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ITIA RESEARCH TEAM ΕΡΕΥΝΗΤΙΚΗ ΟΜΑΔΑ

This presentation participates in OSPP
Outstanding Student Poster & PICO Contest

Comparison of climate change vs. urbanization

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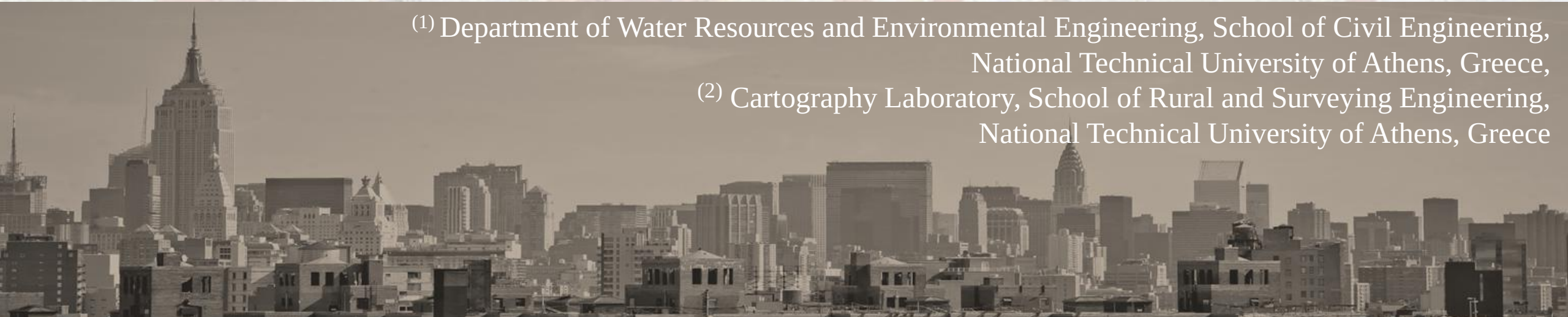


Introduction

'*Urbanization* is the process by which towns and cities are formed and become larger as more and more people begin living and working in central areas.'

demographic partitions.org http://demographicpartitions.org/urbanization-2013/#ZsflHCsp0QJkt6o7.99

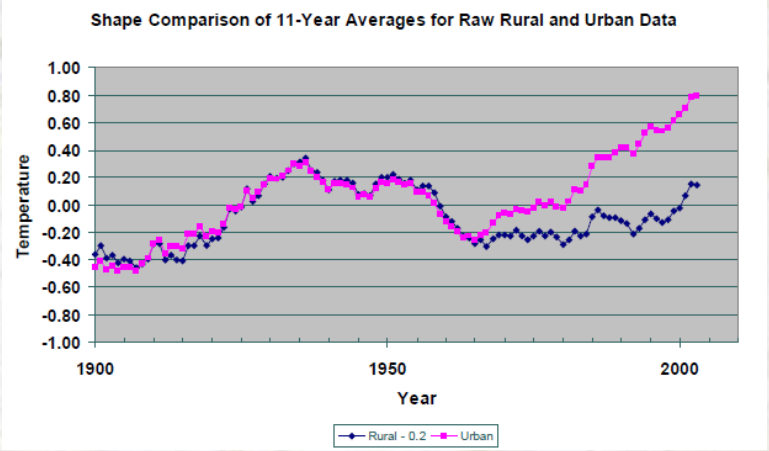
comparison of climate change & urbanization → comparing temperature change & trends between stations in urban & in non-urban areas studying how land-cover changes have influenced climate

Objective of study: investigate the effect of urbanization on temperature change using large scale land-cover change geodatabase

Similar works

--Using nighttime light satellite imagery to determine urbanization and meteorological stations (Yang et.al, 2011)

--Raw data provide 0,13 and 0,79°C/century temperature increase for rural and urban areas (Long, 2010)



Materials and Methods

Historical Land-Cover Change Global Dataset: netCDF files (open source)

HYDE 3.1(Historical Database of the Global Environment)(Klein Goldewijk et al.,2011)

HYDE-CHVEG ***land-use transformations/conversions***

area of one land-cover type that was converted to another land-cover type, between two consecutive years

global 0,5° x 0,5° lat/lon grid (≈50 km*50 km) annual time steps,Years: **1900-2010**

Land Cover Changes:

- annual 92 different types of land-use conversions
  - **23 types of land-use conversions to urban areas**

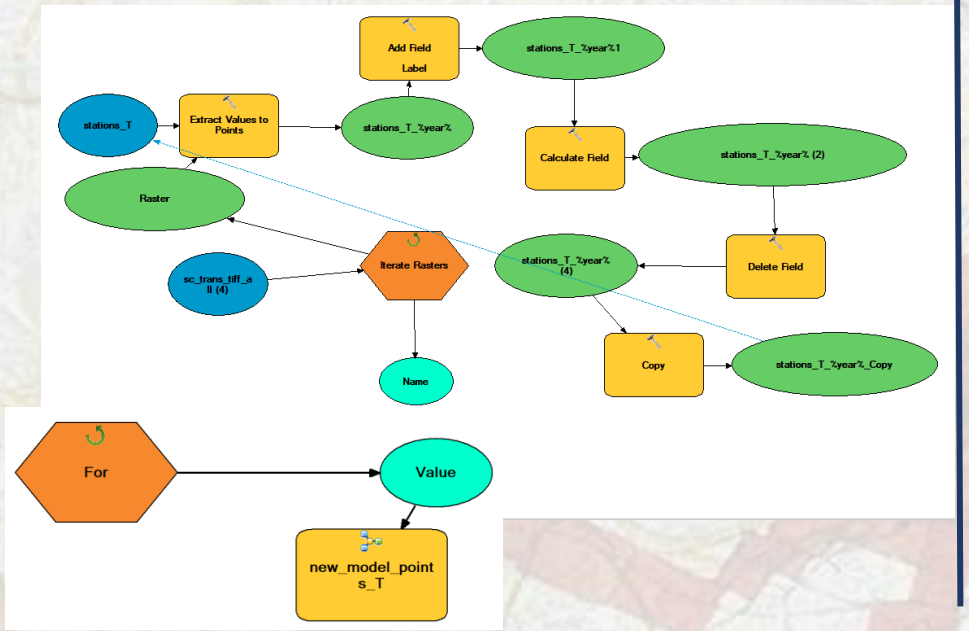
Land-Use Conversions	Explanation
4.TrpEBF → Urban	Tropical Evergreen Broadleaf Forest → Urban land
8.TrpDBF → Urban	Tropical Deciduous Broadleaf Forest → Urban land
12.TmpEBF → Urban	Temperate Evergreen Broadleaf Forest → Urban land
16.TmpENF → Urban	Temperate Evergreen Needle leaf Forest → Urban land
20.TmpDBF → Urban	Temperate Deciduous Broadleaf Forest → Urban land
24.BorENF → Urban	Boreal Evergreen Needle leaf Forest → Urban land
28.BorDNF → Urban	Boreal Deciduous Needle leaf Forest → Urban land
31.Savanna → Urban	Savanna → Urban land
34.Grass → Urban	Grass → Urban land
37.Denseshrub → Urban	Dense Shrub land → Urban land
40.Openshrub → Urban	Open Shrub land → Urban land
43.Tundra → Urban	Tundra → Urban land
46.Desert → Urban	Desert → Urban land
49.PdRI → Urban	Polar Desert/Rock/Ice → Urban land
52.SecTrpEBF → Urban	Secondary Tropical Evergreen Broadleaf Forest → Urban land
55.SecTrpDBF → Urban	Secondary Tropical Deciduous Broadleaf Forest → Urban land
58.SecTmpEBF → Urban	Secondary Temperate Evergreen Broadleaf Forest → Urban land
61.SecTmpENF → Urban	Secondary Temperate Evergreen Needle leaf Forest → Urban land
64.SecTmpDBF → Urban	Secondary Temperate Deciduous Broadleaf Forest → Urban land
67.SecBorENF →Urban	Secondary Boreal Evergreen Needle leaf Forest → Urban land
70.SecBorDNF → Urban	Secondary Boreal Deciduous Needle leaf Forest → Urban land
86.Crop → Urban	Cropland → Urban land
89.Past → Urban	Pastureland → Urban land

Materials and Methods

National Centers for Environmental Information
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Land Cover Data processing

