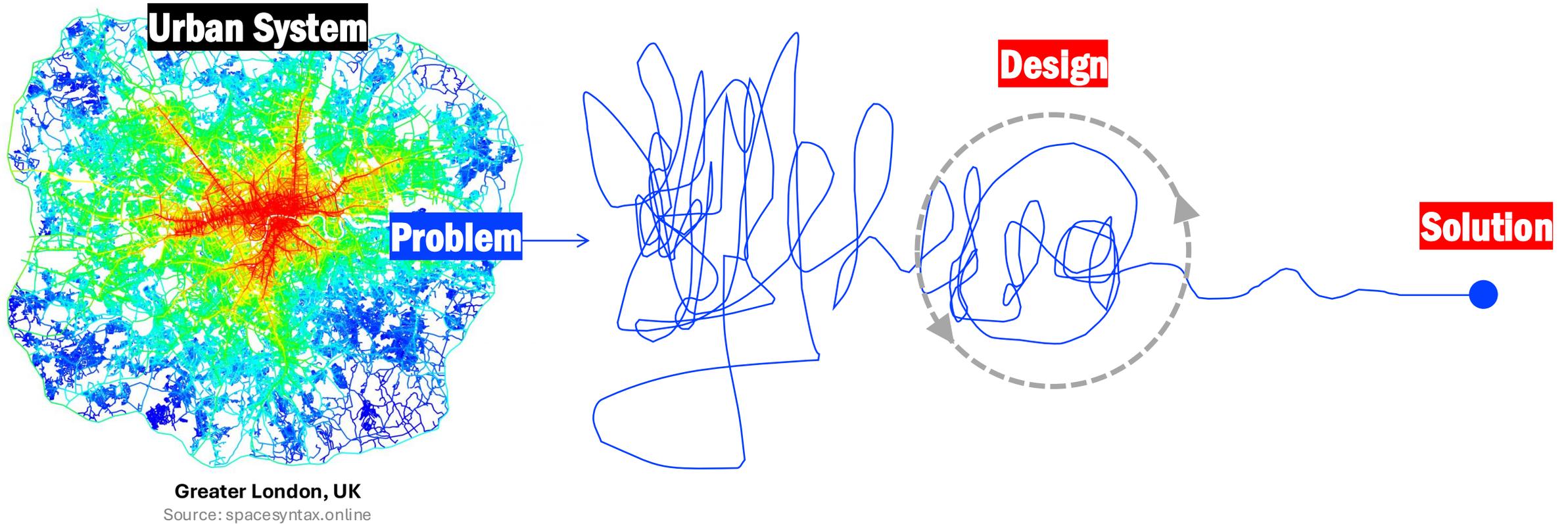


# Planning the Unplannable: Navigating Wicked Urban Problems

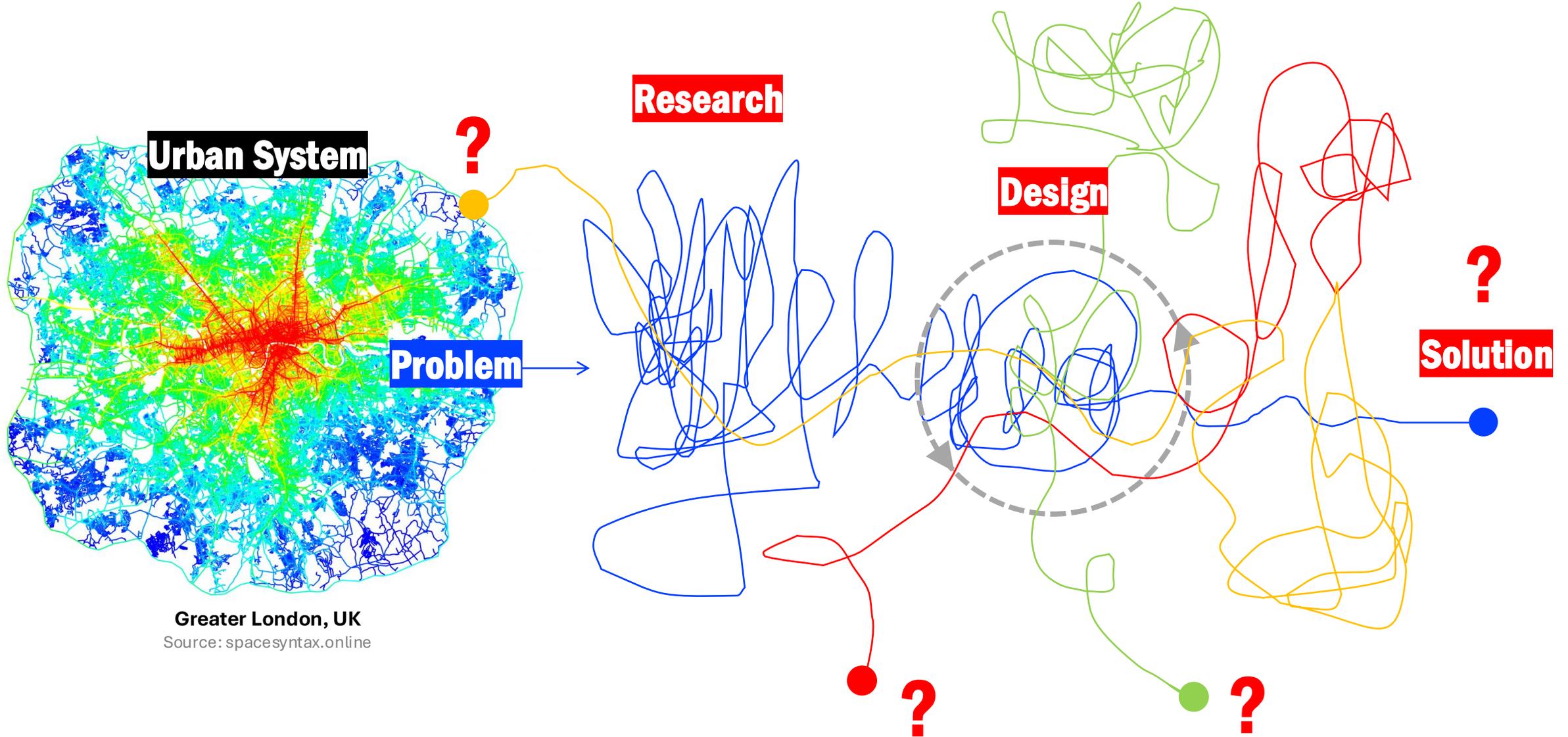
Prof. G. Manoli  
gabriele.manoli@epfl.ch  
EPFL URBES



