Cities and climate conference
Potsdam, 2017-09-19/21

Assessing energy precarity and heat-related health risks from climate change in Asian cities

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My workplace:
Clean Energy and Sustainable Development Lab

Founded in 2014, building a world-class interdisciplinary research team with the mission to contribute to the green growth of the energy sector in Vietnam and other South East Asian countries.

http://cleaned-usth.com

Outline

1. Introduction : project partners & sponsor
2. Research goals
3. Preliminary results
4. Conclusion : research needs

1. Introduction : the project

- Sponsor : the Wellcome trust
- One year, starting 2017-05

- International partnership
  - Robert Gordon University, Scotland
  - Ming Chuan University, Taiwan
  - University of Science and Technology Hanoi, Vietnam
  - Kyushu University, Japan

2. Scientific goal

Assess the effect of energy policy on

health risks associated with urban heatwaves,

integrating measures for :

- Physical exposure to heat
- Socio-economic vulnerability
- Future energy pricing

in Asian cities of Hanoi, Taipei and Fukuoka.

An interdisciplinary challenge

Bring together bodies of research on :

- Economy : Energy poverty
- Geography : Urban planning in climate change
- Sociology : Heatwave risk management

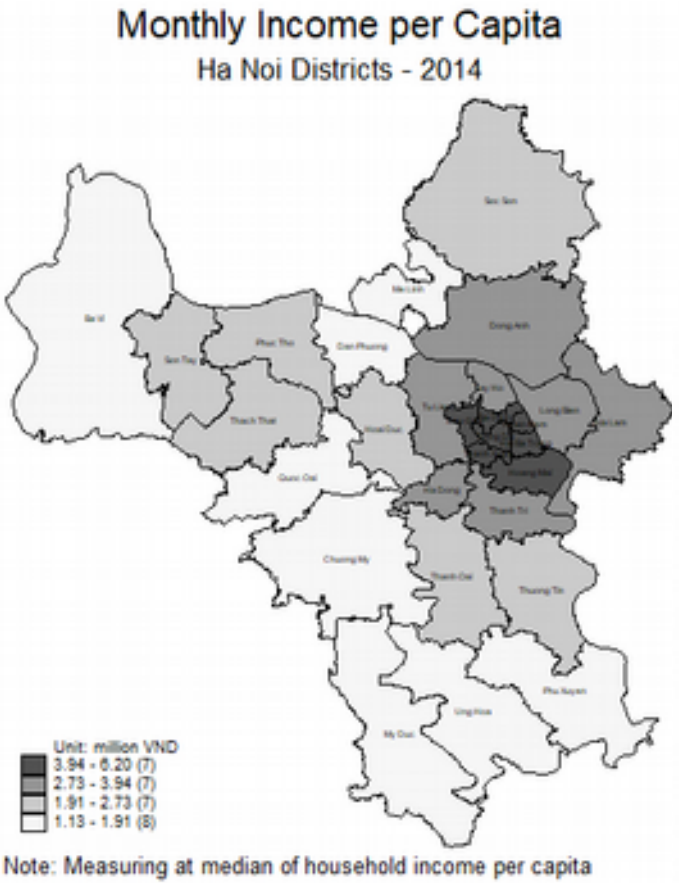
Economy

Energy poverty in Hanoi

Electricity use

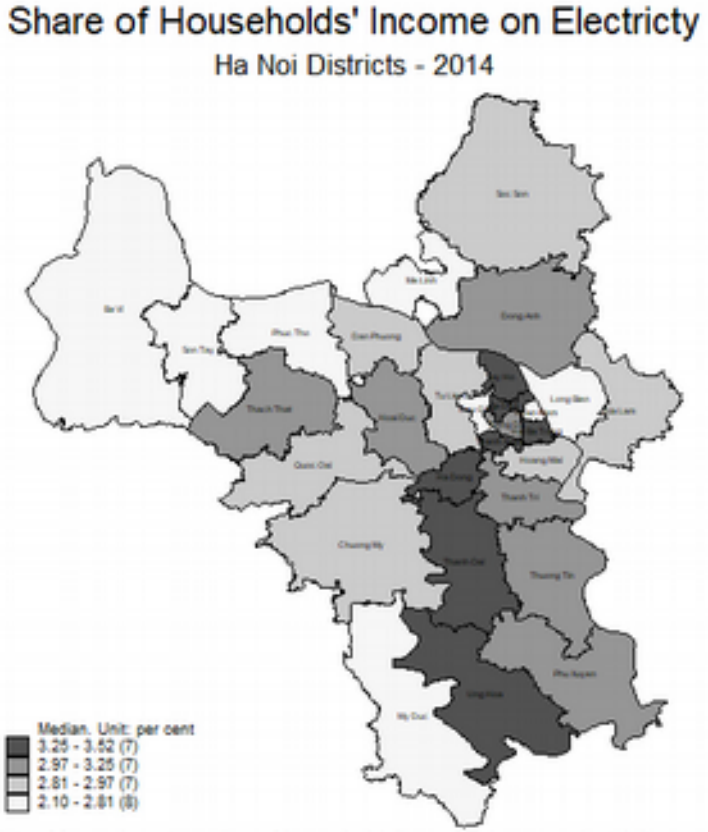
Note: Measuring at median of household electricity consumption

