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Climate Arts & Sciences Expertise
Asheville, North Carolina

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Climatic Variables, Migration and Dengue - Cases in Southeast Florida

14th Climate Prediction Applications Science Workshop (CPASW)
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Overview

- Background
- Objective
- Research Method and Design
- Data Collection
- Findings
- Discussion
- Conclusion
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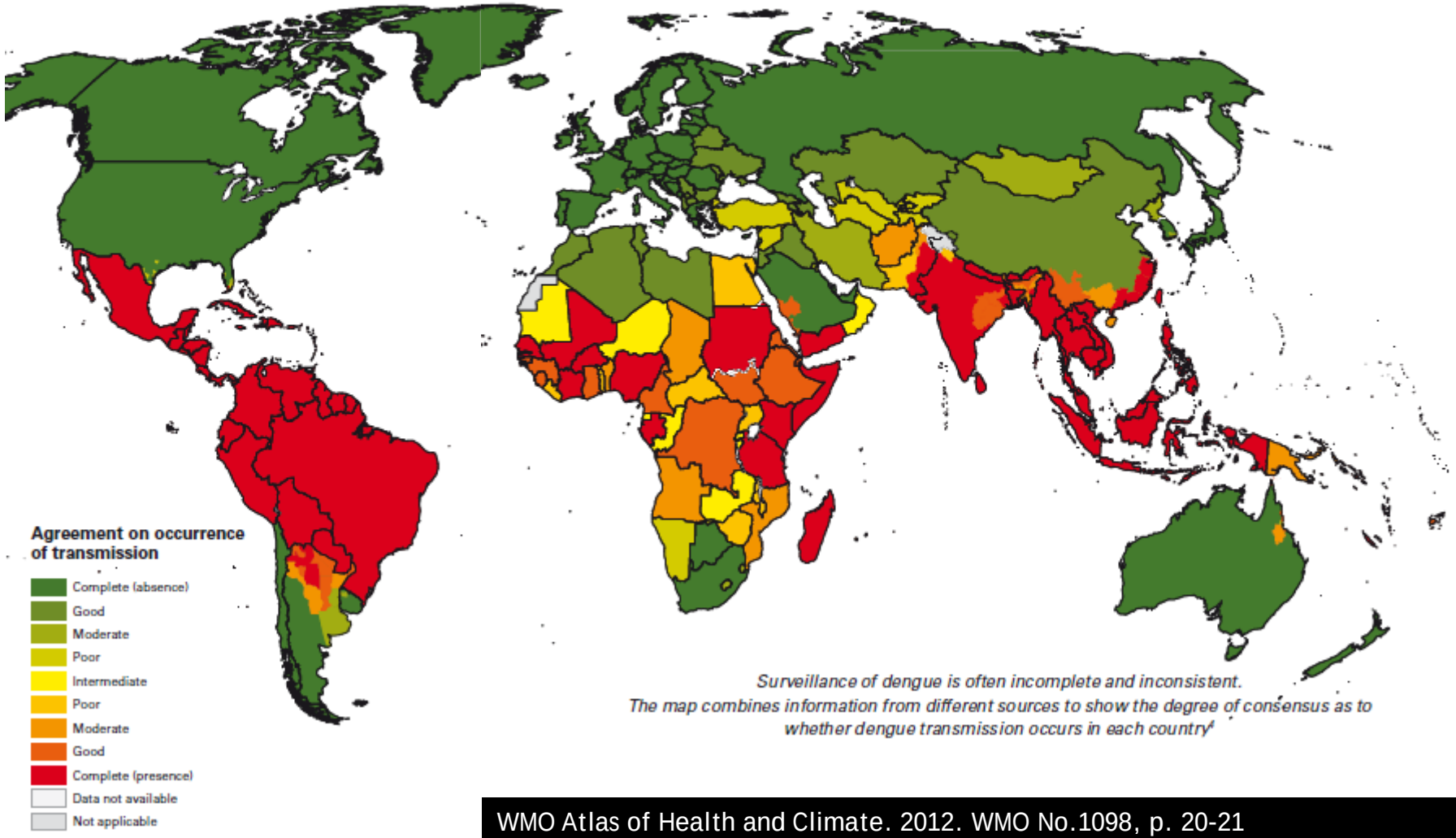
- References