ArcGIS → Model Builder



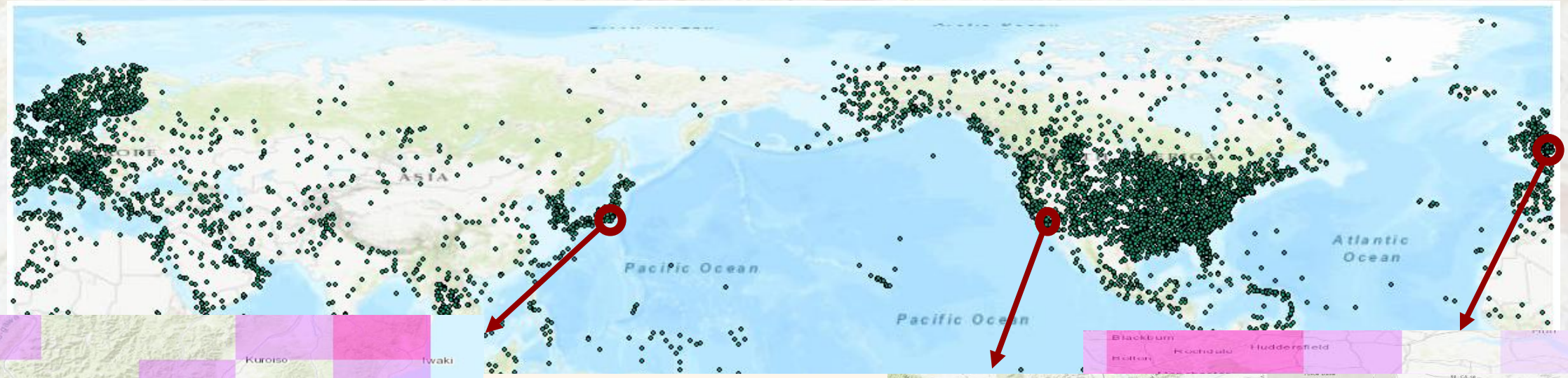
Global Historical Climatology Network (GHCN)

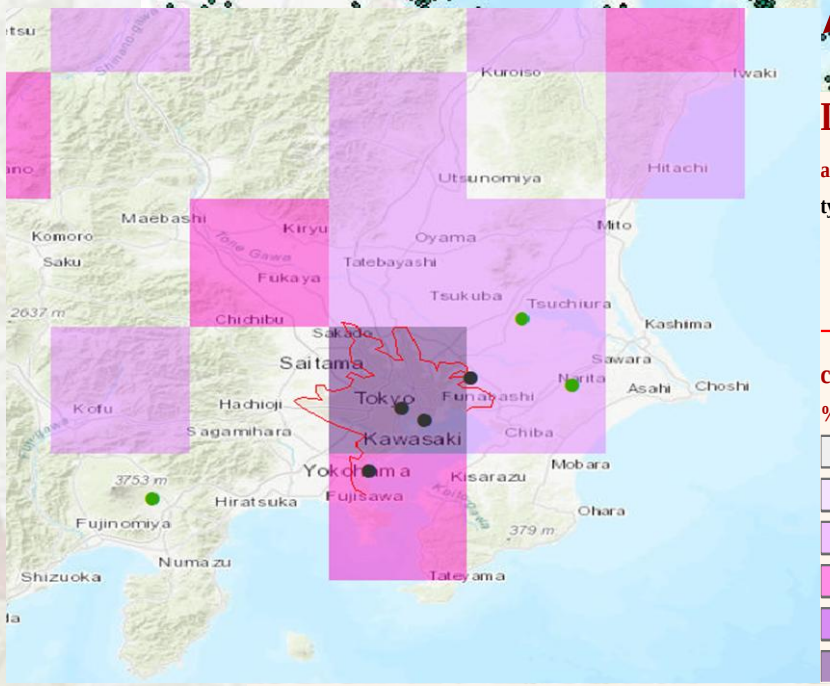
- integrated database of climate summaries from land surface stations
- hourly air temperature data from 7572 meteorological stations across the globe

https://www.ncdc.noaa.gov/ghcnm/

originality of research: *original time series* of *global network* of meteorological stations (not reanalysis data) & *long time series of global* land-use conversions

Description of study areas





Legend

all temperature stations

type

! non-urban

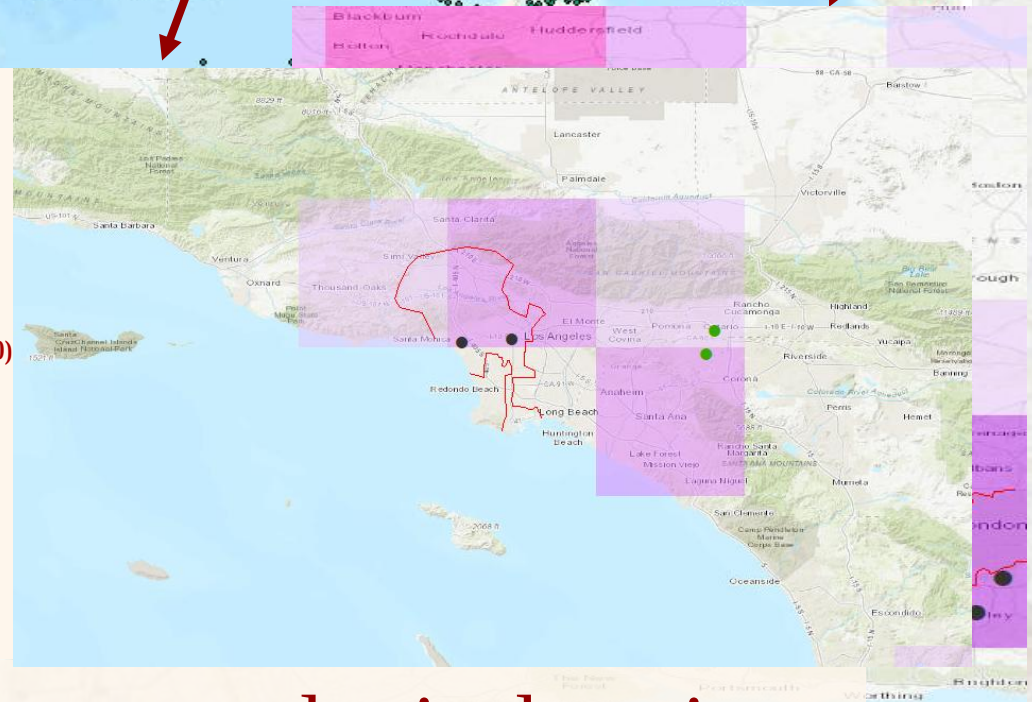
! urban

city boundaries

cumulative land-use conversion to urban land (1900-2010)

