
Days
3,1
2,5
2
1,5
1
0,5
0
Climate Centre
Heat stress across Honduras
Toledo District
Puerto Barrios
Izabal
Islas de la Bahía
Tegucigalpa
Chalatenango
Departamento de Chalatenango
Departamento de Cabañas
Departamento de Morazán
Departamento de San Miguel
Departamento de La Paz
El Salvador
Apopa
Berlín
Usulután
Chirilagua
La Unión
Ocotepeque
Lempira
Intibucá
Yuscarán
Nueva Segovia
Ocotal
Madriz
Estelí
Jinotega
Costa Caribe Norte
Bilwi
Reserva de la Biósfera
N

Studies on heat stress in Honduras…

Most literature is around impacts on livestock, agriculture, and coral reefs

- **Honduras** is identified among the **10 most affected countries** in the Americas by heat stress through %GDP loss to heat stress (and the associate health, well-being and productivity effects). (ILO, 2019)
- "Tropical countries with a large share of agricultural employment such as Honduras, El Salvador, Nicaragua and Guatemala are also among the most affected by heat stress in the region" (ILO, 2019)
- "Bean farmers in the high temp lowlands of Atlantida avoid heat stress by planting at higher elevations" (Porch et al., 2007)
- Impact on productivity of dairy cows, chickens, sugar cane, coffee, etc. (Sanders et al., 2019)
- **Coral reefs** declining due to heat stress (Castillo et al., 2019)

Table 4.2 Working hours lost to heat stress, by sector and country, Central America, 1995 and 2030 (projections)

Country	1995						2030					
	Agriculture (in shade) (%)	Industry (%)	Construction (in shade) (%)	Services (%)	Total (%)	Total (thousand full-time jobs)	Agriculture (in shade) (%)	Industry (%)	Construction (in shade) (%)	Services (%)	Total (%)	Total (thousand full-time jobs)
Belize	4.30	1.46	4.30	0.09	**1.63**	**1.0**	7.95	3.57	7.95	0.42	**2.45**	**4.9**
Costa Rica	1.41	0.40	1.41	0.02	**0.47**	**6.5**	2.99	1.02	2.99	0.09	**0.65**	**16.3**
El Salvador	1.19	0.34	1.19	0.02	**0.43**	**8.9**	2.51	0.88	2.51	0.08	**0.73**	**32.3**
Guatemala	1.02	0.38	1.02	0.04	**0.42**	**14.6**	1.95	0.86	1.95	0.13	**0.87**	**88.4**
Honduras	1.24	0.40	1.24	0.03	**0.59**	**11.6**	2.71	1.11	2.71	0.14	**1.09**	**54.2**
Mexico	1.54	0.71	1.54	0.13	**0.64**	**214.9**	2.45	1.27	2.45	0.30	**0.90**	**544.4**
Nicaragua	1.77	0.47	1.77	0.02	**0.69**	**8.5**	3.94	1.39	3.94	0.10	**1.19**	**34.7**
Panama	1.93	0.37	1.93	0.01	**0.57**	**5.6**	4.77	1.24	4.77	0.05	**1.20**	**24.6**
Central America	**1.48**	**0.62**	**1.48**	**0.11**	**0.61**	**271.6**	**2.50**	**1.21**	**2.50**	**0.24**	**0.91**	**799.8**

Note: The table shows the percentage of working hours lost to heat stress (and the associated health, well-being and productivity effects) in each sector and in the economy as a whole. It also shows the equivalent loss in terms of full-time jobs for the economy as a whole. Work in agriculture and construction is assumed to be carried out in the shade. The heat stress index for work in the afternoon sun adds around 2–3°C to the in-shade WBGT (see Appendix II for further details). The data are based on historical observations and on estimates obtained using the RCP2.6 climate change pathway, which envisages a global average temperature rise of 1.5°C by the end of the century.

Source: ILO estimates based on data from the ILOSTAT database and the HadGEM2 and GFDL-ESM2M climate models.

Source: ILO, 2019

54200 full-time jobs projected to be lost in 2030 due to heat stress, mostly in agriculture and construction

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Studies on heat stress in Honduras… (2)

- One paper on child health and changes in the climate in Honduras: “Areas experiencing significant temperature anomalies are also the ones with the **worst child respiratory problems”** (Bradatan et al., 2020)

- Central American countries (Honduras, El Salvador, Nicaragua) have some of the highest mortality rates from CKD (**chronic kidney disease**) (Mattson, 2018)

- **In the media:** the deaths of farm workers in Central America (/ El Salvador) are being linked to extreme temperatures. Researchers warn that far worse is to come (The Guardian, 2015).

There is a LARGE gaps in our knowledge on heat-health impacts across **tropical and high-latitude** countries (with almost no studies across South and Central America)

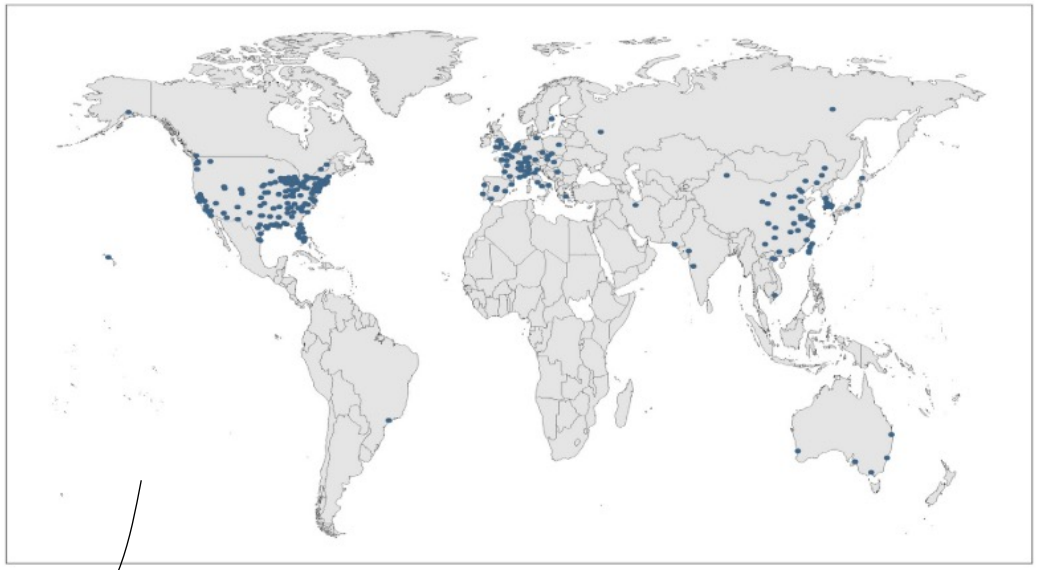

Fig. 2. Locations of heatwave and health impact research, 1964–2017.

