



Climate
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Research findings on heat stress in Indonesia

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Red Cross Red Crescent Climate Centre

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Person-days per year (*10⁵)

▲ < 0,8

▲ 0,8 - 2,5

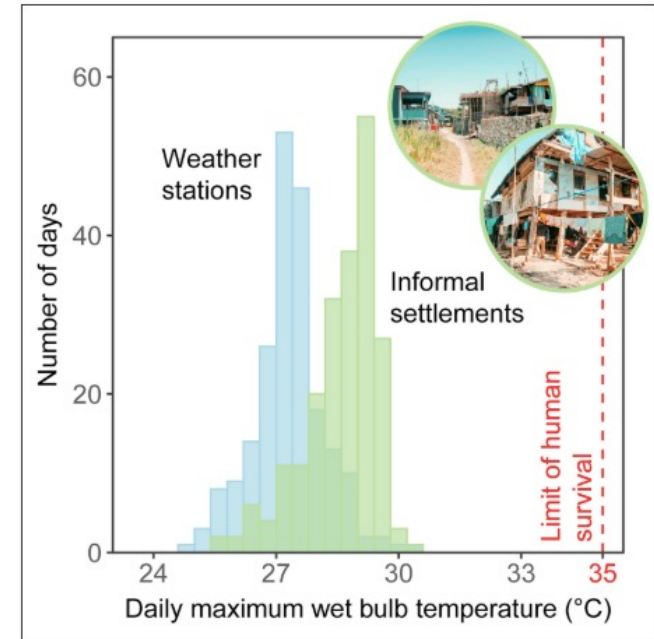
Studies have shown...

Heat stress is rising

- Tropical, humid areas will be disproportionately exposed to deadly heat stress, compared to higher latitudes. (Mora et al., 2017)
- Chronic heat stress has been observed in informal settlements in Makassar, which was underestimated by weather stations
- Indonesia is projected to experience more frequent, longer, and more intense heat stress in the future.

Article

Chronic heat stress in tropical urban informal settlements



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Highlights

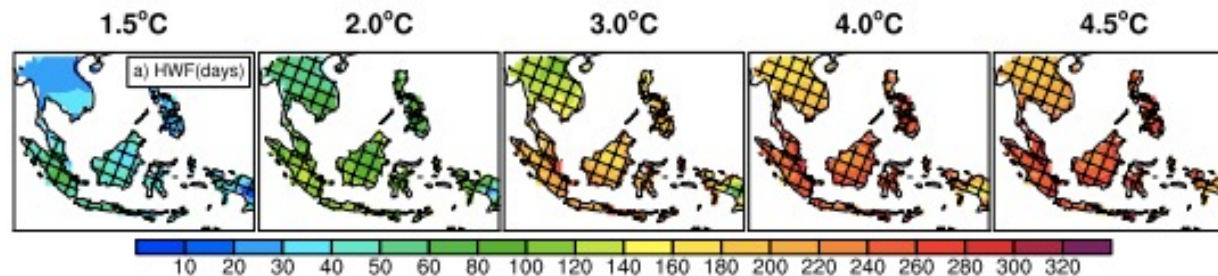
Chronic heat stress was observed outdoors and in houses in informal settlements

Wet bulb temperature reached 30.5°C, approaching the limit of survival

Heat stress regularly exceeded recommended physical activity thresholds

Heat stress in informal settlements was underestimated by weather stations

Source: Ramsay et al. (2021)



Source: Dong et al. (2021)

Indonesia is a country vulnerable to various climate risks, but heat stress has been **largely overlooked**.

Shinji Kaneko · Masato Kawanishi
Editors

Climate Change Policies and Challenges in Indonesia

Source: Kaneko & Kawanishi (2016)



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Aims of this study

Objective 1: Hazard

R01

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

R02

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)

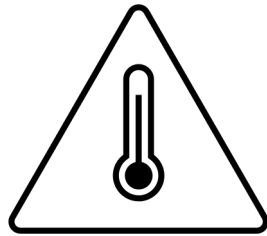


Methods & datasets

Wet-bulb Globe Temperature (WBGT) 1983 – 2016

- **WBGT** = a combination of radiated heat, 2m air temperature, wind, and relative humidity.
- High-resolution daily extreme urban heat exposure (UHE-daily)
- 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.



