SESSION 1 – Health

Urban Extreme Heat Exposure Trajectories in AmeriGEO Countries

Tuesday August 24, 2021

AmeriGEO Week 2021: Advancing Collaboration and Data Integration for Decision Support

#AmeriGEOWeek2021

Presenter BIO

I am a human-environment geographer working with CIESIN at Columbia University. My current research focuses on the intersection of extreme heat exposure, climate change, and food security.

My goal is to inform adaptation strategies that reduce the harmful and inequitable impacts of extreme heat events.

I also contribute to NASA's Human Planet Project, analyzing the use of gridded population datasets to measure and map progress towards the United Nations Sustainable Development Goals.

I received my PhD in Geography from UC Santa Barbara in 2020.

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Presentation Agenda

- Background Information

- New Data Development

- Key Findings

- Next Steps

- Summary/Key Takeaways

Background Information

Extreme heat exposure harms human health and well-being through many inter-connected pathways.

Mora et al. 2017
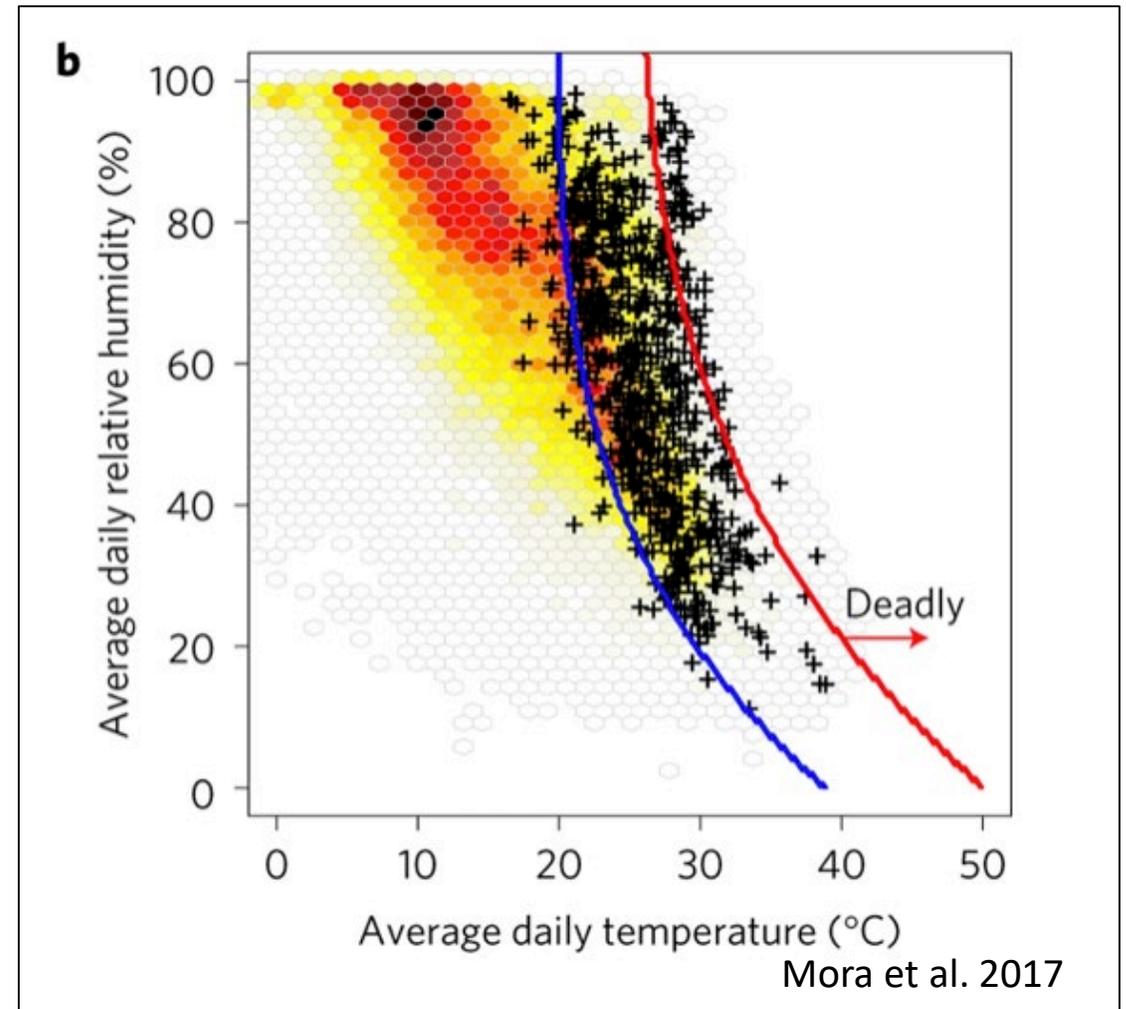
Background Information

- Many of the planet's urban areas, including those in AmeriGeo countries, lack weather stations.

- Previous temperature datasets and reanalysis products are <u>inaccurate</u> at measuring temperature extremes, especially over long distances (Verdin *et al.* 2020, Funk *et al.* 2019).

GHCN/GSOD Stations
Urban Settlements
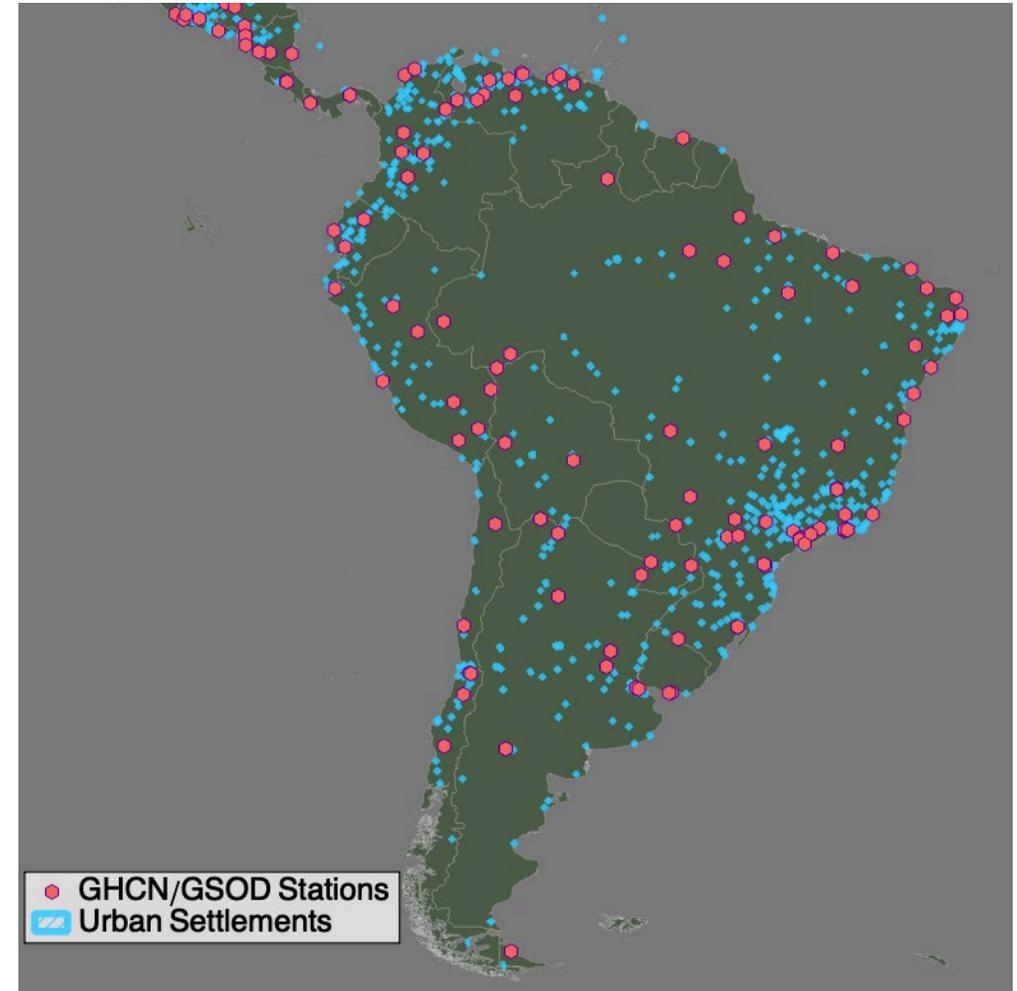
New Data, New Opportunities - CHIRTS-daily