# Urban sustainability

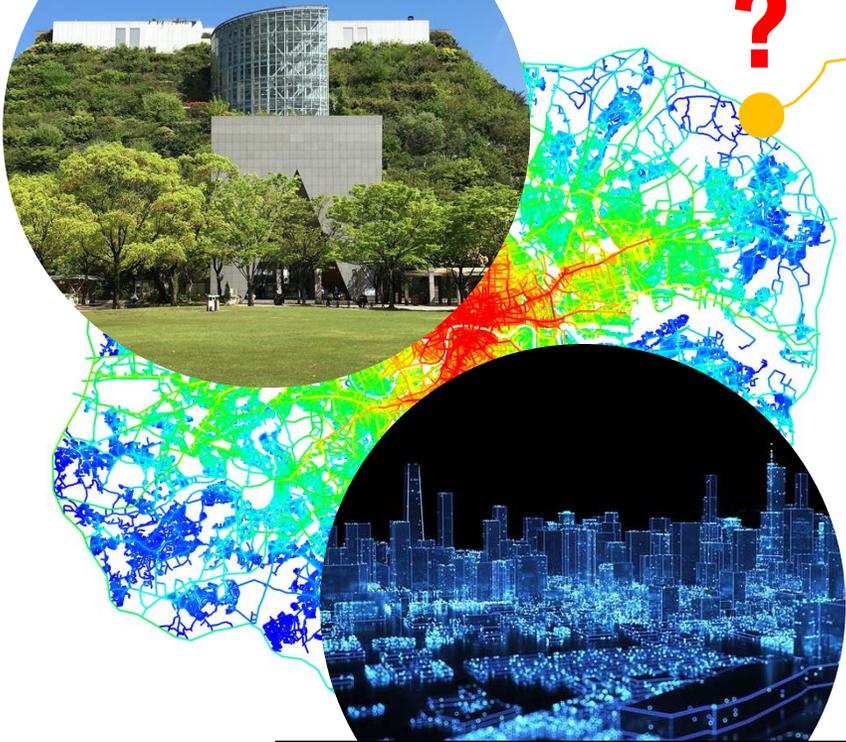


# Urban sustainability



# Urban sustainability

**Urban Greening**



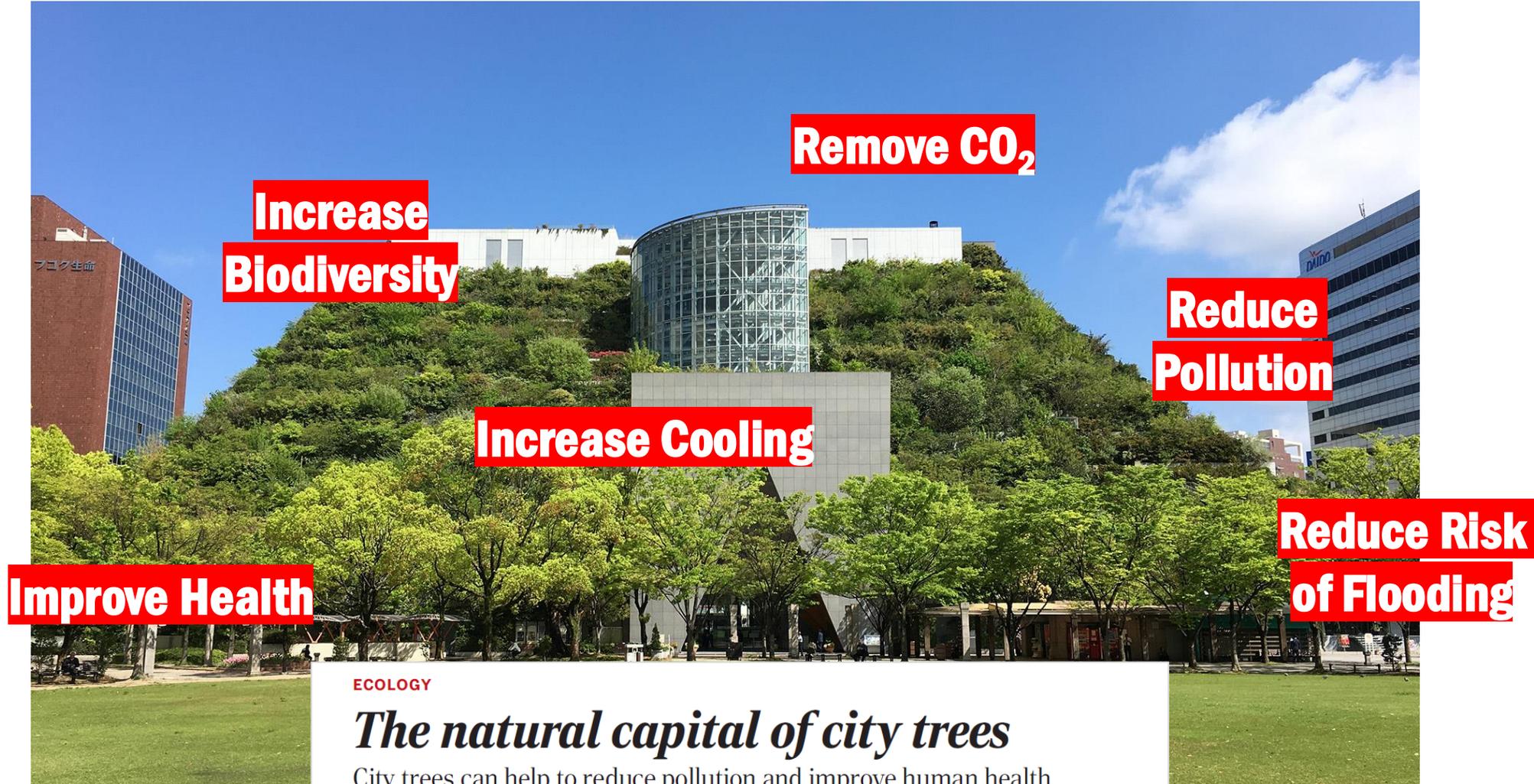
**Urban Digital Twins**

**Research**

**Design**

**Solution**





Source: [acros.or.jp](http://acros.or.jp)

**ECOLOGY**

## *The natural capital of city trees*

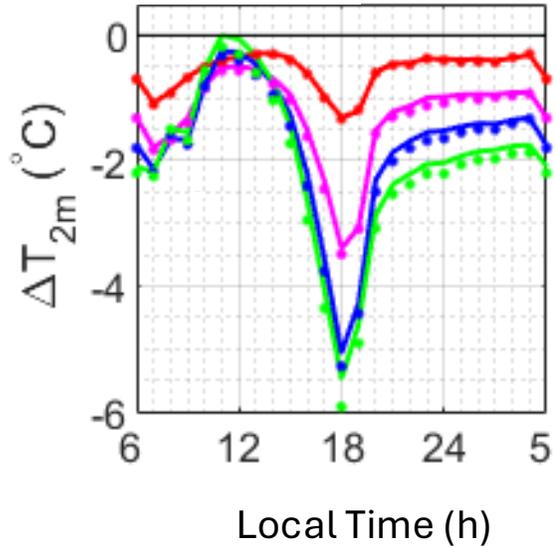
City trees can help to reduce pollution and improve human health

By Katherine J. Willis<sup>1,2</sup> and Gillian Petrokofsky<sup>2</sup>

Science, 2017

# Urban greening & heat

## Phoenix (summertime)



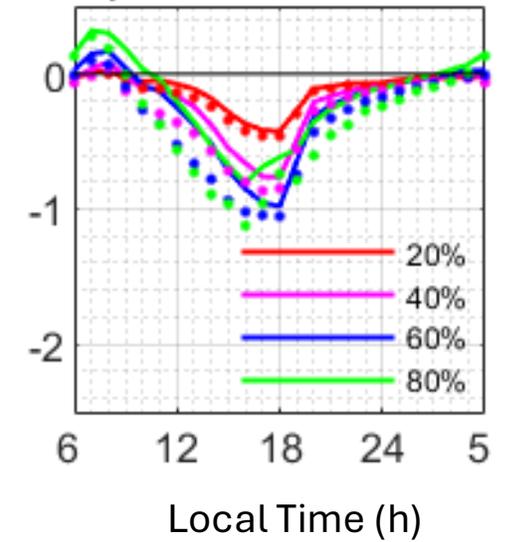
**-6°C**



**Enough?**



## Zurich (summertime)



**-1°C**

**Temporal scales? Trade-offs?**



**Increase Cooling?**

**Water?**

**The Guardian**

Source: theguardian.com

**Temporal scales? Trade-offs?**



Source: theguardian.com



Source: latimes.com

**Increase Cooling?**

**Water?**

**Exposure? Vulnerability? Risk?**



**Increase Cooling?**

**Water?**

Source: theguardian.com



Source: changing-transport.org

# Urban greening & heat

Who? Where?

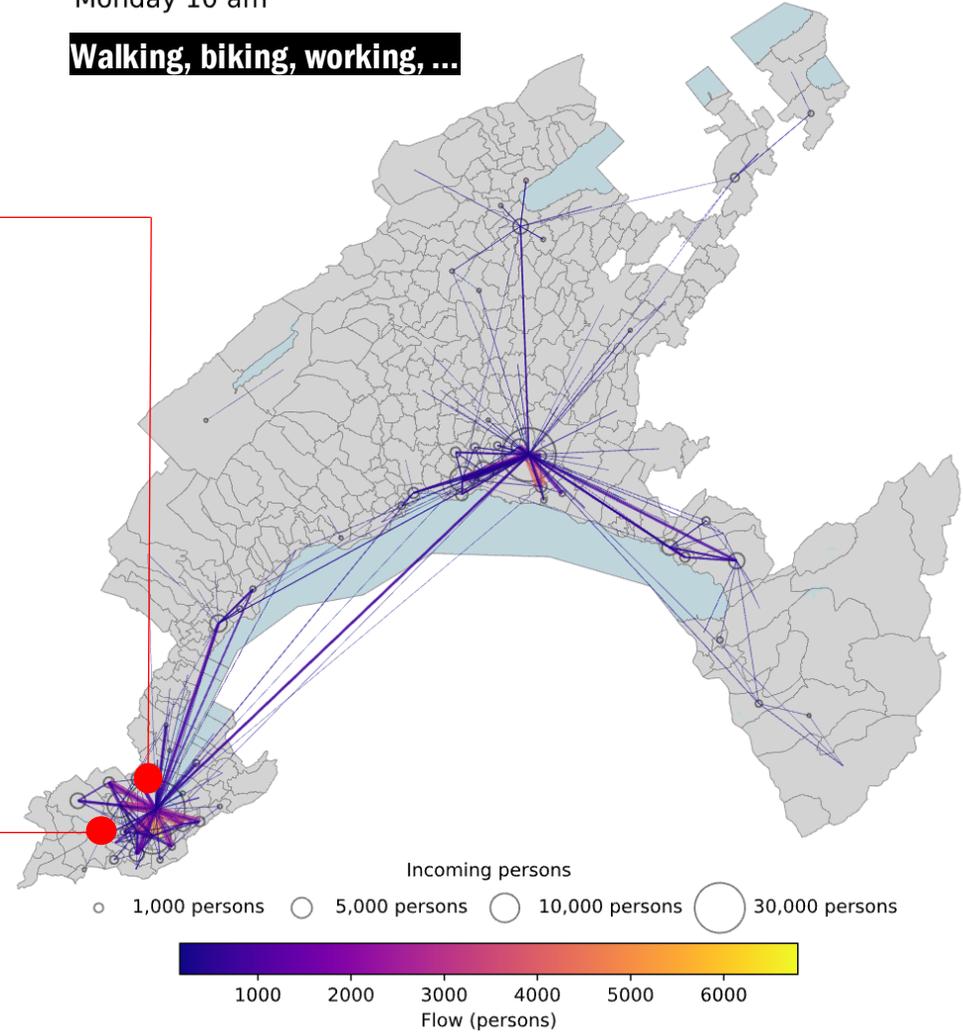


Source: Google images



Monday 10 am

Walking, biking, working, ...



Lin et al. (2026), arXiv

# Urban greening & heat

Who? Where?

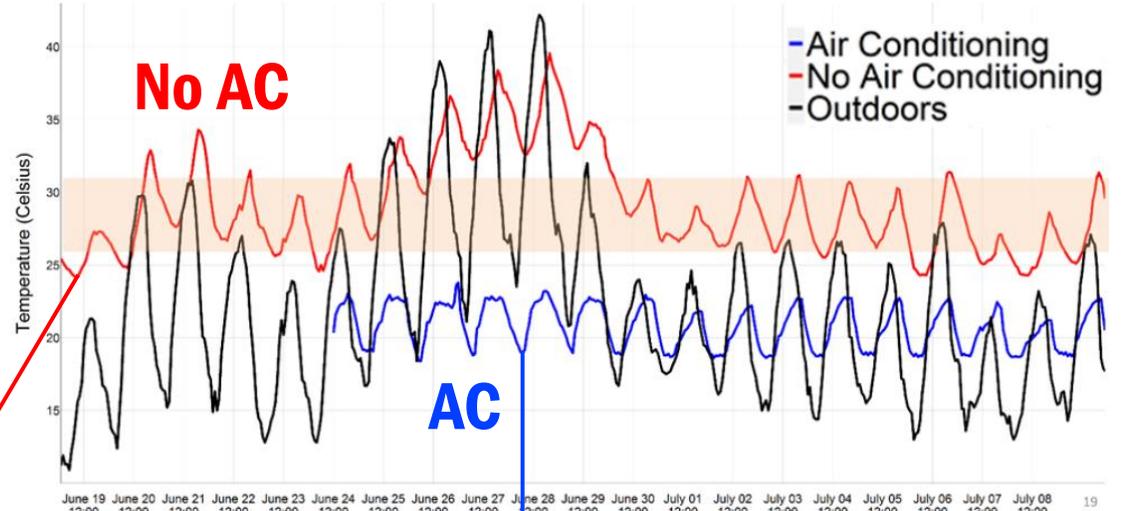


Source: Google images

Outdoor or indoor?



