

Resilience and adaptation to climate change in cities: time for action with nature-based solutions

Sao Paulo Research Foundation – FAPESP
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OVERVIEW

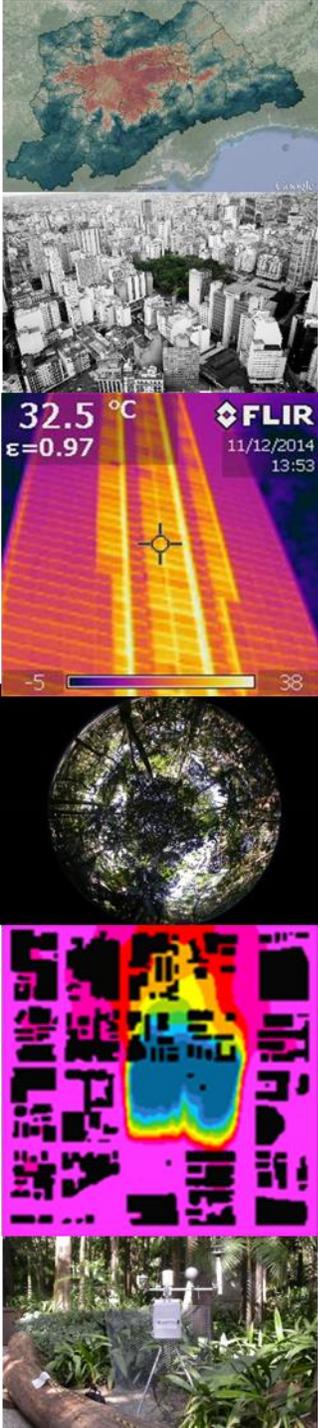
Extreme heat events have caused several **heat disasters** and threatened the **health** of urban residents, especially vulnerable people

To ameliorate urban heat extremes, **urban green** is one of the most effective means due to its cooling effect and socioecological win-wins

China and Brazil are facing rapid urbanization and are vulnerable to extreme high temperatures. By exploring the spatial heterogeneity of urban extreme heat in Beijing and Sao Paulo, the research team aims to **assess urban thermal risk** and **propose an urban greening planning framework** to cope with urban climate change

The **methods** encompass attribution of urban heat extremes, heat risk assessment, within-city spatial variation of urban tree's cooling efficiency and the optimization of green space under the current and future climate, considering socioeconomic vulnerability to extreme heat

Finally, we quantify the pathways governing urban temperature and **propose spatial plans for tree planting under different scenarios based on future climate change and urbanization**

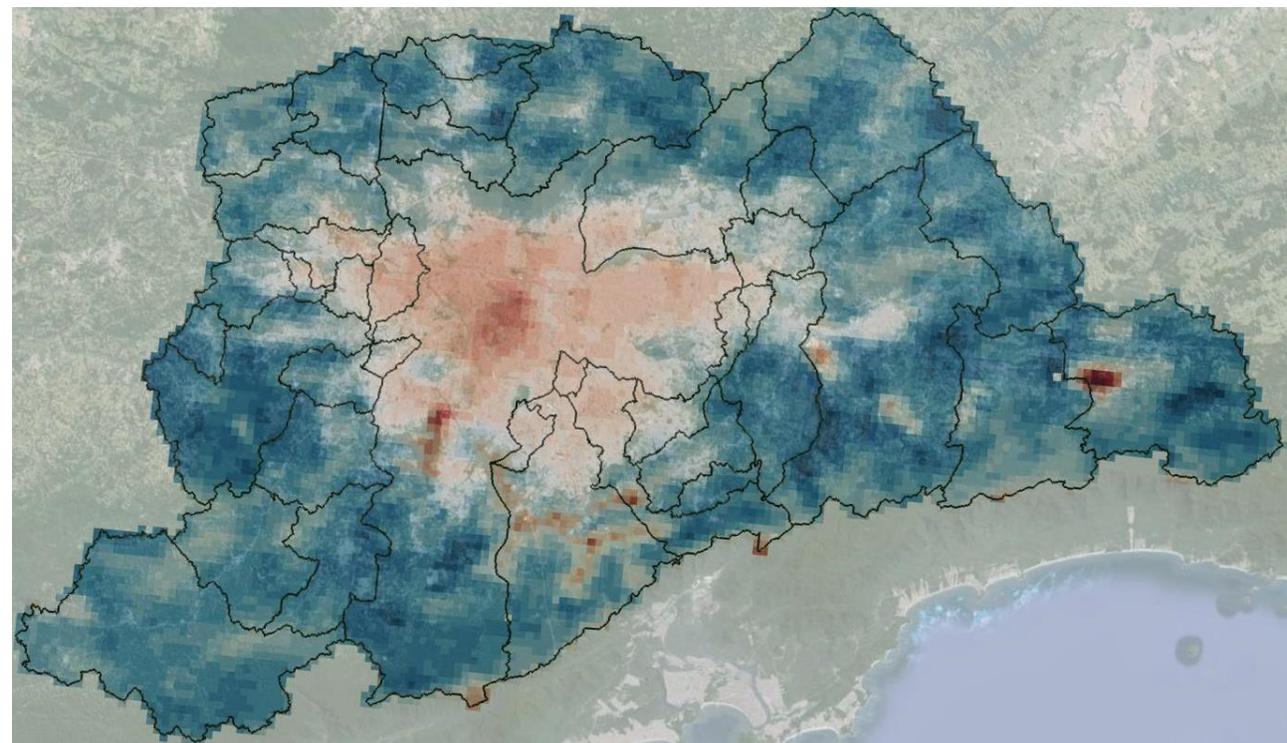
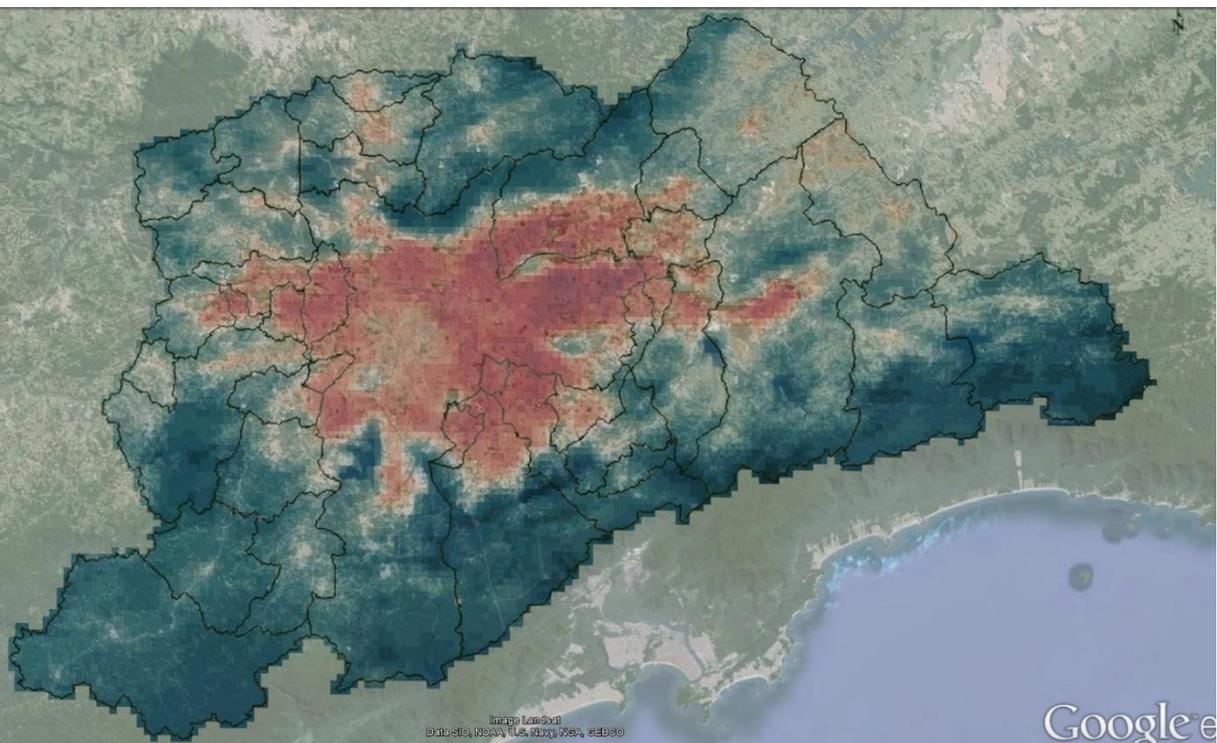