- High-resolution (0.05°) daily temperature maximum and minimum and relative humidity record 1983 – 2016.

- Relies on fusing geostationary satellite thermal infrared observations with a set of ~15,000 stations observations.

- CHIRTS-daily is produced by bias adjusting ERA5 climate reanalysis.

- Most accurate daily T_{max} record in rapidly urbanizing, data-sparse regions.

CHIRTS-daily vs Global Meteorological Forcing Dataset
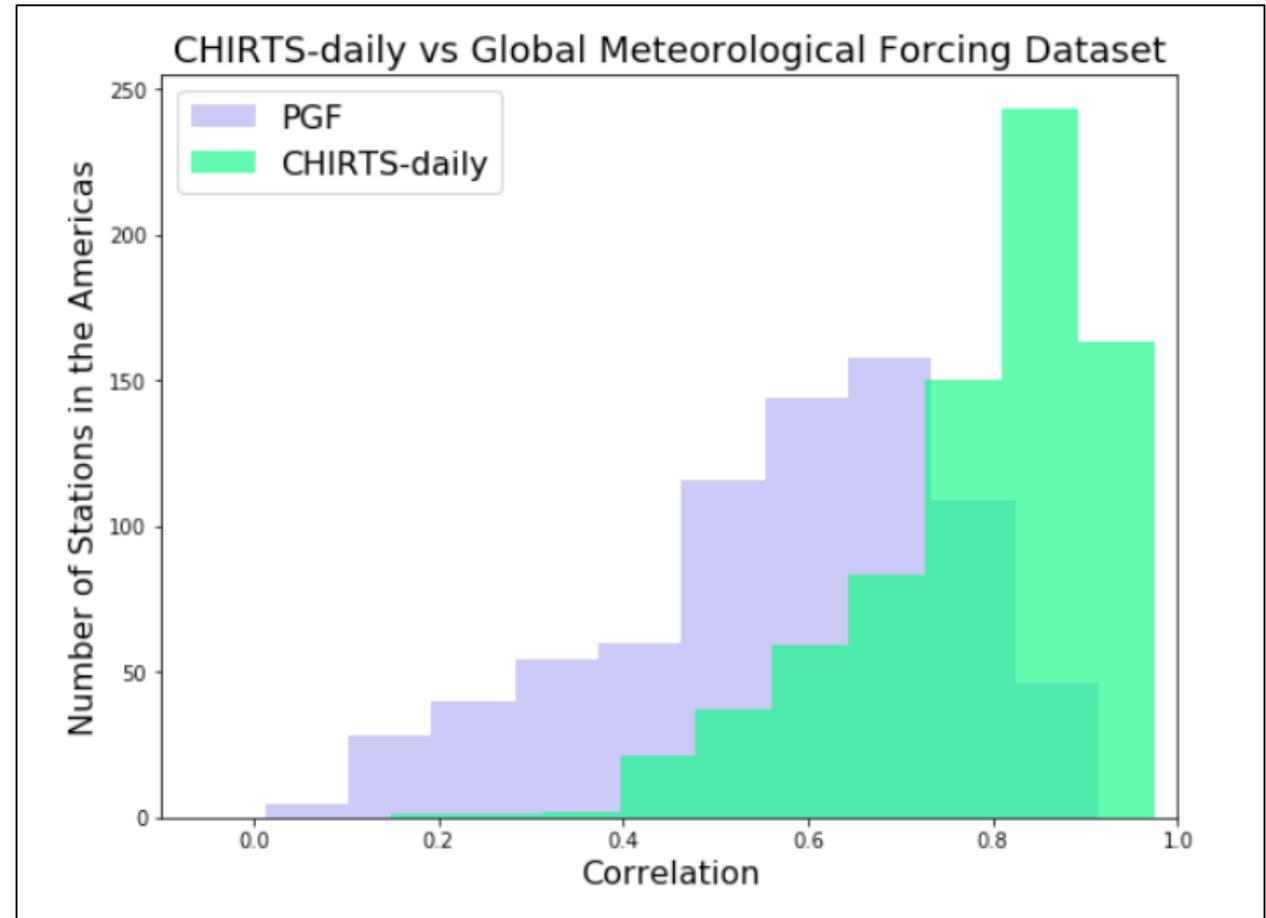
Estimating Urban Extreme Heat Exposure in AmeriGEO Countries