Egilson, M. (2022). British Columbia Coroners Service



# Urban greening & heat

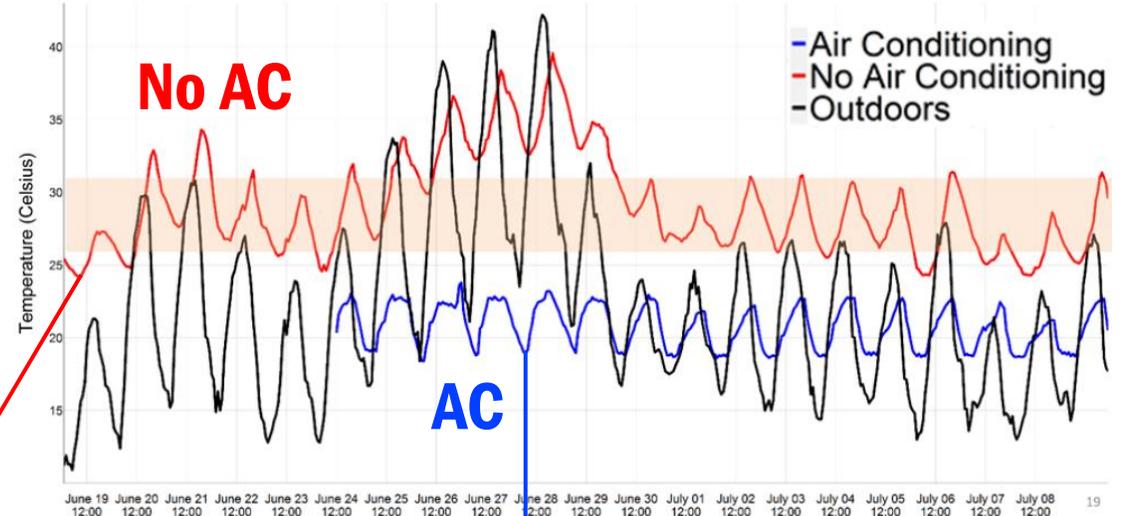
**Energy consumption?**  
**Carbon emissions?**

Source: Google images

**Outdoor or indoor?**

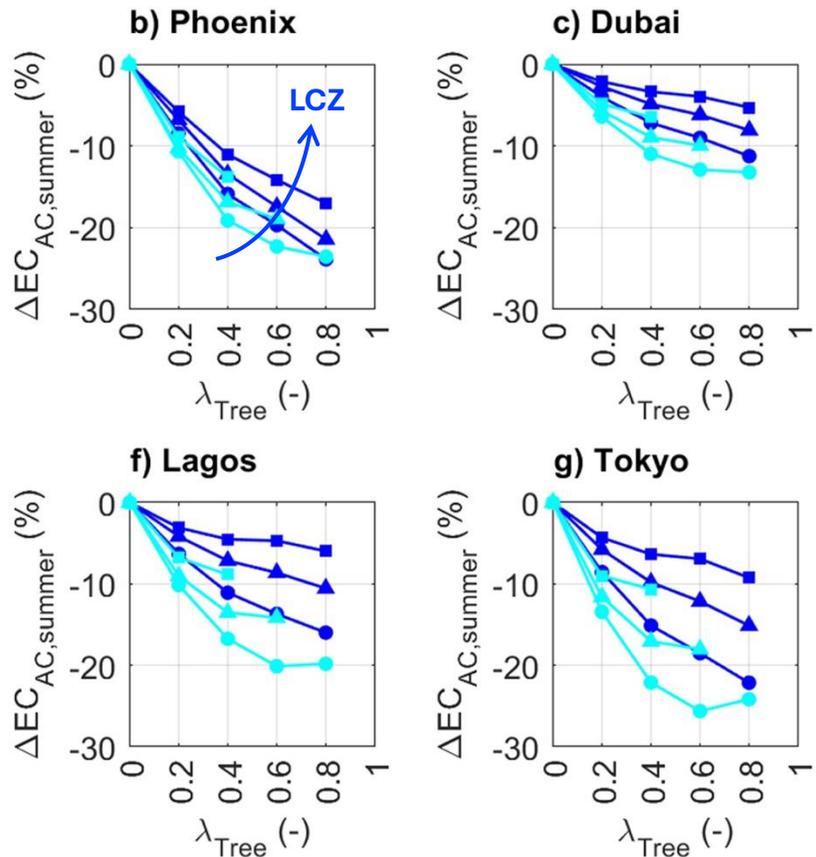


Egilson, M. (2022). British Columbia Coroners Service

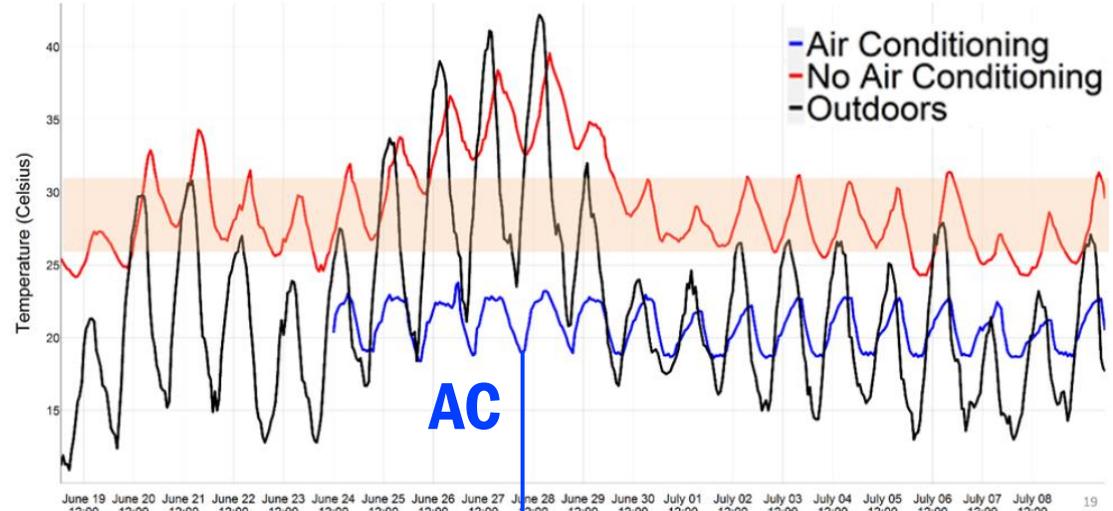


# Urban greening & heat

## Well-watered trees lead to AC energy reductions



Egilson, M. (2022). British Columbia Coroners Service



Meili et al. (2025), JAMES

# Urban greening & carbon

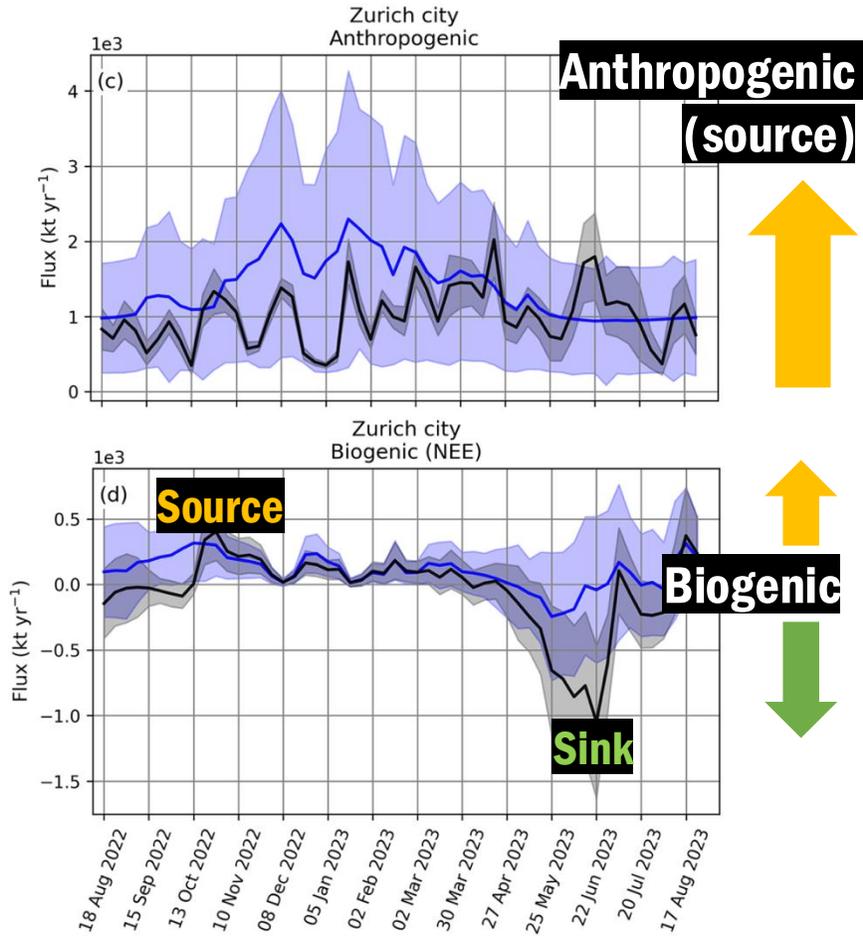
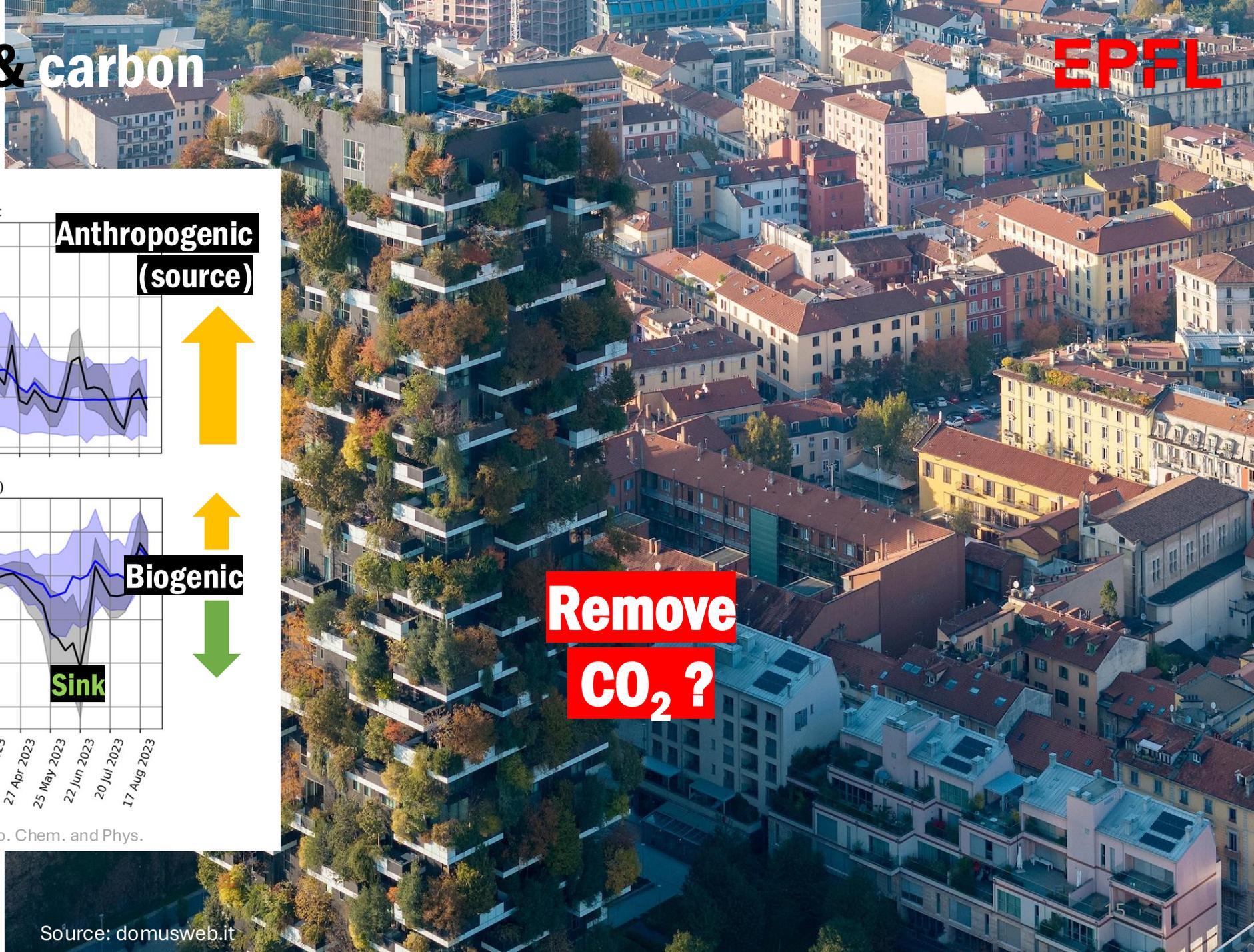
EPFL