Table 1
Study locations by continent.

Continent	No. of study sites	No. of unique locations
Africa	0	0
South America	1	1
Australia	34	5
Asia	91	53
Europe	144	64
North America	584	167
TOTAL	**854**	**292**

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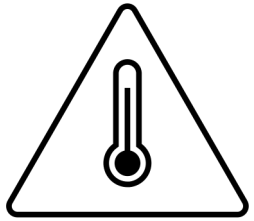
Methods & datasets

Wet-bulb Globe Temperature (WBGT) = a type of apparent temperature used to estimate the effect of **temperature**, **humidity**, wind speed, and visible and infrared radiation (usually sunlight) on humans.

Datasets:
1) High-resultion daily extreme urban heat exposure (UHE-daily)
2) WBGT > 28, 30, and 32 °C

Developed by NASA Socioeconomic Data and Applications Center (SEDAC)
Available through: https://sedac.ciesin.columbia.edu/data/set/sdei-high-res-daily-uhe-1983-2016. (Tuholske et al., 2021)

The datasets were analyzed and visualized using Excell and ArcGIS Software.



Heat stress definition

Heat stress was defined as: WBGT > 30 °C, as this follows the **International Standards Organization** (ISO) criteria for risk of heat-related impacts.

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Wet Bulb Globe Temperature > 28, 30 or 32?

Air temperature (typical value)	WBGT	Guides to how much exercise can be safely performed	
≥ 35 ℃	≥ 31	Danger (exercise prohibited)	At a WBGT of 31 or above the actual temperature is higher than the skin temperature, so body heat cannot escape, and except for special cases, all exercise should be stopped.
31 - 35 ℃	28 - 31	Severe Warning (heavy exercise prohibited)	At a WBGT of above 28 the danger of heatillness is high, so events that require heavy exercise or events where the body temperature will rise, like endurance races should be avoided. When such events are held, rest periods should be provided often and water replenishment conducted aggressively. People who are weak or not used to the heat should stop the exercise.
28 - 31 ℃	25 - 28	Warning (rests should be provided often)	At a WBGT of above 25 the danger of heatillness increases, so rest periods should be provided often and water replenishment conducted. Rest periods should be provided every 30 minutes for events requiring heavy exercise.

WBGT > 30 °C can already be deadly and dangerous (for healthy adults!)

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Aims of this study

Objective 1: *Hazard*

1	***How many days of heat stress have occurred and has this changed over time?***	To understand spatio-temporal characteristics of heat stress & corresponding trends

Objective 2*: Exposure*

2	***How many people have been exposed and has this changed over time?***	To understand the **number of people** exposed to heat stress and the driving factor (warming vs. population)

→ On a country-wide scale!