%

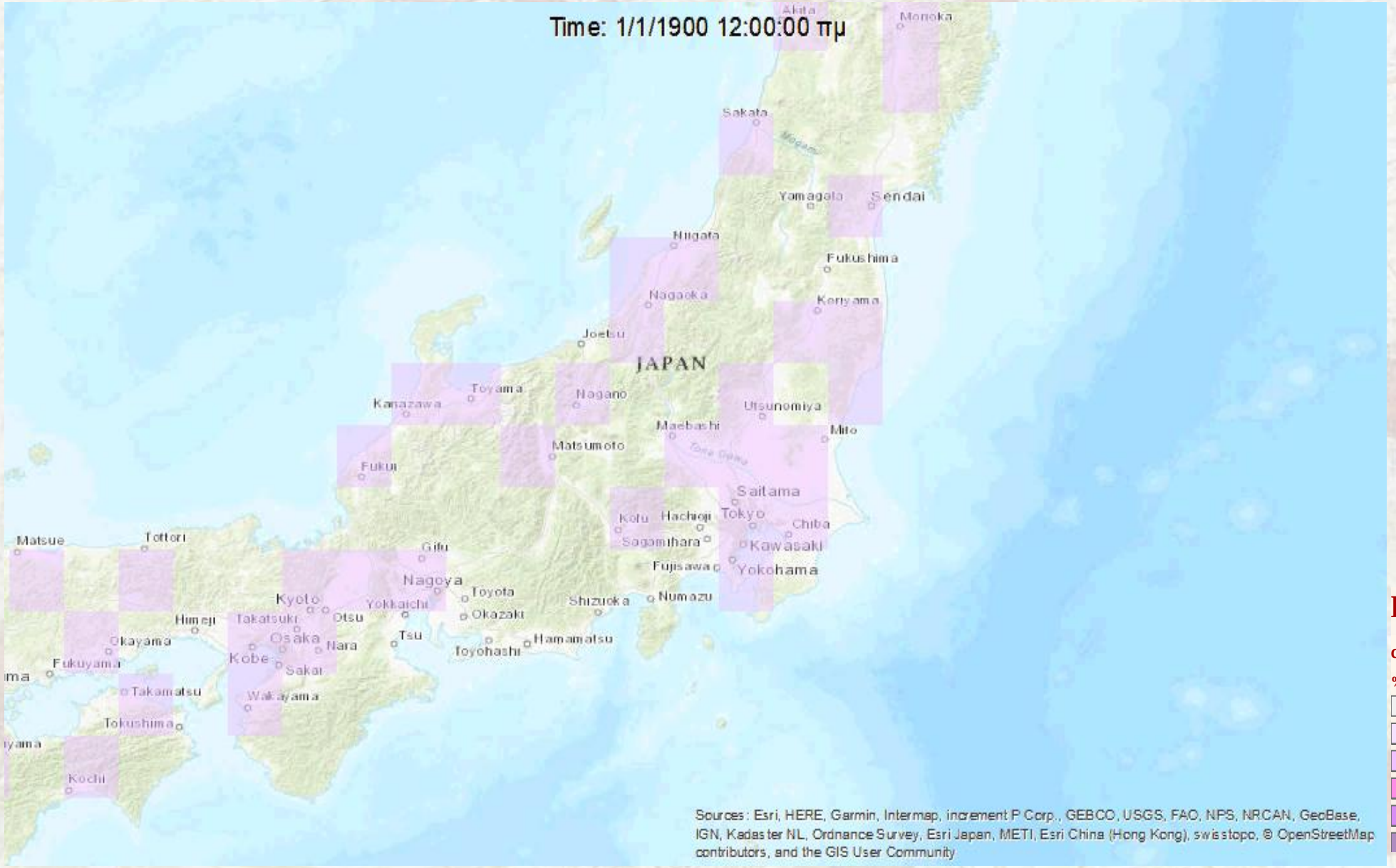
- 0 - 0,0000001
- 0,000000101 - 0,002666747
- 0,002666747 - 0,007030514
- 0,007030514 - 0,014303459
- 0,014303459 - 0,026909897
- 0,026909897 - 0,061820034



Global Map and the network of meteorological stations

Results

Tokyo, Japan



Legend

cumulative land-use conversion to urban land (1900-2010)

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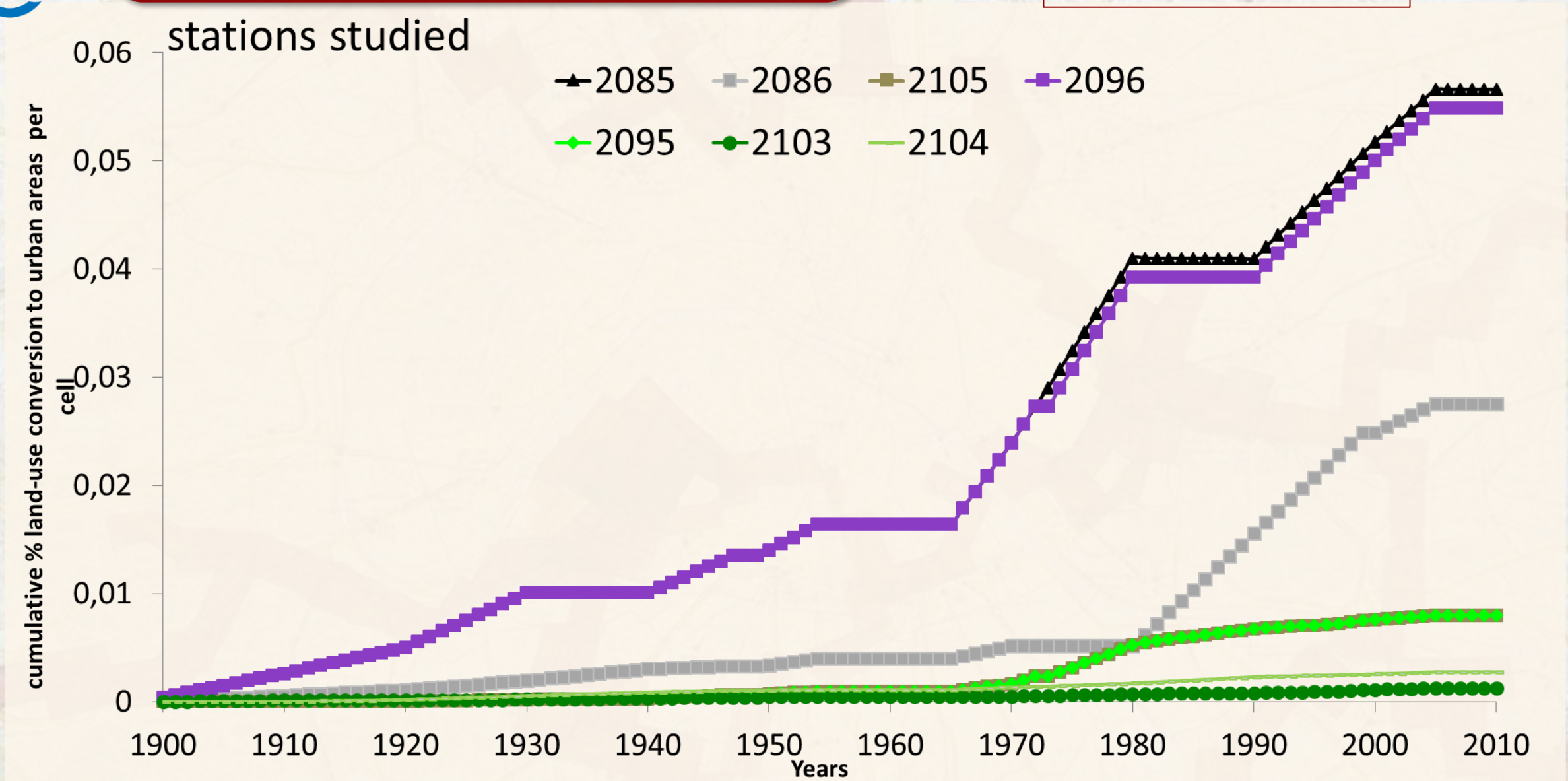
Results