Increase  
Cooling

Remove  
CO<sub>2</sub>



# Urban greening & carbon



Ponomarev et al. (2026), Atmo. Chem. and Phys.

# Urban greening & carbon

EPFL

The tower's greenery could take around **55 years** to offset the carbon emissions produced solely by constructing its balconies

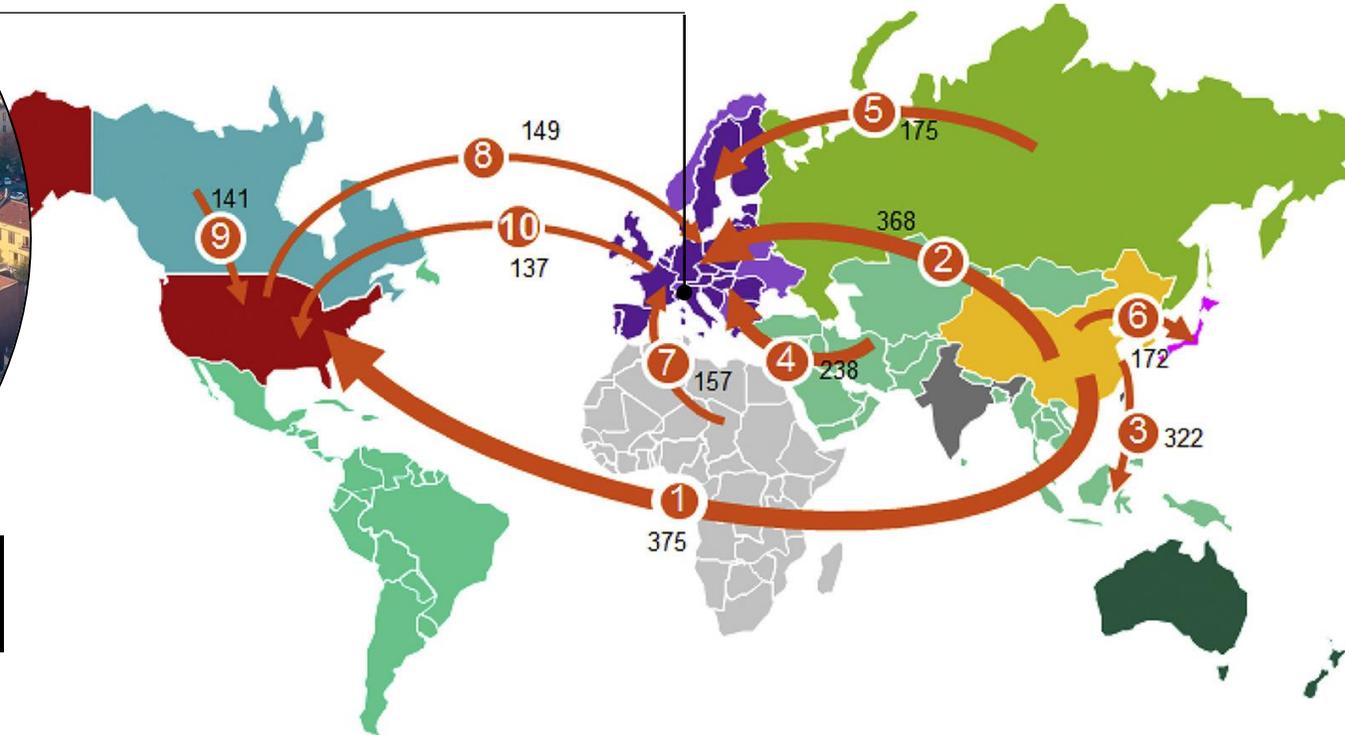
Remove  
**CO<sub>2</sub> ?**

Al-Kodmany (2023) Buildings



**Local vs Non-local Emissions**

## Carbon flows embodied in international trade



Liu et al. (2017), J of Clean. Prod.

# Urban greening & health

EPFL

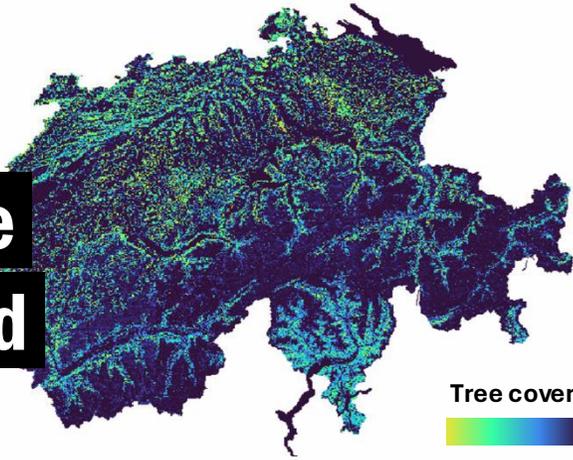
Increase  
Cooling

Improve  
Health

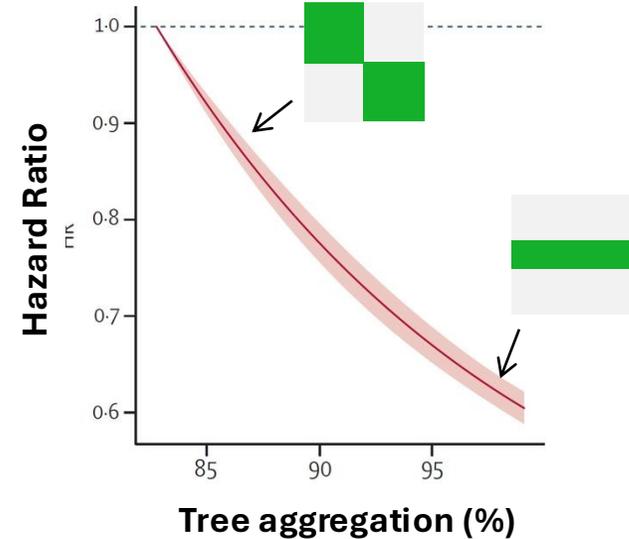
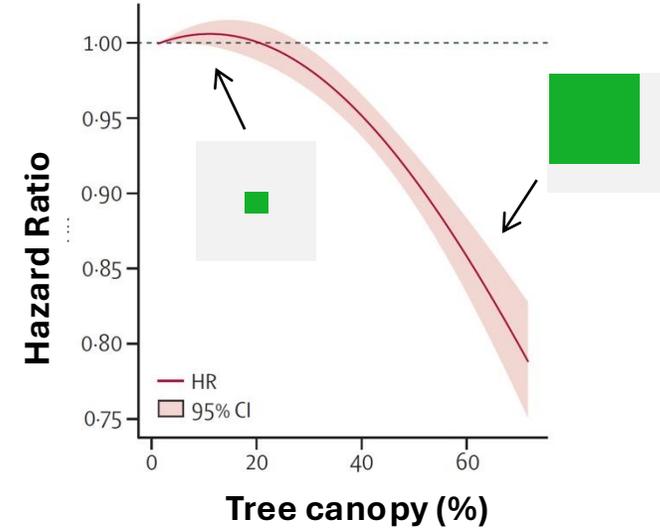
Remove  
CO<sub>2</sub>