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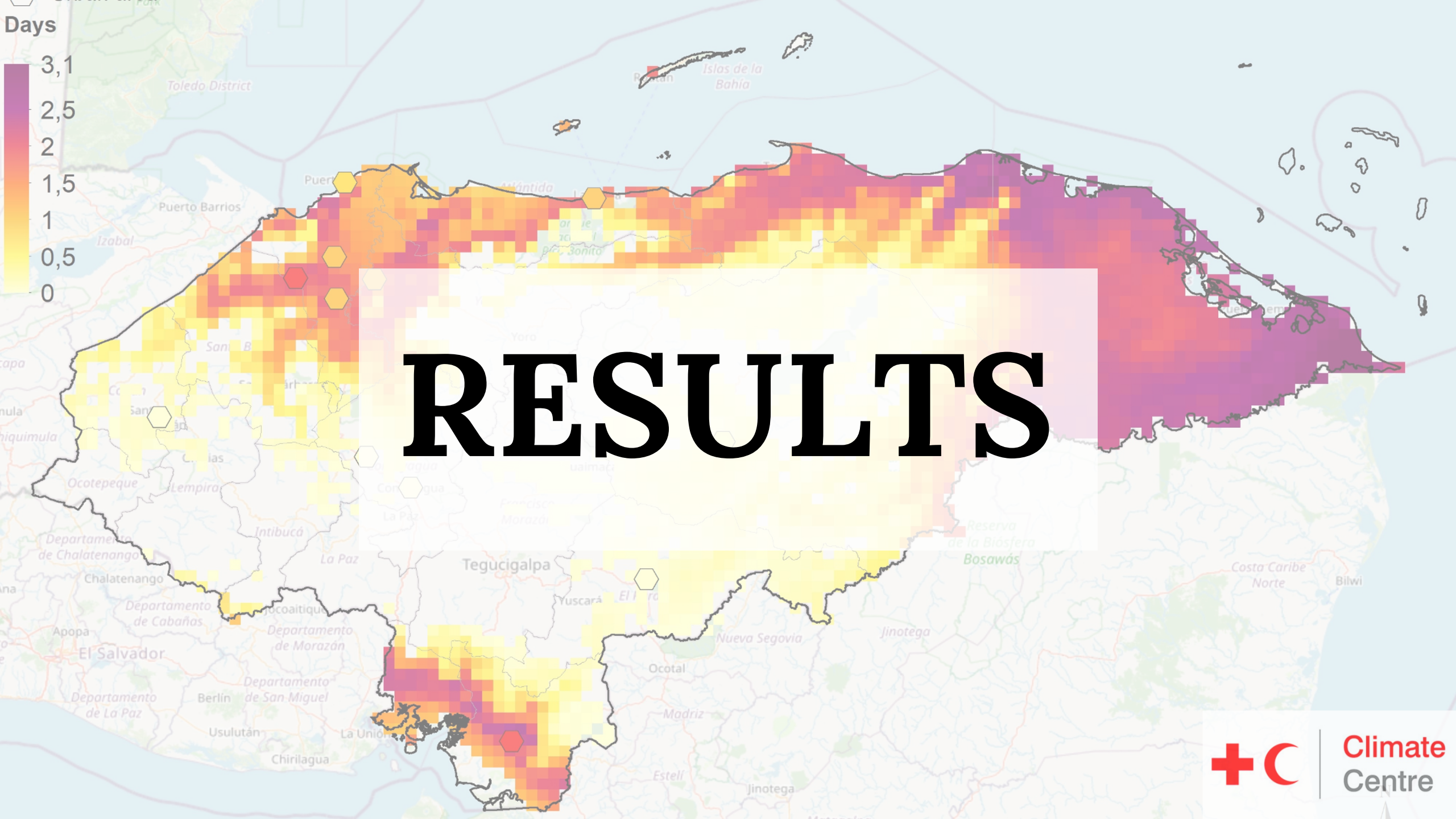
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Reserva de la Biósfera Bosawás
Costa Caribe Norte
Bilwi