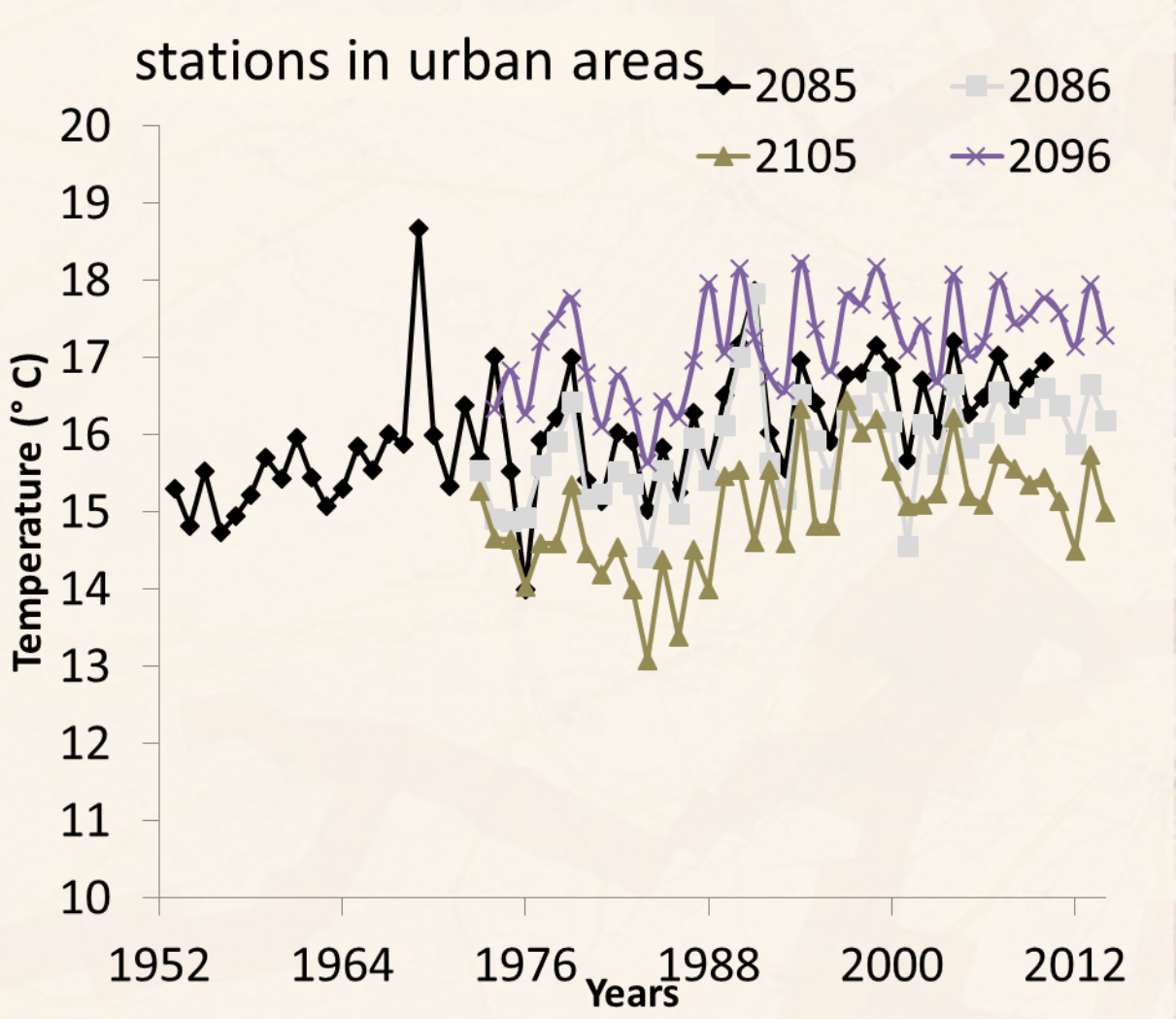
Tokyo, Japan

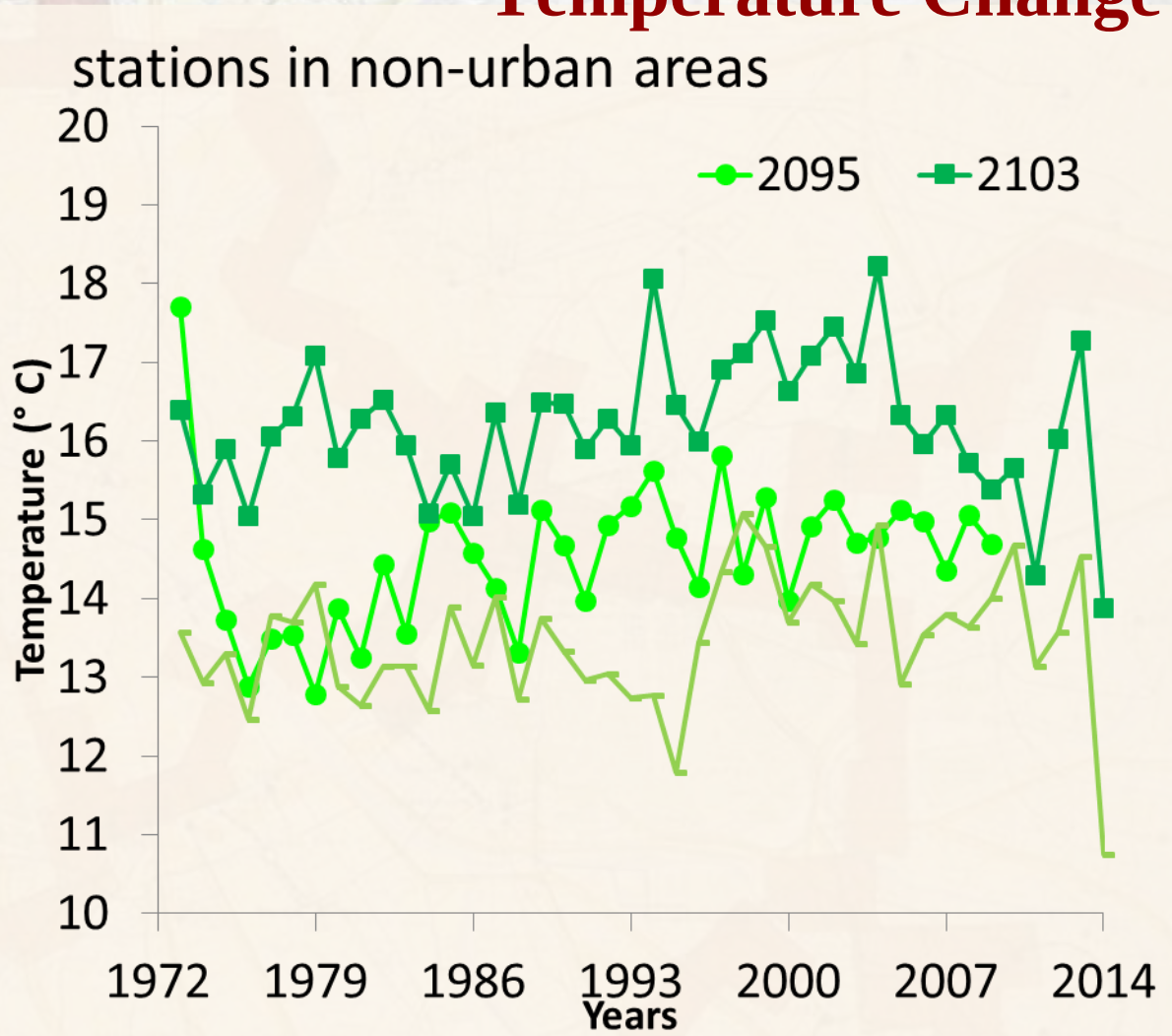


Results

Tokyo, Japan

Temperature Change





cross correlation

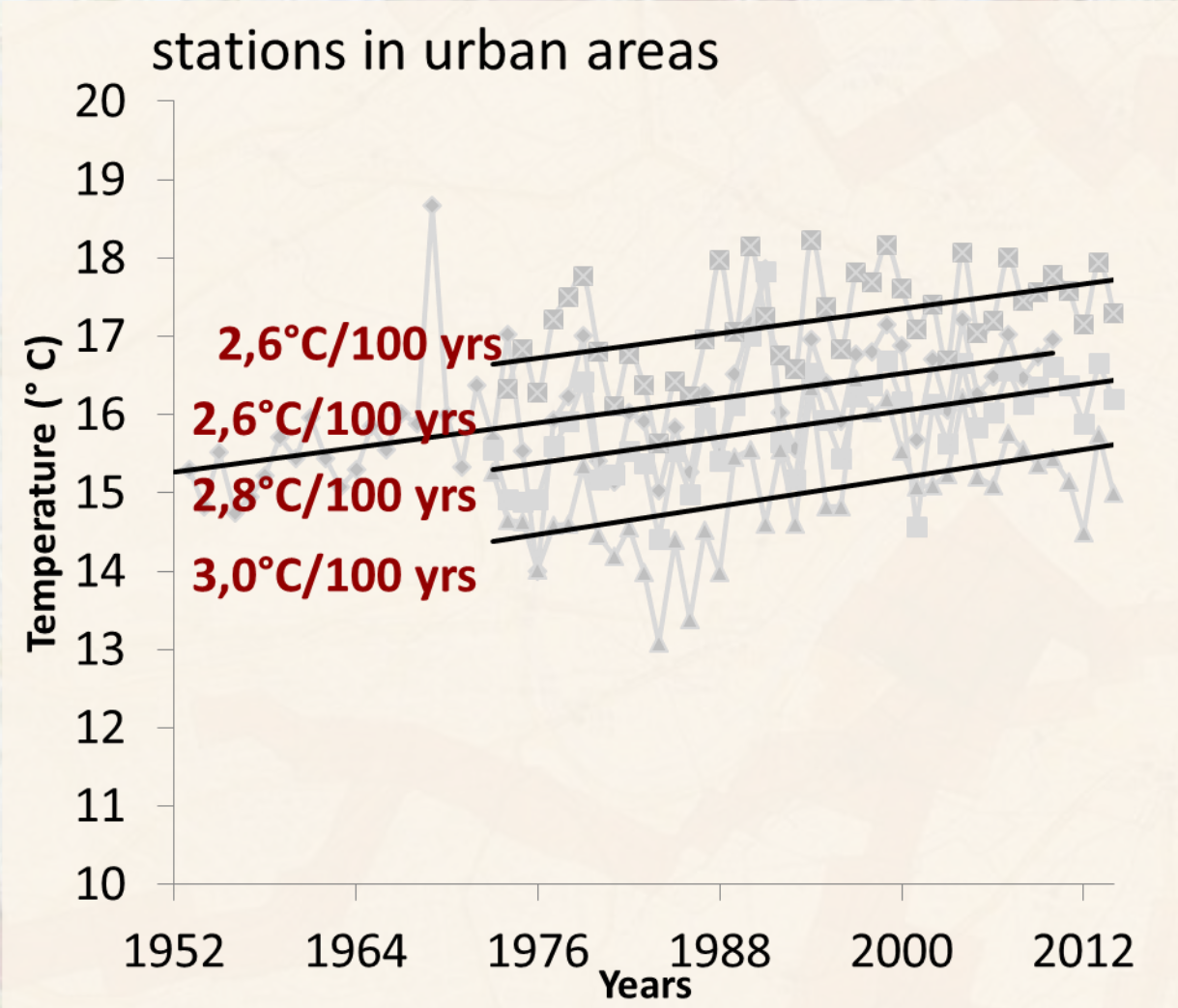
2085	0,48
2086	0,46
2096	0,45