# Urban greening & health

**Residential exposure  
to trees is associated  
with reduced  
mortality risks**



Chi et al. (2025), The Lancet Planetary Health



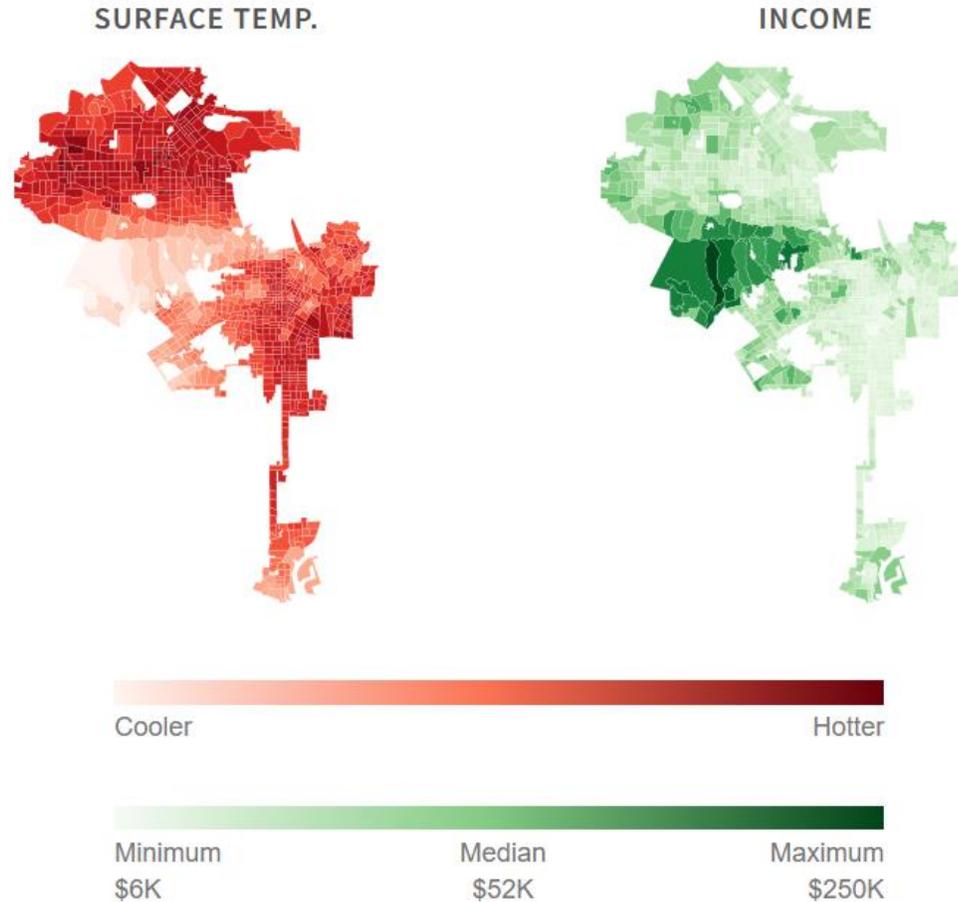
# Urban greening & society

EPFL

Who profits from  
the benefits of  
urban greening?



# Urban greening & society



Los Angeles: <https://www.npr.org/>

## ARTICLE

Check for updates

<https://doi.org/10.1038/s41467-021-22799-5> OPEN

## Disproportionate exposure to urban heat island intensity across major US cities

Angel Hsu<sup>1,2,3</sup>, Glenn Sheriff<sup>4</sup>, Tirthankar Chakraborty<sup>1,3,5</sup> & Diego Manya<sup>5</sup>

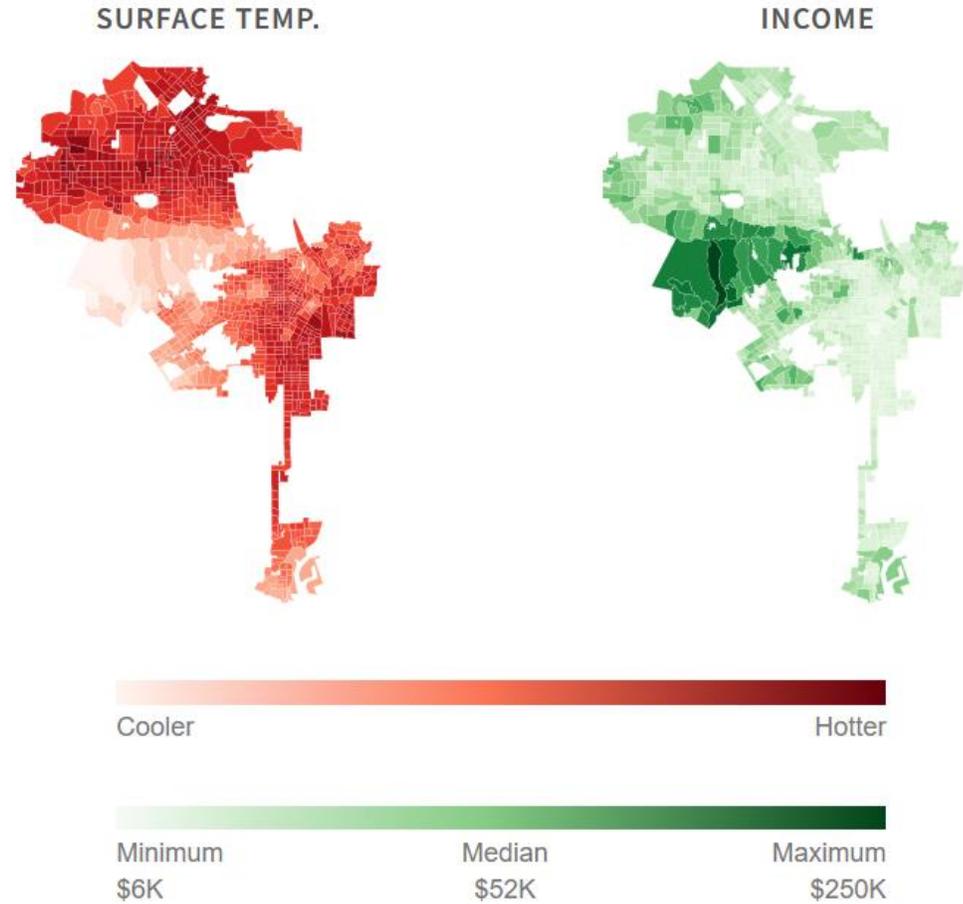
## OPINION

## Opinion: Why green “climate gentrification” threatens poor and vulnerable populations

Isabelle Anguelovski, James J. T. Connolly, Hamil Pearsall, Galia Shokry, Melissa Checker, Juliana Maantay, Kenneth Gould, Tammy Lewis, Andrew Maroko, and J. Timmons Roberts

PNAS December 26, 2019 116 (52) 26139-26143; <https://doi.org/10.1073/pnas.1920490117>

# Urban greening & society



Los Angeles: <https://www.npr.org/>



Highline in 2021 (credits: Wil Fyfordy)