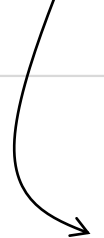
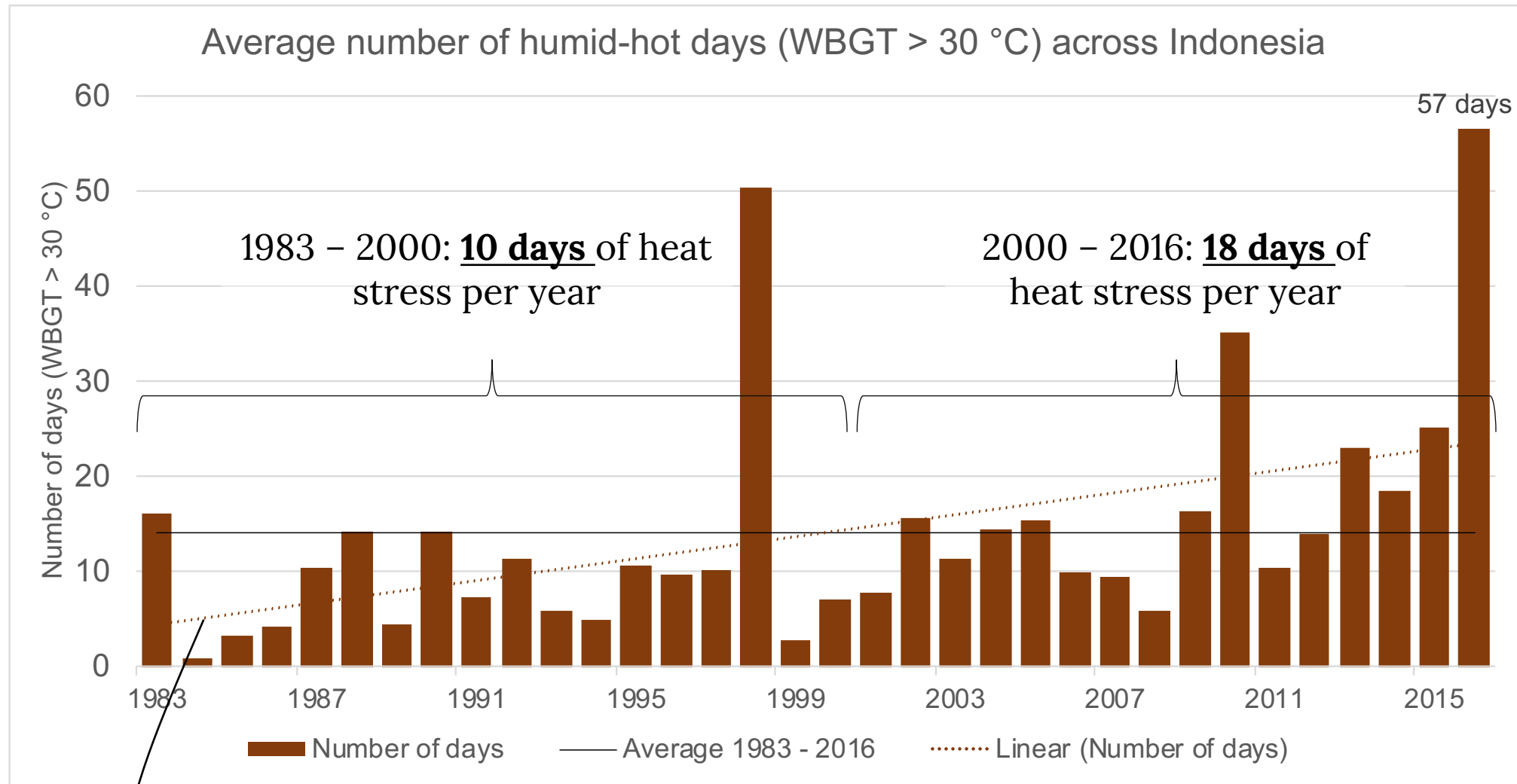
Heat stress definition

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

RESULTS

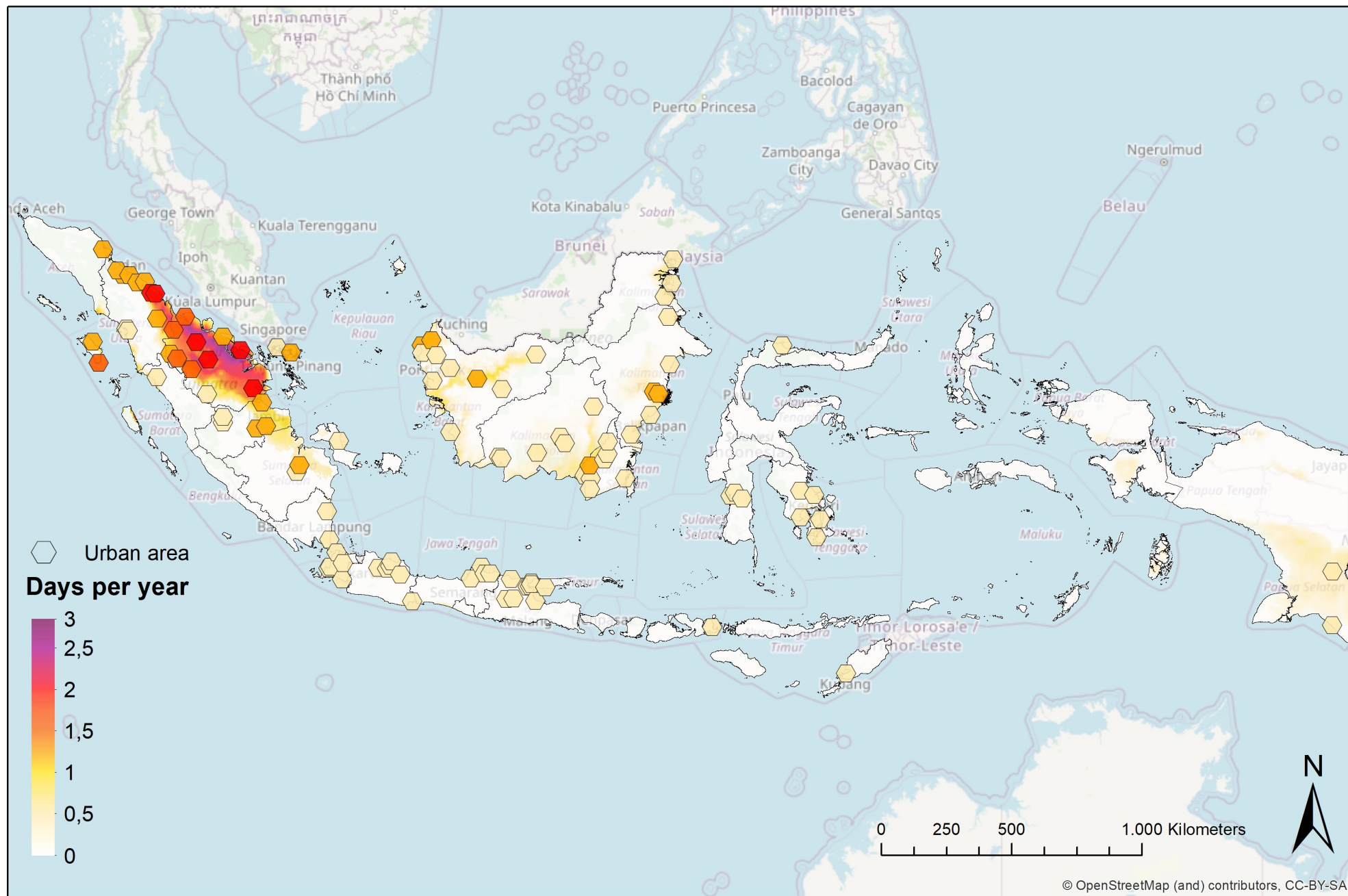
Person-days per year (*10⁵)