2105	0,44

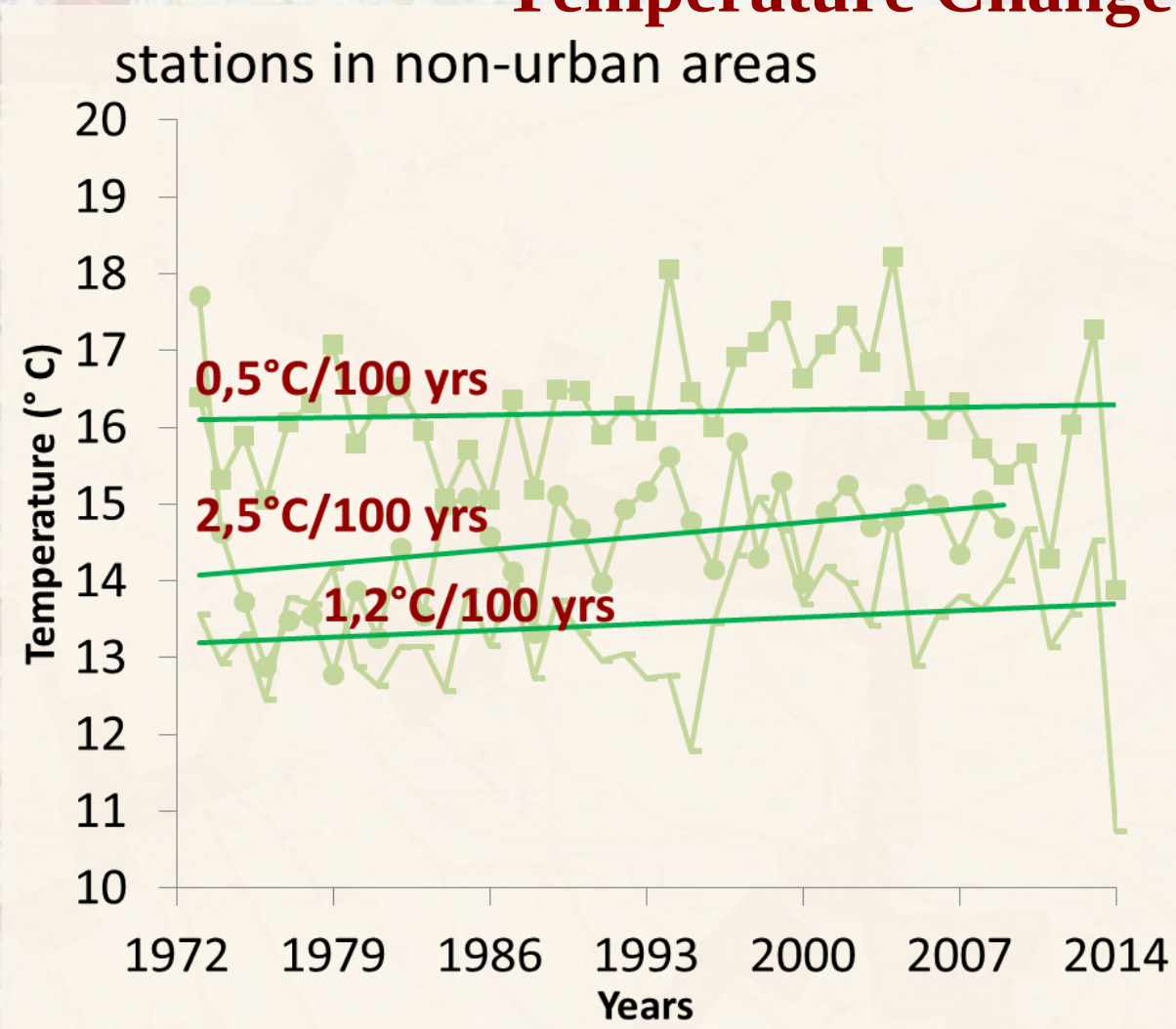
2095	0,19
2103	0,32
2104	0,34

Results

Tokyo, Japan

Temperature Change





Hurst coefficient

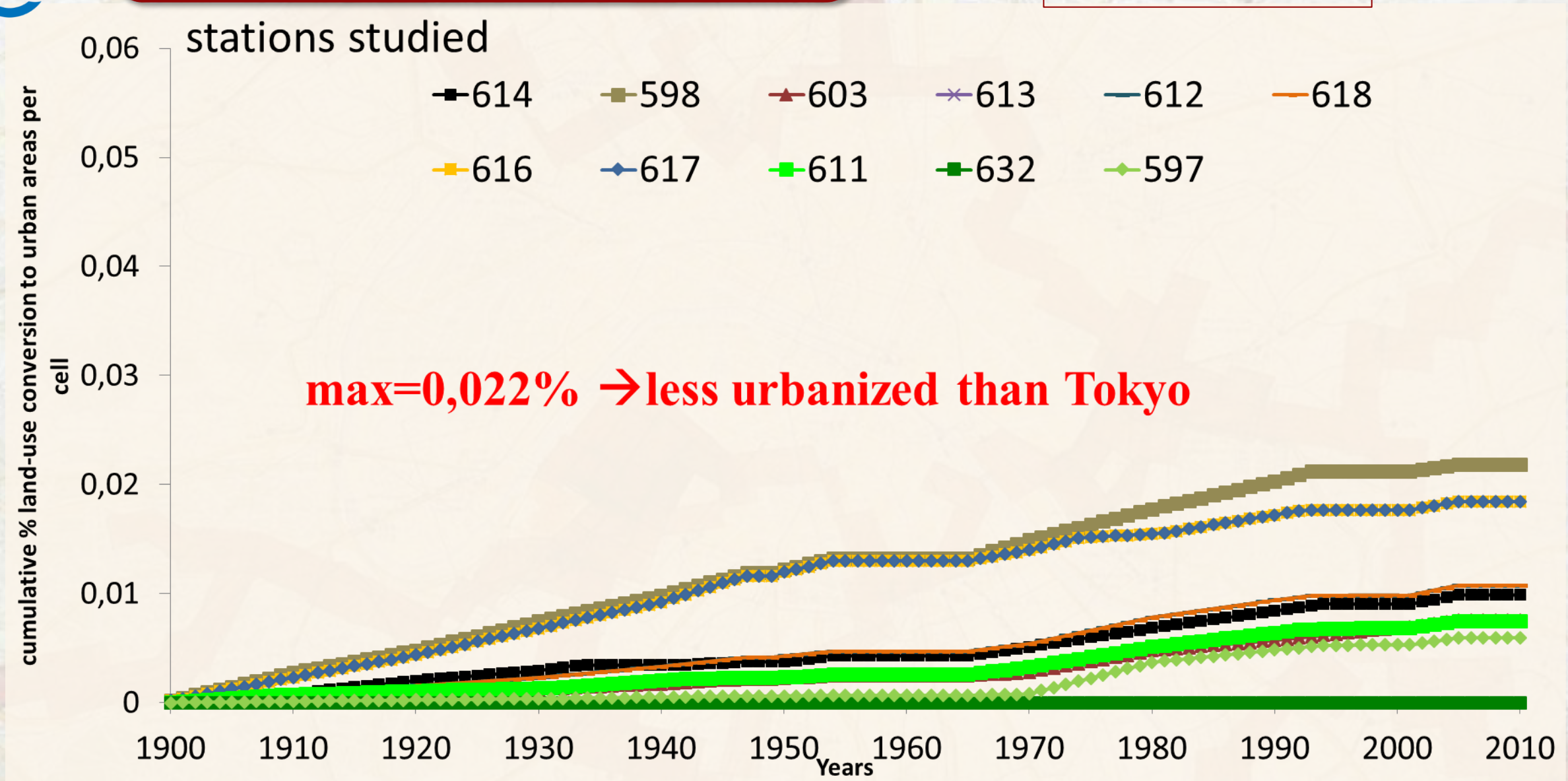
(Dimitriadis and Koutsoyiannis, 2015)