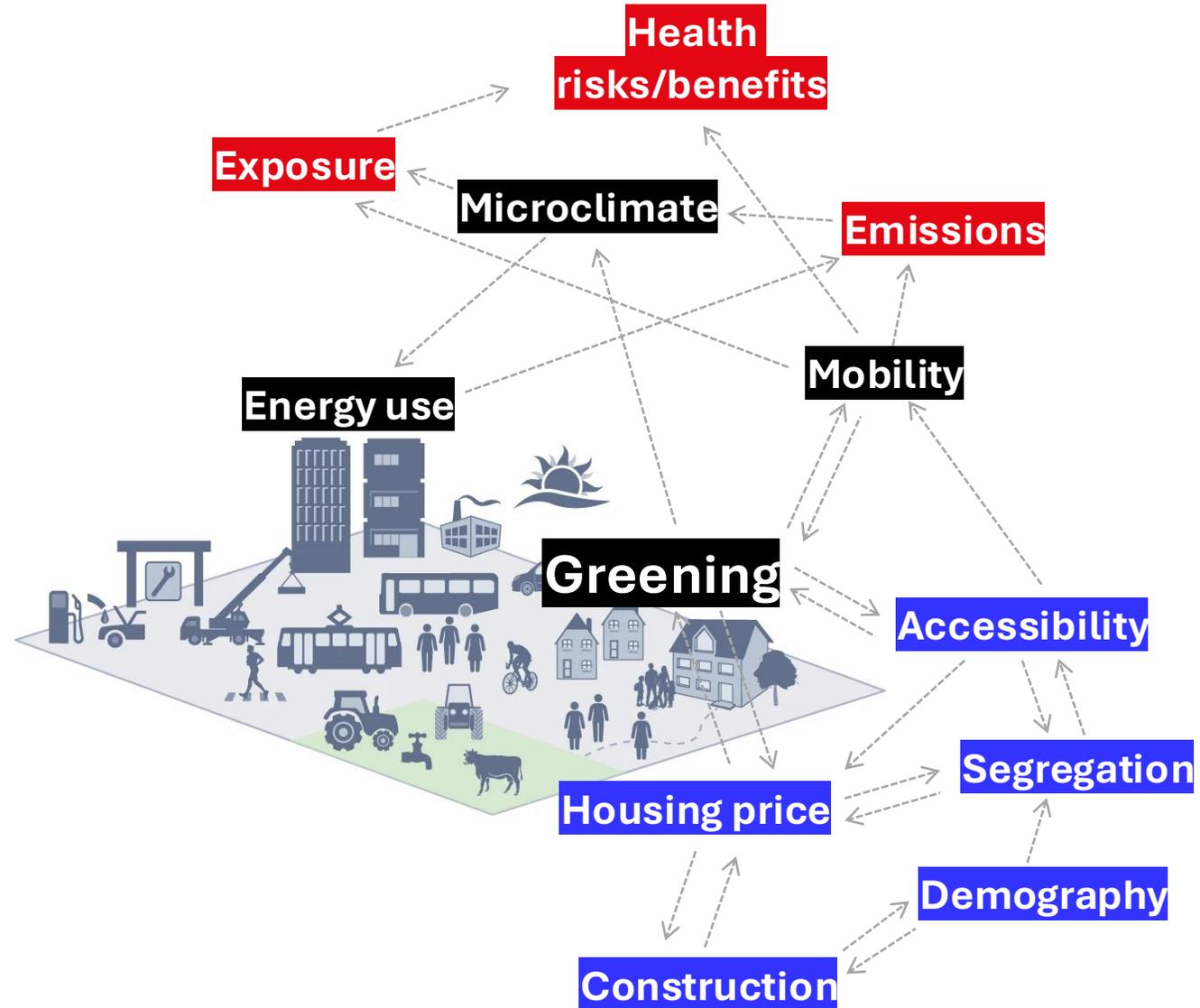


# Urban complexity and digital twins

## Urban digital twins (UDTs)?

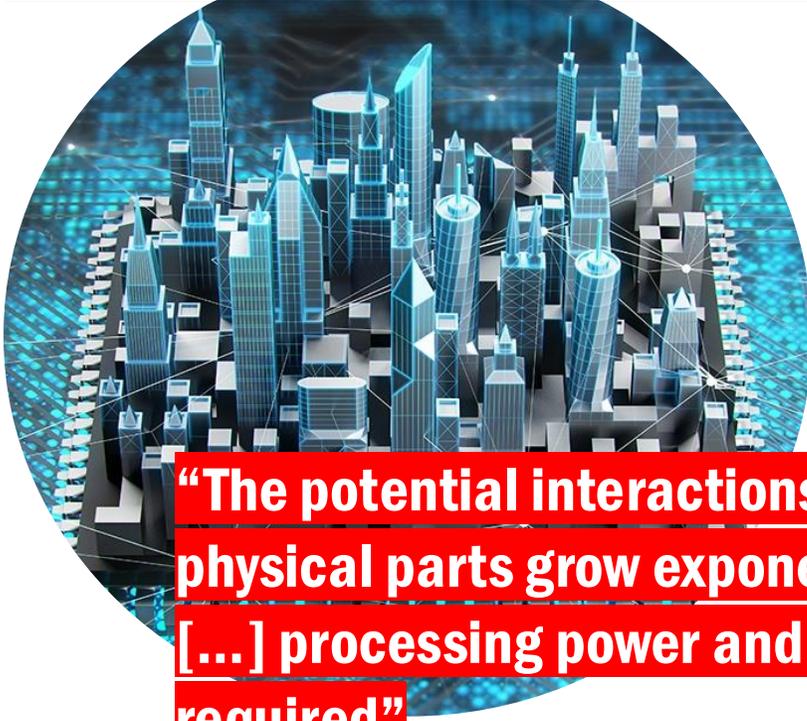


**“At this time, UDT are not up to the task”**



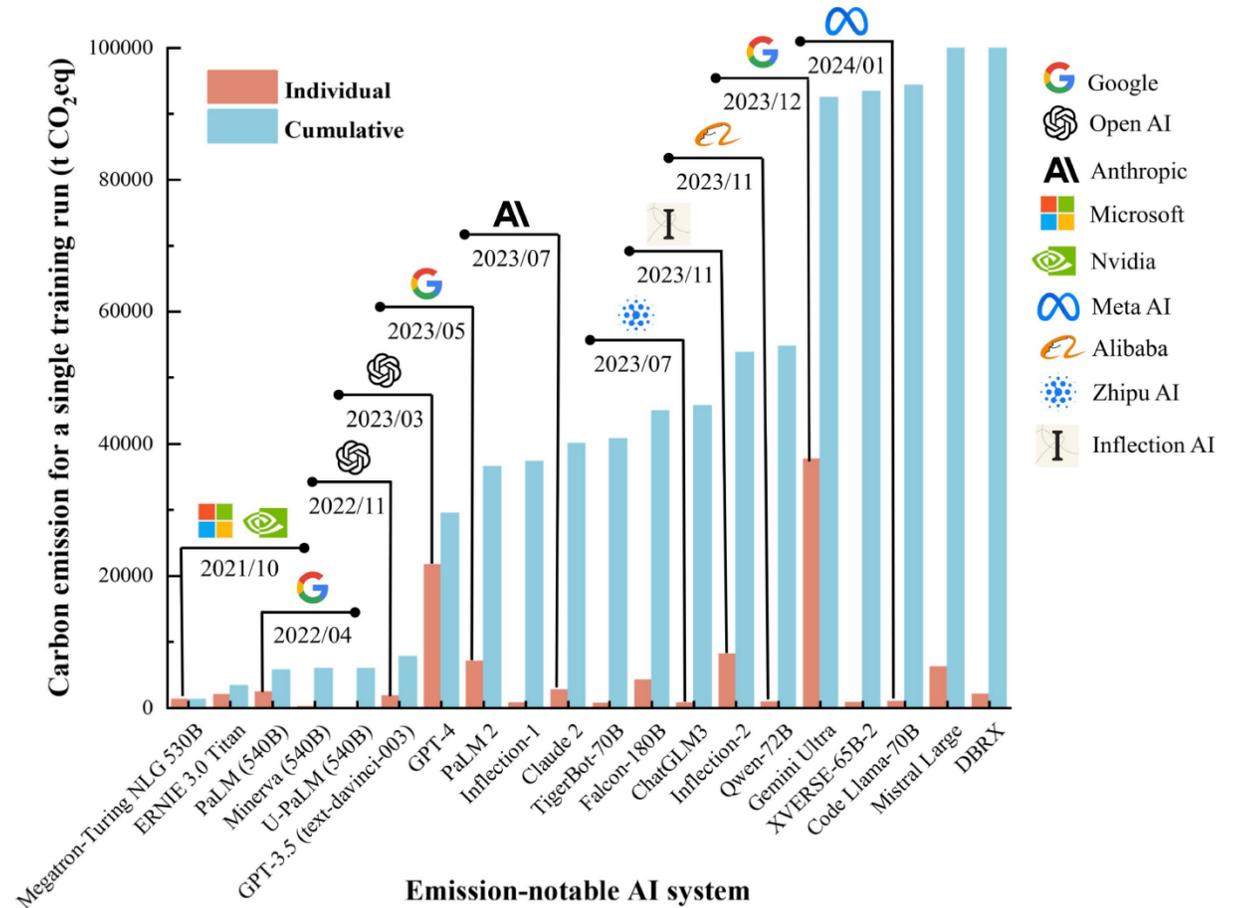
Malleson et al. (2024), Environ. Plan. B: Urban Anal. City Sci

## Urban digital twins (UDTs)?



**“The potential interactions between physical parts grow exponentially [...] processing power and memory required”**

Batty (2023), Nature Computations Sciences



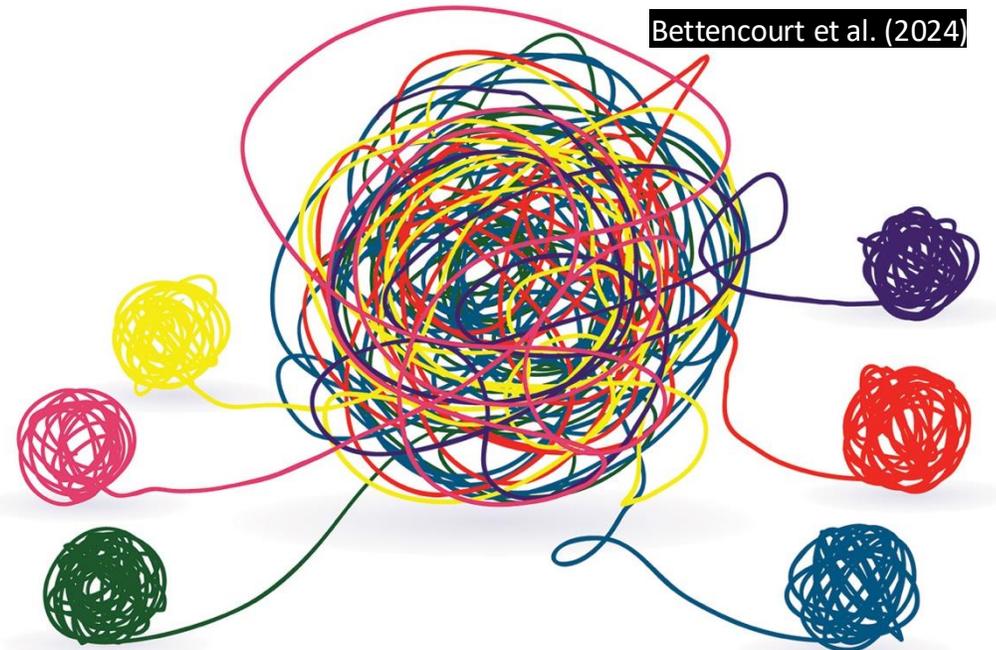
Yu et al. (2024), Front. Environ. Sci. Eng

## Urban planning is a wicked problem:

- **Stakeholders have conflicting goals**  
e.g., residents want affordability, developers want profit
- **Every intervention changes the system**  
e.g., greening reshapes market and migration patterns
- **Many interconnected subcomponents**  
e.g., housing, transportation, environment, economy
- **Long time horizons and uncertainty**  
e.g., demographic changes, technology shifts
- **A definitive solution is impossible**

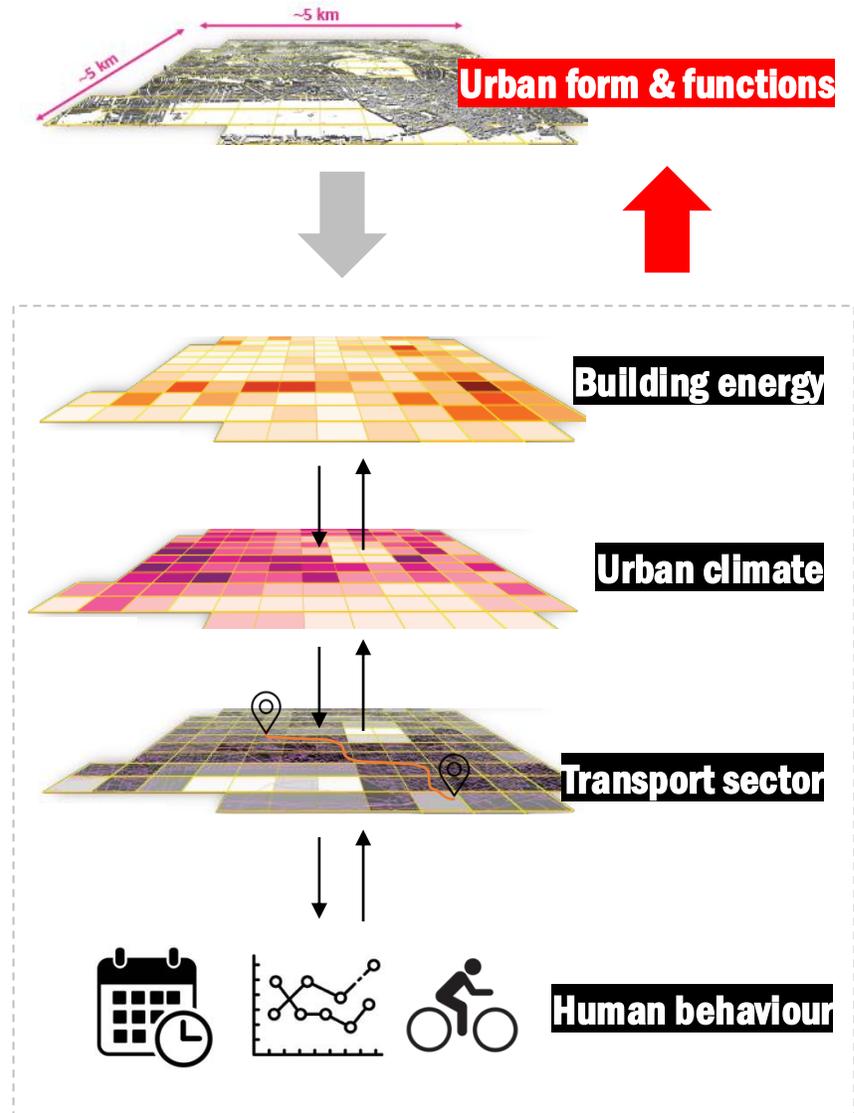
“ This feature of all complex systems is why their dynamics must remain evolutionary