Income



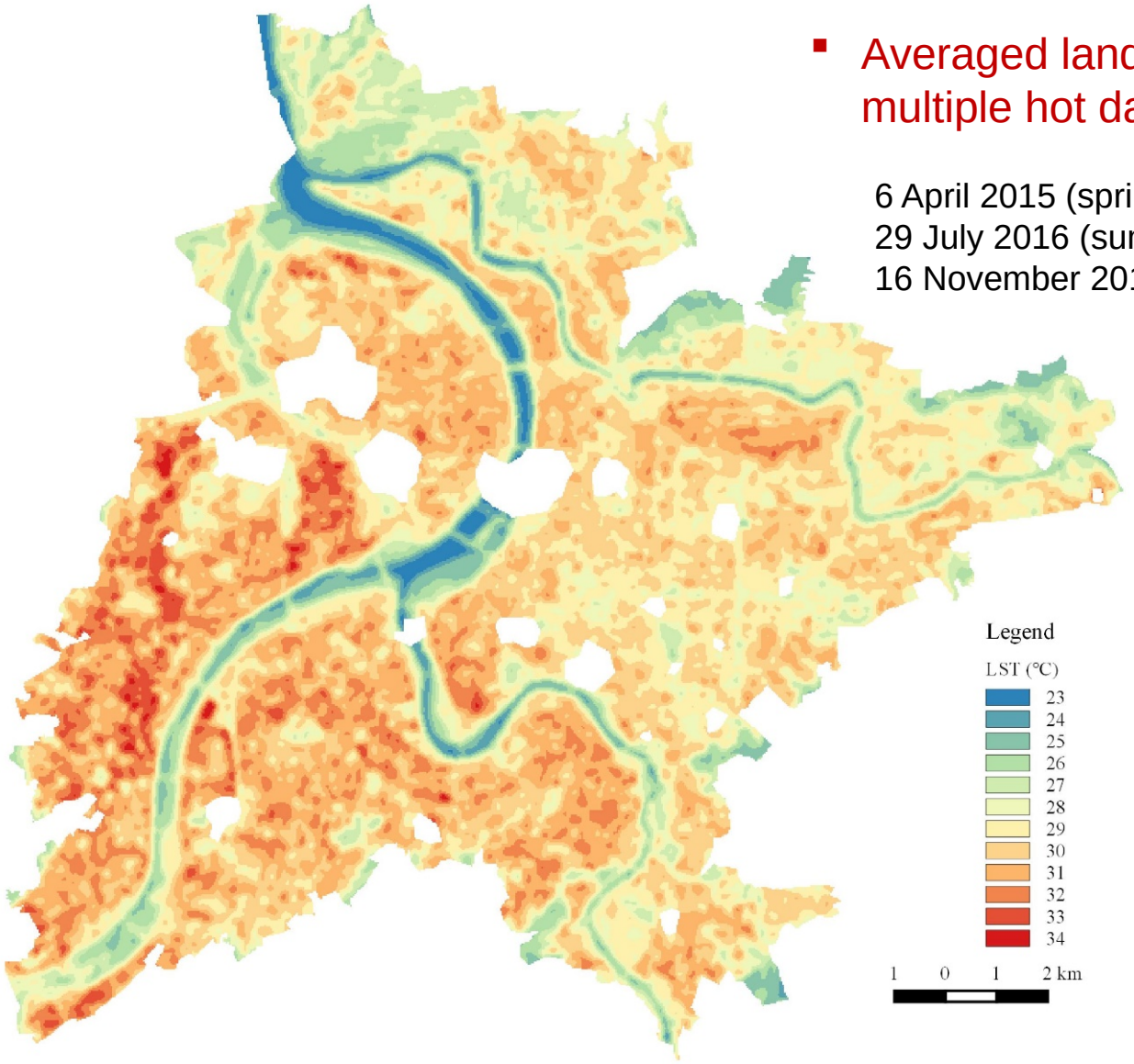
Note: Measuring at median of household income per capita

Electricity bill / Income



Note: Measuring at median of households'income share on electricity

Urban planning and heat in Taipei



- Averaged land surface temperature from multiple hot days.

6 April 2015 (spring);
29 July 2016 (summer);
16 November 2015 (autumn).

→ More available summer dates

Land surface temperature was calculated based on the Band 10 of Landsat 8 satellite image. In order to avoid the potential bias deriving from the use of single satellite image, this study utilises multiple thermal images of each city to retrieve land surface temperature.

Fukuoka Governance

- Fukuoka City – interviews with 8 people (municipal government, prefectural government, NGOs, environmental consultancy); policy analysis of Fukuoka City + Prefecture Climate Change Action Plan;

- Early recognition of need for adaptation planning in Fukuoka (+ strong budget support) due to regional history of disease and pollution;

- Strong local environmental research tradition (Kyushu Uni + Kyushu Environmental Evaluation Association) informs evidence-based policy;

- Cooling considered in current planning (e.g. trial green infrastructure areas) plus sustained citizen engagement on heat and energy;

- But Fukuoka a *very* well-resourced city – is this replicable elsewhere?