- ▲ $< 0,8$
- ▲ $0,8 - 2,5$

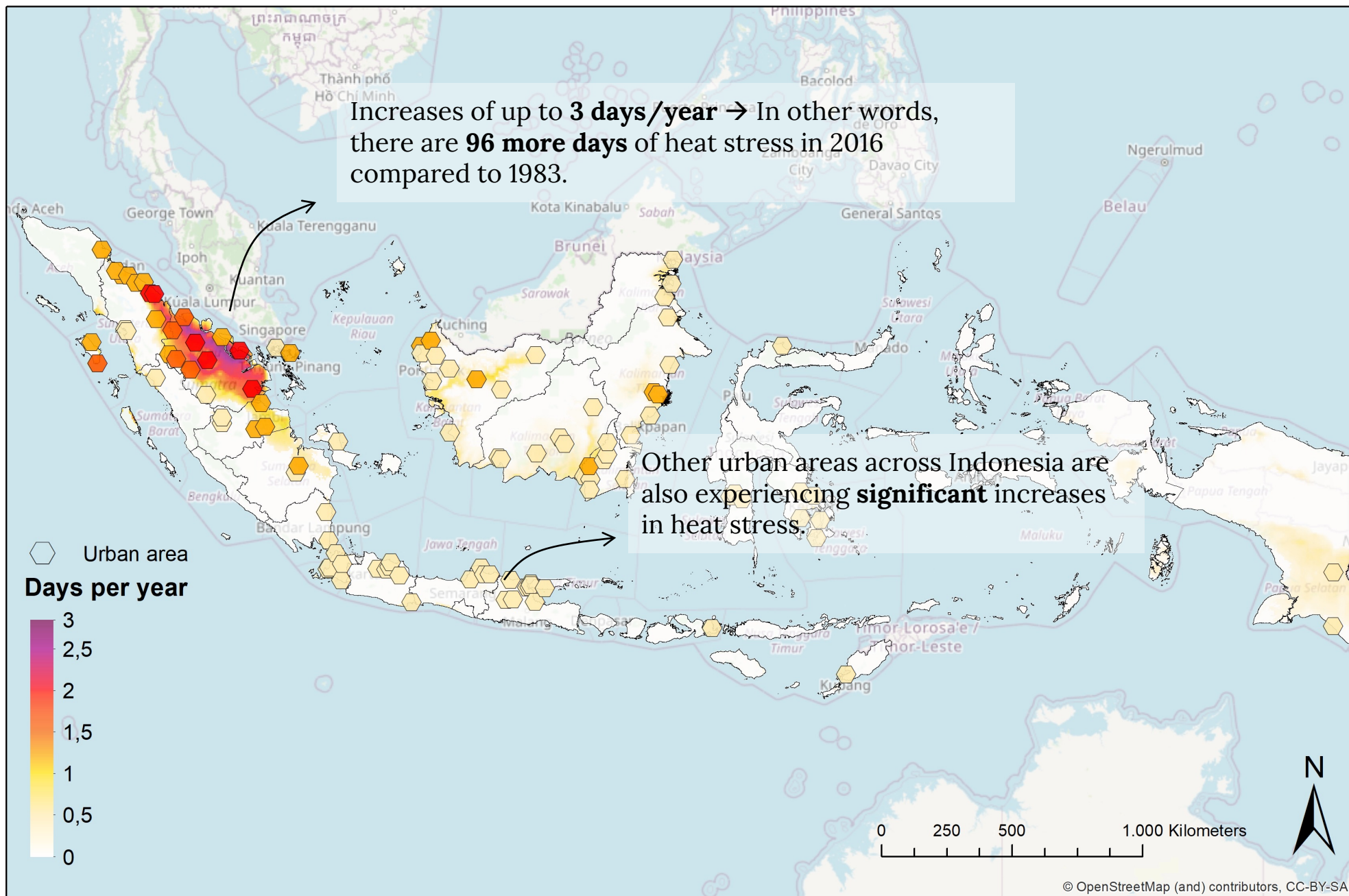


Over time, the number of heat stress days has significantly **increased** across Indonesia.