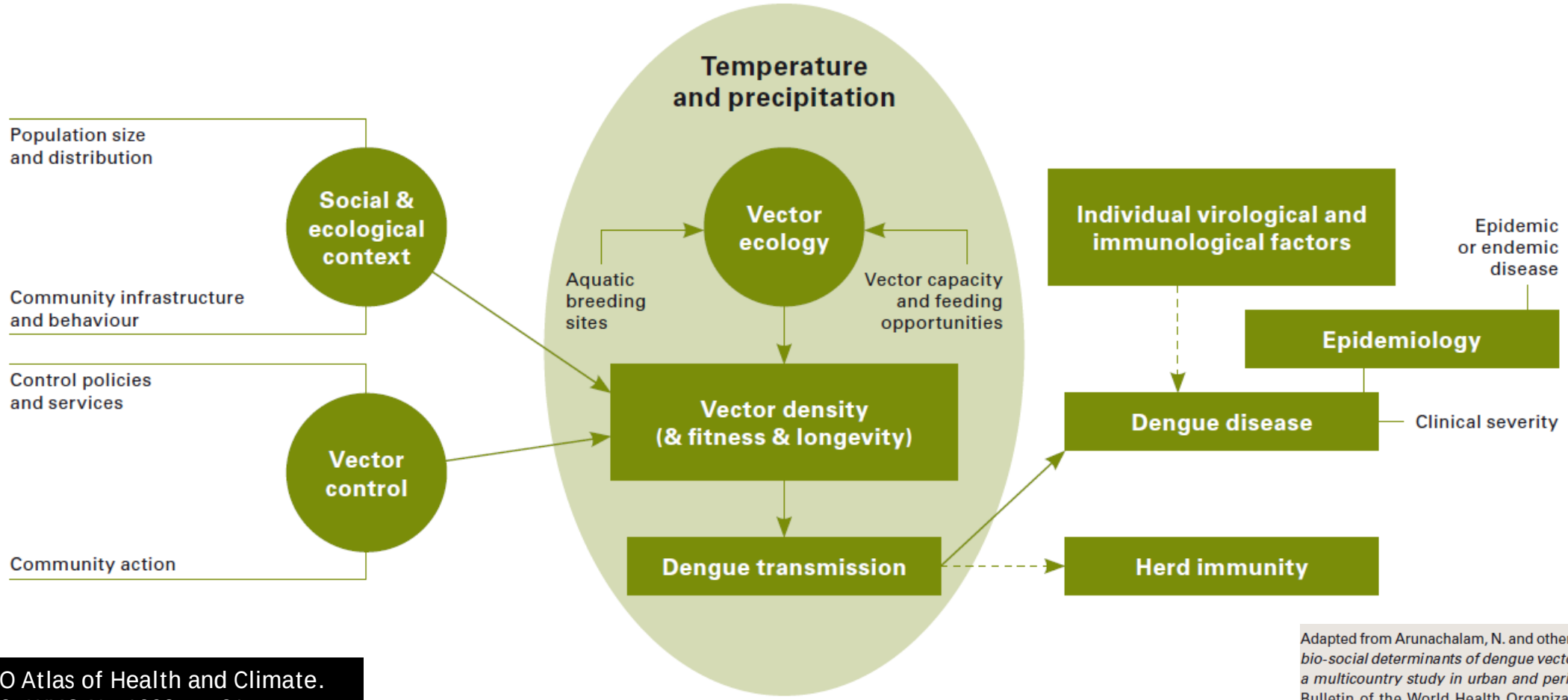
Background

- Dengue fever is the most common mosquito borne viral disease.
- Dengue fever is a global public health threat as non endemic regions experience outbreaks (WHO, 2016).



Surveillance of dengue is often incomplete and inconsistent. The map combines information from different sources to show the degree of consensus as to whether dengue transmission occurs in each country

WMO Atlas of Health and Climate. 2012. WMO No.1098, p. 20-21



Adapted from Arunachalam, N. and others 2010. *Eco-bio-social determinants of dengue vector breeding: a multicountry study in urban and periurban Asia.* Bulletin of the World Health Organization; 88(3): 173-84.

WMO Atlas of Health and Climate. 2012. WMO No.1098, p. 21

Background

- The main vector, Aedes aegypti mosquito also transmits other viral diseases:
- Yellow fever
- Chikungunya
- Zika

Background

The *Aedes aegypti*

mosquito

Background

Factors that can contribute to the emergence of dengue fever in non-endemic regions:

- Climate change
- Increase in the mosquito population
- Availability of host
- Migration of infected carriers (CDC, 2010)

Objective

Determine if there is a relationship between local climate variables (temperature and precipitation) and migration with the geographic expansion of dengue fever in the non-endemic region of southeast Florida.