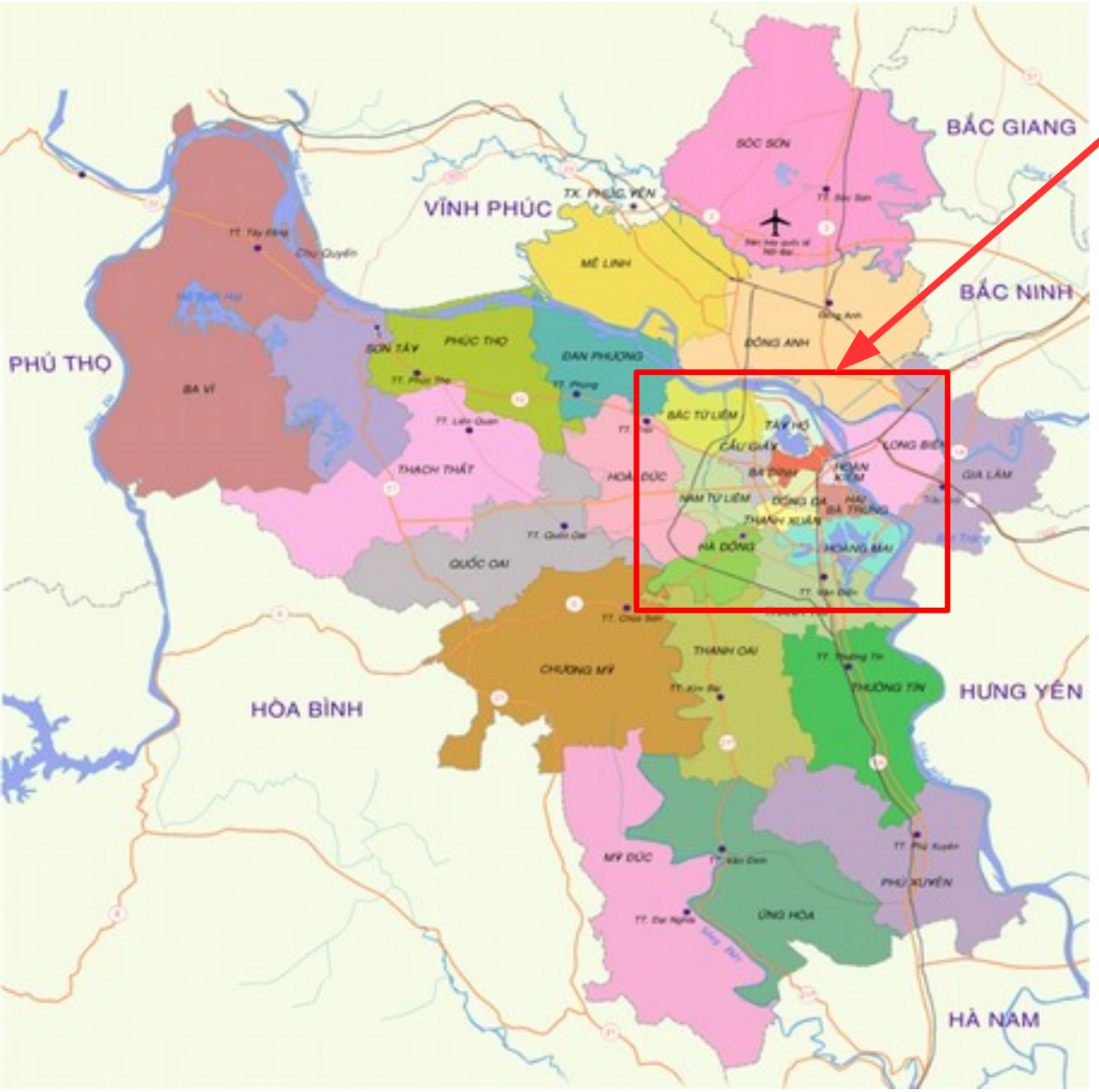
Hanoi team approach

(we are economists)

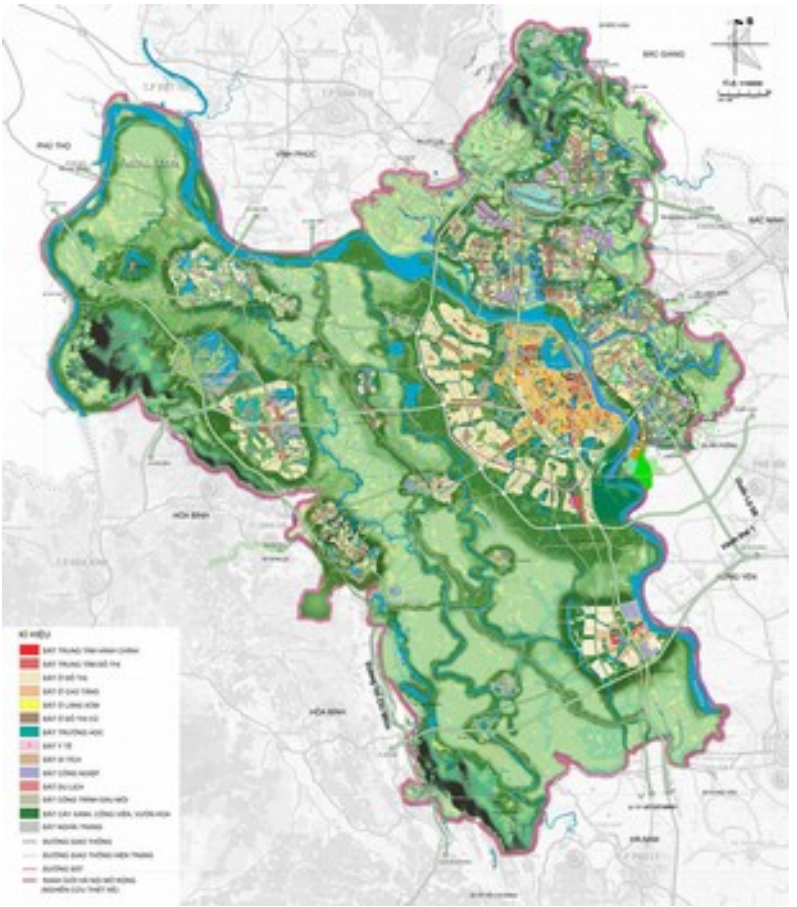
Electricity poverty as vulnerability to heat risk

- In which districts is it a problem?
- How it interacts with inequalities?
- How will it evolve?

