ASSESSING CLIMATE CHANGE IN CITIES USING URBCLIM

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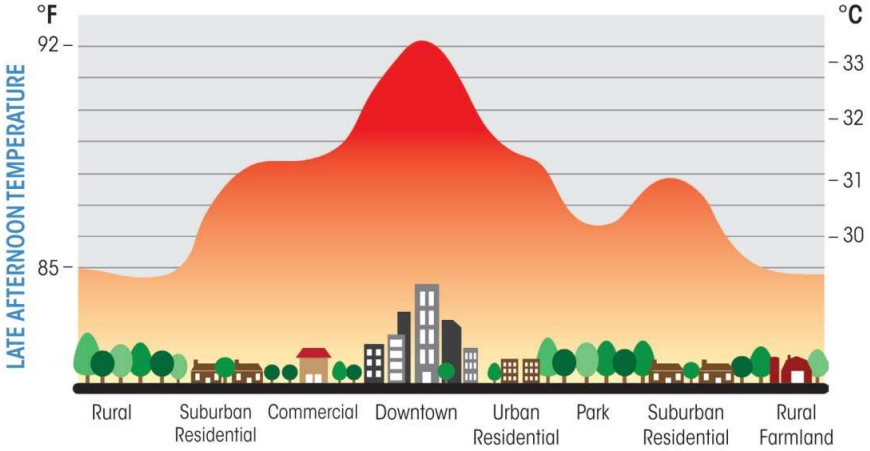
Overview

- The urban heat island
- UrbClim model
  - Description
  - Validation
- Current climate assessment
  - Temperature maps
    - Evolution of the UHI during a day
    - Analysis of night-time temperature in 100 EU-cities
  - Number of heat-wave days
- Future climate assessment

The Urban Heat Island

Health effects



- Cities tend to be warmer than their rural surroundings
- Higher levels of heat stress in urban areas.
- Increased mortality in urban areas

Increased mortality during 2003 European heat-wave

Small town: +40%

Paris: +140%

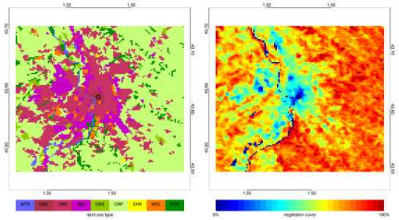
Lyon: +80%

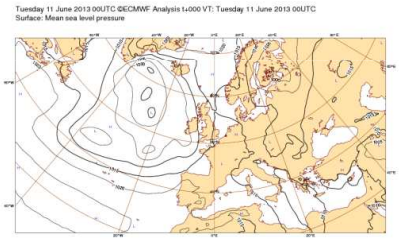
Vandentorren S., et al., 2004. Am J Public Health, 94, p. 1518.

The UrbClim model

Brief description

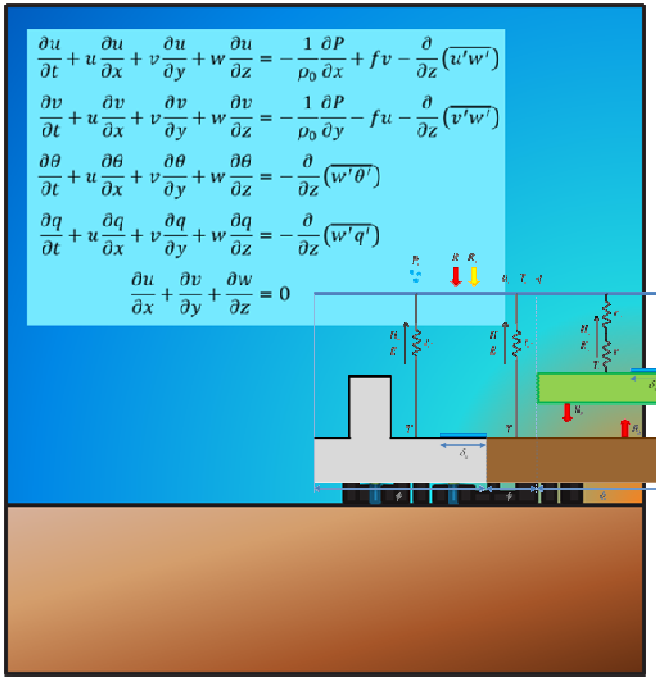
Terrain (Corine/GlobCover)





