framework for *Aedes aegypti* Study



Hayden et al, 2011

Fieldwork for *Aedes aegypti*

Pupae and larvae collection at Córdoba ,Veracruz.



We arrive at 2011: To Collect weather and climate data (in situ), to collect data on mosquito presence/abundance and to conduct focus groups

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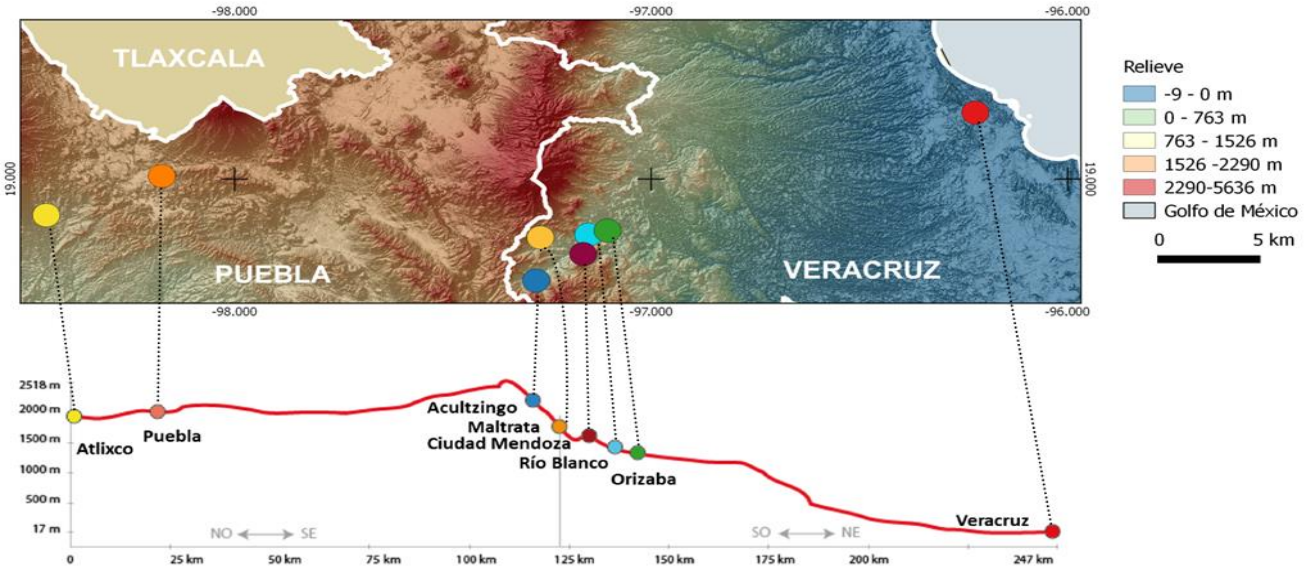
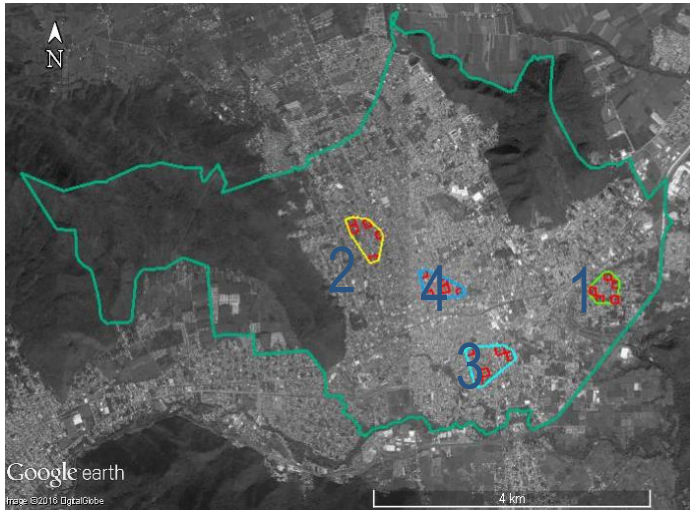
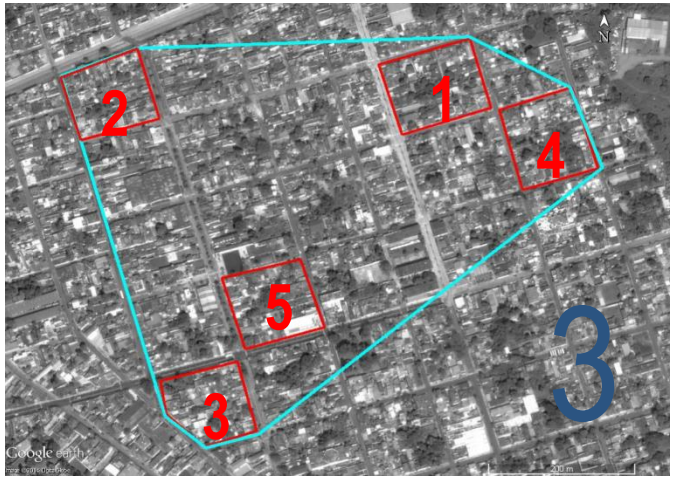
Transecto de estudio: Veracruz- Puebla







Clusters at Orizaba, Veracruz.