Hanoi



Focus area : bounding box around urban districts: Ba Đình, Hoàn Kiếm, Tây Hồ, Long Biên, Cầu Giấy, Đống Đa, Hai Bà Trưng, Thanh Xuân, Hoàng Mai, Hà Đông, Bắc Từ Liêm, Nam Từ Liêm



2030 plan

Higher electricity tariff

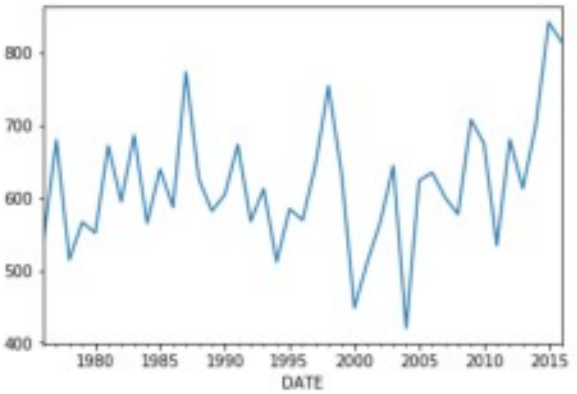
Urban planning

Climate change

Income

Electricity use

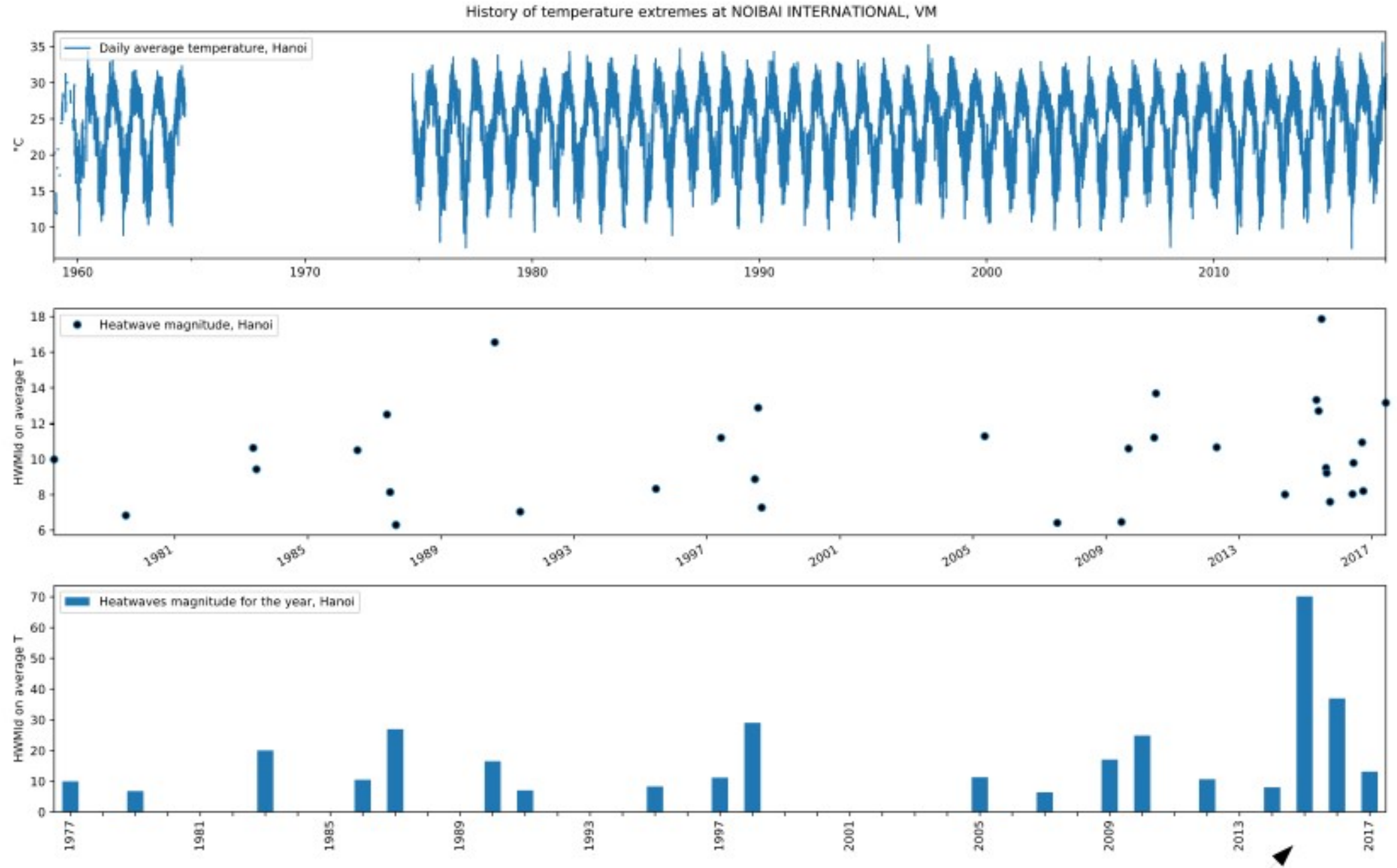
Temperature, Heatwaves



Electricity poverty as vulnerability to heat risk