- How many people per year (person-days yr^{-1}) were exposed to hot-humid conditions of a daily maximum wet bulb globe temperature (WBGT$_{max}$) > 30°C?

- Threshold or percentile heat-health metrics are possible to derive for both dry and humid heat conditions (maximum, minimum, and average daily temperature, heat index, wet bulb globe temperature)

- Dataset allows us to pinpoint how extreme heat exposure is changing at fine spatiotemporal scales to priorities resources for interventions and adaptations.

Estimating Urban Extreme Heat Exposure in AmeriGEO Countries

(A) Total Exposure — Avg. annual increase: 38.3 million person-days yr⁻1

(B) Trend due to population growth — Avg. annual increase: 23.9 million person-days yr⁻1

(C) Trend due to urban warming — Annual increase: 14.4 million person-days yr⁻1
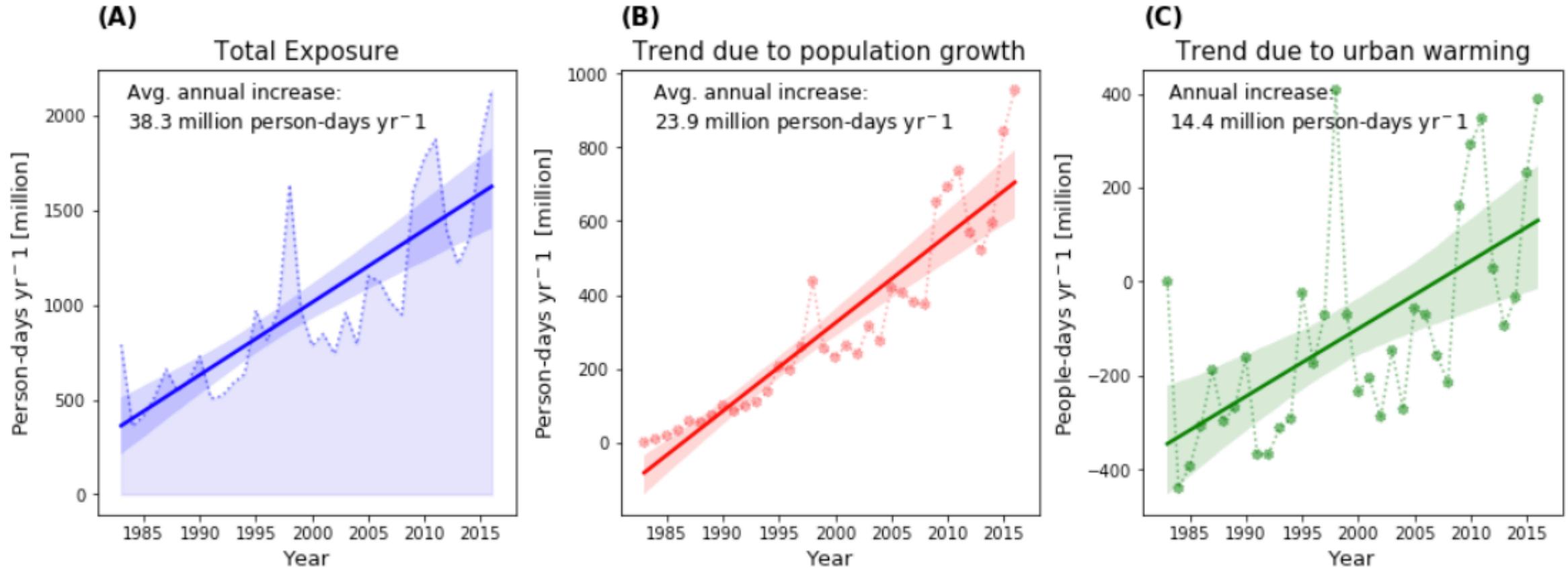
Estimating Urban Extreme Heat Exposure in AmeriGEO Countries