Green under pressure
São Paulo, Brasil

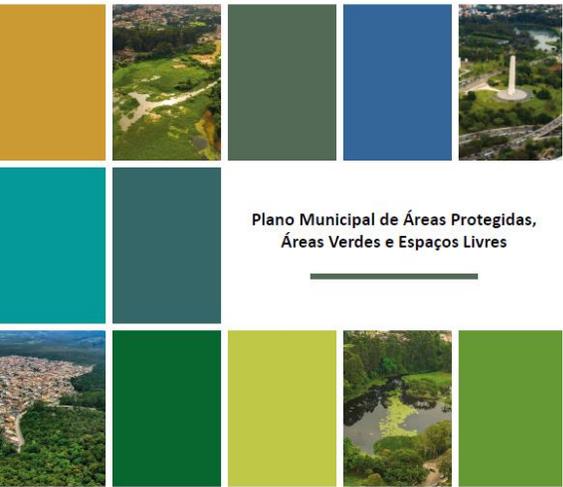




São Paulo Metropolitan Area (39 municipalities, 22 million inhabitants) – surface temperature day and night
Ferreira (2019)

<https://www.researchgate.net/profile/Luciana-Ferreira-3>

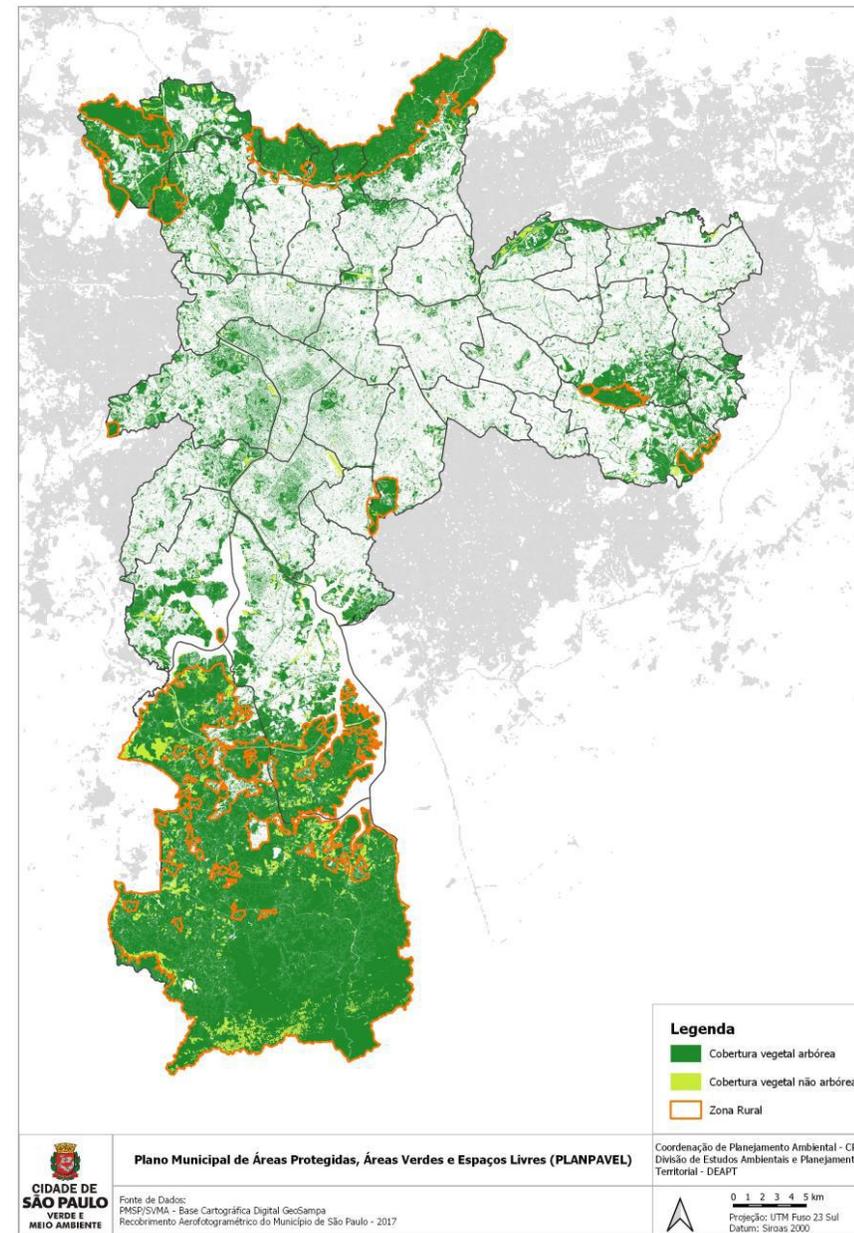
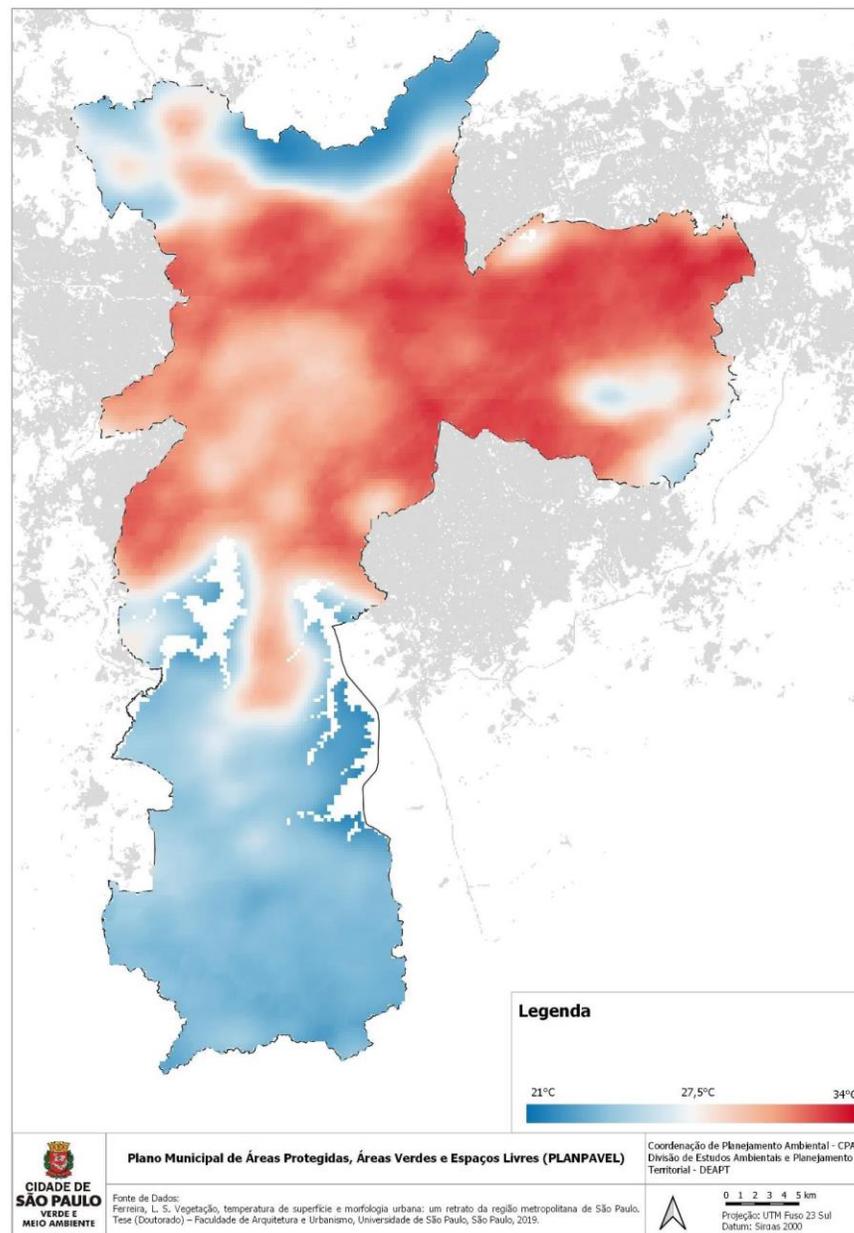
PLANPAVEL