Annual increase in humid-hot days (WBGT > 30 °C) from 1983 - 2016



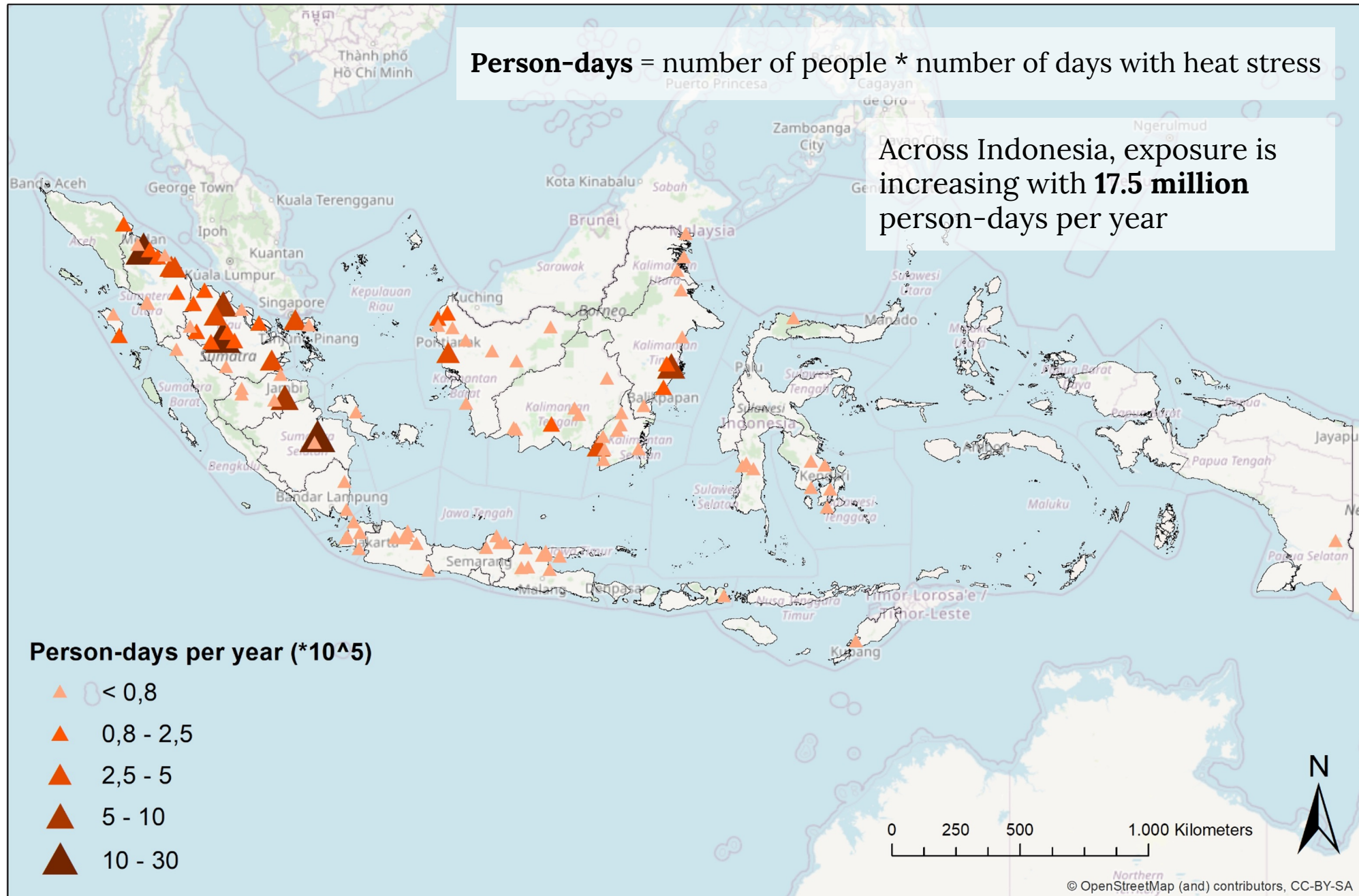
Annual increase in humid-hot days (WBGT > 30 °C) from 1983 - 2016