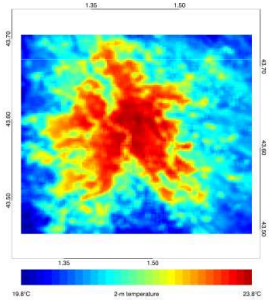
large-scale meteorology
ERA-Interim data (ECMWF)

Input



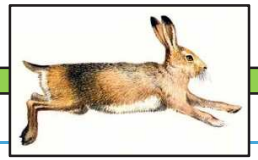
UrbClim

hourly gridded (250-m)
- temperature
- humidity
- wind speed



UHI maps

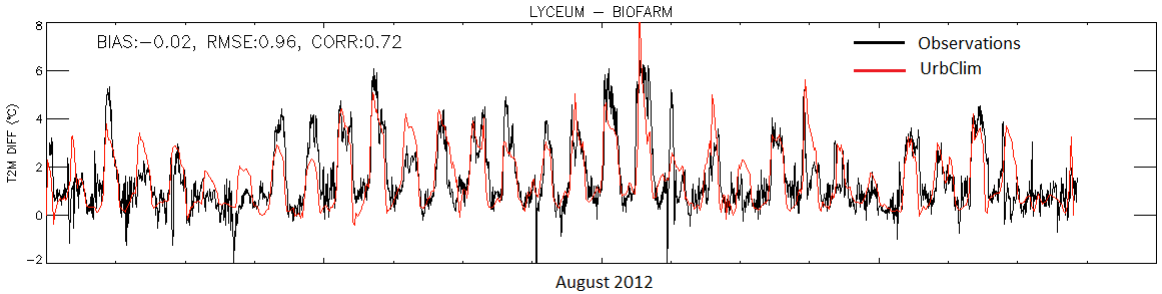
Output



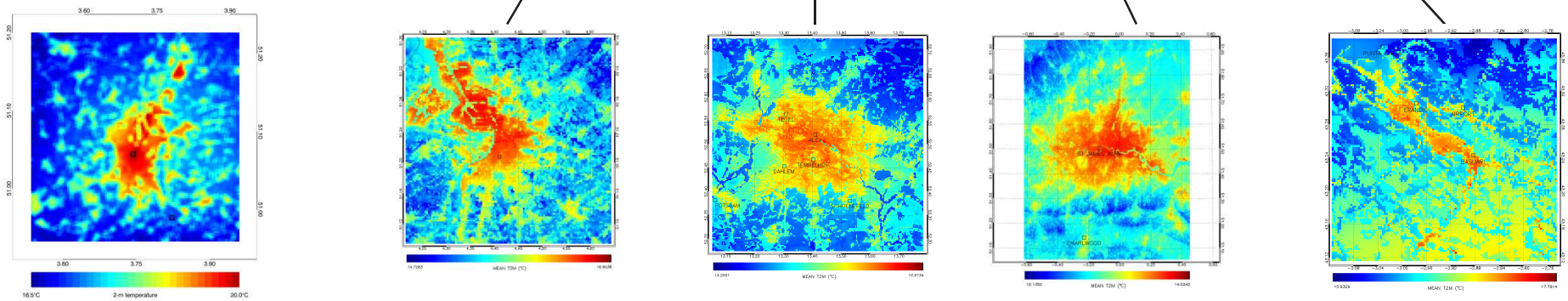
De Ridder K., et al., 2015. Urban Climate, 12, p. 21.