Plano Municipal de Áreas Protegidas,
Áreas Verdes e Espaços Livres

2022

Prefeitura do Município de São Paulo
Secretaria Municipal do Verde e do Meio Ambiente



Ferreira (2019) - maps available at PLANPAVEL/SVMA/PMSP

https://www.prefeitura.sp.gov.br/cidade/secretarias/meio_ambiente/projetos_e_programas/index.php?p=284679

'Heatwave 2020: rewriting climatology in Brazil'

Climatempo, 09/10/2020

The heatwave from September to mid October 2020 established a new threshold for extreme temperatures in Brazil

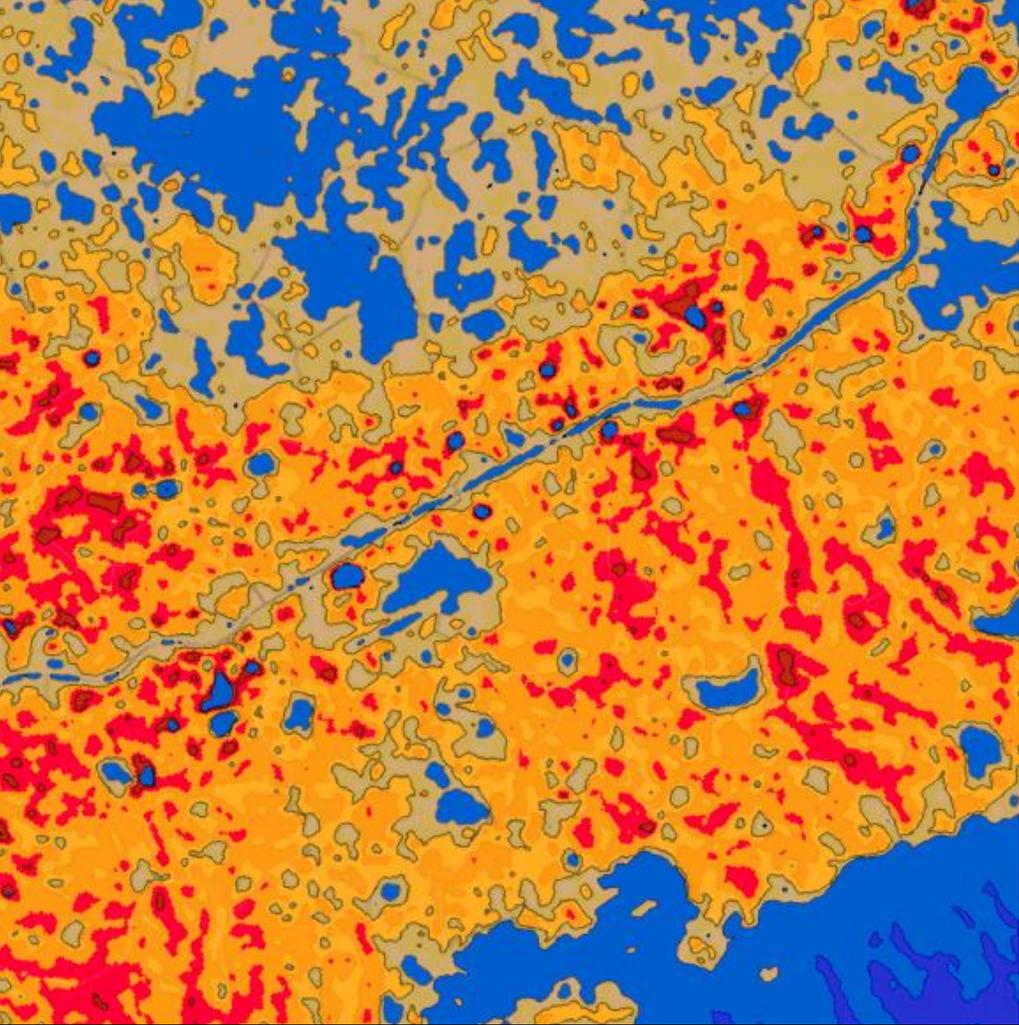
The last 8 years (2015-2022) were the hottest registered worldwide ever