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

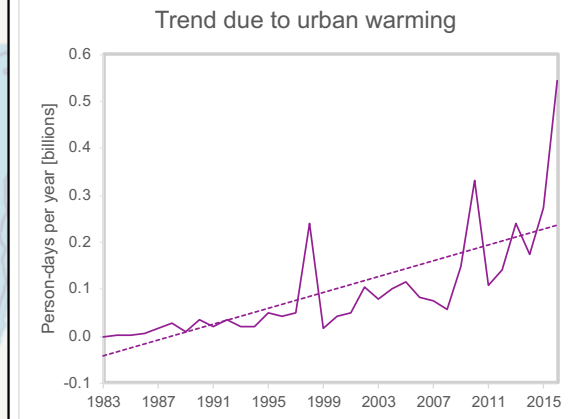
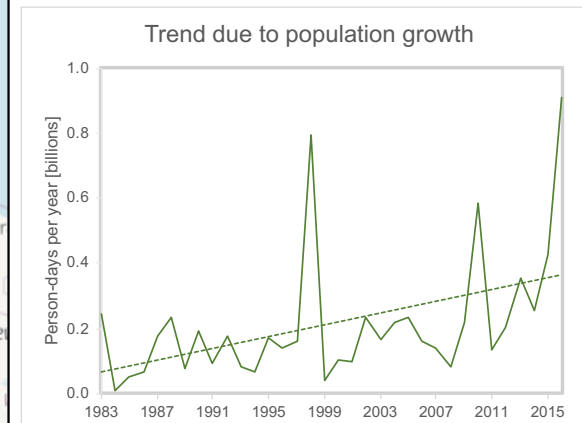
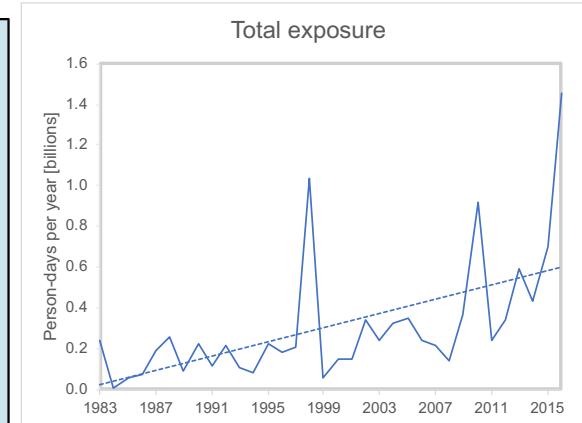
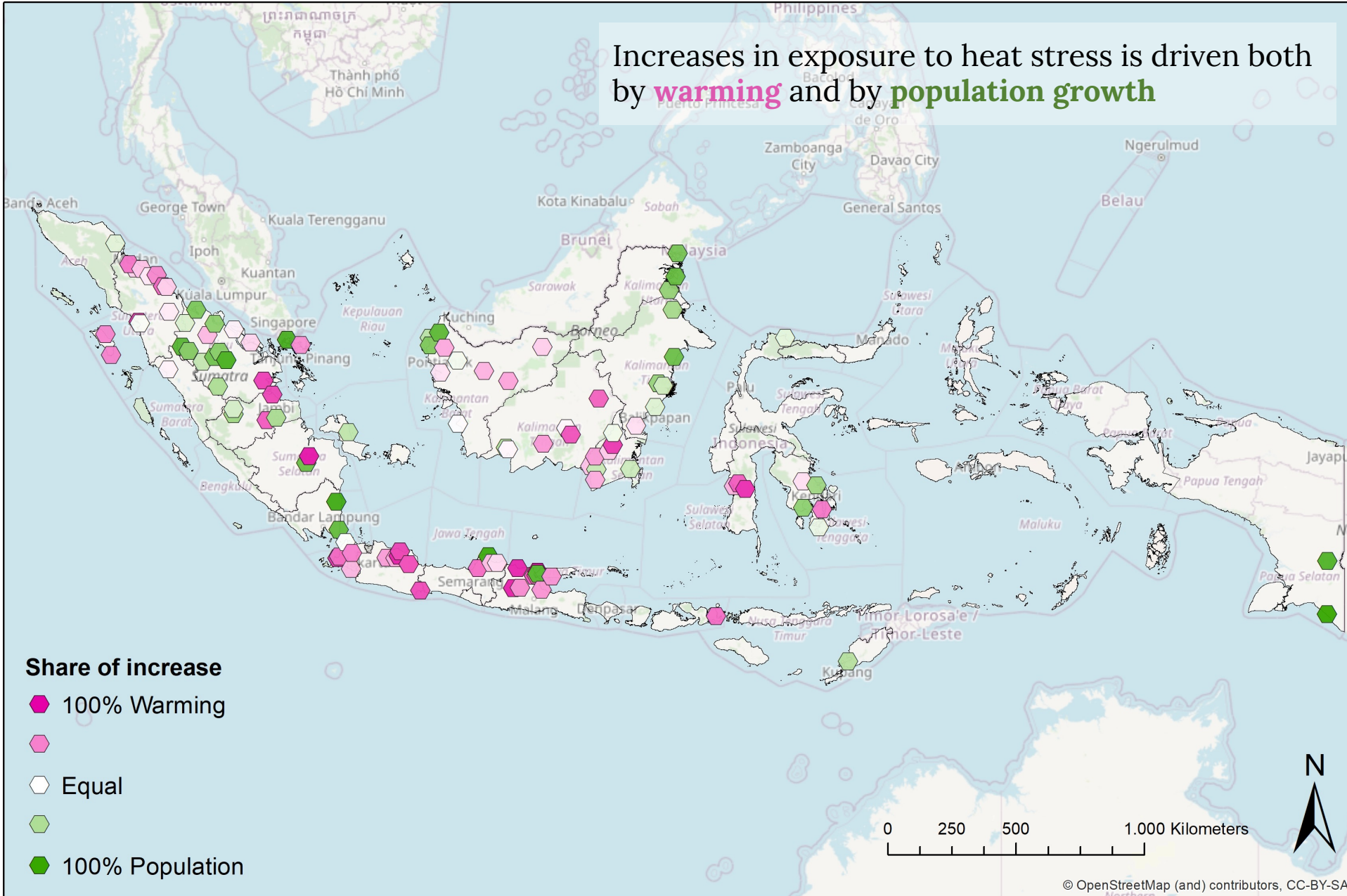
Person-days = number of people * number of days with heat stress

Across Indonesia, exposure is increasing with **17.5 million** person-days per year