- Nearly 200 urban settlements had significant exposure trends in AmeriGeo countries from 1983 – 2016.

- These urban settlements housed 57 million people in 2016.

- Top 3 AmeriGEO - Houston (USA), Culiacan (MEX), and Reynosa (MEX).

- Spatially heterogeneous exposure trajectories were found across the region.

Person-days yr⁻¹
- 10^{2-3}
- 10^{3-4}
- 10^{4-5}
- 10^{5-6}
- 10^{6-7}
- 10^{7-8}
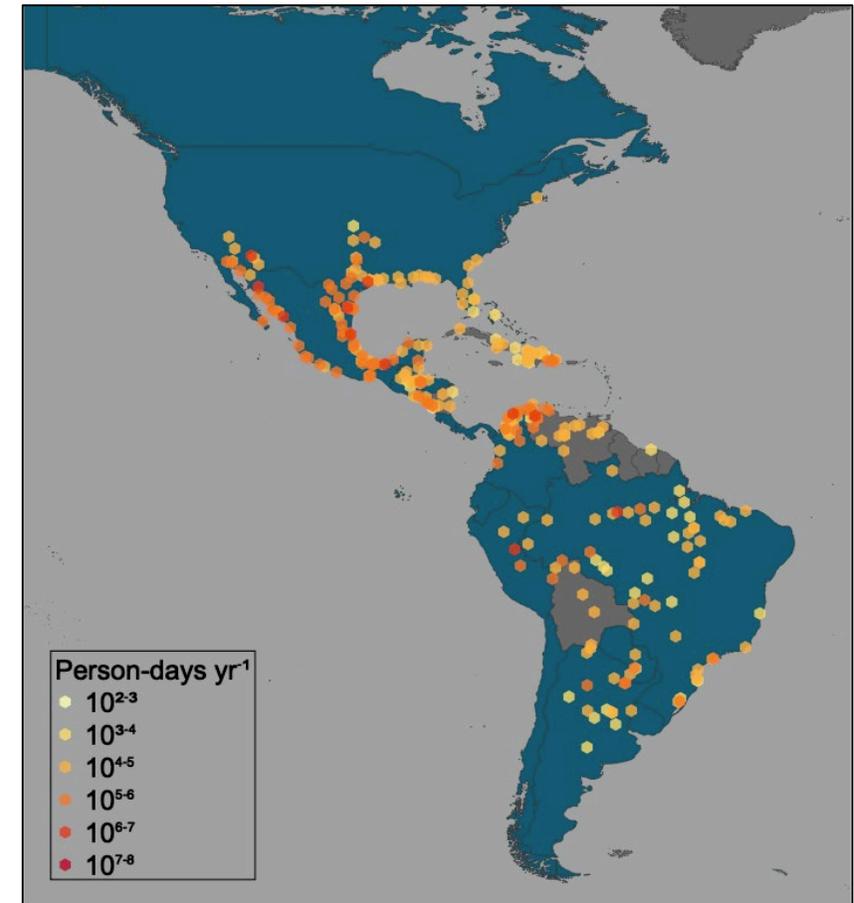
Estimating Urban Extreme Heat Exposure in AmeriGEO Countries

- How population growth and total urban warming contributed to total exposure increases was highly spatially heterogeneous.