In 2023, after 3 years, La Niña is gone, and El Niño probably will be back

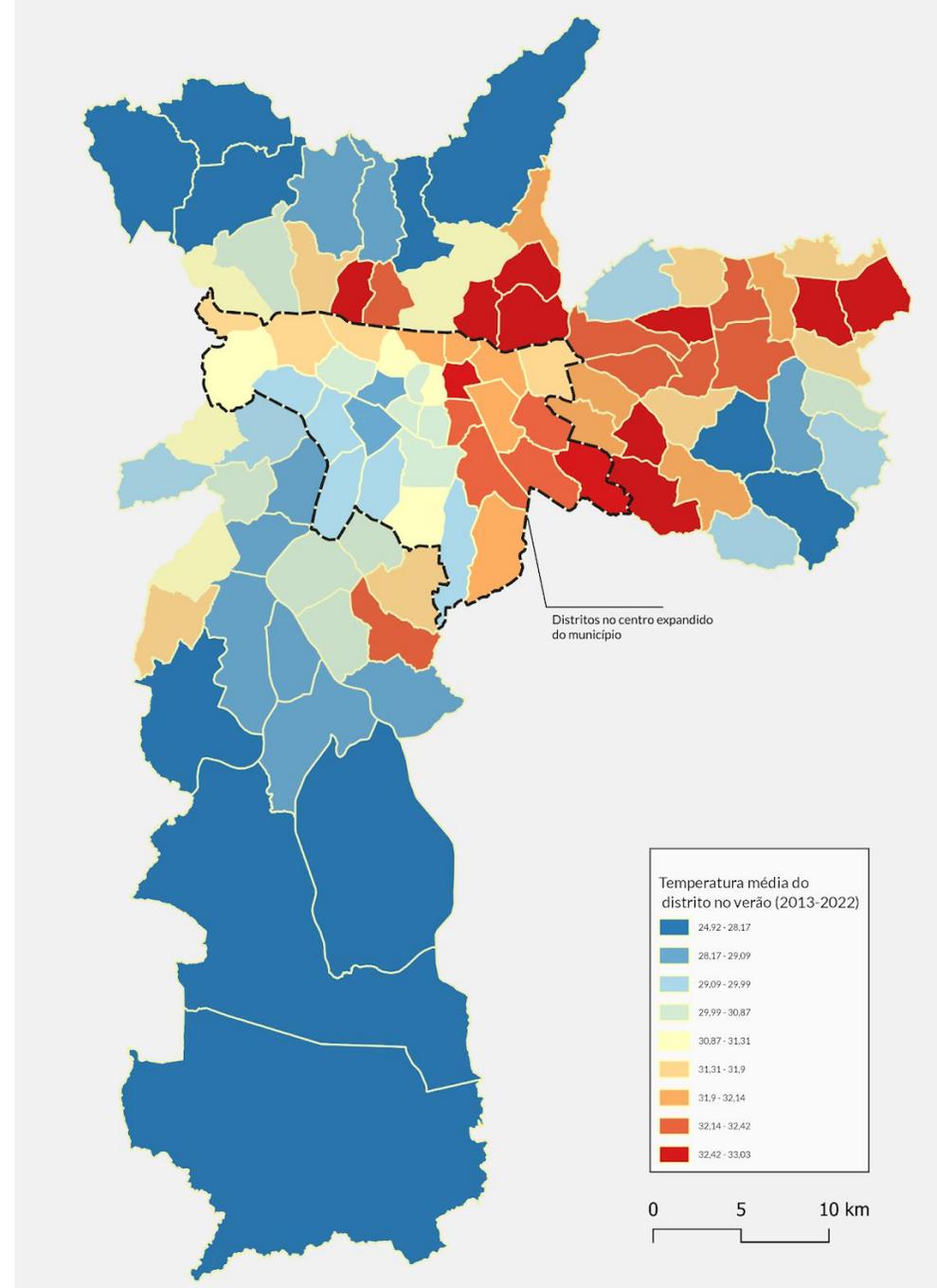
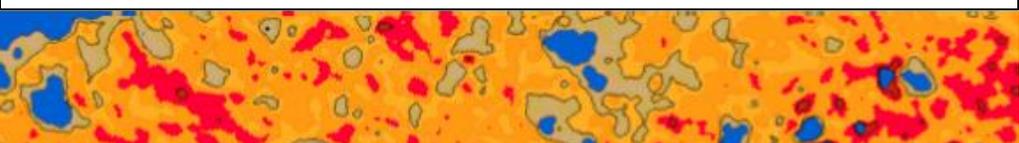


Observatório do Clima

Dados do serviço europeu Copernicus



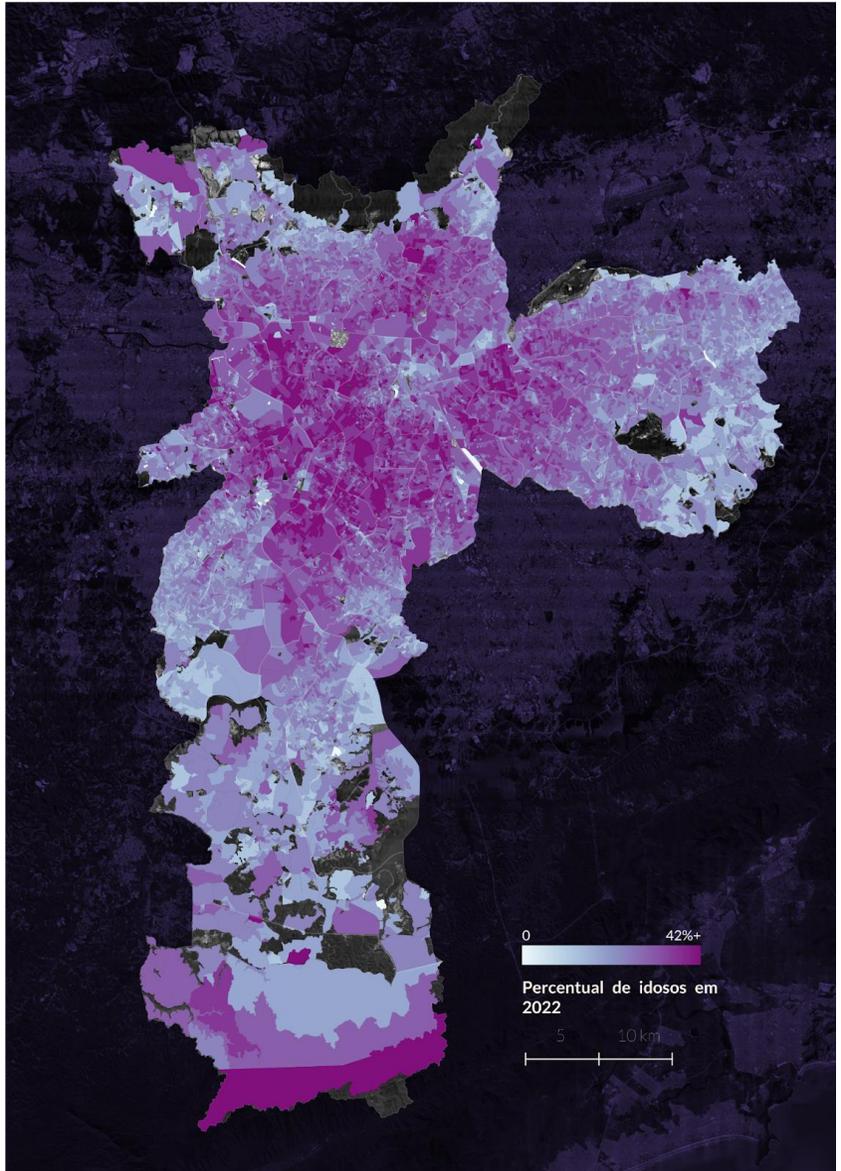
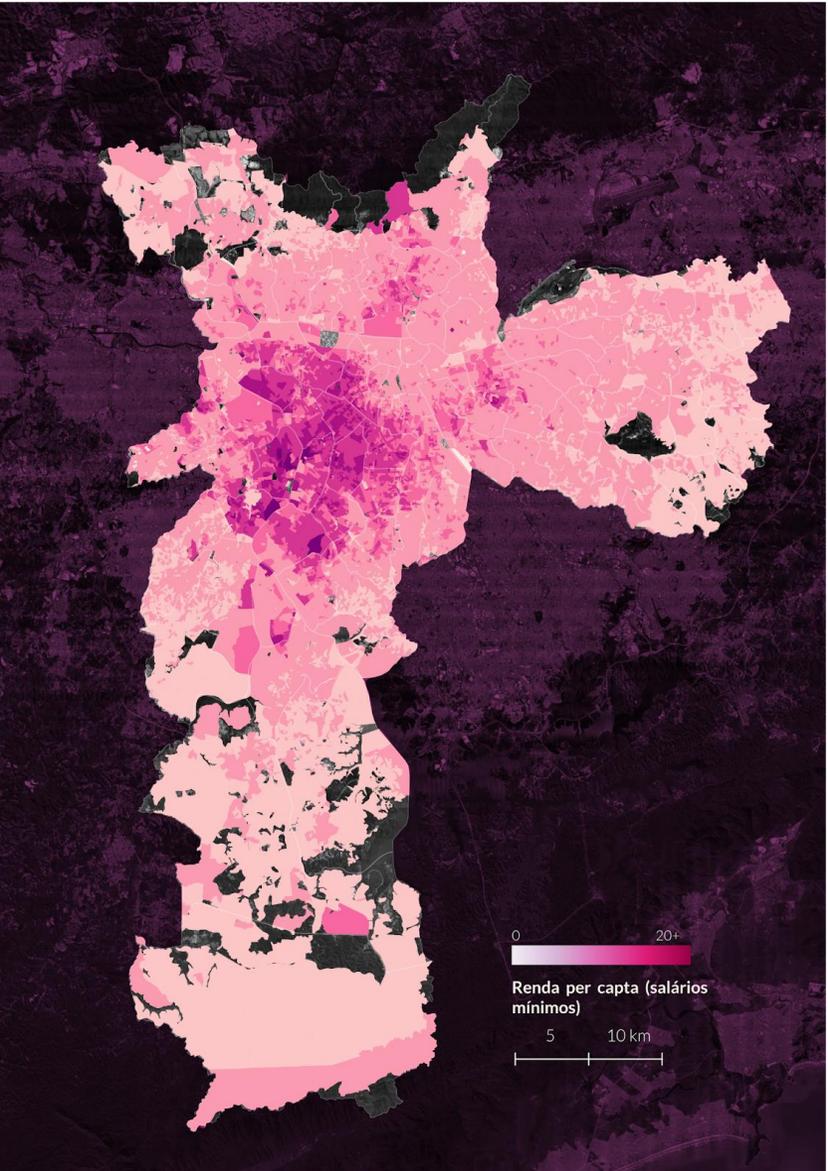
Between access and excess
understanding the urban warming in the city of São Paulo