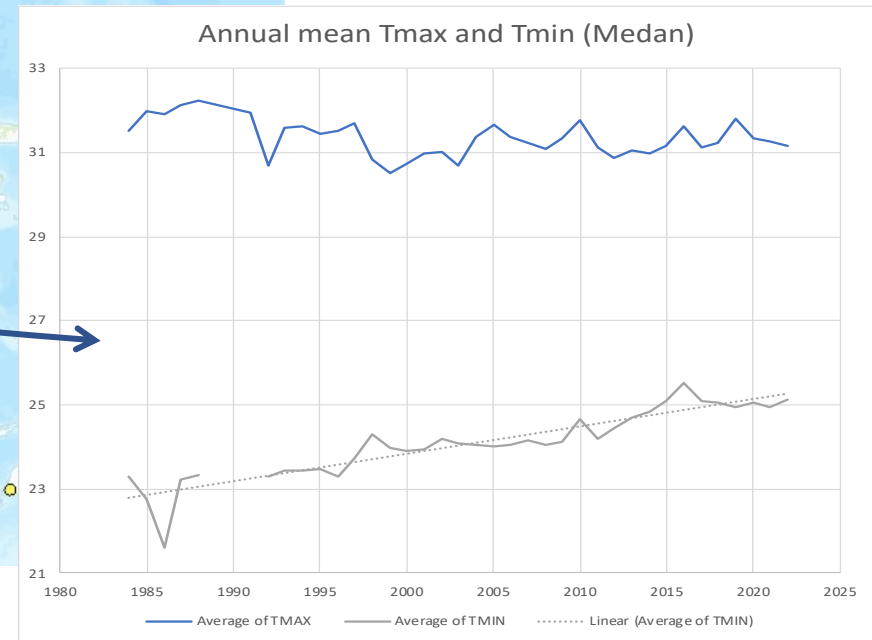
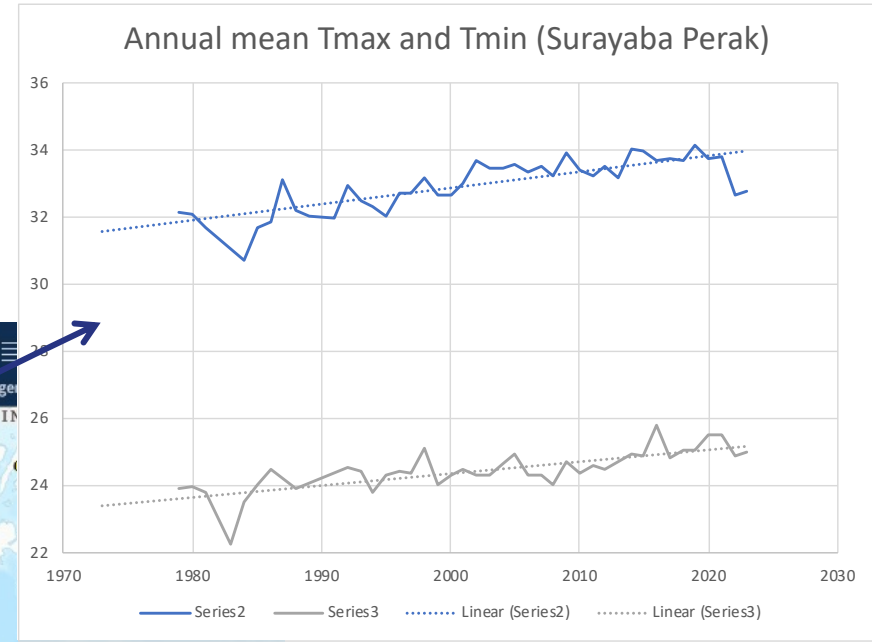
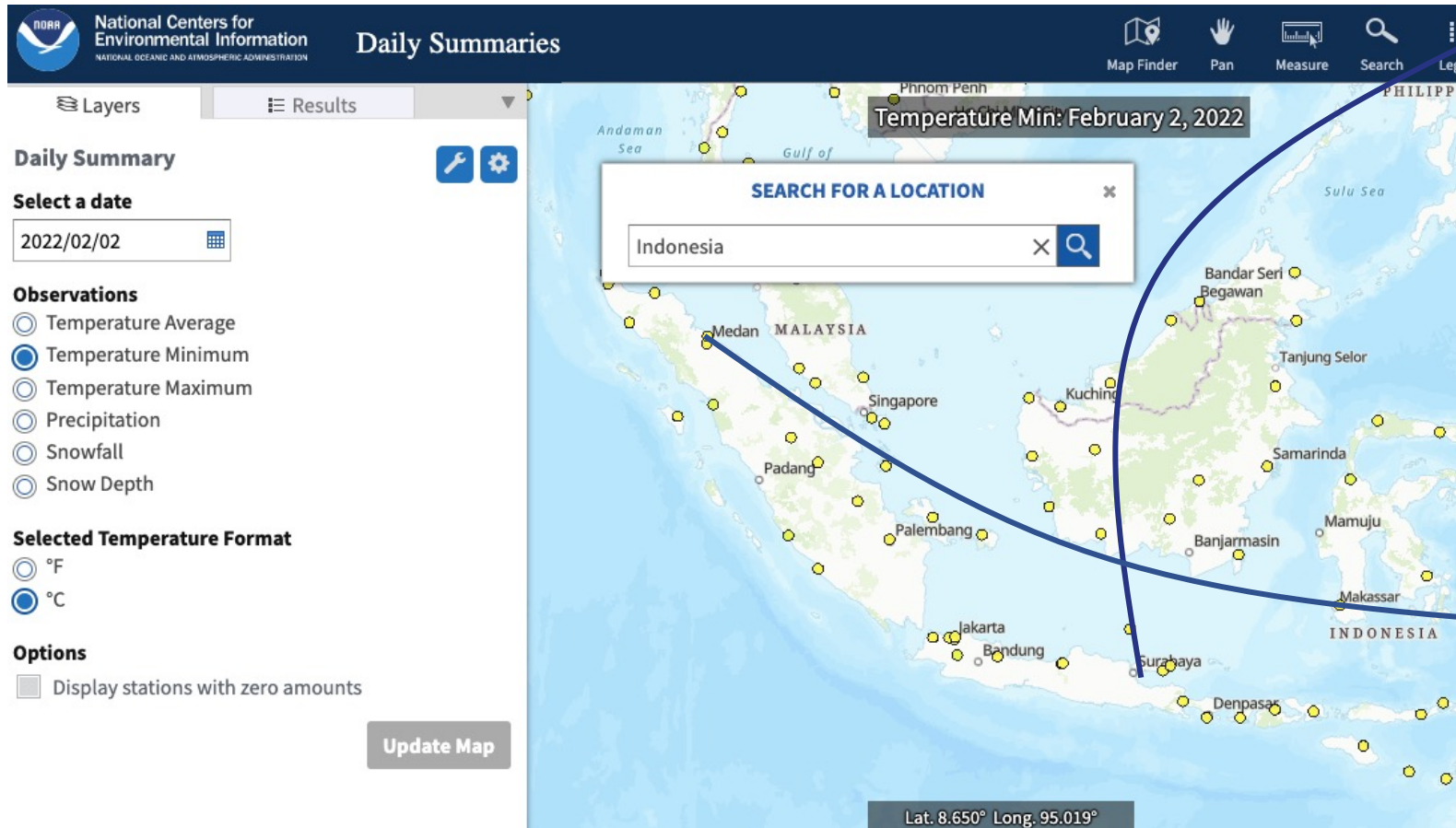