3. Preliminary results

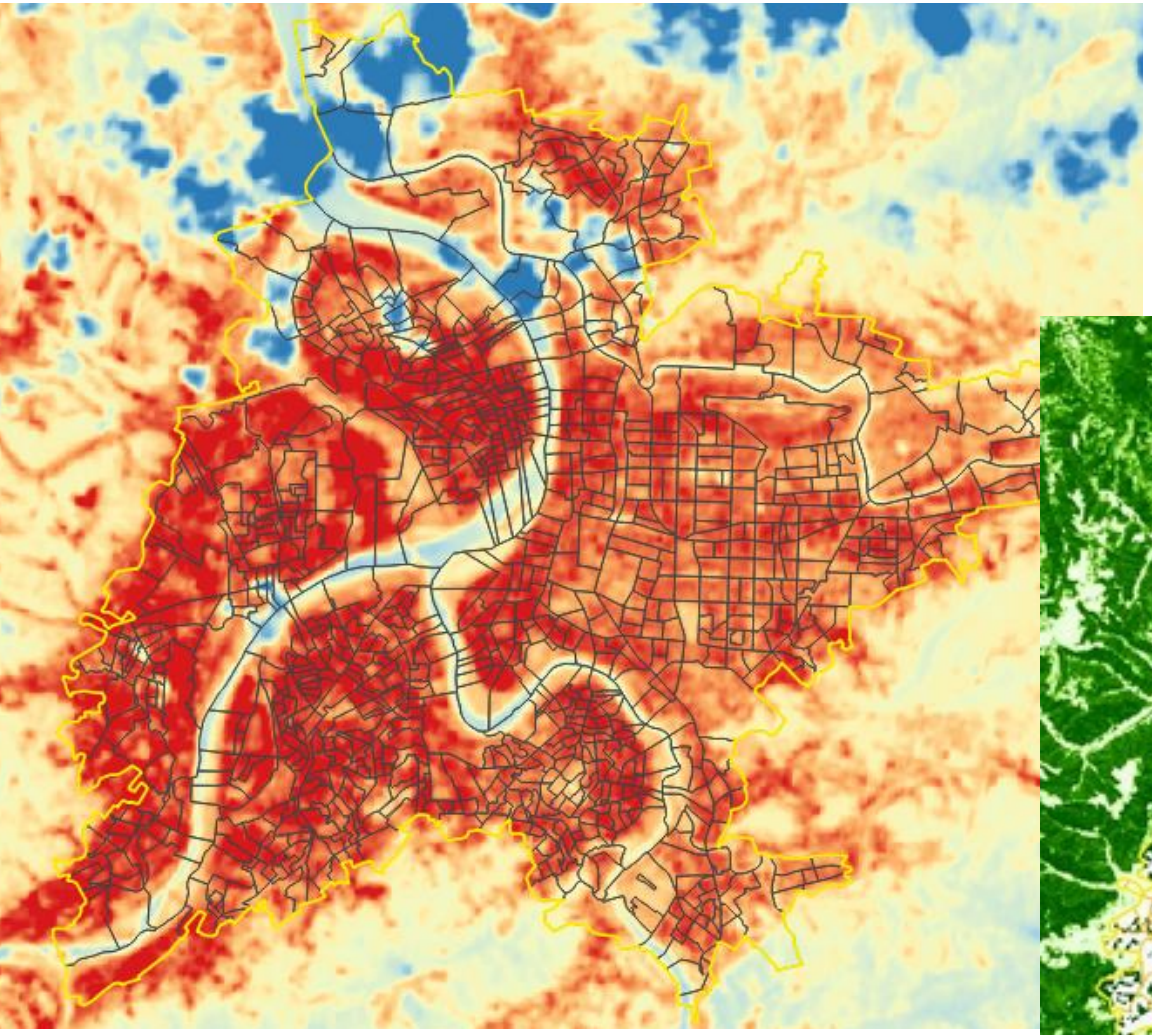
- More frequent, severe heatwaves in Hanoi
- Hotspots in Taipei
- Electricity cost are increasing
- Cooling needs influence electricity costs



Heatwaves in Hanoi : more frequent and severe

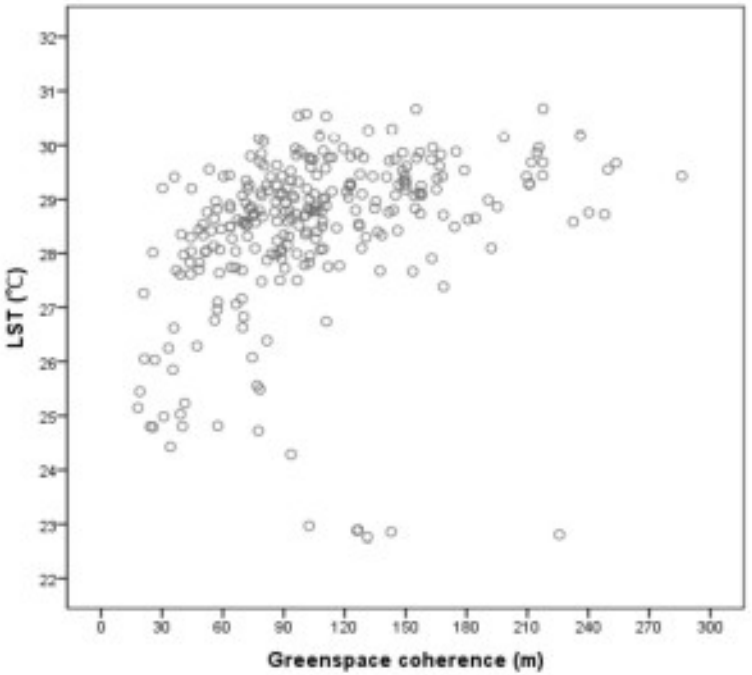
Hotspots in Taipei : associated with lower income districts

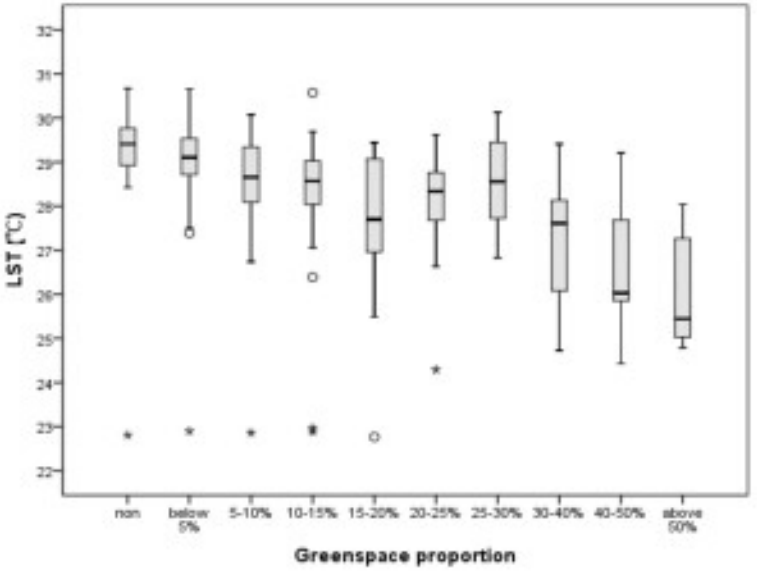
More large greenspaces are located in rich districts.