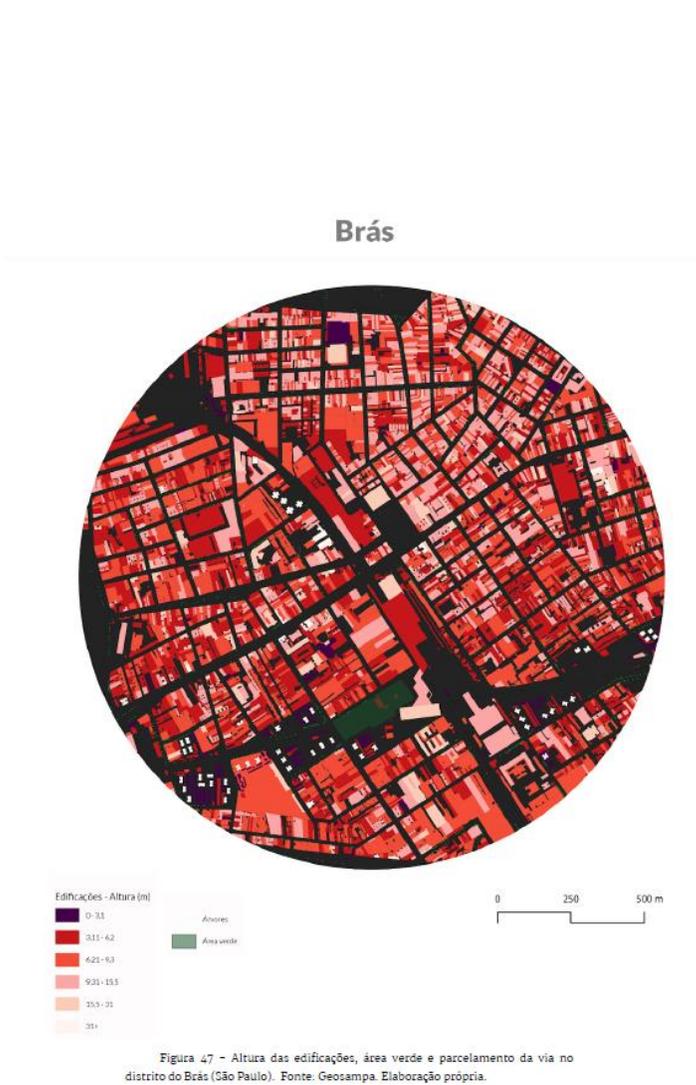
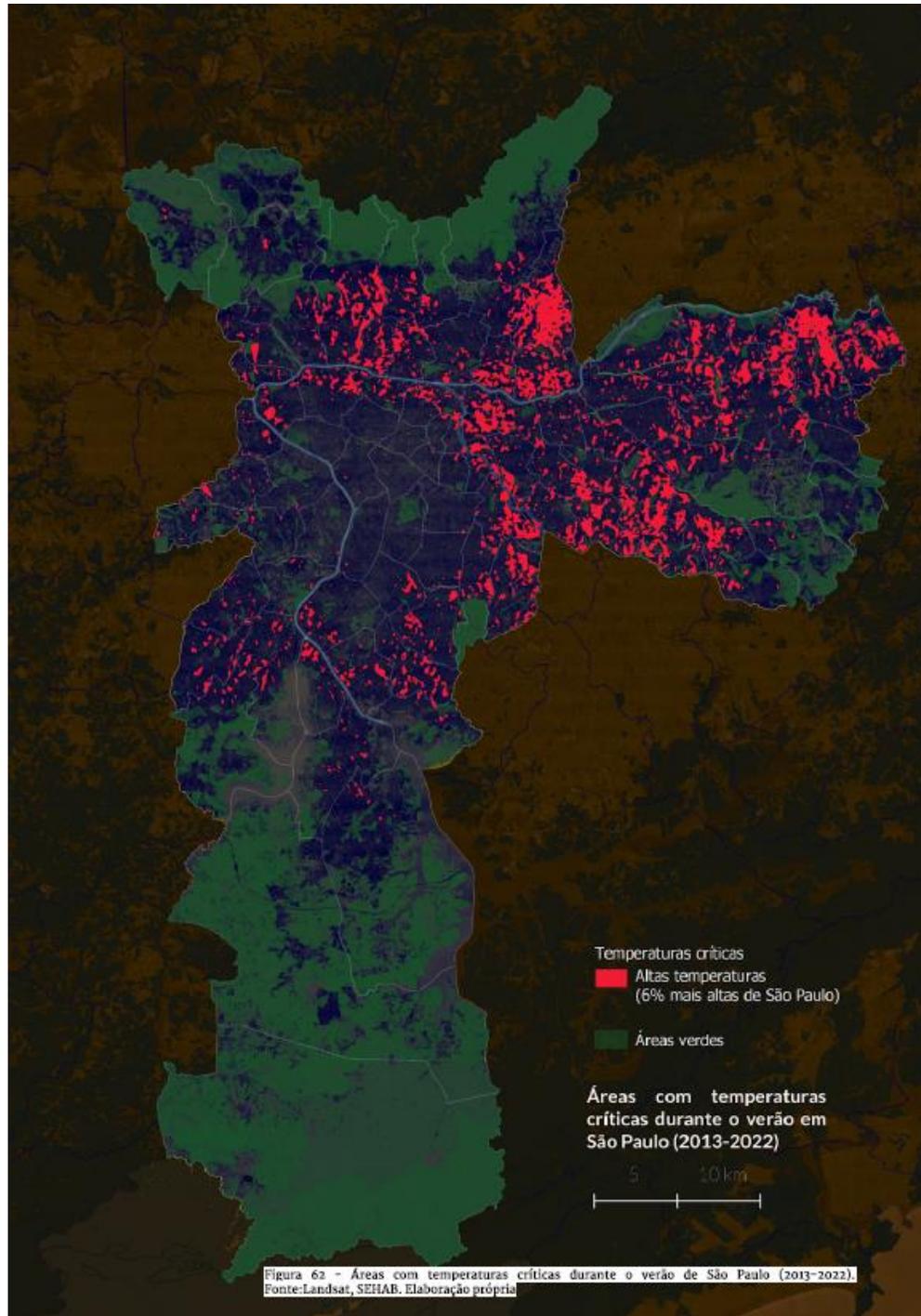
Castro (2022)