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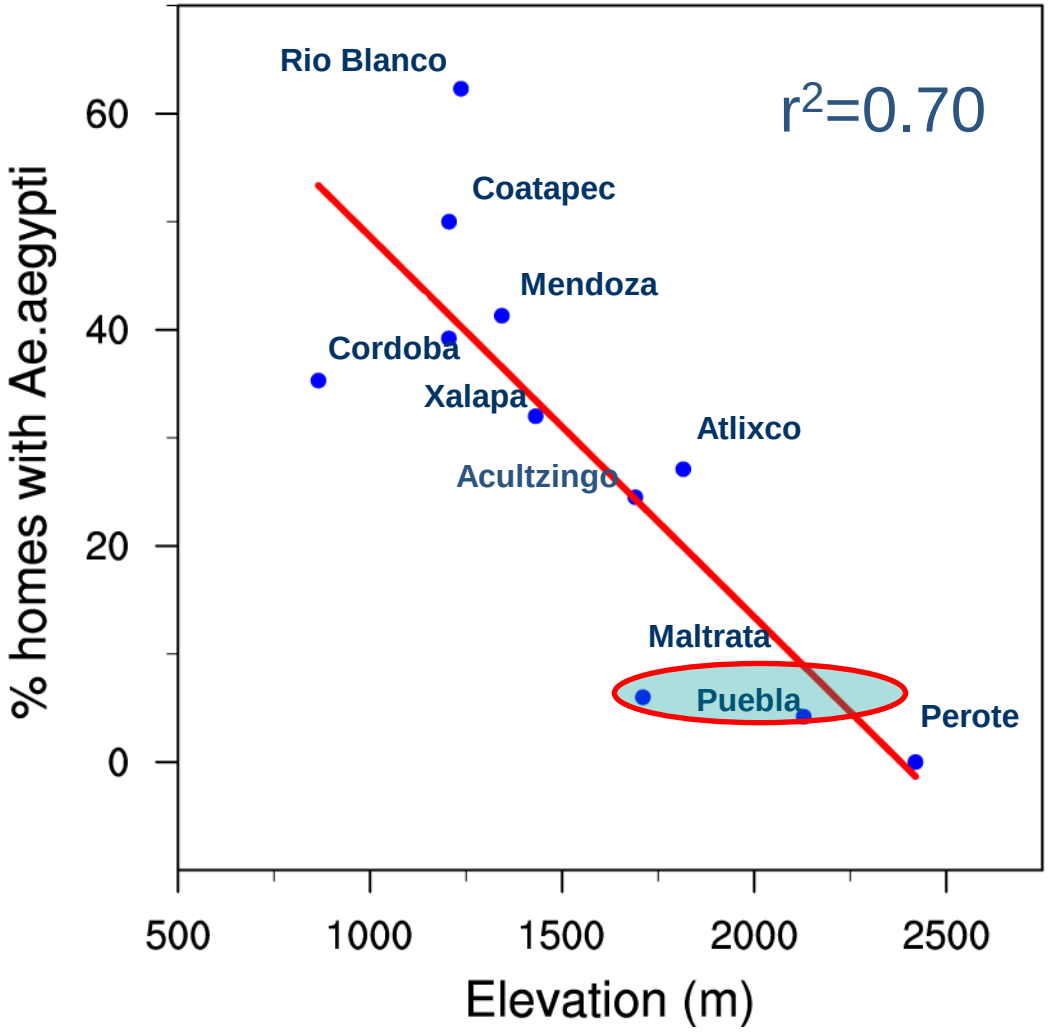
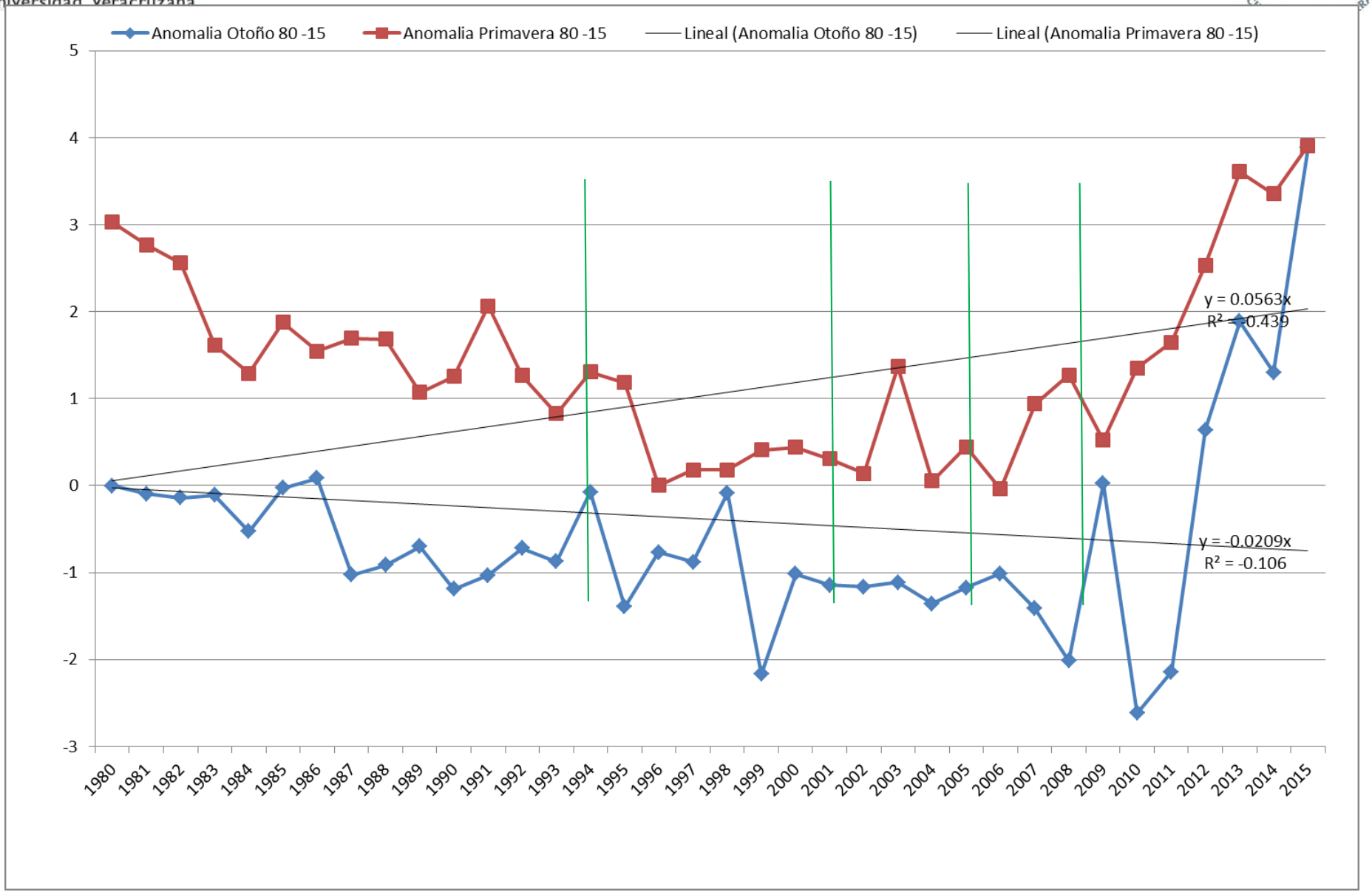
Results