Data Collection

Dengue fever cases were collected in five counties or regions:

1. Monroe County (Key West)
2. Miami-Dade County
3. Broward County (Fort Lauderdale)
4. Palm Beach County (West Palm Beach)
5. Treasure Coast Region (Martin County, St Lucie and Indian River)

Data Collection

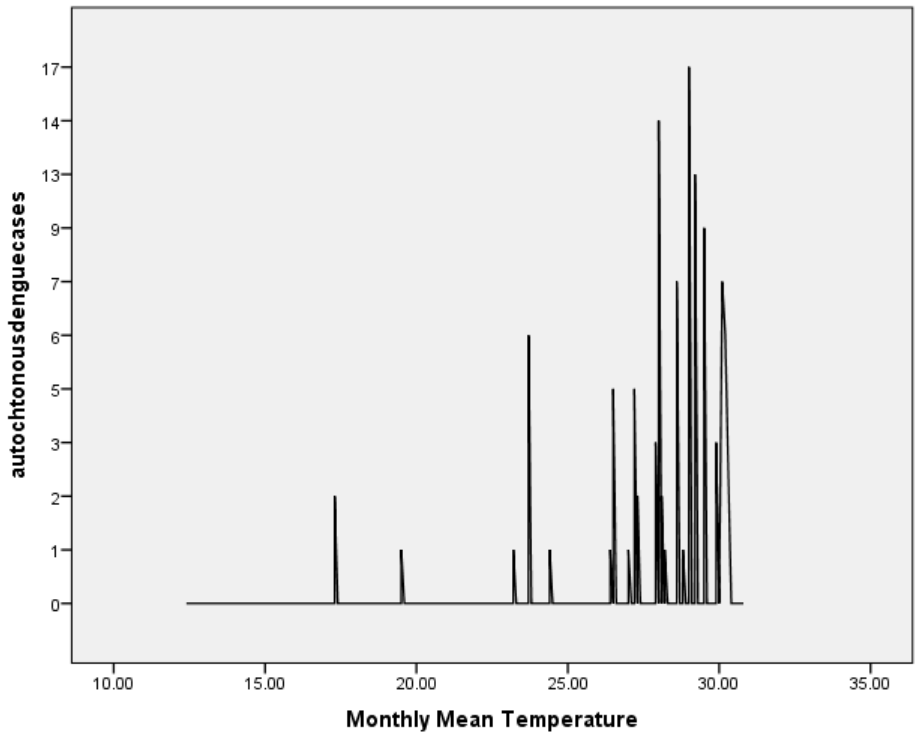
Climatic data included monthly temperature and precipitation for the period of 1980 to 2013 (34 years) per each county or region.

Findings (Bivariate analysis)

Temperature and autochthonous dengue fever cases

- Statistically significant relationship between temperature and locally acquired dengue fever incidence and a weak correlation (*rho*= .099; *p*= .000).

Findings



- The line graph clearly shows the effects of temperature on the number of autochthonous dengue fever cases.

Parameter Estimates

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	-39.302	2.0174	-43.256	-35.348	379.523	1	.000	1.000E-013	1.000E-013	1.004E-013
importdenguecases	.050	.0636	-.074	.175	.626	1	.429	1.052	.928	1.191
totalprecip	-.009	.0014	-.012	-.006	41.218	1	.000	.991	.988	.994
MNTM	.787	.0735	.643	.931	114.777	1	.000	2.198	1.903	2.538
(Scale)	1a									
(Negative binomial)	1a									

Dependent Variable: autochtonousdenguecases
Model: (Intercept), importdenguecases, totalprecip, MNTM, offset = Ln_peryacquiredimported
a Fixed at the displayed value.

Negative Binomial Regression Results

Findings (Multivariate analysis)

Temperature

- A positive relationship between temperature and dengue fever cases.
- For every 1 unit (°C) increase in temperature there is an increase of 100% in autochthonous dengue fever cases in Southeast Florida.

Findings (Multivariate analysis)

Precipitation

- A negative relationship between precipitation and dengue fever cases.
- For every unit (mm) increase in precipitation, the rate of autochthonous dengue fever decreases by .9%.