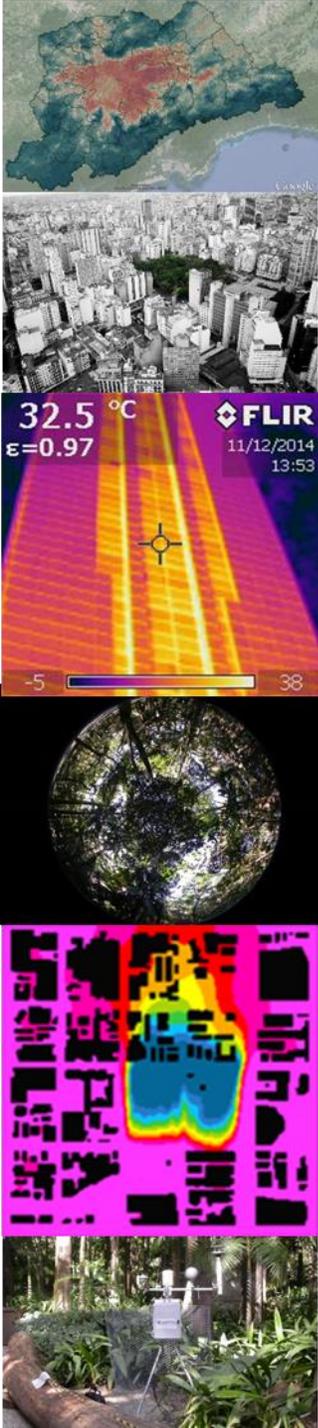
<https://www.researchgate.net/publication/366547761>

Socioeconomic data, e.g., income, age, informal settlements and extreme temperatures



Castro (2022)





PROBLEM STATEMENT

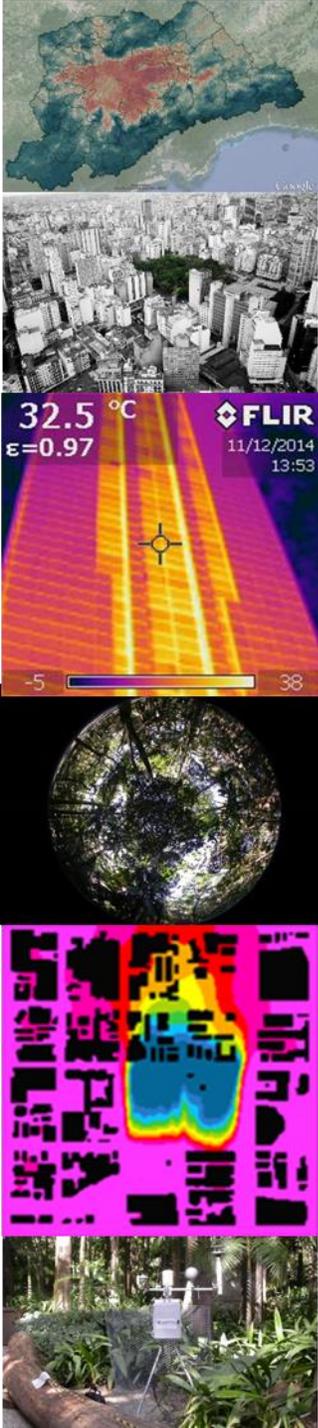
Extreme heat events caused by global warming will be further driven by land cover/use changes at the urban/regional scale forming a synergistic effect

Can this synergistic effect exacerbate their total effects on extreme heat events ?

Will the high heterogeneity of land cover/use within cities lead to spatial heterogeneity of such synergistic effects?

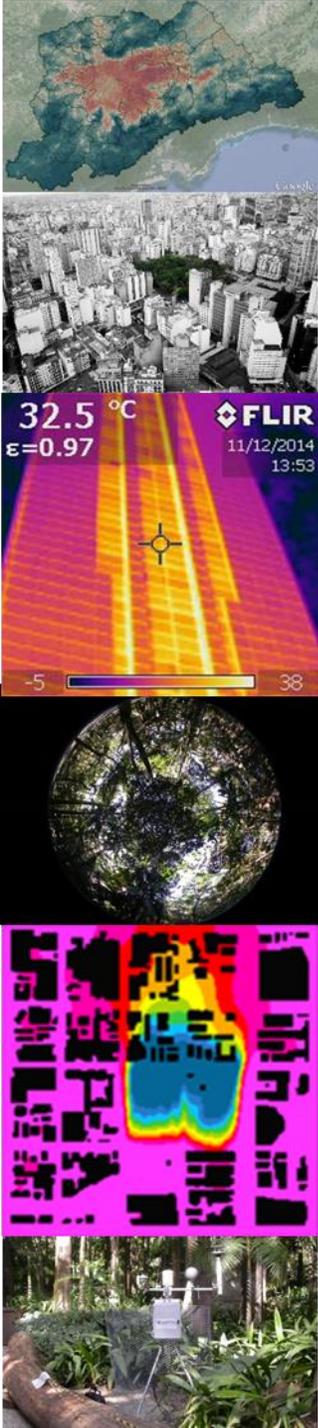
Urban extreme heat affects vulnerable people most.

Exposure-sensitivity-adaptive thermal risk assessment framework has been widely adopted in current studies but this kind of research framework lacks consideration for **the damage magnitude of extreme heat and the socioeconomic vulnerability**