- Local climate and population dynamics are key.

- Separating and then mapping these two signals is important for adaptation, anticipatory actions, and early warning systems to reduce harm.

- Top down-approaches need to be met with bottom up knowledge.

Share of Increase
100% Warming
Equal
100% Population
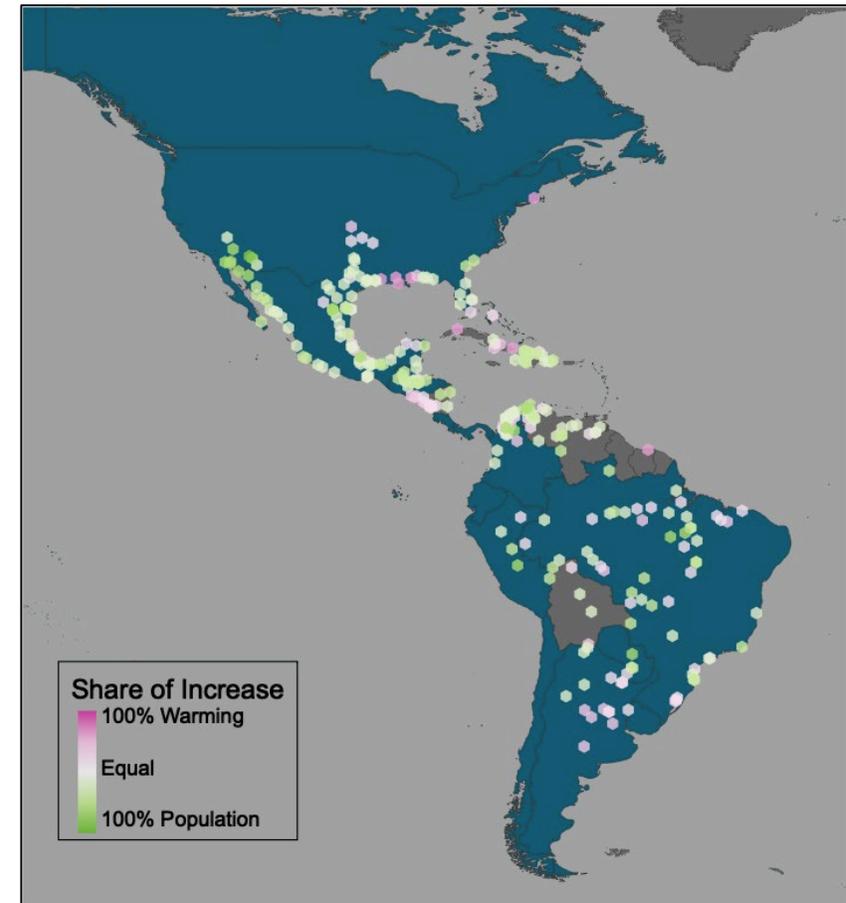
Next Steps

- Operationalize CHIRTS-daily – update dataset in near-real time.
- Extend analysis beyond urban populations.
  - Identify which areas face increasing heat stress that can impact both crop production and human-health outcomes.
- Conduct analysis across multiple heat-stress metrics and ensure that real-time release includes metrics related to human-health (not just 2m air).
- Ensure data and analysis are accessible/utilizable by broader public.
- With partners, develop early warning systems.
- Future projections under climate change.

Summary and Key Takeaways

- Earth Observation data is key for understanding heat stress, especially in data-sparce regions.

- Urban extreme heat exposure is rapidly increasing across many AmeriGEO urban settlements

- The contribution from population growth vs. total urban warming is spatially heterogeneous, key for adaptations.

- Top-down approaches need to be met with bottom-up knowledge.

- **DATA AND CODE WILL BE PUBLICALLY AVAILABLE SOON! PLEASE EMAIL ME - cascade@ciesin.columbia.edu**

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Thank You

Questions and answers will be received after the final presentation in this session.

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