Estimated % of homes with Ae.aegypti vs. Median elevation



**Based on sample of ~50 homes per city*


Anomalia Otoño 80 -15
Anomalia Primavera 80 -15
Lineal (Anomalia Otoño 80 -15)
Lineal (Anomalia Primavera 80 -15)
y = 0.0563x
R² = 0.439
y = -0.0209x
R² = -0.106
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-3
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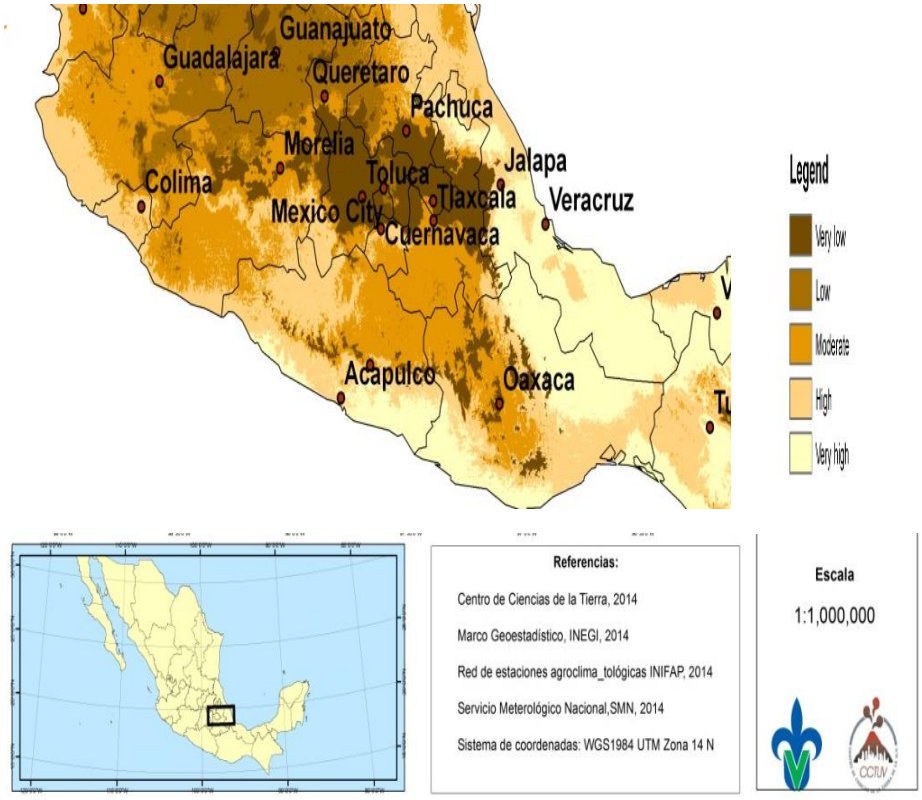
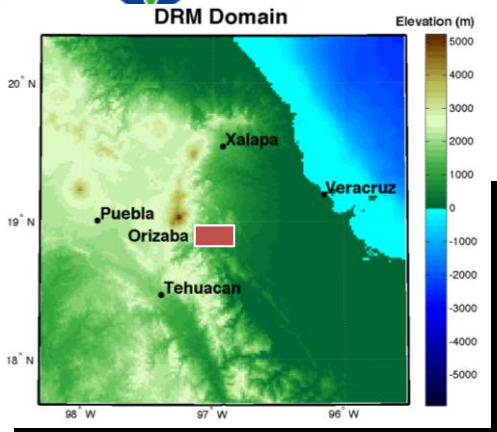
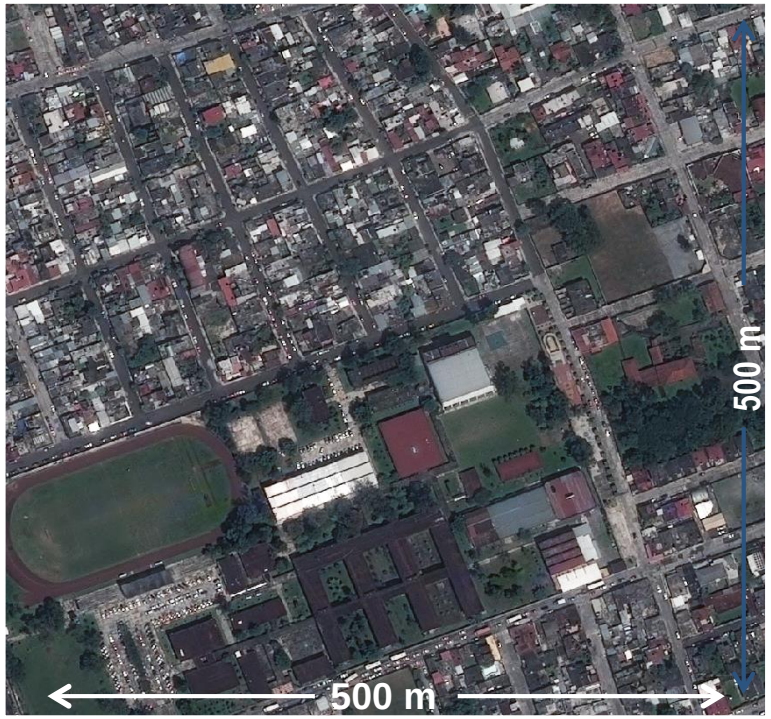
Vector risk scenario



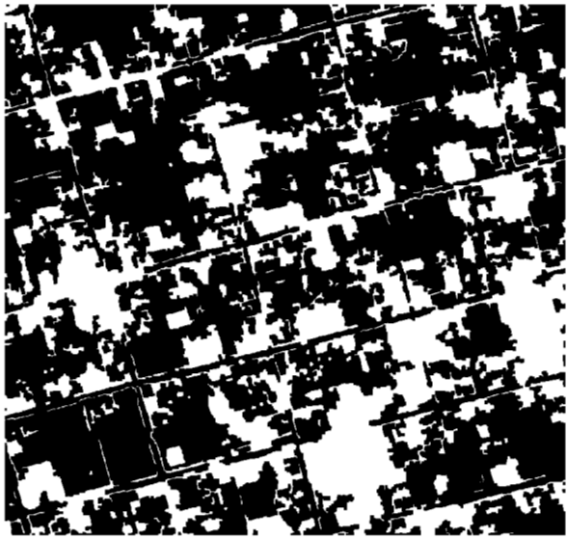
Geospatial Data

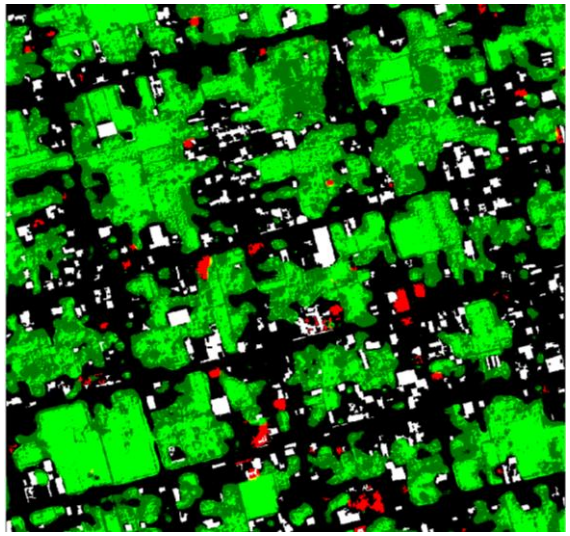




- Collected in September 2013
- 50 cm resolution, 4 channels (red, green, blue, near infra-red