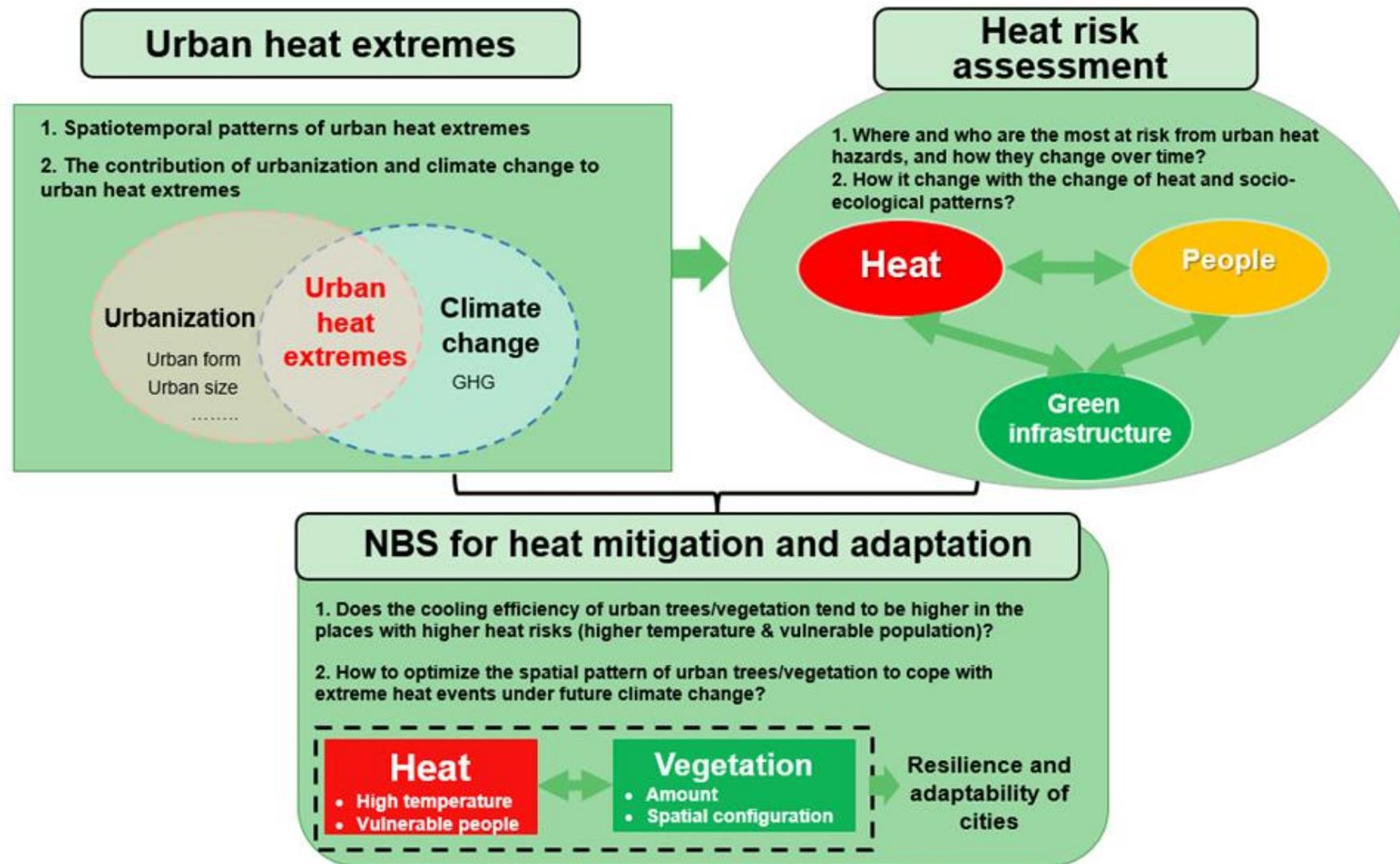
OBJECTIVES AND RESEARCH QUESTIONS

1. What are the synergistic effects of climate change and urbanization on extreme heat events in cities?
2. How do urban extreme heat events disproportionately affect urban residents?
3. In what physical and social conditions does the cooling capacity of trees have the greatest environmental and social impact?
4. How to maximize the cooling effects of urban trees for more resilient and adaptive cities?



Overall strategy: comparison study of two megacities — Beijing, China, and São Paulo, Brazil

Data and Methodology: 1) The spatiotemporal patterns of EHE and the attribution to climate change and urbanization; 2) Urban heat risk assessment using social-ecological framework; 3) Urban tree planting as a NbS to enhance the resilience and adaptability of cities to climate change



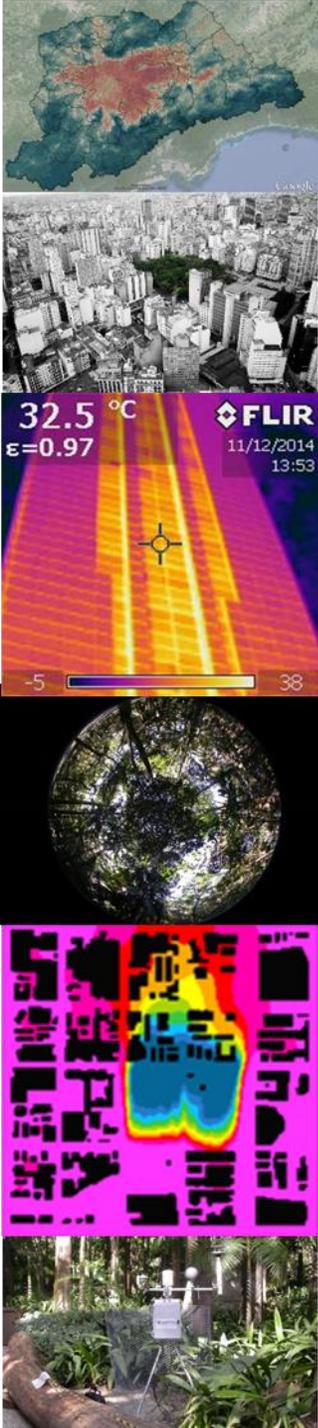
EXPECTED RESULTS

By exploring the spatial heterogeneity of urban extreme heat based on Sao Paulo and Beijing, assessing urban thermal risk and finally proposing an urban greening planning framework to cope with urban climate change

Beijing and Sao Paulo face common ecological and environmental problems, but São Paulo has higher socioeconomic inequalities, while Beijing has a higher percent of elderly population

This study will propose a socio-ecological win-win urban green space planning framework that maximizes the cooling effect of green space, alleviates high temperature to a greater extent and benefits more vulnerable populations

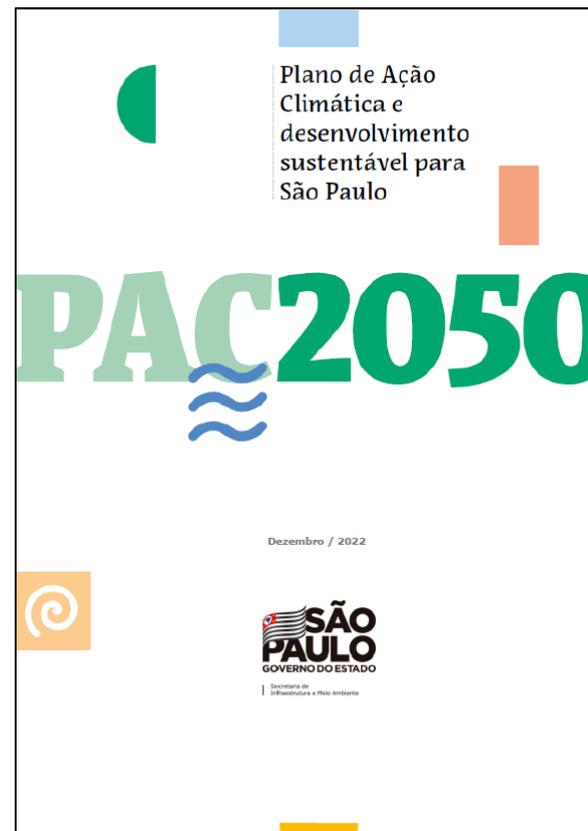
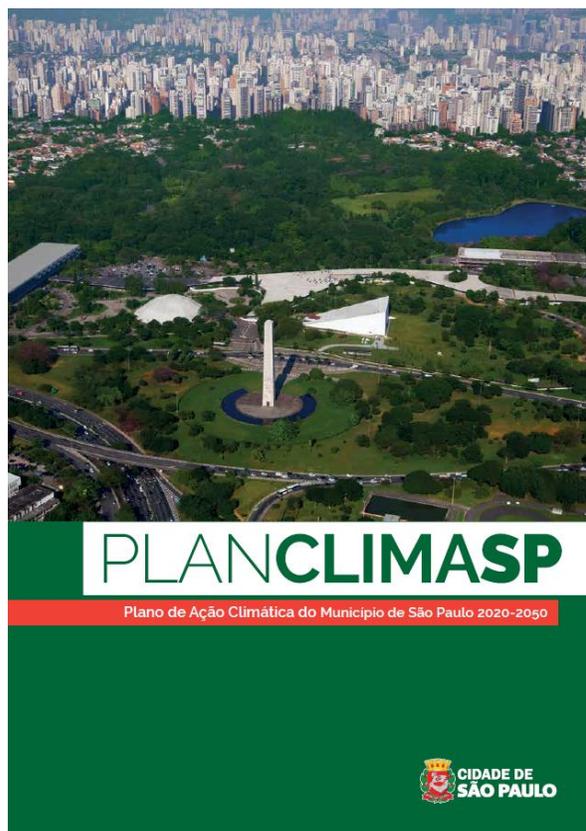
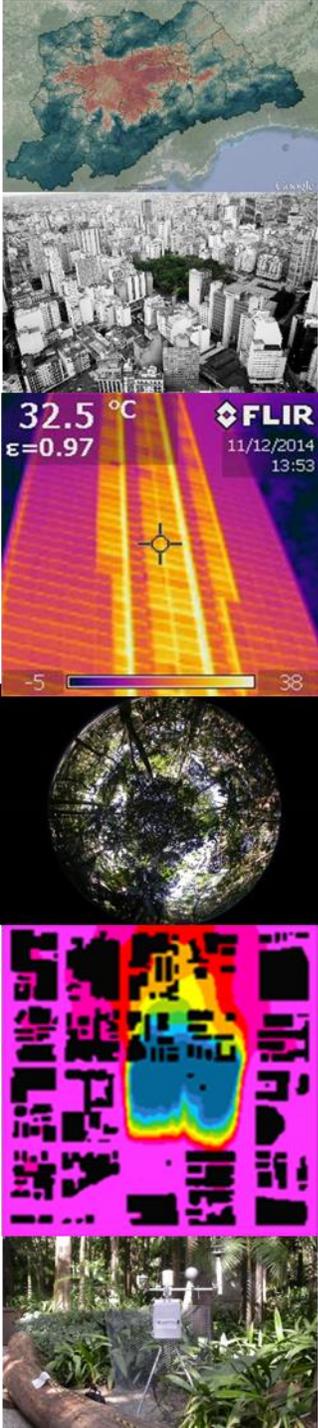
It can provide **scientific basis for urban green space planning and management** to improve urban thermal environment and enhance the resilience and adaptability of urban ecosystem, showing important **practical significance**