The UrbClim model

Validation



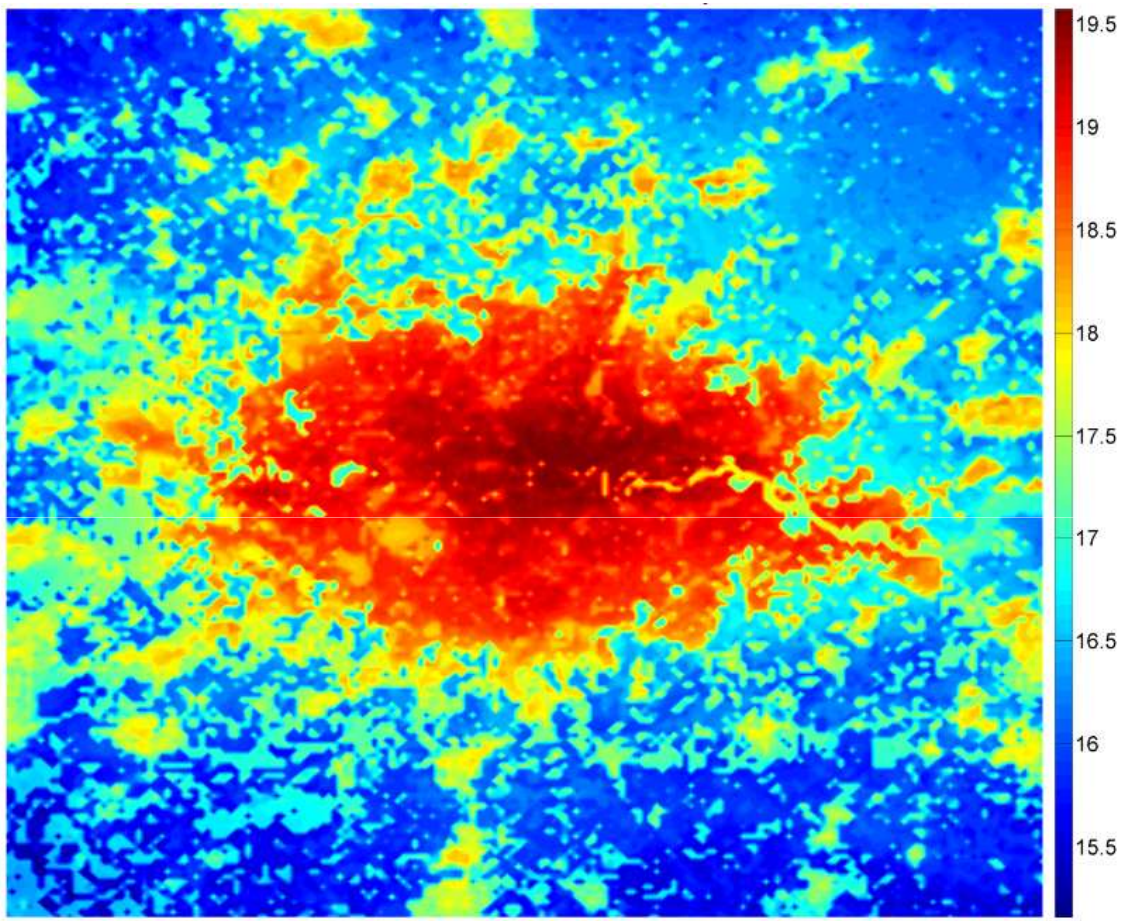
	Ghent	Antwerp	Berlin	London	Bilbao
RMSE (°C)	1.0	1.0	0.9	1.2	1.0
CORR(-)	0.68	0.70	0.71	0.62	0.70



De Ridder K., et al., 2015. Urban Climate, 12, p. 21.
De Ridder K., et al., 2011. Boundary layer Meteorology, 138, p. 511