Contribution to increase in exposure (warming vs. population)

Increases in exposure to heat stress is driven both by **warming** and by **population growth**



Weather stations contain **MANY missing values** (for many years, 30-100% is missing); difficult to calculate trends



Heat stress impacts **human health, livelihoods, and the economy**

Heat stress leads to **great economic losses** and impacts **livelihoods**

- Decreased productivity & reduced work hours. (Indonesia has been identified as one of the countries suffering **most losses** of potential labour capacity, estimated at **4-6% of the annual GDP**.⁷⁾
- Crops & livestock can be lost, threatening food security.
- Impacts can be compounded when heat stress interacts with other hazards such as wildfires or droughts.

Heat stress impacts **human health** & can be **deadly**

- Heat stress exacerbates pre-existing health conditions (e.g. respiratory, cardiovascular, and kidney diseases)
- Heat-illnesses: dehydration, heat cramps, heat stroke, dizziness, fatigue, and more.
- Increases hospitalizations and emergency admissions, putting strain on health services

	Billions of work hours lost in 2000 (n=199-0)	Billions of work hours lost in 2019 (n=302-4)	Work hours lost per person in 2019
Global	199-0	302-4 (100-0%)	52-7
India	75-0	118-3 (39-1%)	111-2
China	33-4	28-3 (9-4%)	24-5
Bangladesh	13-3	18-2 (6-0%)	148-0
Pakistan	9-5	17-0 (5-6%)	116-2
Indonesia	10-7	15-0 (5-0%)	71-8

[7] Source: Watts et al. (2020)

In 2019, 71.8 work hours were lost per person due to heat stress, translating to a total of 15 billion lost work hours in 2019.

Although heat stress can impact anyone, **vulnerable groups of people** are affected disproportionately:

Multiple vulnerabilities increase the risk of health impacts:



The less able, pregnant, or already infirm



The poor, displaced, and homeless



Children & the elderly



Athletes



Outdoor & manual workers



Heat stress is **rapidly increasing** across Indonesia, as well as the number of people exposed.



There is an **urgent need to better understand current and future heat risks** on a local scale across Indonesia.



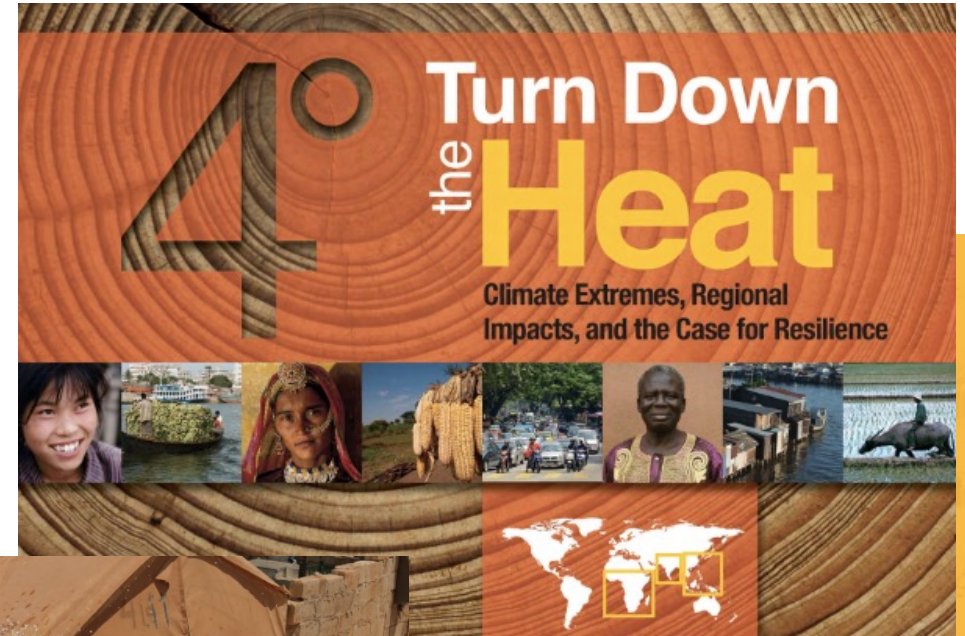
In order to ensure **economic development, healthy & resilient communities** across Indonesia.