Bettencourt et al. (2024)



Source: Google Images

# Urban planning & complexity

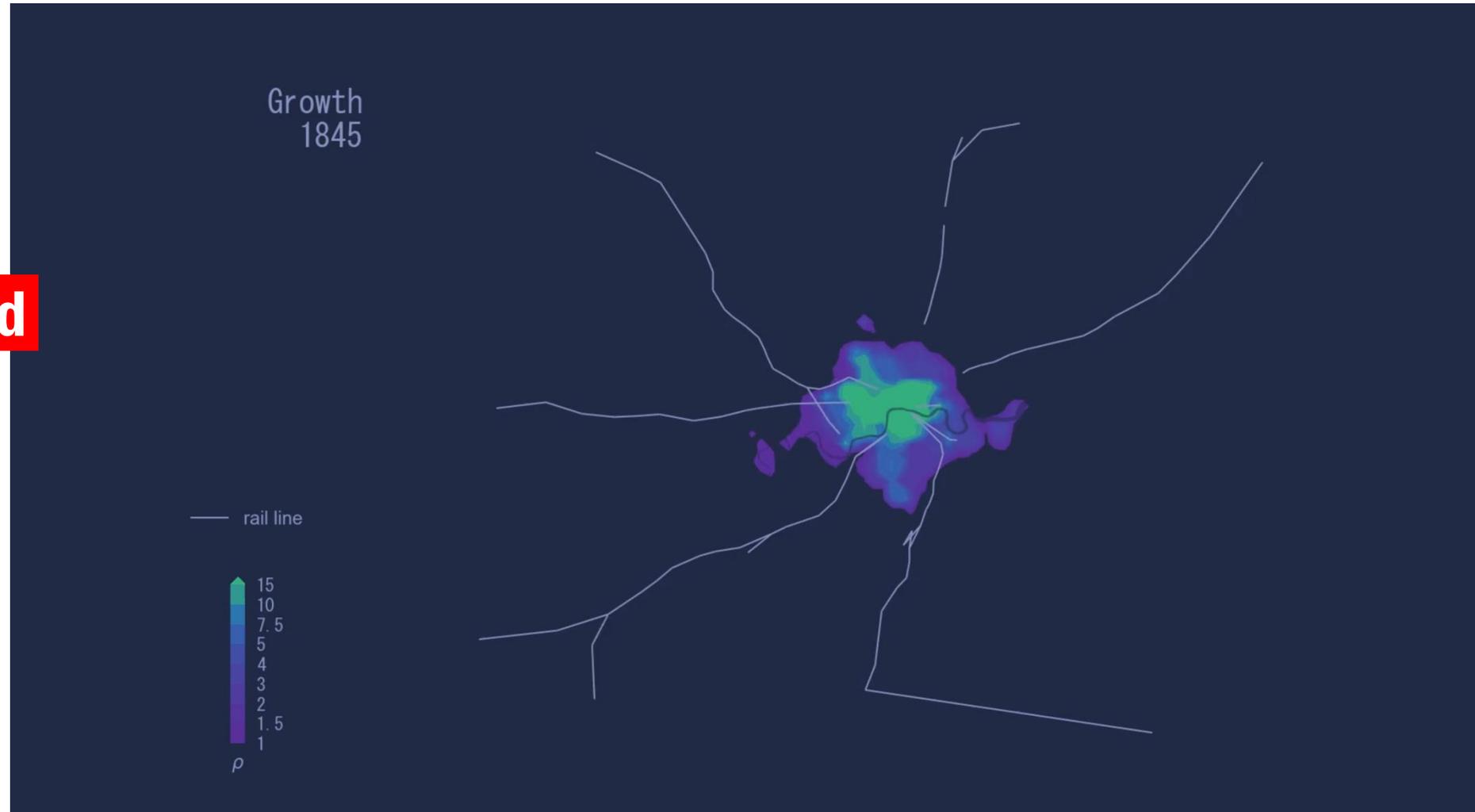


## Evidence-based urbanism



Source: Google Images

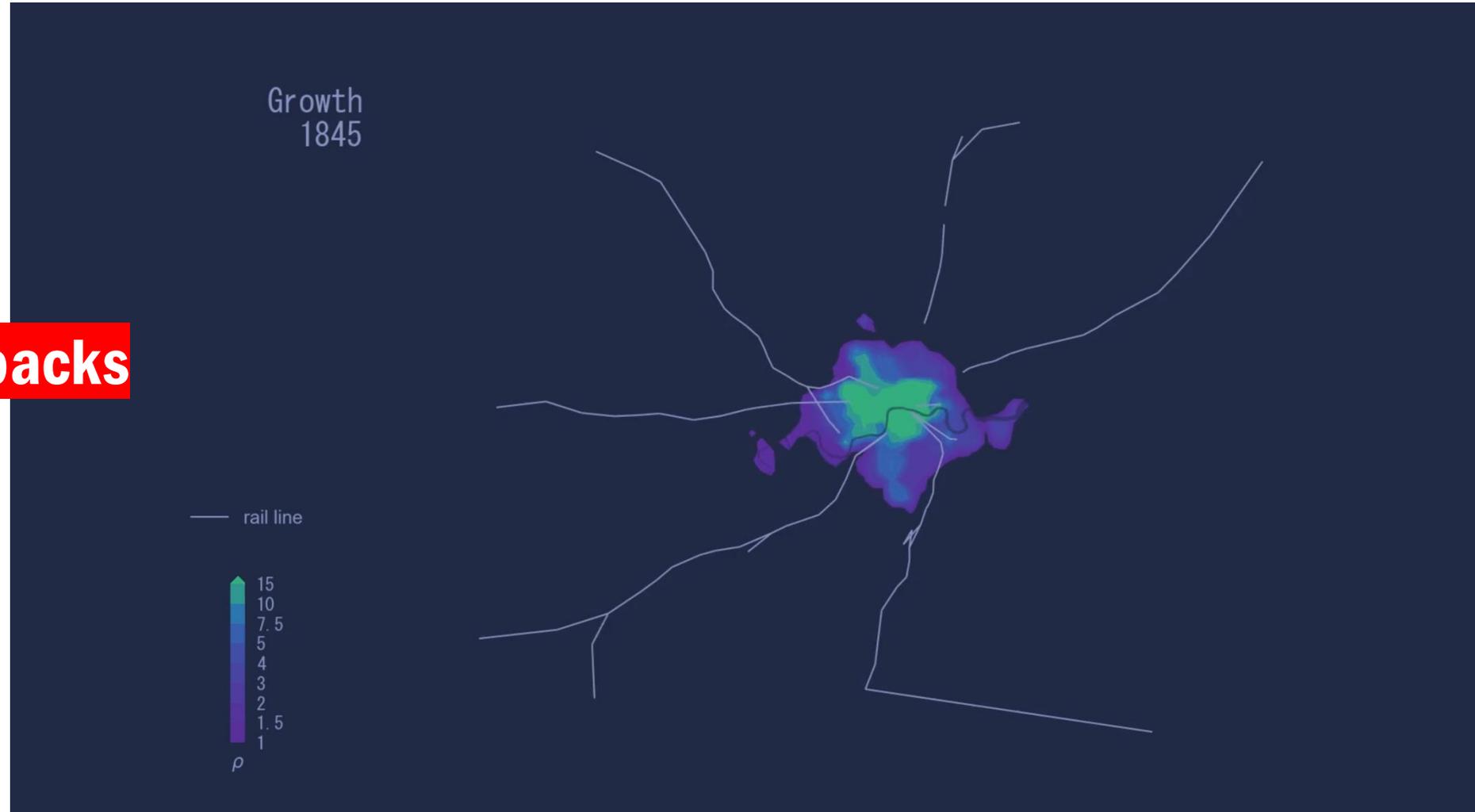
## Urban growth and coevolution



## Human behaviour & mobility

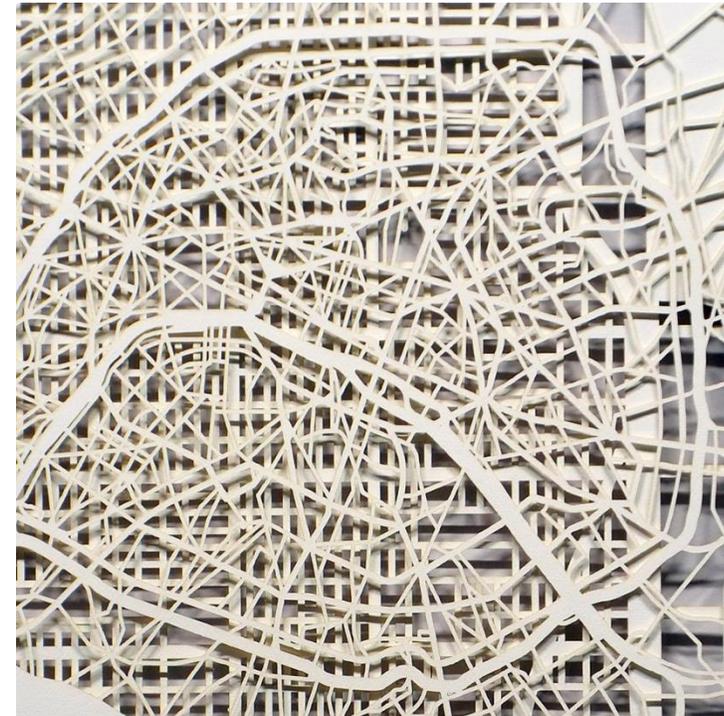


## Urban climate, impacts & feedbacks



## Driving sustainable transitions requires:

- **A systemic approach**  
Interdisciplinary (across the ecological, social and economic dimensions of cities) and multi-scale (from local to global, from seconds to decades)
- **An evolutionary perspective**  
Focusing on interactions, feedback loops, and points of leverage rather than strict optimizations
- **Shared values and bottom-up initiatives**  
To rethink our long-standing separation from the biosphere and drive positive change