Visible Imagery





Building Area

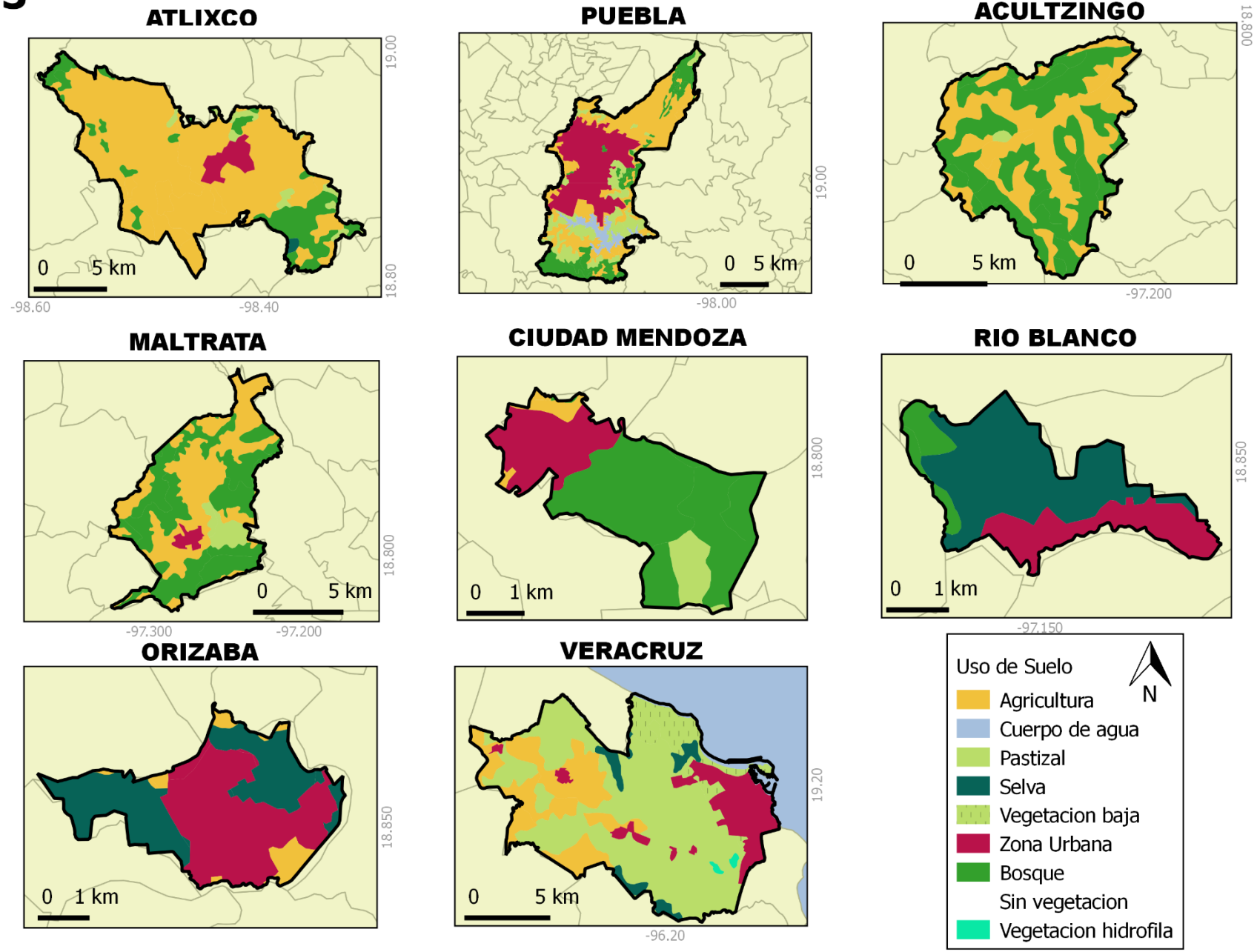
- Buildings
- Other

Image Classification

- Red tile roof
- White concrete roof
- Vegetation (grass)
- Vegetation (trees)
- Unclassified

Satellite Imagery Algorithm
(Preliminary Results @ 0.5 km Resolution)

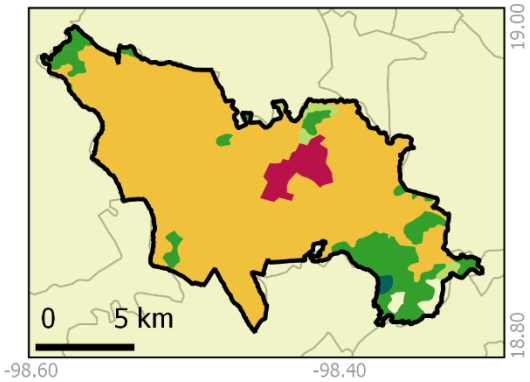
1993



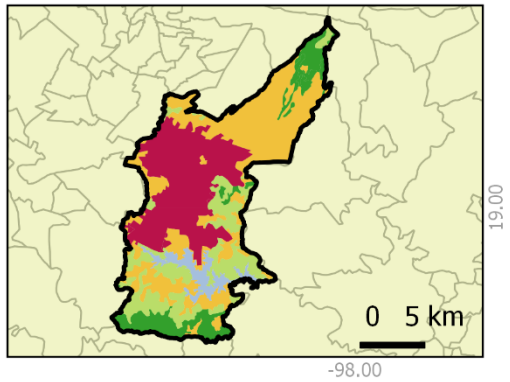
Fuente: INEGI, Uso de suelo serie II
Elaborado por: Q'enty Delgado, 2016