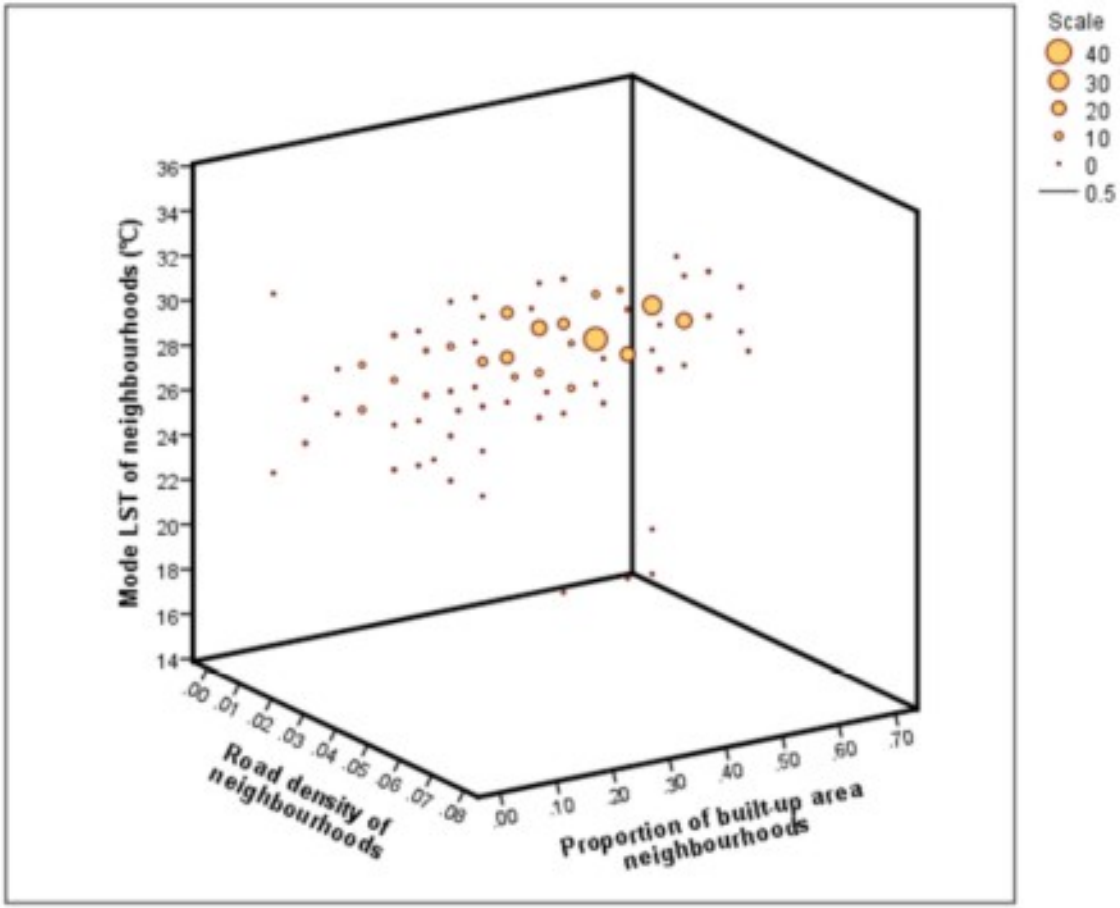
Land Surface Temperature of the interest area from LANDSAT 8 satellite

Urban development patterns influence the intensity of heat exposure: Taipei Case





- Neighbourhoods with higher greenspace proportion and greenspace coherence are cooler; whereas
- Areas with higher road density and building proportion tend to be hotter.



Urban development patterns influence the intensity of heat exposure: Taipei Case

The magnitude of heat exposure varies according to development density and building height.

- Increasing spacing between buildings can reduce heat; but
- Density effect might be offset by building higher.