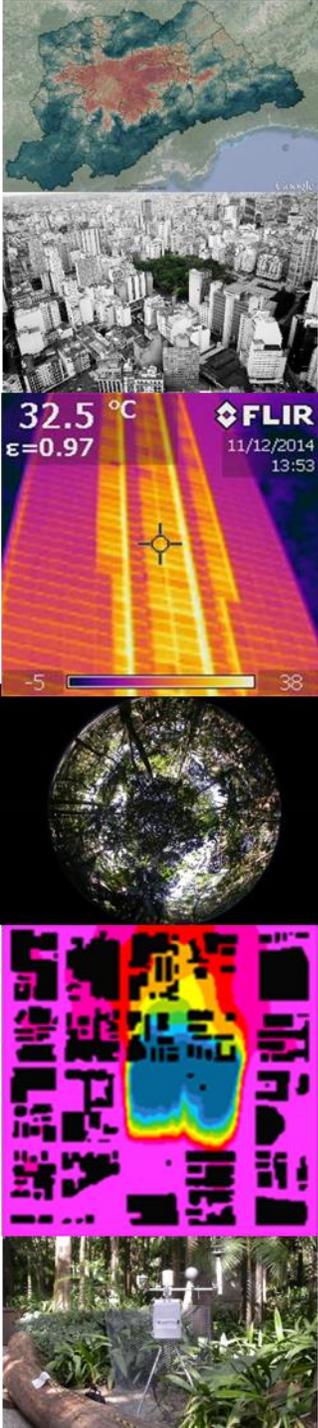


EXPECTED RESULTS

Locally, the results can contribute to the implementation of PlanClimaSP (2021), and for the PAC2050 (2022), the municipal and state of Sao Paulo climate action plans, respectively

Additionally, the results are aligned to the SDG, mainly 13 (Climate Action), 11 (Sustainable Cities and Communities) and 3 (Good Health and Well-being)



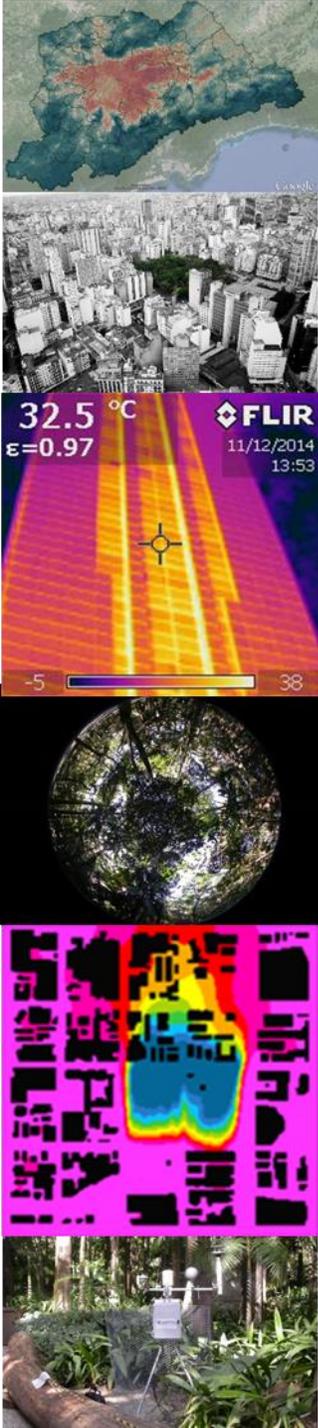


Project coordination, management and added value of the cooperation

The two projects are complementary, with each side contributing more to their respective fields:

Architecture and Urbanism from the Brazilian side, with the support of **Atmospheric Sciences**, and **Urban Ecology** from the Chinese side, for the common objectives of the research

The Chinese and Brazilian research teams cooperate in terms of data sharing, experimental design, model simulation, and academic exchange



Brazilian Research Team

Denise Duarte – Full Professor, Principal Investigator FAUUSP

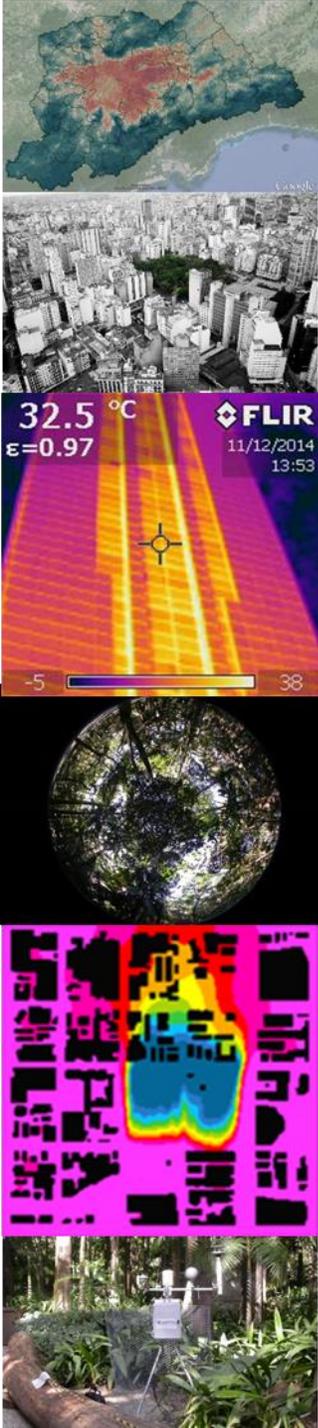
Humberto Rocha – Full Professor, Associate Researcher IAGUSP

Paula Shinzato – Dr, Associate Researcher

Rodrigo Lustosa – PhD Candidate IAGUSP

Luíza Muñoz – PhD Candidate FAUUSP

+ 4 researchers about to join the project holding FAPESP Technical Training grants



Thanks for you attention

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