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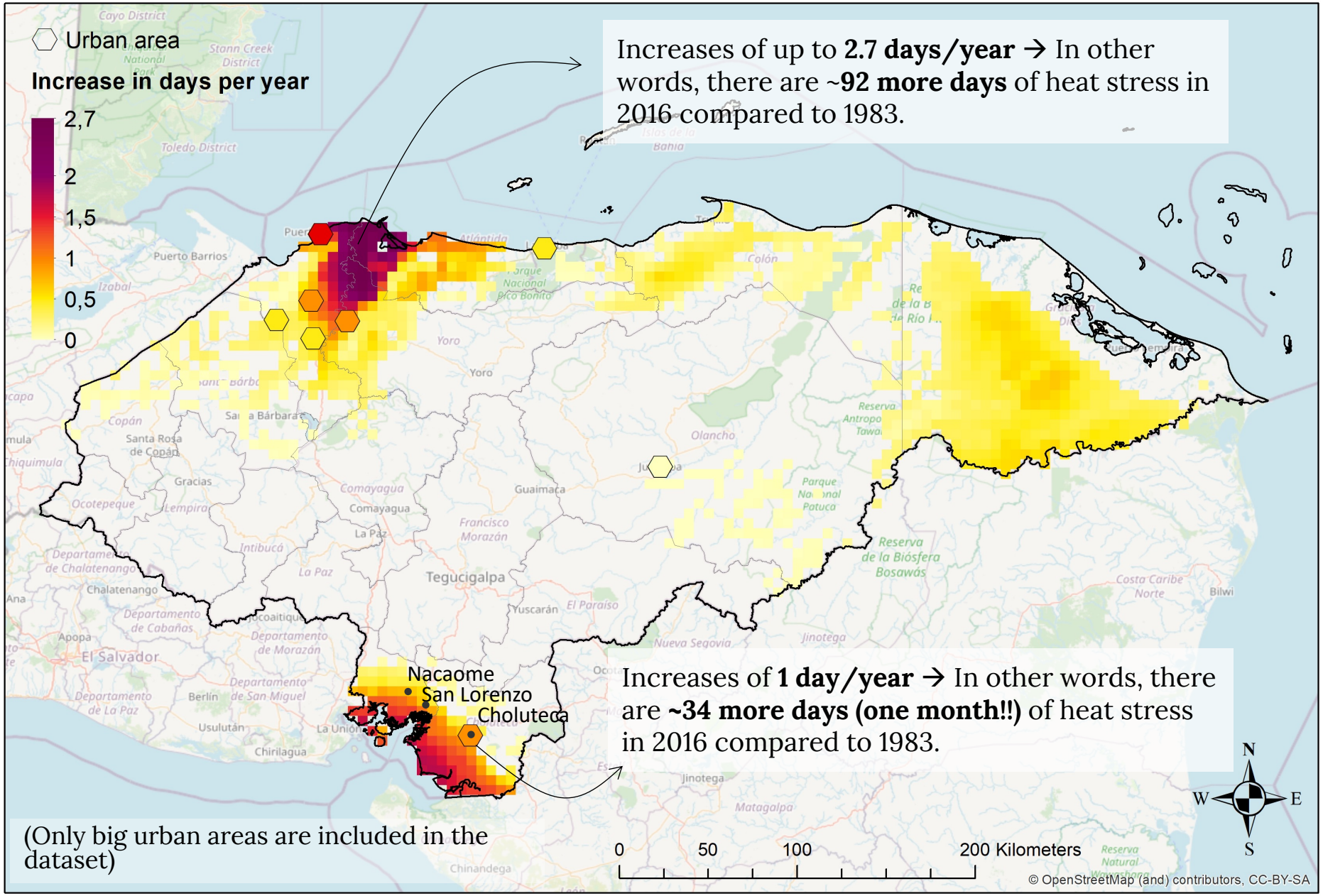
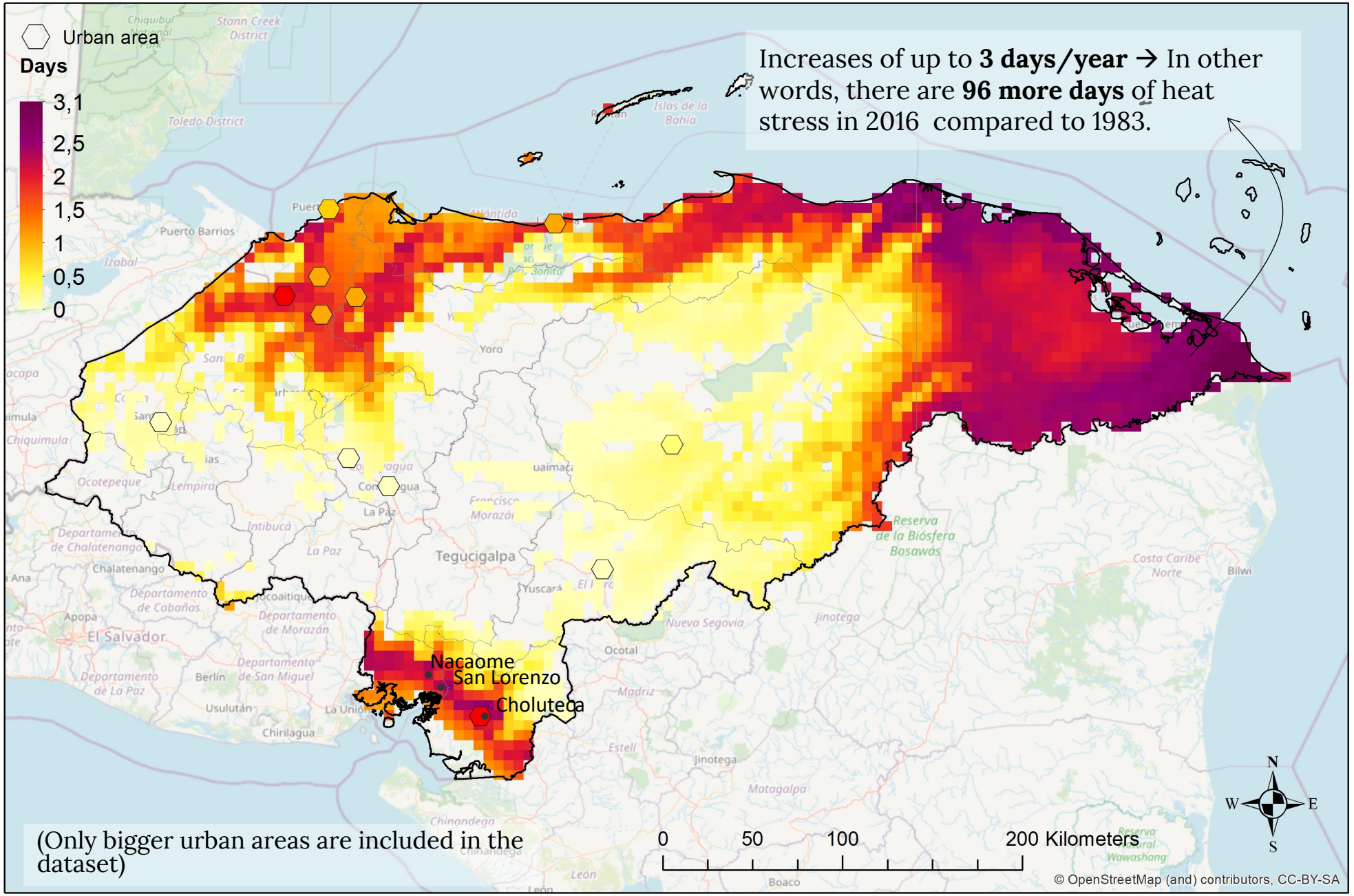
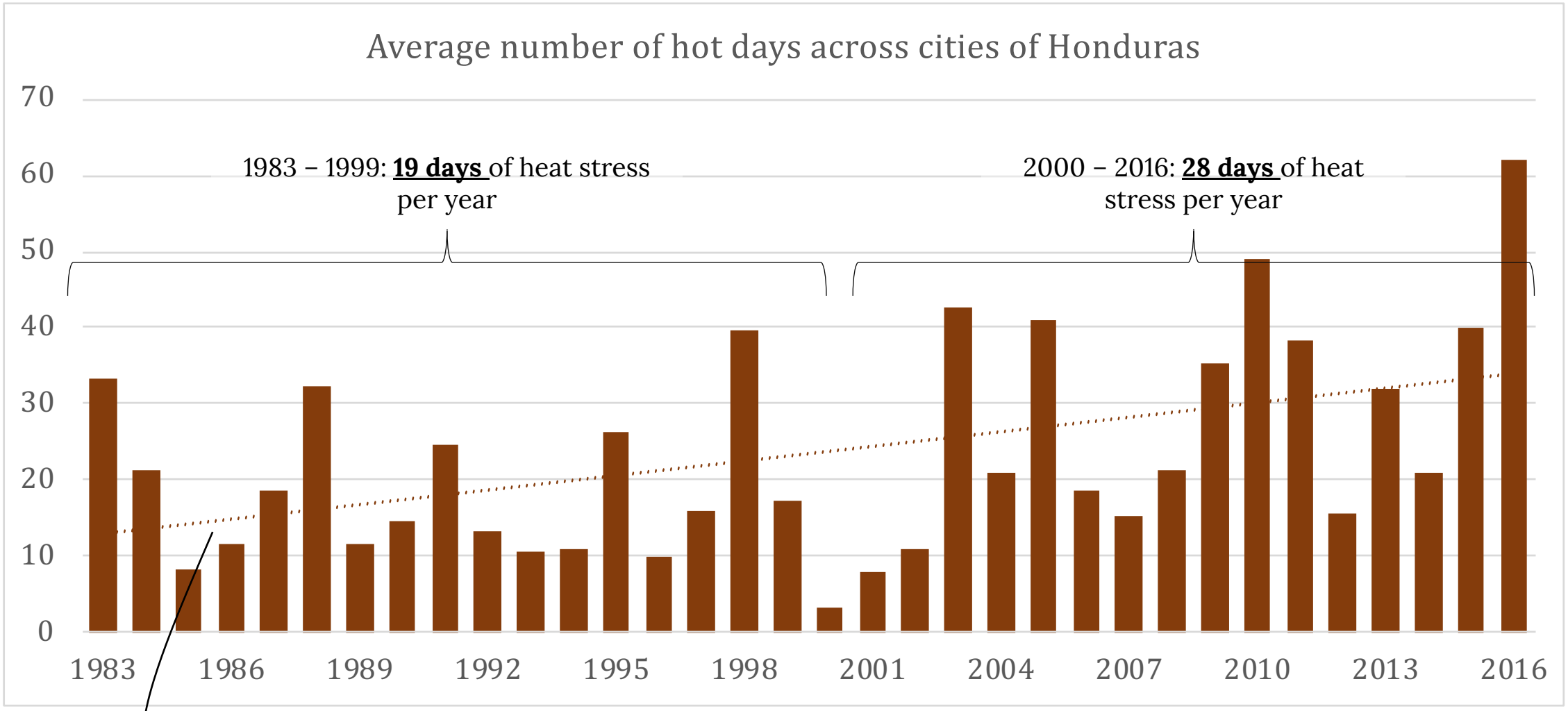
Annual increase in humid-hot days (WBGT > 30 °C) from 1983 - 2016