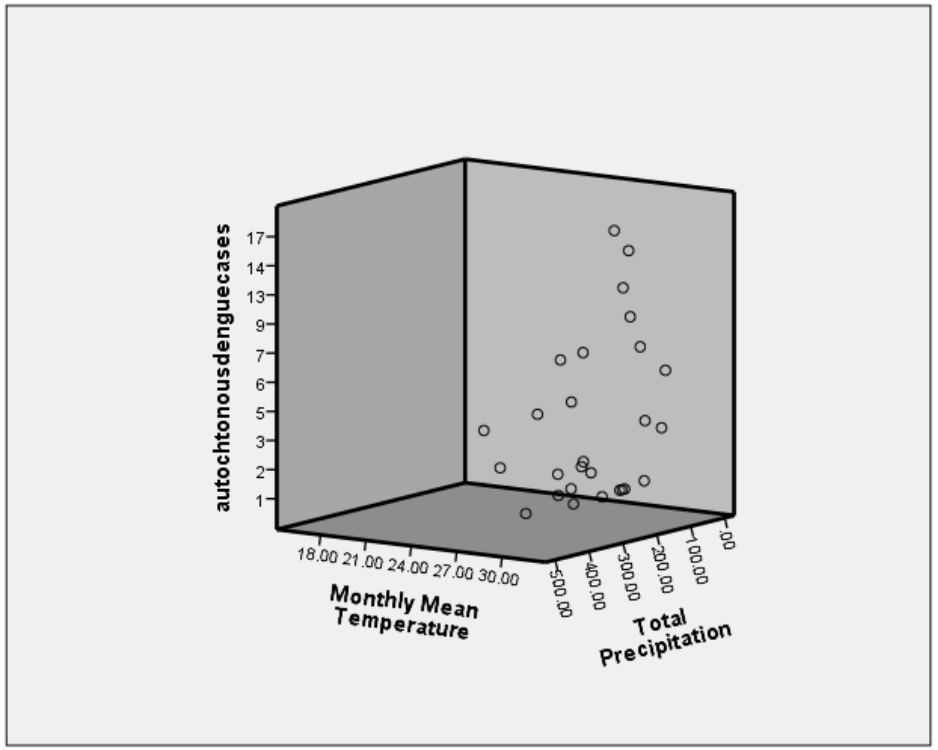
Findings (Multivariate analysis)

Imported Dengue Cases

Not statistically significant to be a predictor for autochthonous dengue fever cases (p = .429) in Southeast Florida.

Findings (3D Graph)

The 3D graph indicates a higher number of dengue fever cases with an increase of temperature and a decrease of precipitation.



Discussion

- The study found an optimal range of temperature and an optimal range of precipitation to predict autochthonous (locally acquired) dengue fever cases in Southeast Florida.
- Temperature: 23°C to 32°C (± 2°C)
- Precipitation: 100 mm to 500 mm

Conclusions

- Main determinants for the geographic expansion of autochthonous dengue fever were the favorable weather conditions, in this study, temperature and precipitation

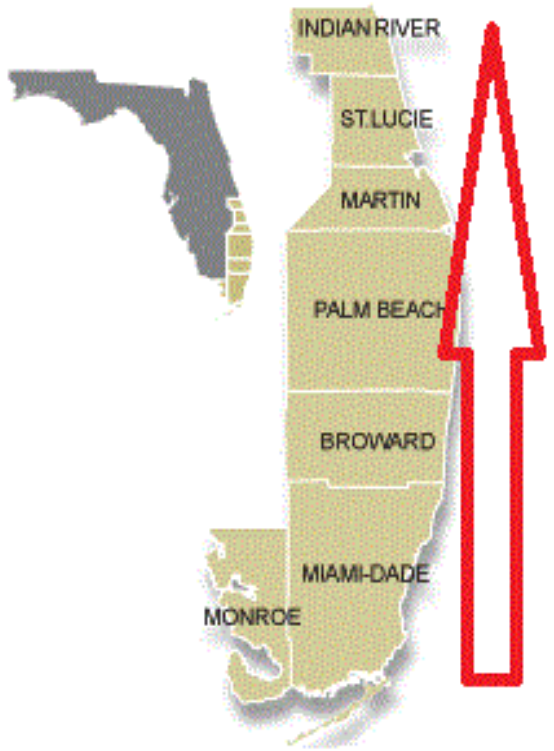
Conclusions

- Studies suggest that imported dengue fever cases are necessary to initiate the outbreaks and for the virus to enter the vector ecology (Shang et al. 2014).

- Imported dengue cases is not a predictor, the appropriate weather conditions need to be present.

Conclusions

The data shows a movement of autochthonous (locally acquired) dengue fever cases from Key West to Miami-Dade to Fort Lauderdale to Palm Beach and finally to the Treasure Coast region.



Limitations

- Reliability and completeness of data on dengue fever cases.
- Lack of data concerning the distribution mosquito population responsible of transmitting dengue fever, yellow fever, and Zika.
- Under-reporting or over-reporting of dengue fever in a region where the health providers were not familiarized with the disease.
- Ecological design can find correlation but not causation.

Recommendations

More studies are needed:

- Understand the factors influencing the *Aedes* mosquito
- Assess the distribution and changes of mosquito population
- Control the Aedes mosquito population, new alternatives

Sources

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