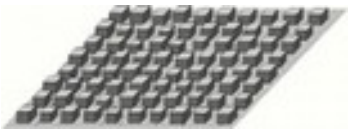
LCZ 1:
Compact high-rise

LCZ 4:
Open high-rise

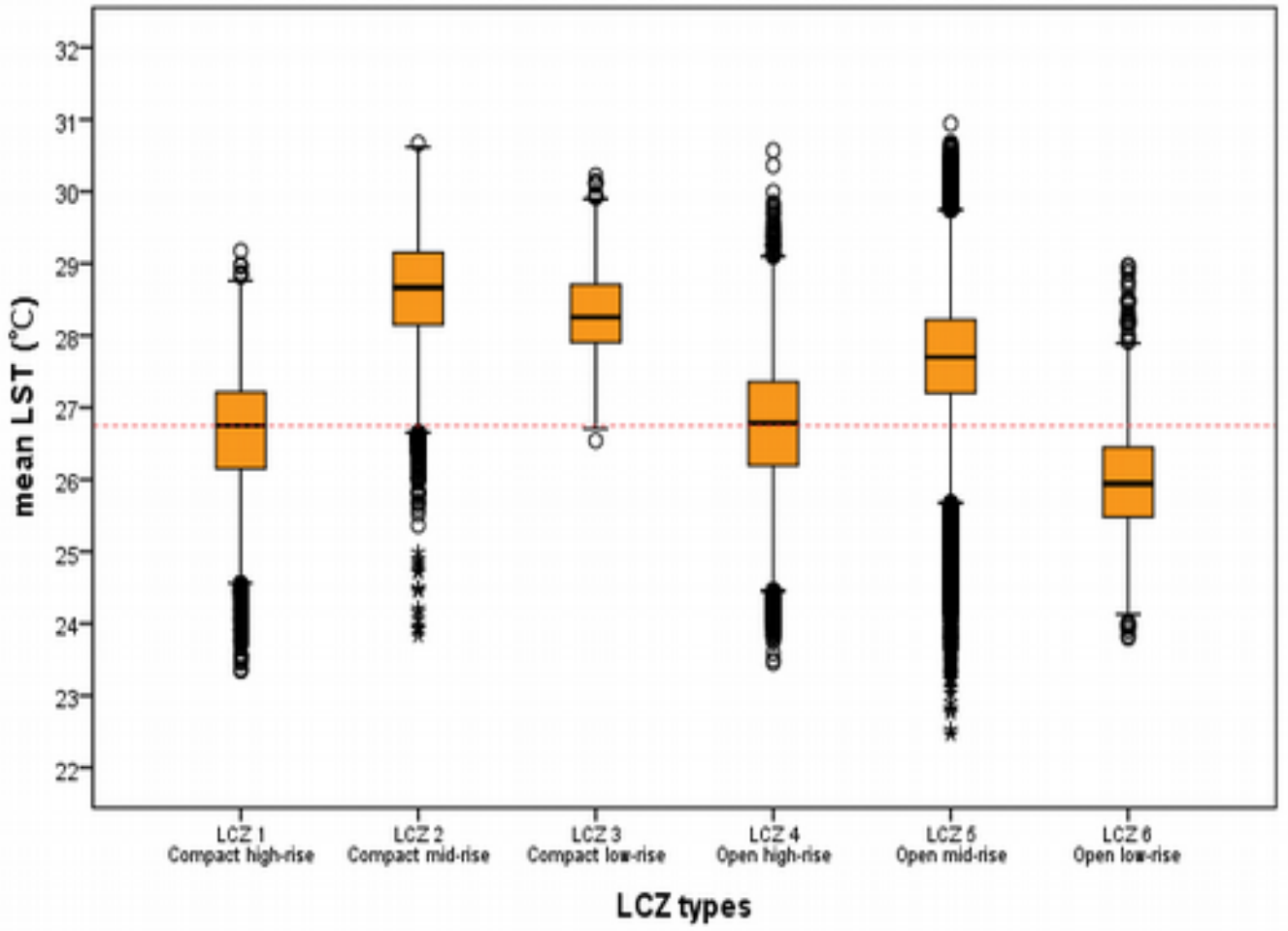
LCZ 2:
Compact mid-rise

LCZ 5:
Open mid-rise

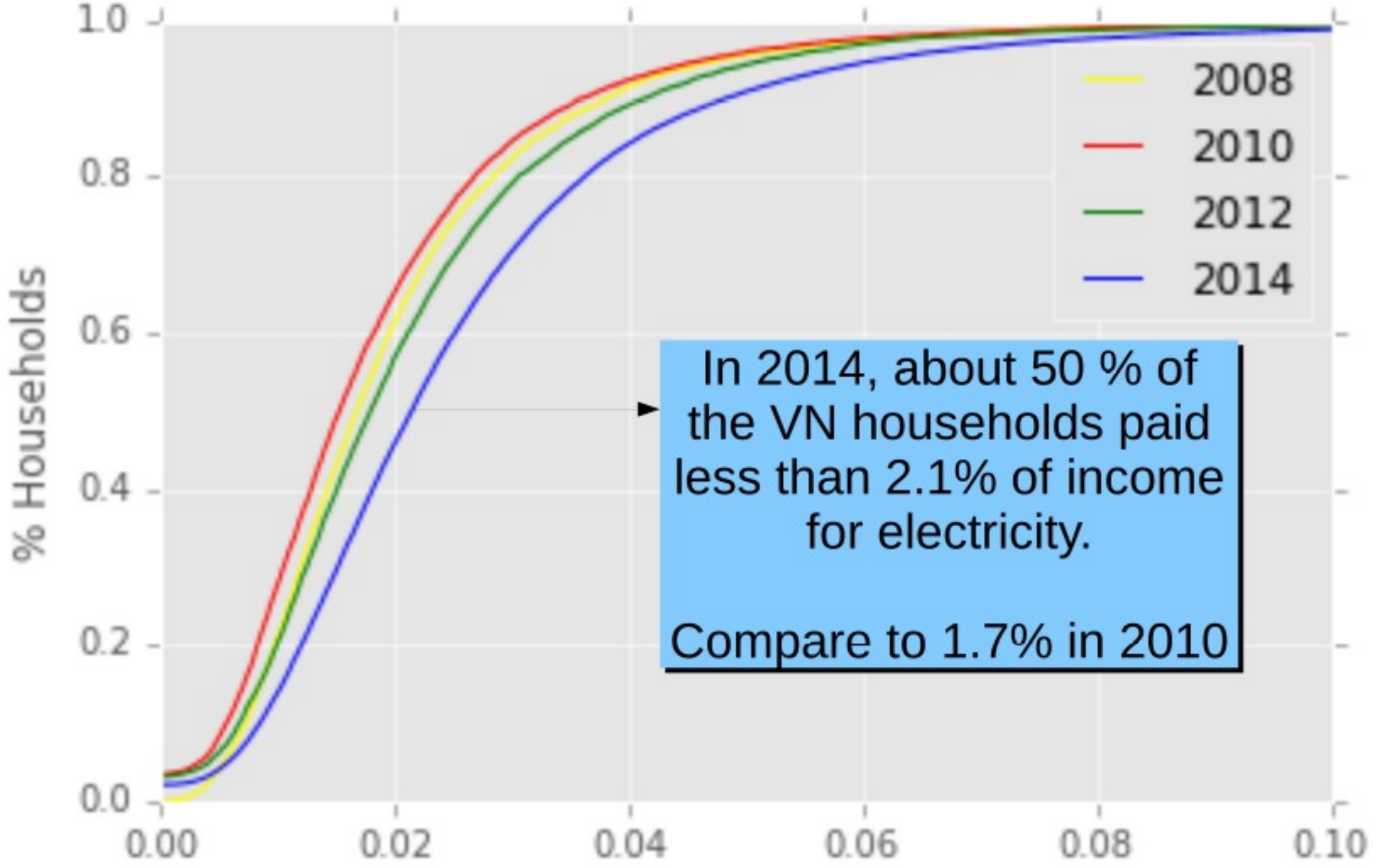
LCZ 3:
Compact low-rise



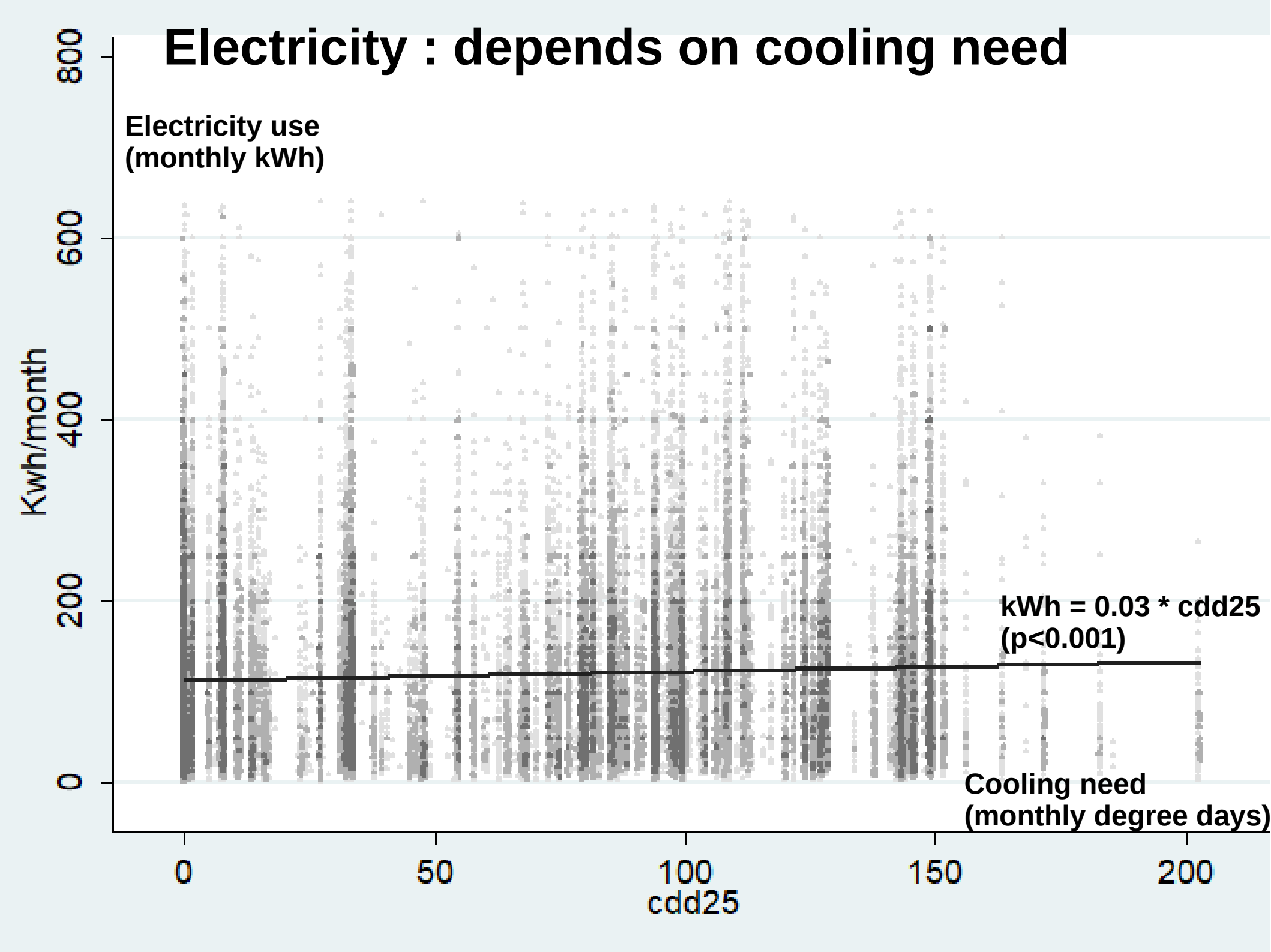
LCZ 6:
Open low-rise



Fraction of income spend on electricity : increasing



Electricity : depends on cooling need



Share of electricity in household budget

VHLSS 2010-2014, urban households, N=14764, p<0.001

Explaining variable	**Elasticity**
Famillly Income*	-0.48
Familly size	-0.33
House surface	+0.28
Temperature (CDD25)	+0.035

*When familly income increase by 1%, the share of electricity in the budget decreases by 0.48%

4. Conclusion : research needs

- Low temperature elasticity
- Measuring heatwave from satellite
- Measuring socio-economic vulnerability
- Measuring health system efficiency
- Urban planning and heat risk engagement

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