2002

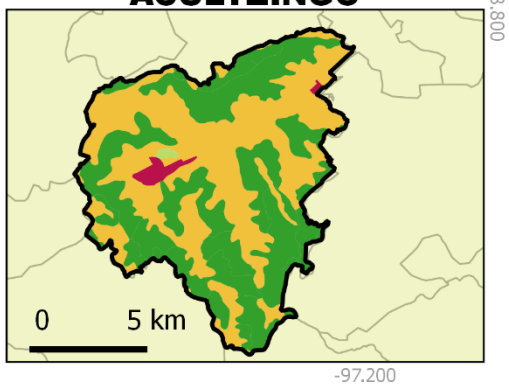
ATLIXCO



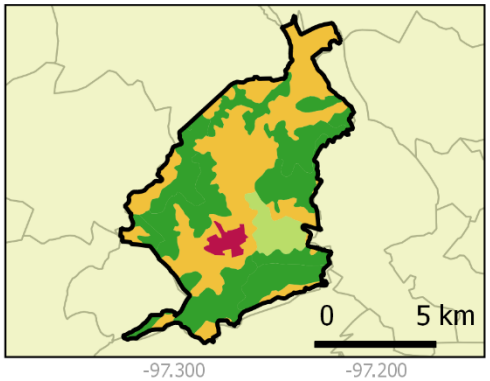
PUEBLA



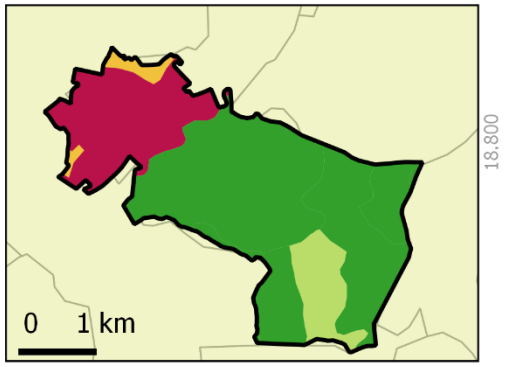
ACULTZINGO



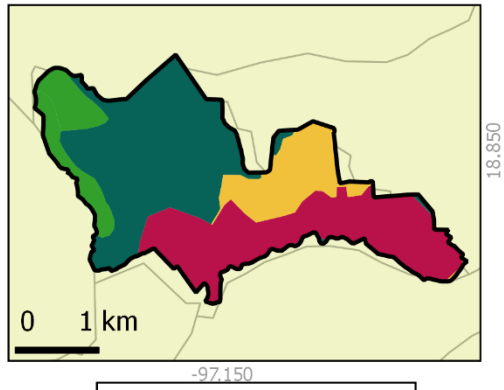
MALTRATA



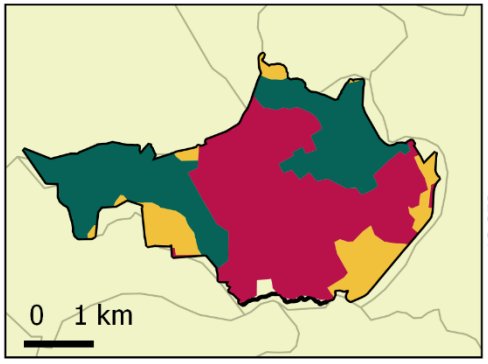
CIUDAD MENDOZA



RIO BLANCO



ORIZABA



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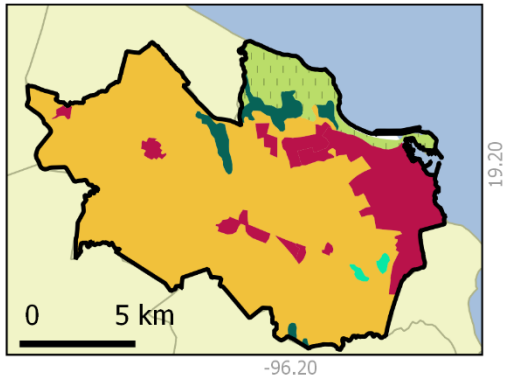
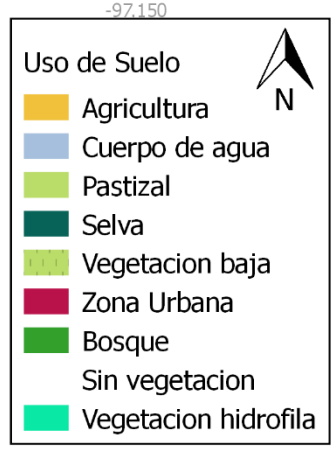
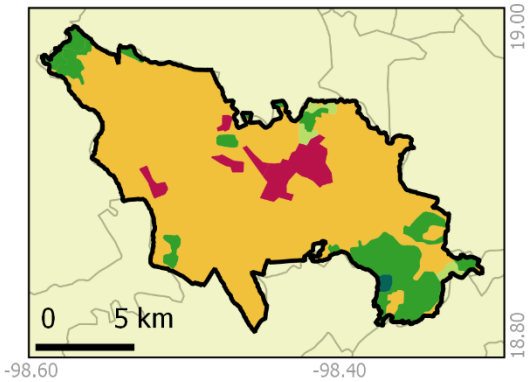




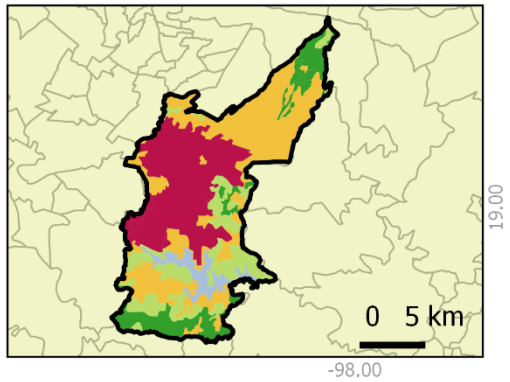
Fuente: INEGI, Uso de suelo serie I
Elaborado por: Q'enty Delgado, 2016