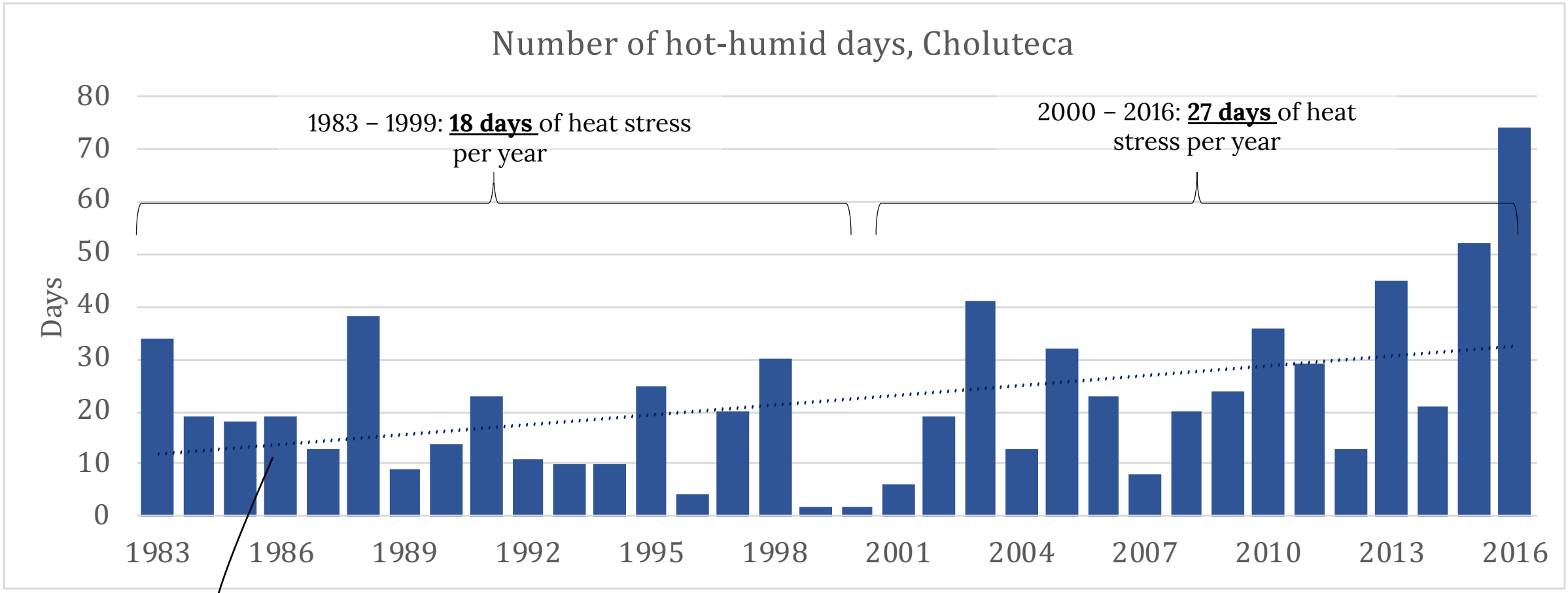
(Only big urban areas are included in the dataset)