2085	0,69
2086	-
2096	~0,5
2105	0,88

2095	0,57
2103	0,78
2104	0,59

Results

London, UK

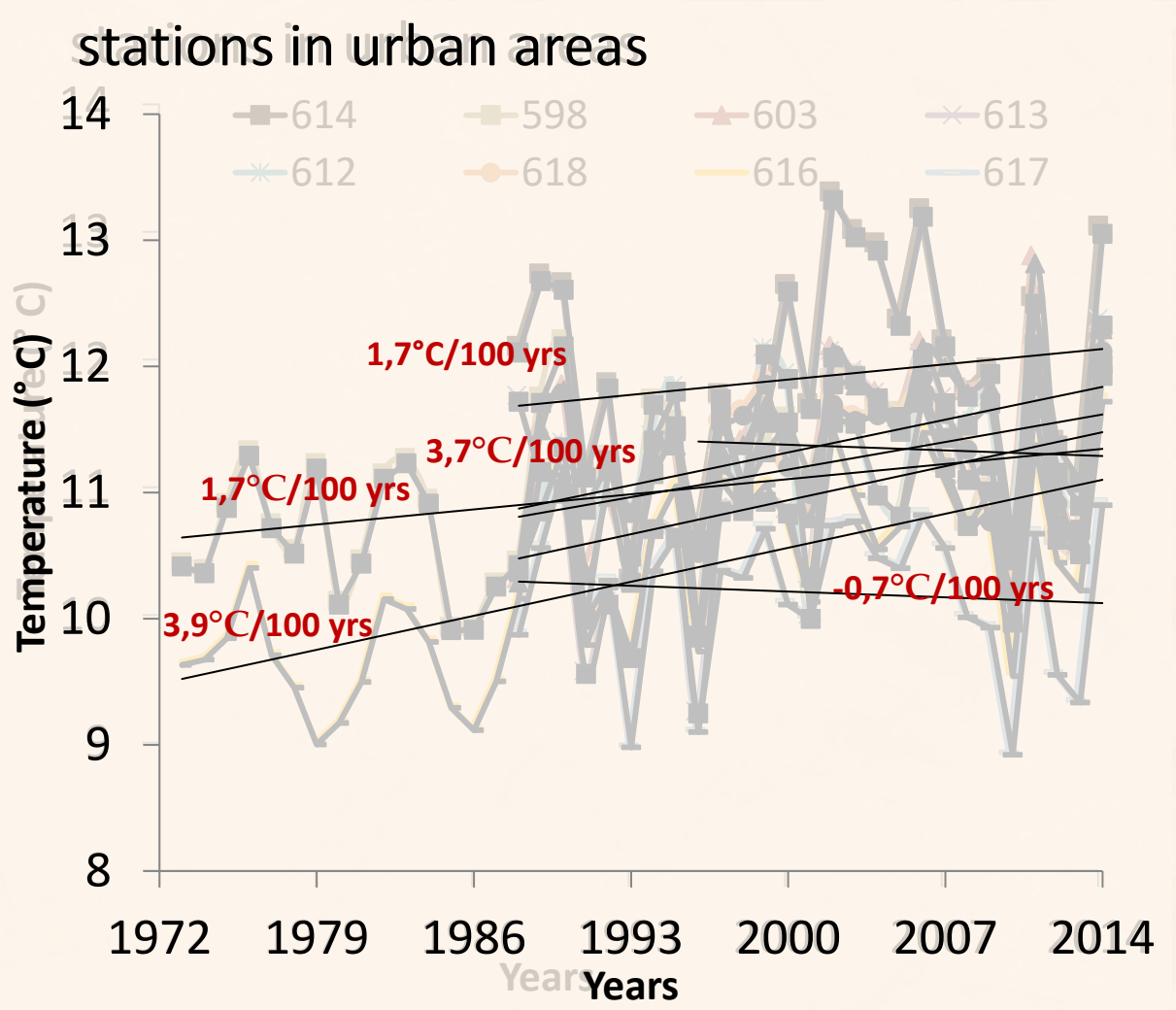


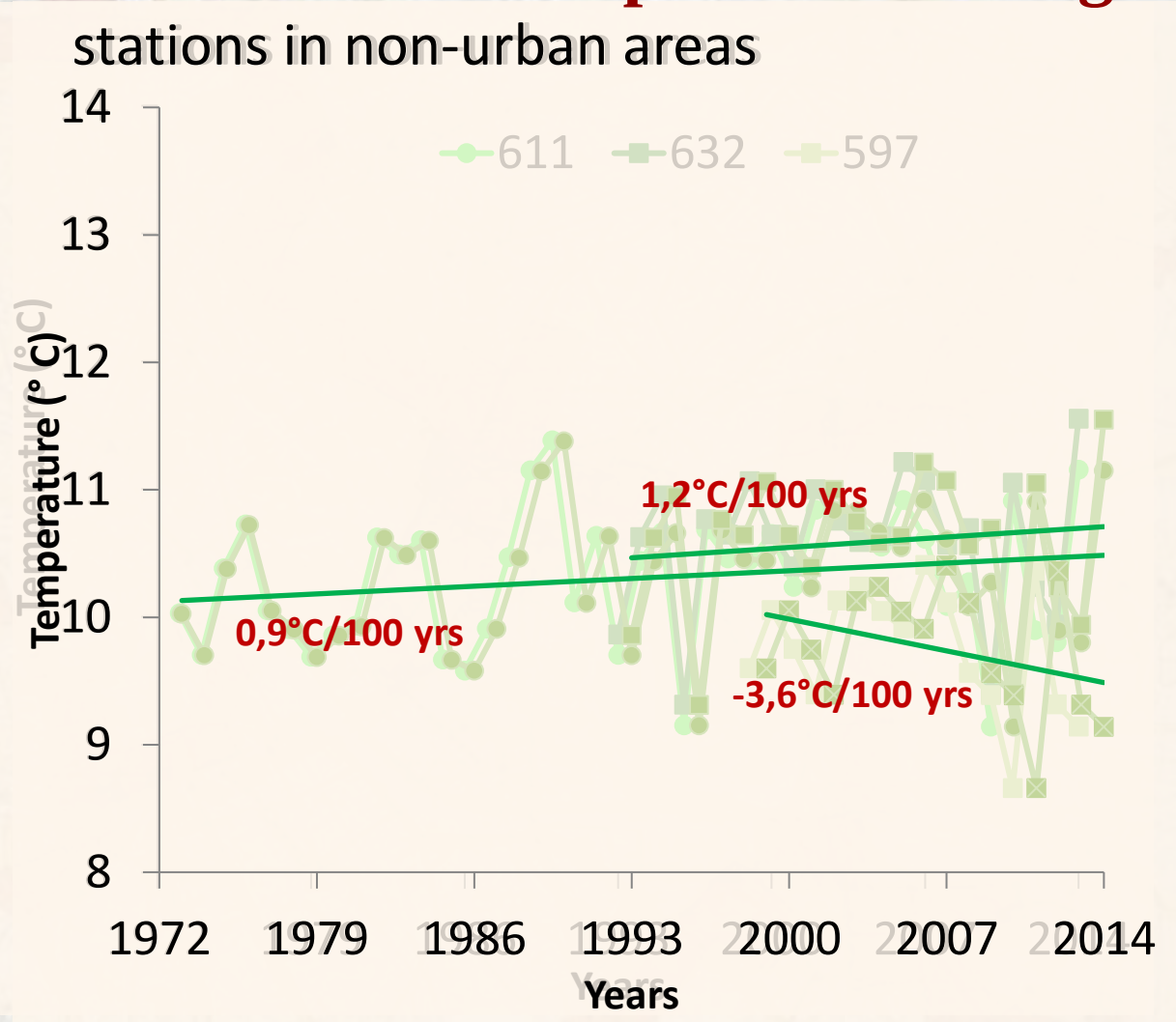
max=0,022% →less urbanized than Tokyo

Results

London, UK

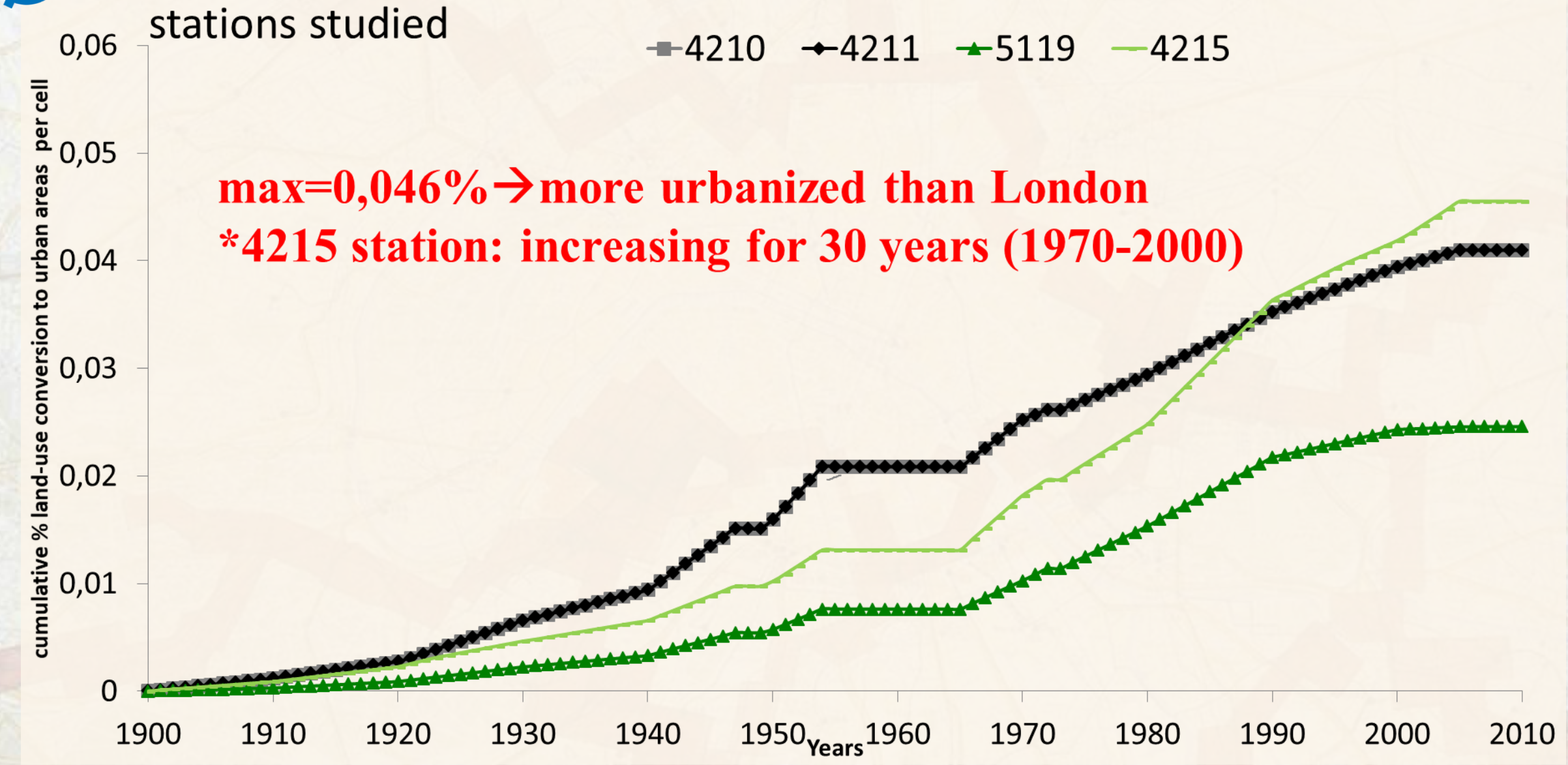
Temperature Change





Results

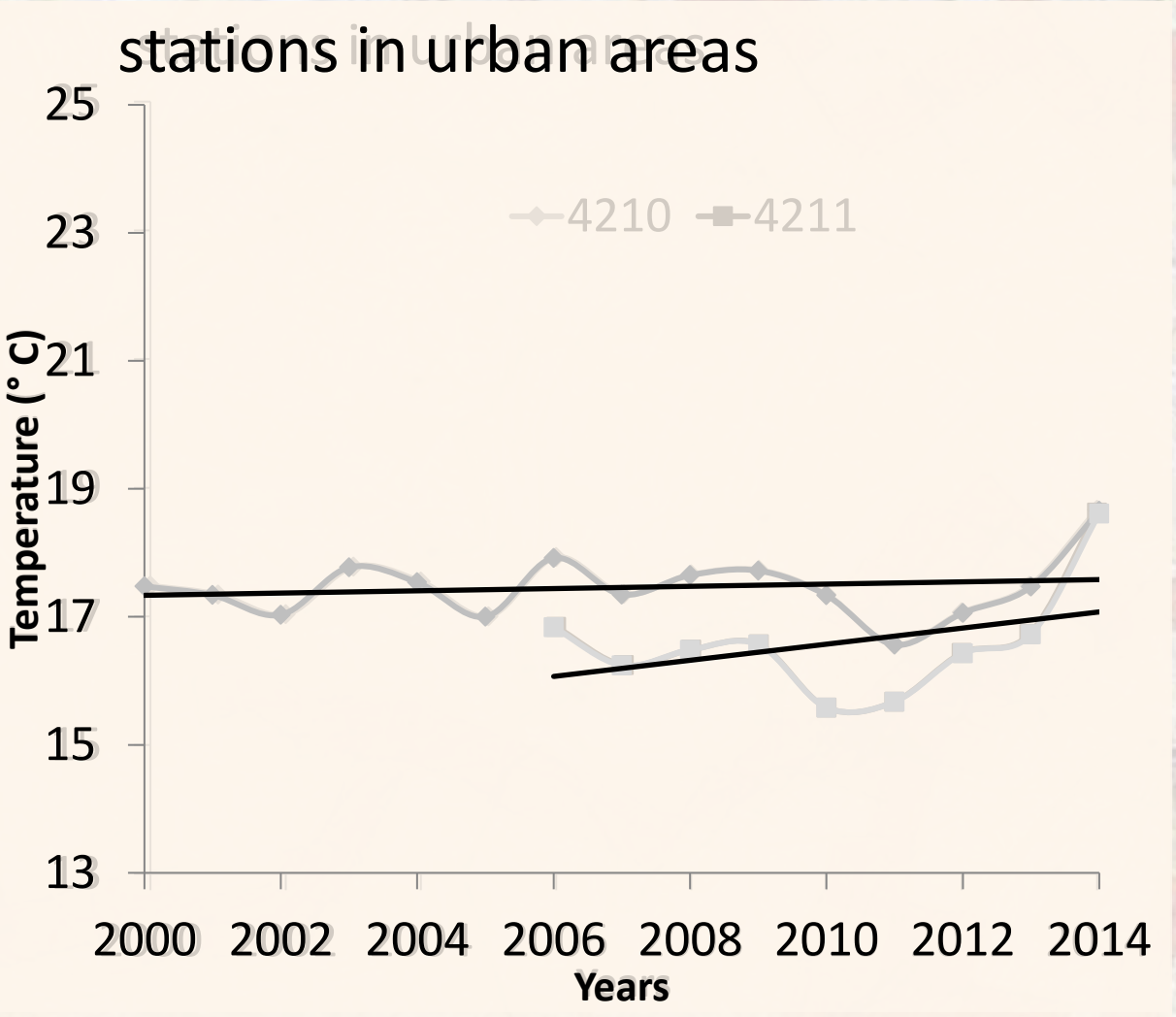
Los Angeles, USA

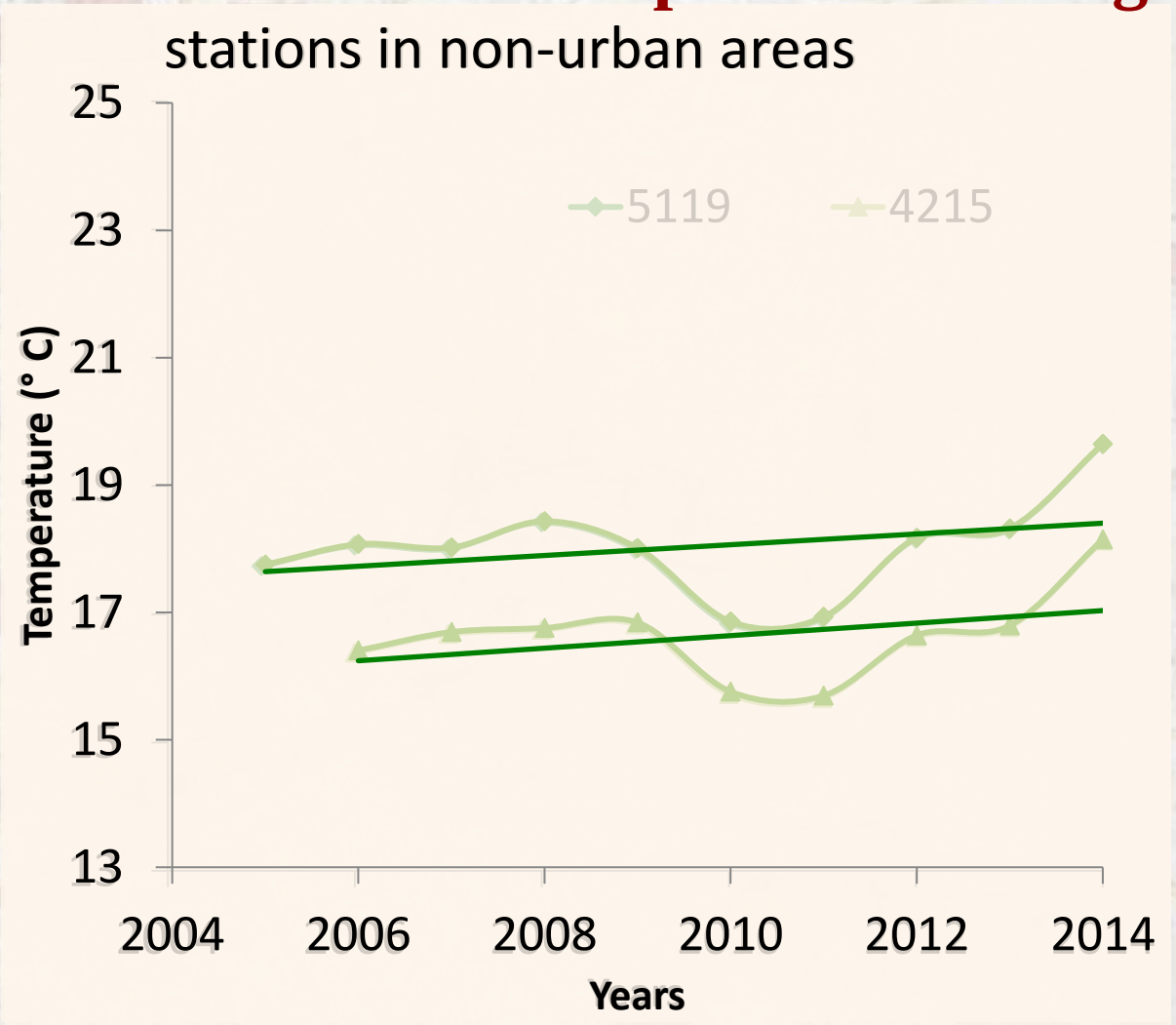


Results

Los Angeles, USA

Temperature Change





Conclusions