2007

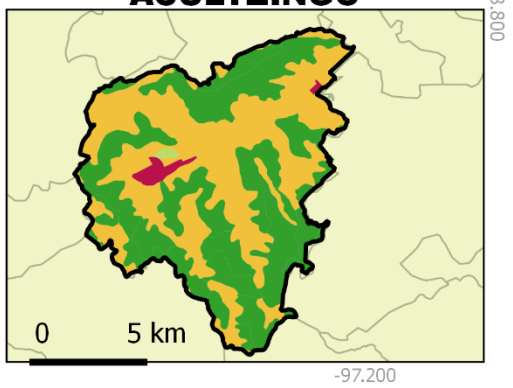
ATLIXCO



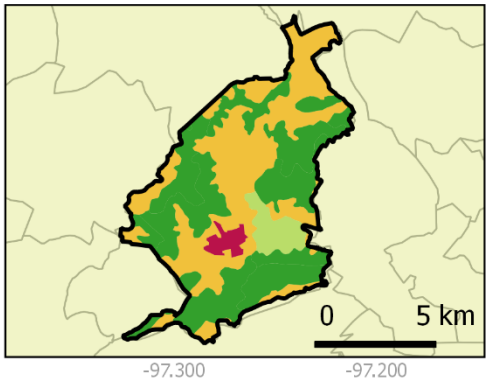
PUEBLA



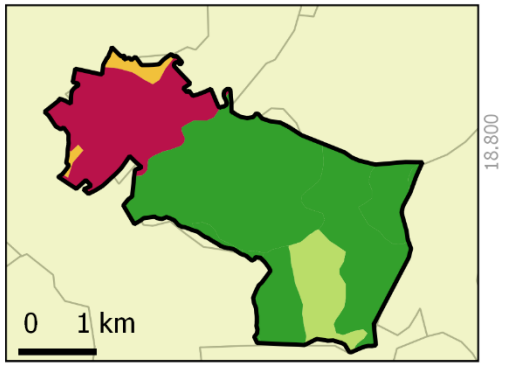
ACULTZINGO



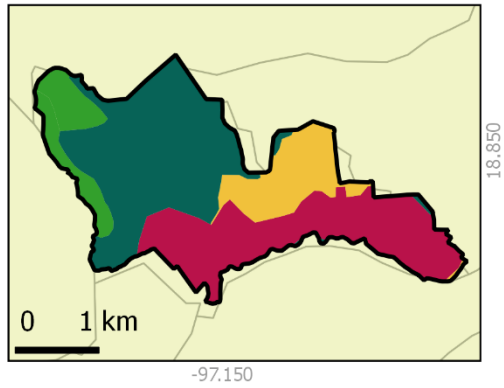
MALTRATA



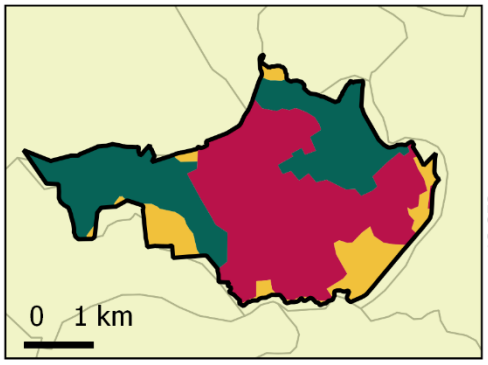
CIUDAD MENDOZA



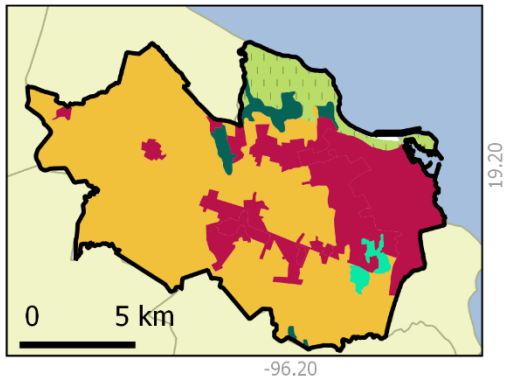
RIO BLANCO



ORIZABA

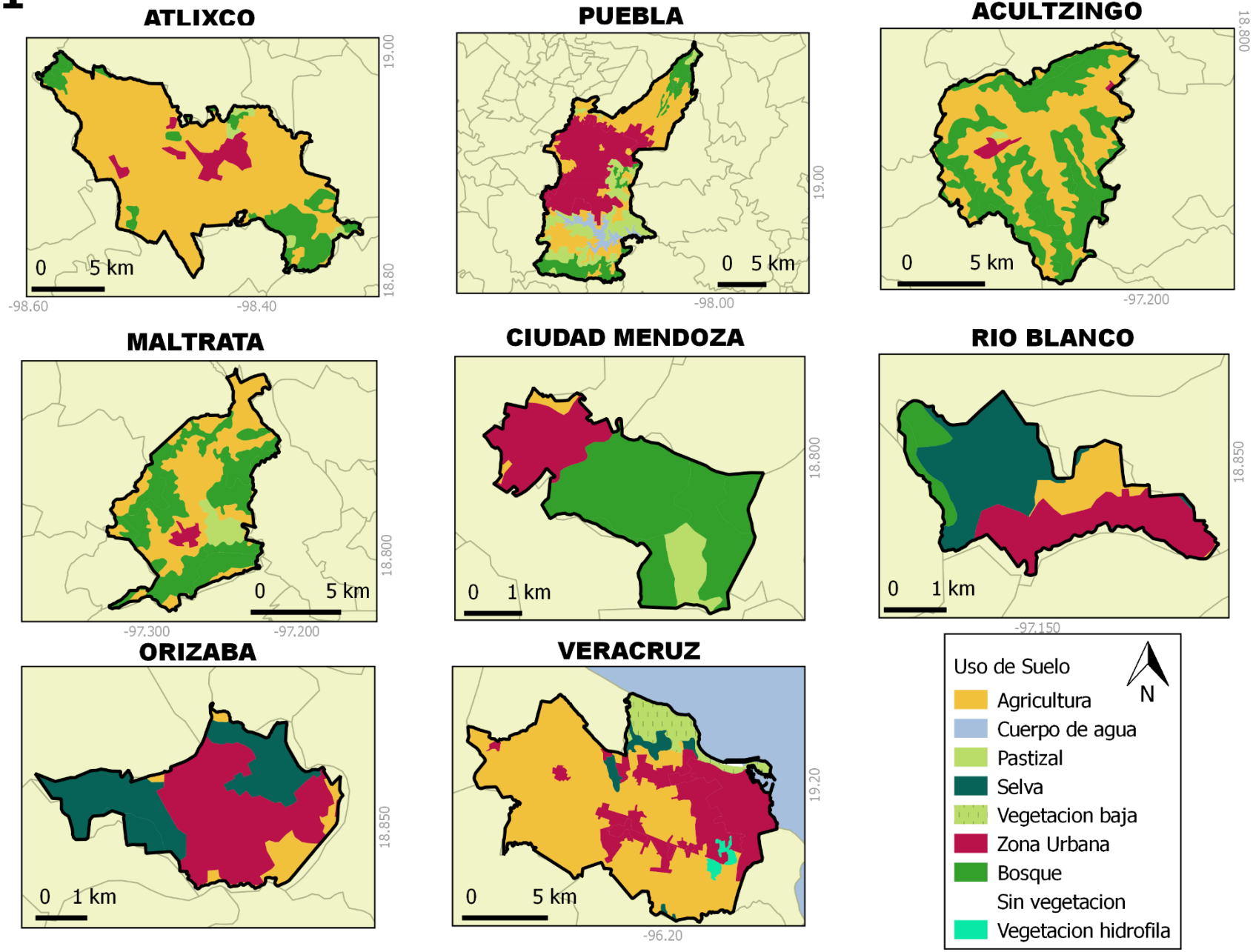


VERACRUZ



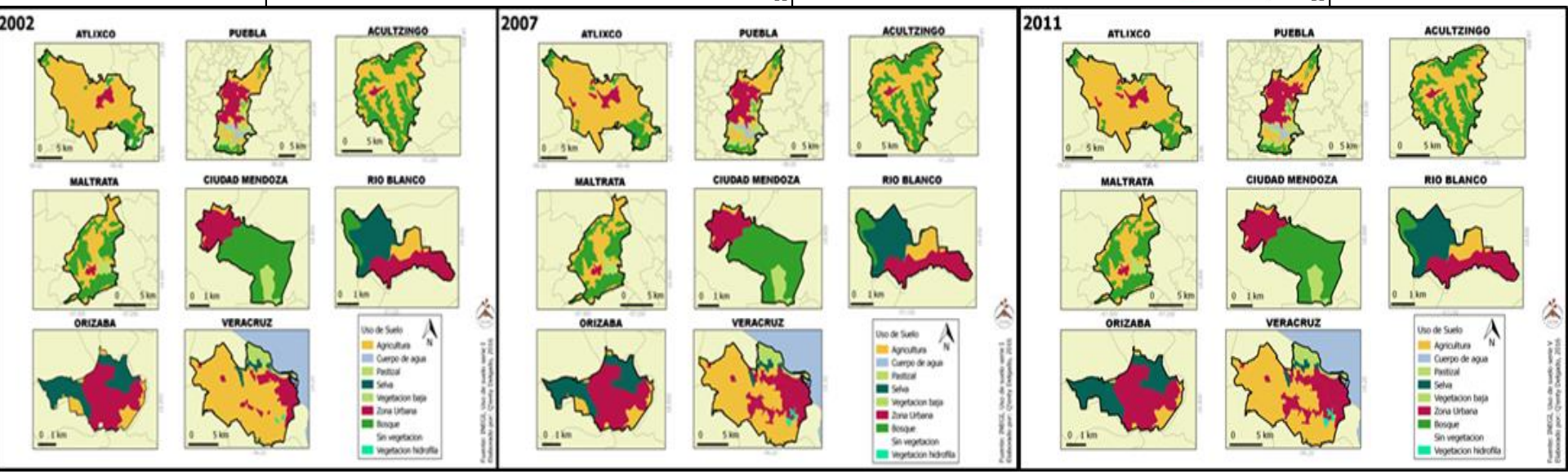
Fuente: INEGI, Uso de suelo serie I