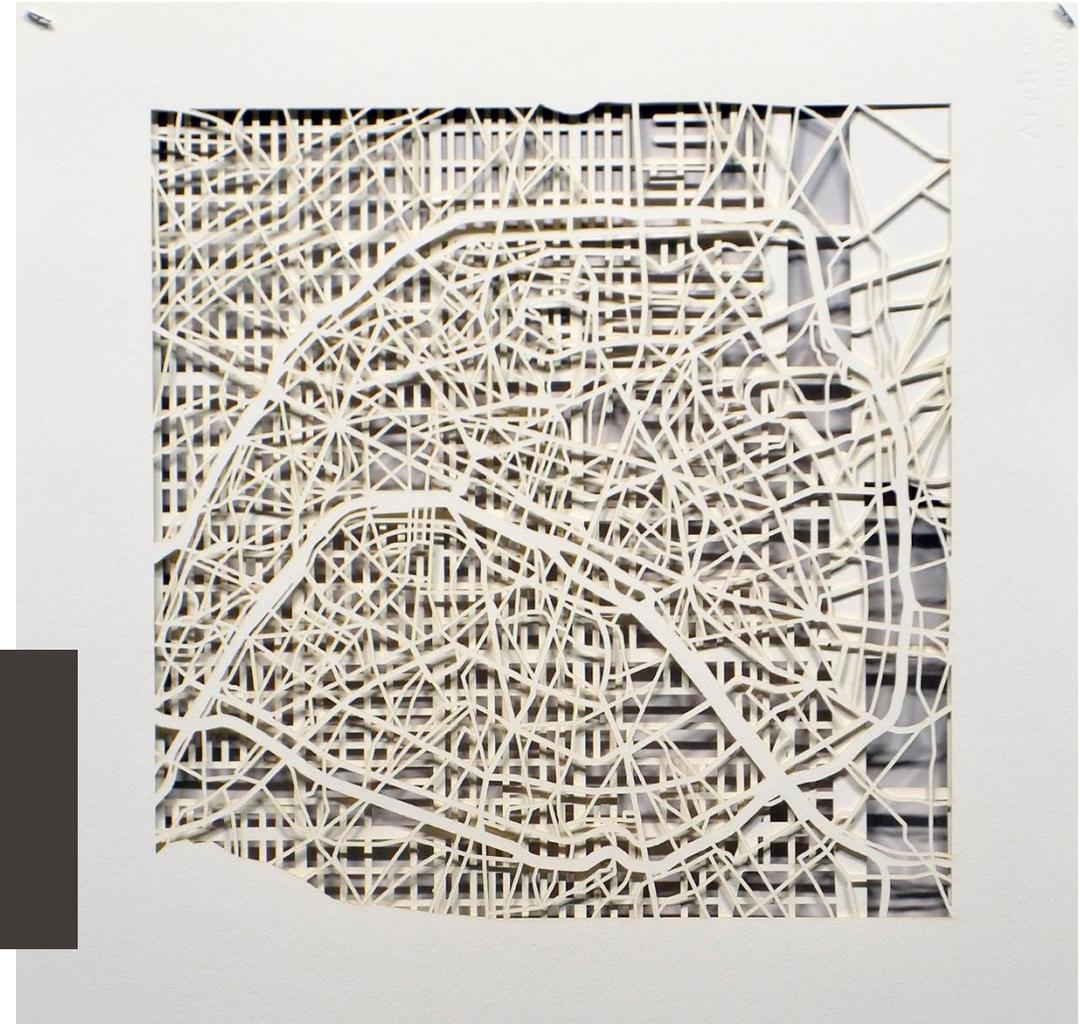


Amanda Williams (2016), Museum of Contemporary Art Chicago

**Thank you for  
your attention!**

Laboratory of Urban & Environmental  
Systems | **URBES**

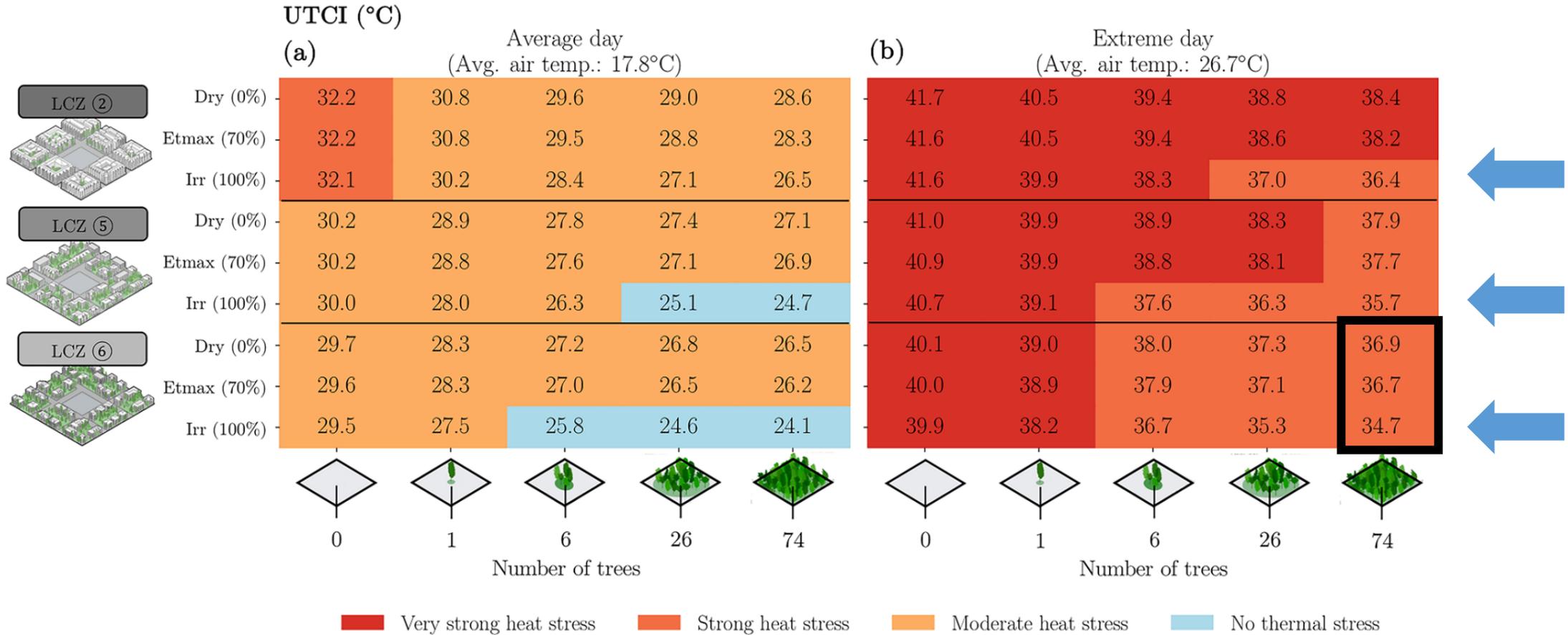
EPFL ENAC IA & IIE



Amanda Williams (2016), Museum of Contemporary Art Chicago

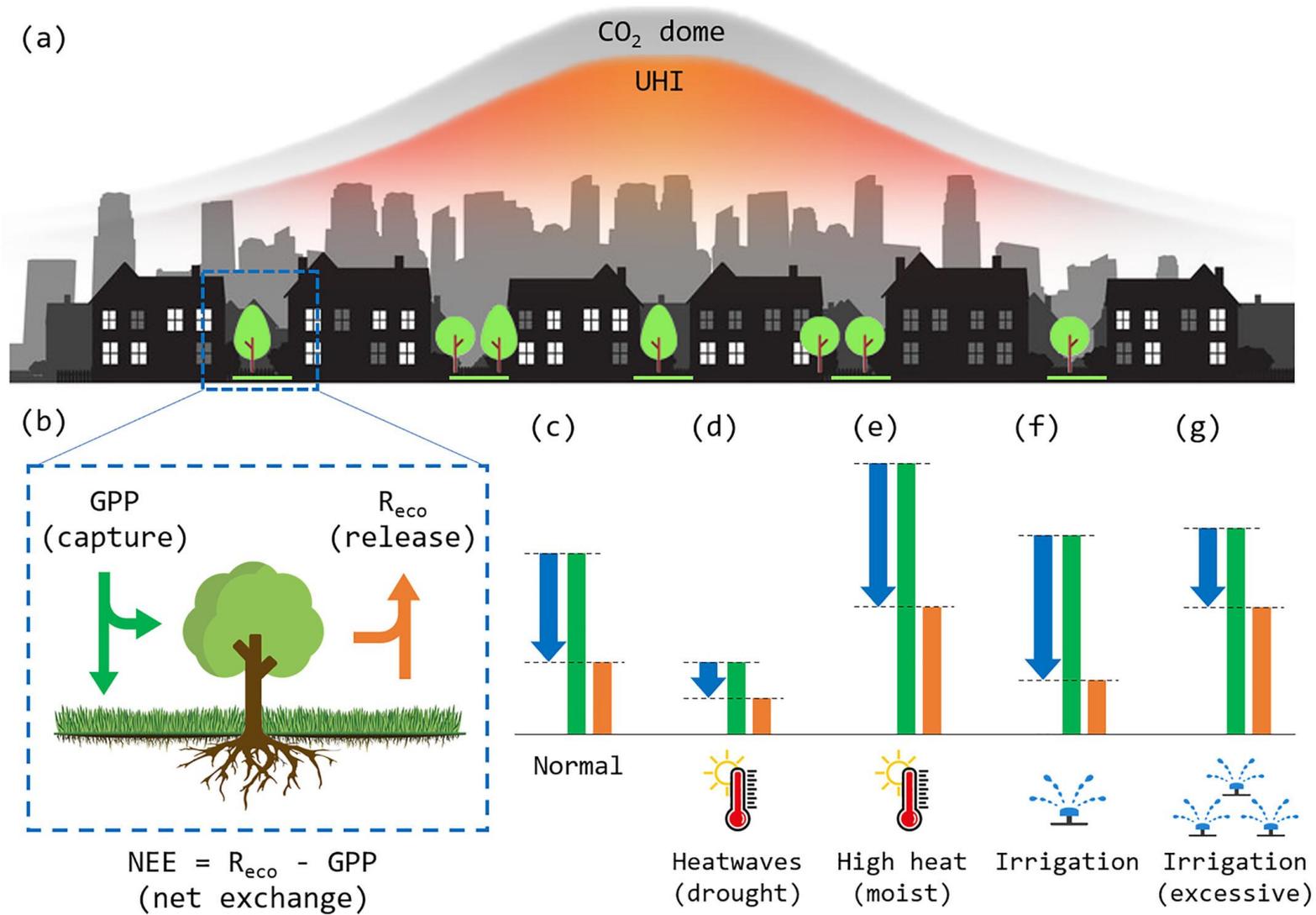


# Urban greening & heat



Gobatti et al. (2025), npj Urban Sustainability

# Urban greening



<https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2023MS003867>