- Urbanization has a significant influence on surface warming over study areas (heavily urbanized cities)
- Regional urban & non-urban temperature trends strongly diverse
- Microclimate of the urban area is not affected by the surrounding rural areas
- Differences between urban and non-urban temperature trends could be related to the urban heat island effect (UHI)
- Potential Seasonal behavior → exploratory research

The research continues…

- Temperature data in longer periods
- Land cover conversions geodatabase with higher grid resolution
- Study precipitation and relative humidity
- Study how uncertainty in historical land-cover change is translated into uncertainty on impacts on environmental variables of interest
- Semi-urban & urban areas → objective criterias

Is the observed change in climate a really global or a resultant of local ones?

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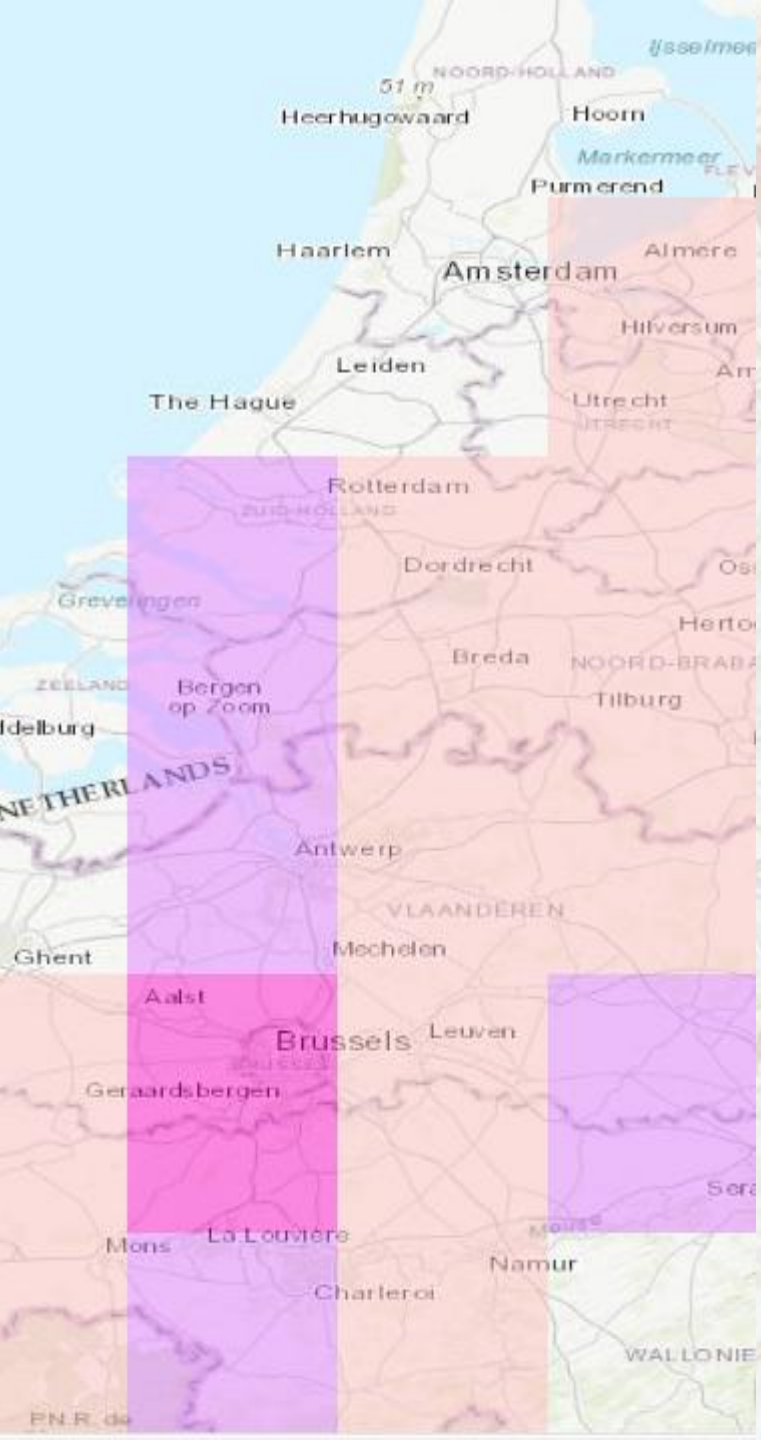

Thank you for your attention

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