Elaborado por: Q'enty Delgado, 2016

2011



Fuente: INEGI, Uso de suelo serie V
Elaborado por: Q'enty Delgado, 2016

Local land use: LANDSAT



Welsh et al, 2016 (on press)

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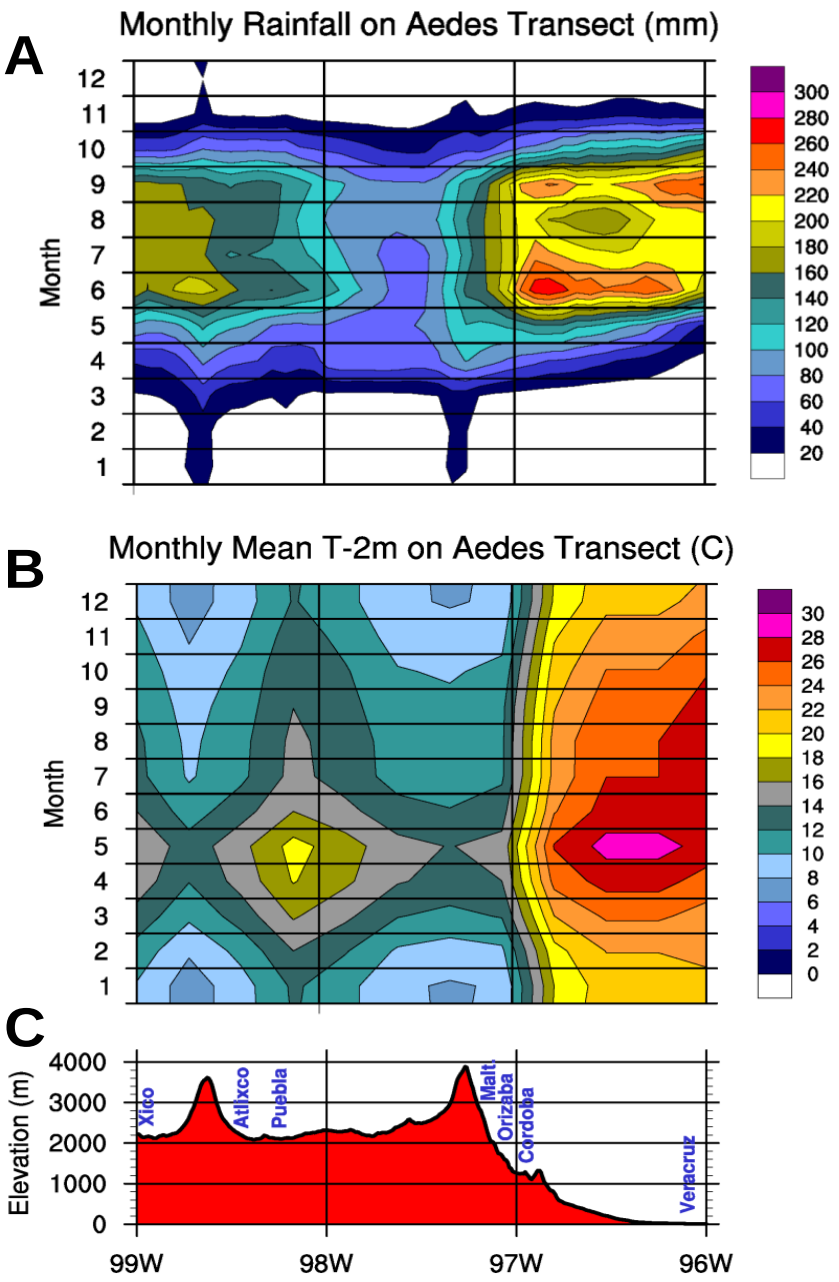
Seasonality of temperature and rainfall along transect

- Field work performed during summer months (Jul-Sep) when it is warmest and rainiest. Dengue cases are most prevalent during this season