Reducing risk to heat

The good news: there is much scientific evidence on how to effectively reduce heat risks, which can be coupled with existing development plans.



ASIAN DEVELOPMENT BANK



+CIFRC | OCHA | +C | Climate Centre

HEATWAVE
GUIDE FOR CITIES

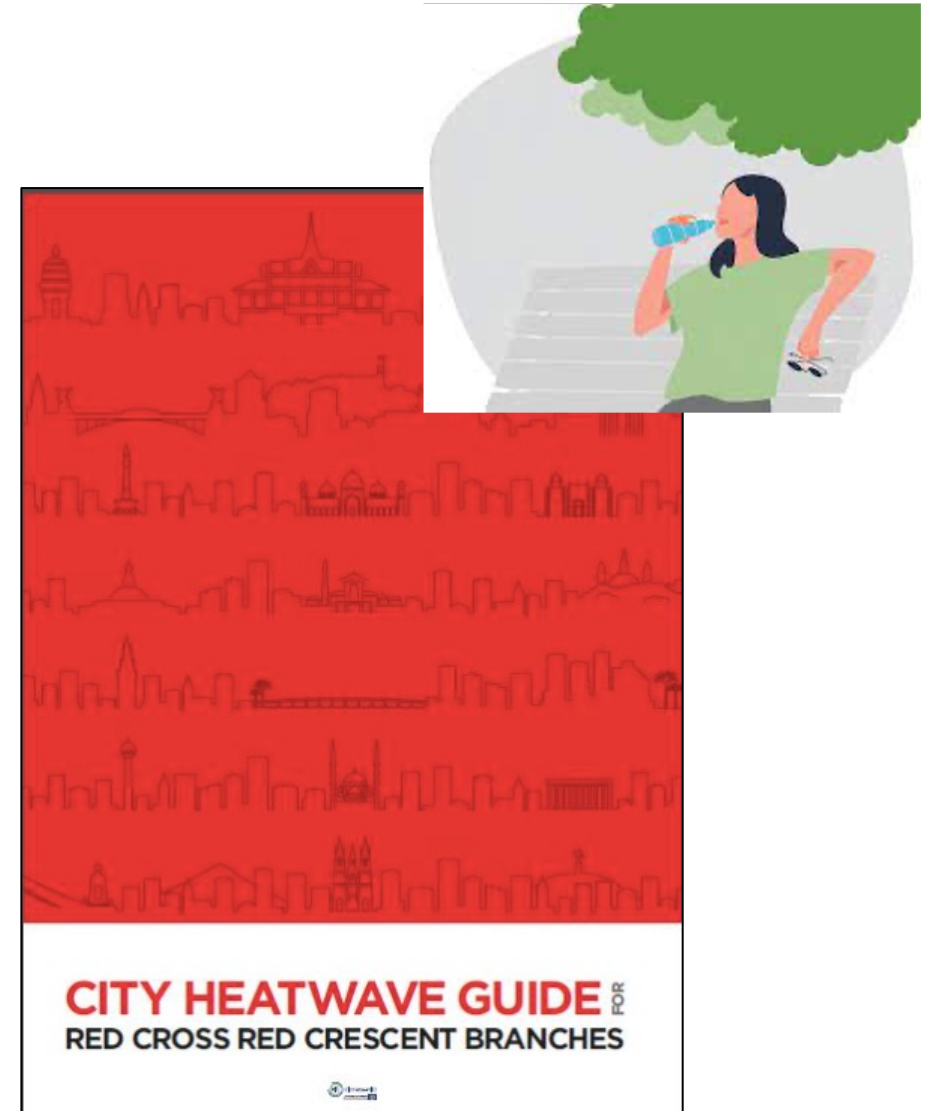
Potential actions for PMI

Long-term

- Improving **public messaging** of heat risks to raise awareness
- **Training** caregivers in social facilities (nursing homes, orphanages, etc.)
- Working together with local universities to **co-develop studies**

Short-term

- Planning **household visits**, as well as **school visits** (particularly in vulnerable neighborhoods) to raise awareness
- Providing **drinking water distribution points**
- Supporting **community early warnings**
- Opening **cooling centers**



[8] Source: City Heatwave Guide, Singh et al. (2019)

An aerial view of a city featuring several tall skyscrapers, including one with a construction crane on top. A wide road with a pedestrian bridge spans across it. The scene is set against a clear blue sky with some light clouds. A semi-transparent white box is overlaid in the center, containing the text.

**Thank you for listening!
Questions?**



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References

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