Annual increase in hot-humid days (WBGT > 28 C) from 1983 - 2016

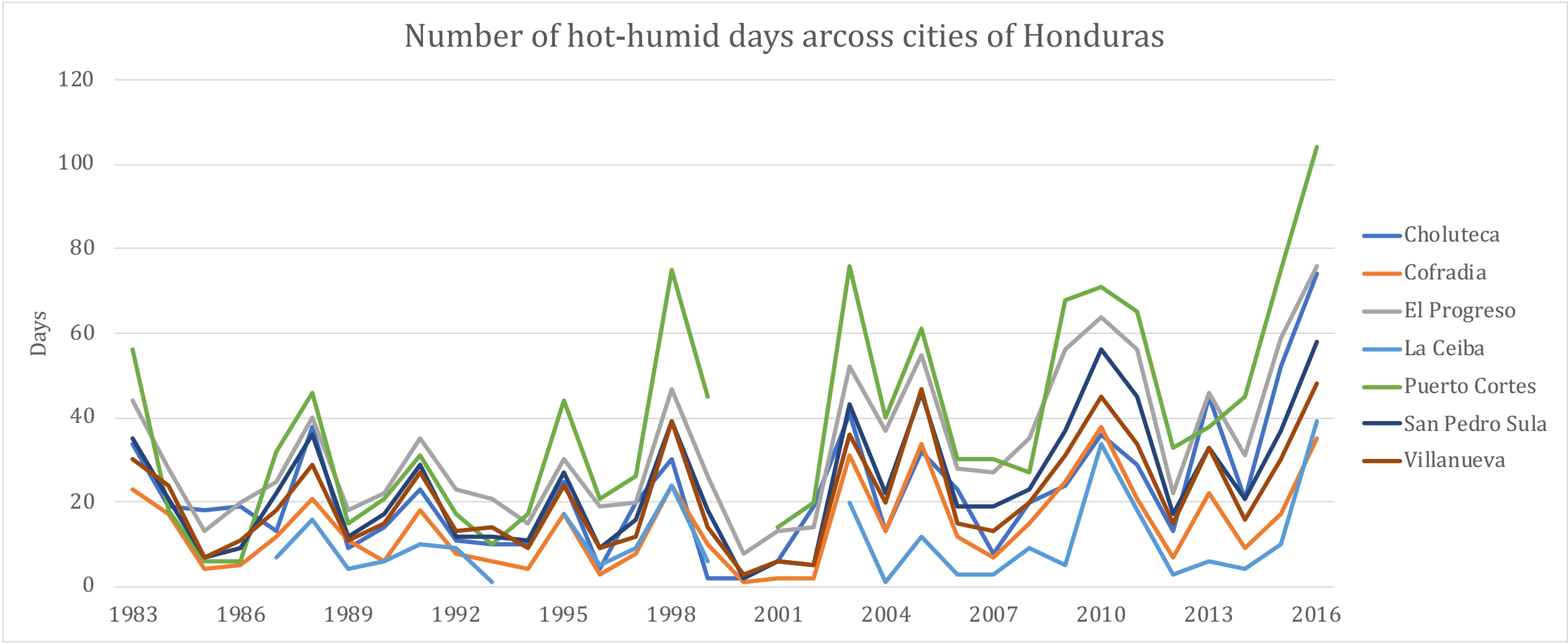




Over time, the number of heat stress days has increased across Honduras

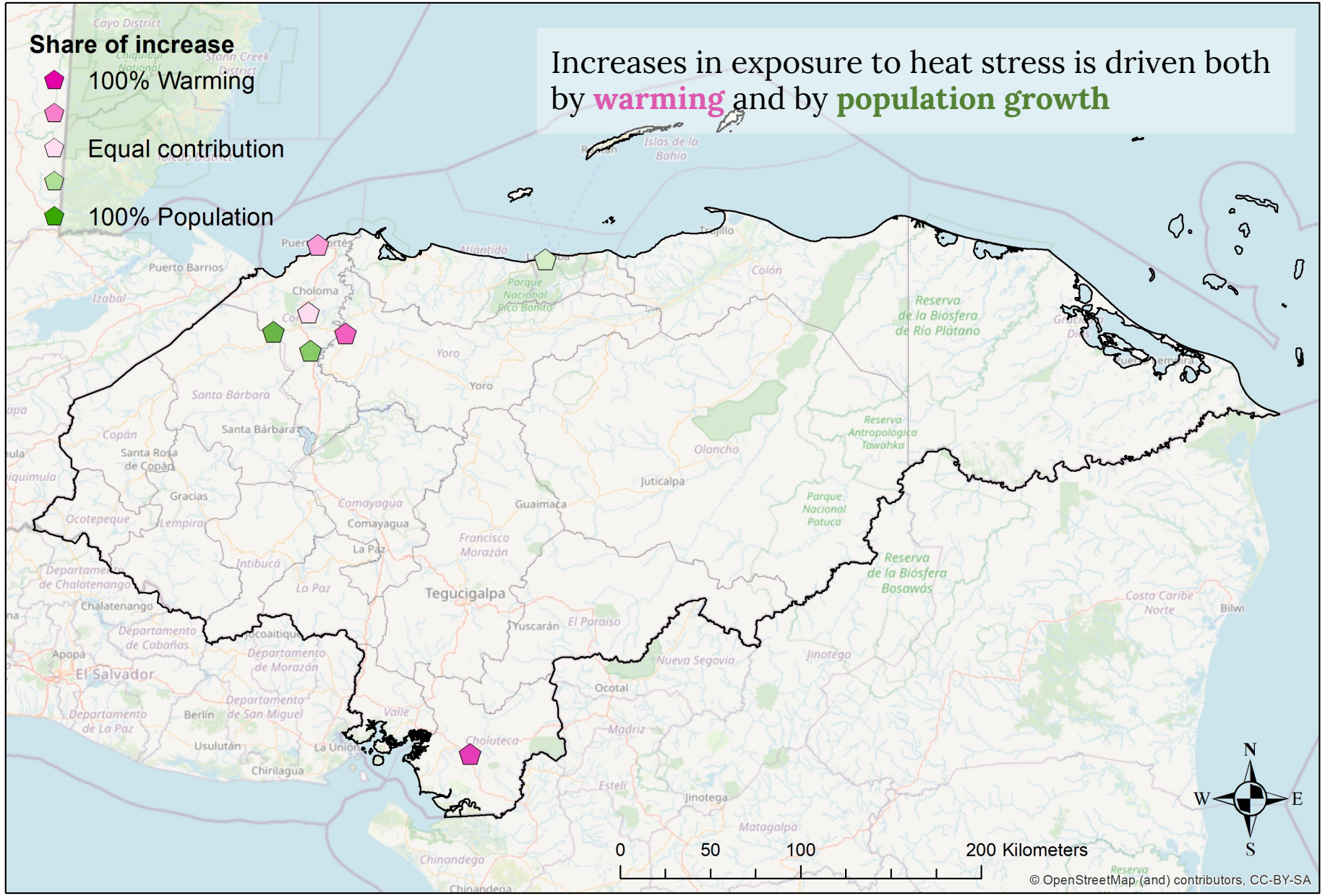


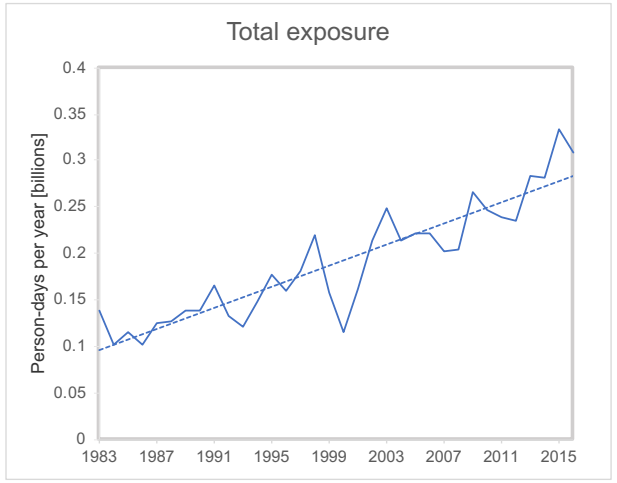
Over time, the number of heat stress days has increased with ~0.6 days/year.

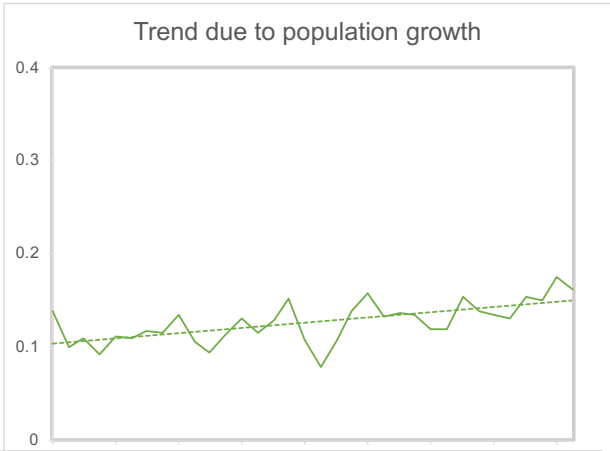


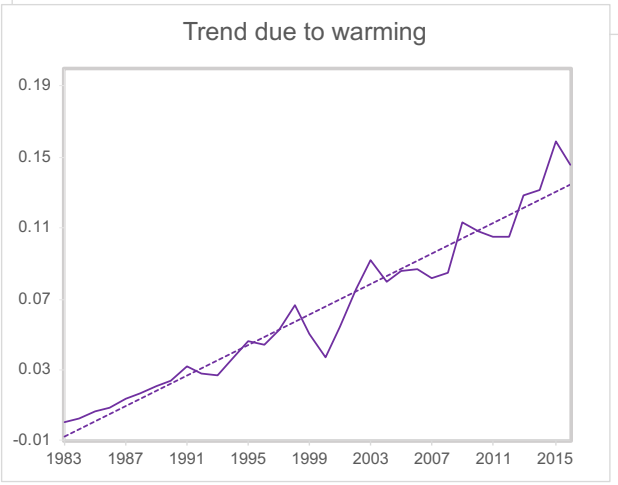
Patterns of heat stress are similar across the country.
Years with most heat stress include 1998, 2003, 2009-11, and 2015-16

Contribution to increase in exposure (warming vs. population)