BG sentinels at work

Lozano-Fuentes et al. 2012 (JME, JTM)

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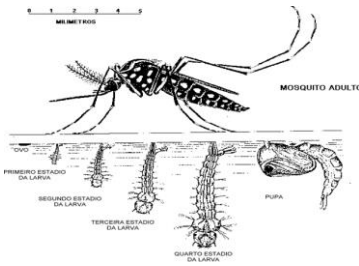
Collections of *Ae. aegypti* from communities in Veracruz and Puebla States, México, during surveys for immatures in artificial containers from July to September of 2011

Community (mean elevation of premises; m)	No. of *Ae. aegypti* identified to species*	Estimated proportion of premises with *Ae. aegypti*†	Estimated no. *Ae. aegypti* pupae per premise†		Selected weather data for the 30-day period before the survey for immatures‡		
			Mean (SD)	Median	Average daily temperature (°C)	Average daily RH (%)	Total rainfall (mm)
Veracruz City (11)	792	0.52	4.91 (11.11)	0	28.9	79.3	146
Córdoba (853)	570	0.36	6.04 (30.26)	0	23.5	83.9	321
Coatepec (1,198)	602	0.46	3.26 (9.82)	0	21.6	82.9	96
Orizaba (1,227)	1,369	0.39	14.29 (38.24)	0	20.5	87.2	292
Rio Blanco (1,251)	1,540	0.62	10.43 (26.35)	0	20.3	86.0	279
Ciudad Mendoza (1,334)	350	0.43	2.63 (8.04)	0	19.8	86.0	236
Xalapa (1,416)	149	0.36	0.98 (2.46)	0	20.6	81.4	73
Acultzingo (1,693)	212	0.26	1.68 (6.24)	0	18.5	84.7	164
Maltrata (1,713)	7	0.07	0.06 (0.40)	0	19.4	81.0	190
Atlixco (1,825)	164	0.17	0.28 (1.19)	0	19.5	72.1	43
Puebla City (2,133)	3	0.05	0.04 (0.27)	0	17.8	71.6	94
Perote (2,417)	0	0.00	0.00 (0)	0	13.6	85.6	53

Table 1. Estimates for the abundance of *Aedes aegypti*, by study community, in relation to climate variables and elevation.

Community	Percentage	Mean	Night LST (C°)	Day LST (C°)	Rainfall (mm)	Elevation (m)
Orizaba	35	14.29	16.0	33.2	354	1236
Rio Blanco	41	10.43	15.0	30.9	334	1258
Cordoba	24	6.04	16.7	33.1	507	860
Veracruz	28	4.91	21.7	40.7	372	18
Coatepec	25	3.26	16.1	32.2	208	1203
Ciud. Mendoza	21	2.63	14.6	31.9	348	1338
Acultzingo	14	1.68	12.8	28.9	217	1695
Xalapa	24	0.98	15.4	31.8	209	1419
Atlixco	12	0.28	15.0	36.6	124	1831
Maltrata	4	0.06	10.9	29.9	210	1714
Puebla	4	0.04	11.4	35.2	112	2141
Perote	0	0.00	8.1	28.5	203	2417

Percentage: the percentage of premises with the presence of *Ae. aegypti* pupae; mean: the mean abundance of *Ae. aegypti* pupae per premise; night LST: the MODIS estimated LST (MYD11A1, night); day LST: the MODIS estimated LST (MYD11A1, day); rainfall: the TRMM estimated precipitation (3B42 V7); elevation: the SRTM's DEM estimated elevation; 3.1. Correlations among RS estimated climate variables.



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- El calentamiento promedio de la superficie del planeta. CALENTAMIENTO GLOBAL O CAMBIO CLIMATICO
- HIPOTESIS 1: Adaptarse a la temperatura.
- HIPOTESIS 2: Lo urbano.
- **Comentarios finales.**

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Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
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Revision to CDC's Zika Travel Notices: Minimal Likelihood for Mosquito-Borne Zika Virus Transmission at Elevations Above 2,000 Meters

Martin Cetron, MD[1]

Since May 2015, when Zika virus, a flavivirus transmitted primarily by *Aedes aegypti* mosquitoes, was reported in Brazil, the virus has rapidly spread across the Region of the Americas and the Caribbean. The association between maternal Zika virus infection and adverse fetal and reproductive outcomes, including microcephaly, prompted CDC to issue a Level 2 alert travel notice* for the 37 countries and U.S. territories (at the national and territorial level) that have reported recent Zika virus transmission as of March 11, 2016. In addition to

virus transmission.† Currently, when laboratory-confirmed local Zika virus transmission is first reported, travel notices are issued for the entire country or U.S. territory. Establishing more precisely defined areas of Zika virus risk in a country or U.S. territory is complicated by incomplete surveillance data on the disease and the presence of the mosquito vector.

In an effort to develop more precise guidance for travelers, CDC evaluated whether subnational travel notices could be based on an ecologic indicator of the probable absence of the

ing Zika virus transmission and elevation points >1,500 m indicate that *Ae. aegypti* is unlikely to be found at elevations >2,000 m because of unsuitable ecologic factors, including but not limited to, low temperatures. Consequently, at elevations

§ CDC provides updated travel notice maps for areas with ongoing Zika virus transmission, including Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, and Venezuela. http://wwwnc.cdc.gov/travel/page/zika-travel-information.

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Bad news or opportunity scenario?

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Medical and Veterinary Entomology

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SHORT COMMUNICATION

First report of *Stegomyia aegypti* (=*Aedes aegypti*) in Mexico City, Mexico

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Abstract. *Stegomyia aegypti* (=*Aedes aegypti*) (Diptera: Culicidae) is a species of mosquito that is currently widespread in Mexico. Historically, the mosquito has been distributed across most tropical and subtropical areas lower than 1700 m a.s.l. Currently, populations that are found at higher altitudes in regions with cold and dry climates suggest that these conditions do not limit the colonization and population growth of *S. aegypti*. During a survey of mosquitoes in September 2015, larvae of *S. aegypti* mosquitoes were found in two different localities in Mexico City, which is located at about 2250 m a.s.l. Mexico City is the most populous city in Mexico and has inefficient drainage and water supply systems. These factors may result in the provision of numerous larval breeding sites. Mosquito monitoring and surveillance are now priorities for the city.

Key words. *Stegomyia aegypti* (=*Aedes aegypti*), invasive species, mosquito control, vector-borne diseases, Mexico City.

Science and prediction

David G Vaughn

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Importa por donde empezar?

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CALENTAMIENTO "Urbano".

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