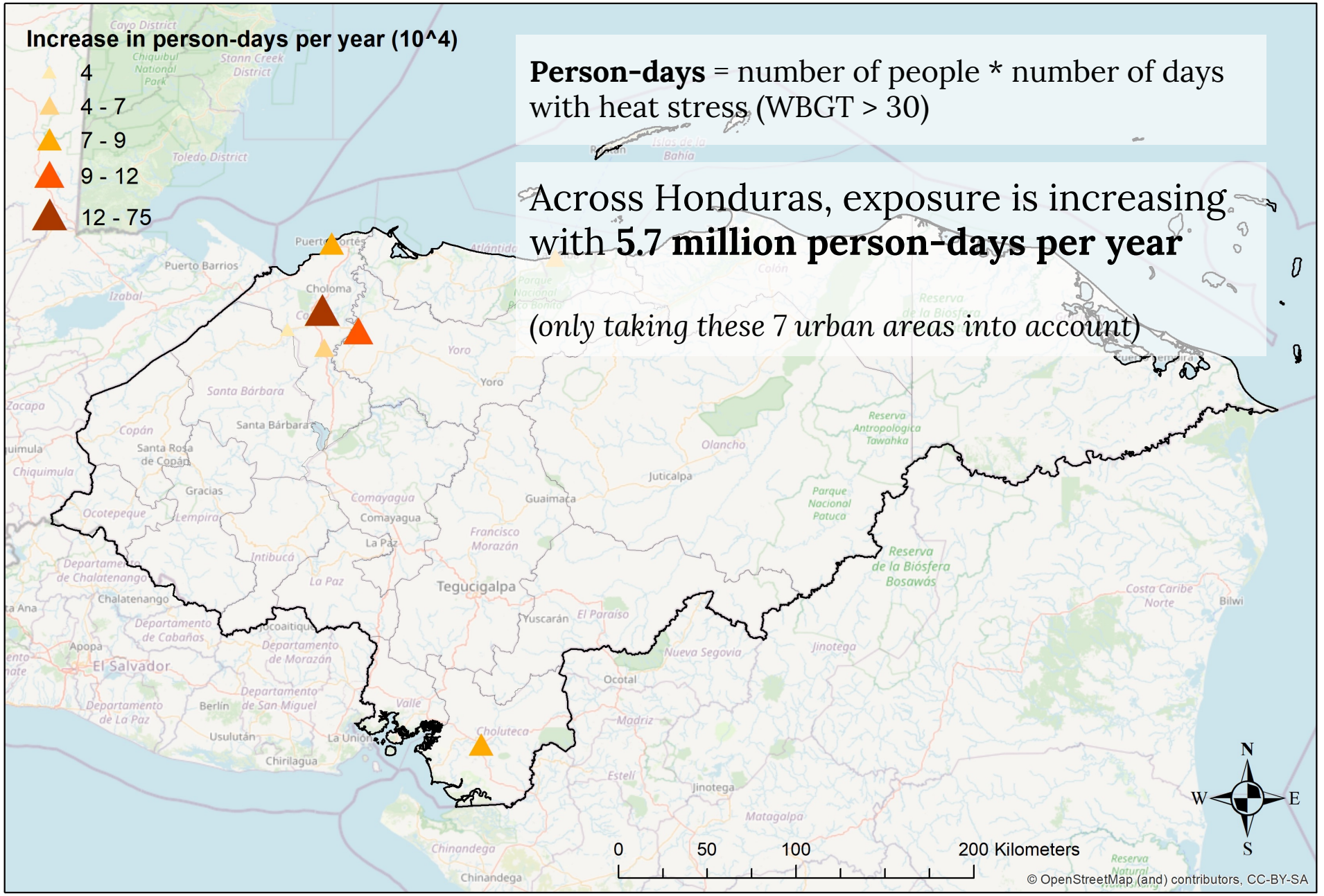








Annual increase in exposure (person-days) for 1983 - 2016



Weather stations data?

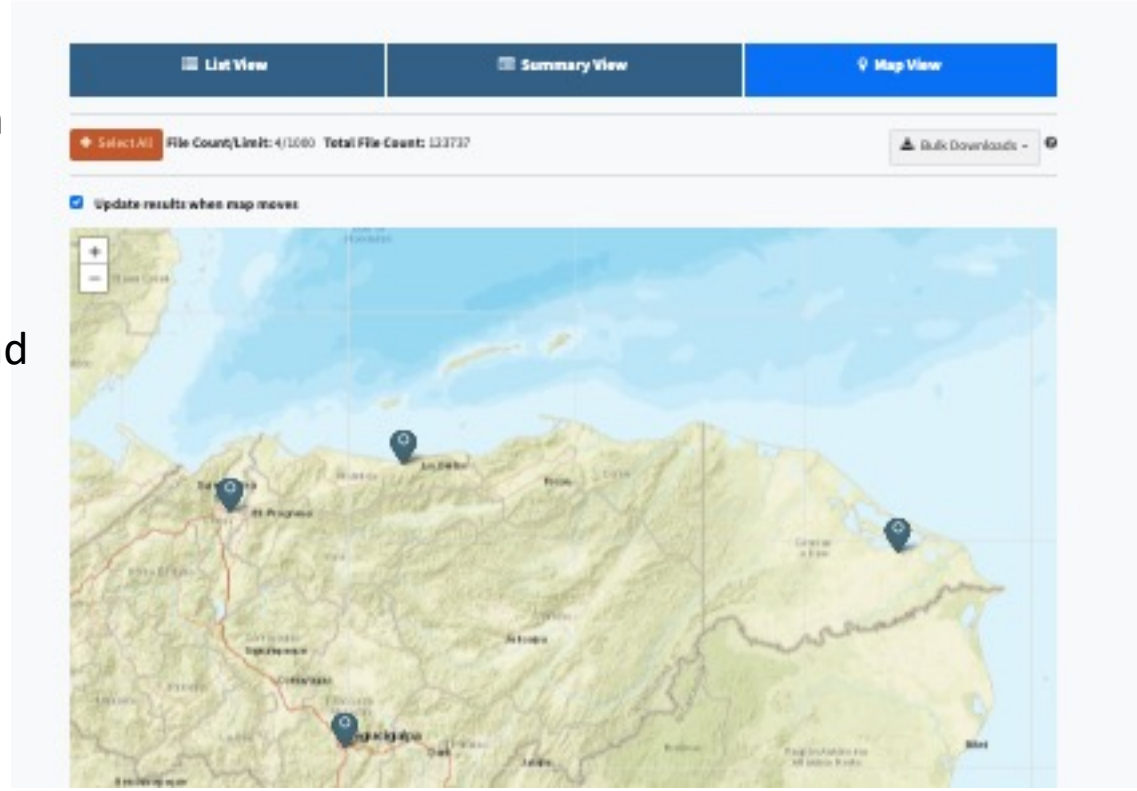
https://www.ncei.noaa.gov/access/search/data-search/global-summary-of-the-day

https://www.ncei.noaa.gov/access/search/data-search/daily-summaries

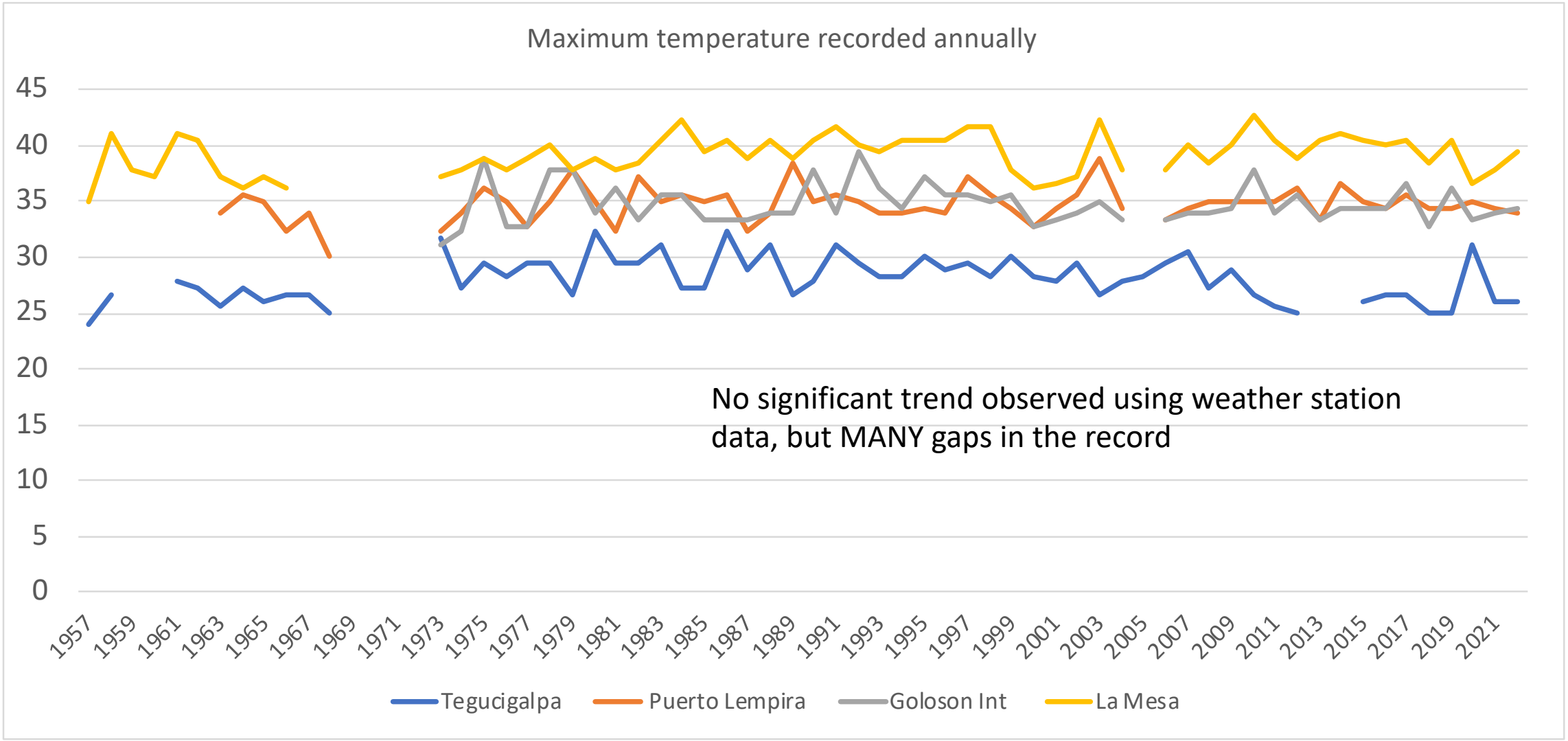
Very few weather stations with temperature data…

- San Pedro Sula (La Mesa International); La Ceiba (Goloson International); Puerto Lempira; Tegucigalpa

- What are temperature trends for Choluteca, Nacaome, and San Lorenzo?

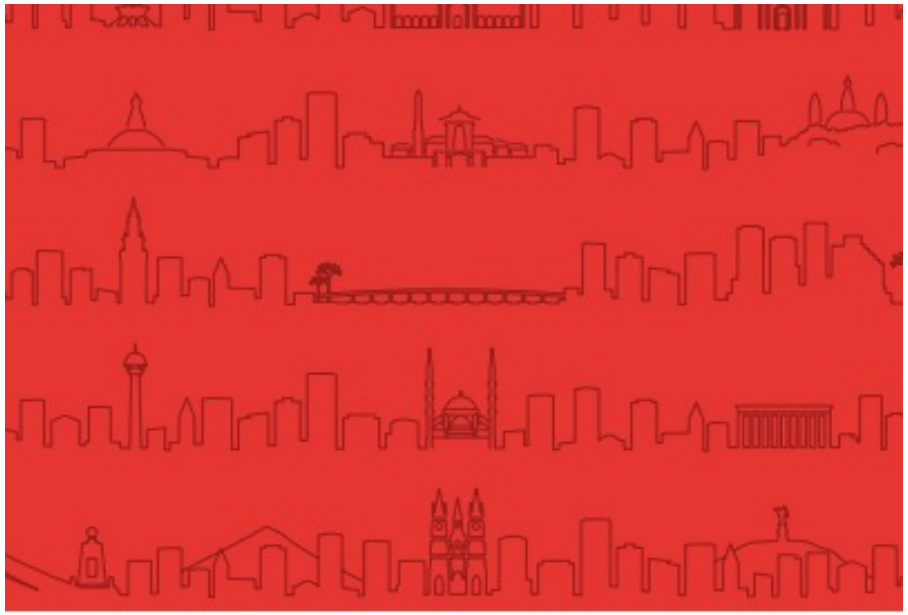


Difference in cities, La Mesa/San Pedro Sula highest maximum temperatures



Discussion

- What temperatures are considered “hot” across Honduras?
- From your perspective, what is the general perception around heat stress?
- Is there a heat warning issues by your local meterological service?
- What are some of the most vulnerable groups in Honduras?
- Are there ventilated/air conditioned areas in the cities of Honduras?
- ….



Source: Singh et al. (2019)
(Available in English and also Spanish)

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References

1. Balch, O. (2015). Heat stress: the next global public health crisis? The Guardian. Available through: https://www.theguardian.com/sustainable-business/2015/nov/20/heat-stress-public-health-prodcutivity-el-salvador-sugarcane-workers-chronic-kidney-disease

2. Bradatan, C., Dennis, J.A., Flores-Yeffal, N. et al. Child health, household environment, temperature and rainfall anomalies in Honduras: a socio-climate data linked analysis. Environ Health 19, 10 (2020). https://doi.org/10.1186/s12940-020-0560-9

3. International Labour Organization. (2019). Working on a warmer planet: the impact of heat stress on labor productivity and decent work. Available through: https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_711919.pdf

4. Mattson, D. L. (2018). Heat Stress Nephropathy and Hyperuricemia. American Journal of Physiology-Renal Physiology. doi:10.1152/ajprenal.00244.2018

5. Muñiz-Castillo, A. I., Rivera-Sosa, A., Chollett, I., Eakin, C. M., Andrade-Gómez, L., McField, M., & Arias-González, J. E. (2019). Three decades of heat stress exposure in Caribbean coral reefs: a new regional delineation to enhance conservation. Scientific Reports, 9(1). doi:10.1038/s41598-019-47307-0

6. Porch, T., Bernsten, R., Rosas, J., & Jahn, M. (2007). Climate change and the potential economic benefits of heat-tolerant bean varieties for farmers in Atlantida, Honduras. Journal of agriculture of the University of Puerto Rico, 91, 133-148.

7. Sanders, Arie; Thomas, Timothy S.; Rios, Ana R.; and Dunston, Shahnila. (2019). Climate change, agriculture, and adaptation options for Honduras. IFPRI Discussion Paper 1827. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.13321

8. Singh, R., Arrighi, J., Jjemba, E., Strachan, K., Spires, M. and Kadihasanoglu, A. (2019). Heatwave Guide for Red Cross Red Crescent Branches. *Red Cross Red Crescent Climate Centre*, 2019. Available from: https://preparecenter.org/resource/city-heatwave-guide-for-red-cross-red-crescent-branches/