Current climate assessment

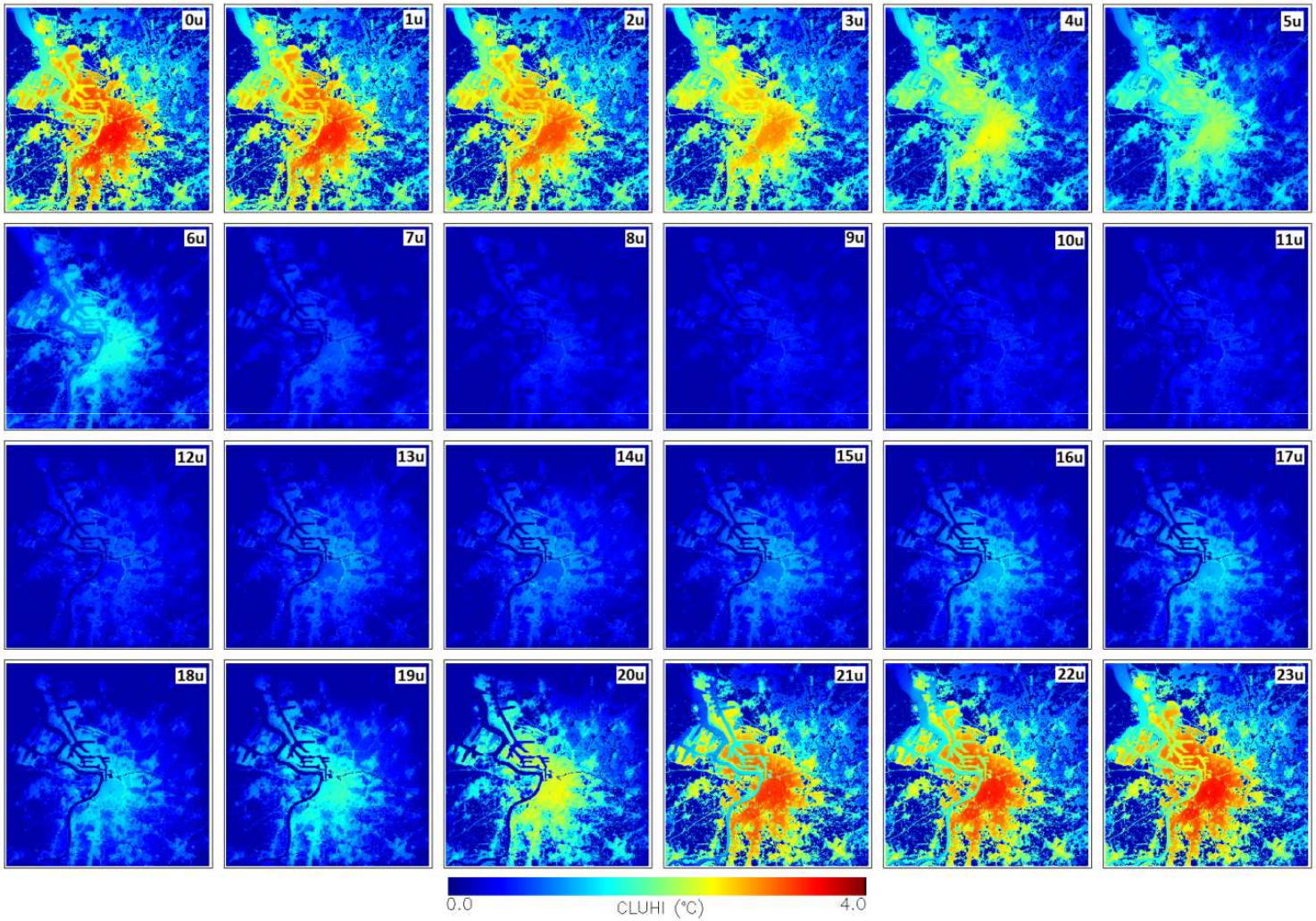
Example result

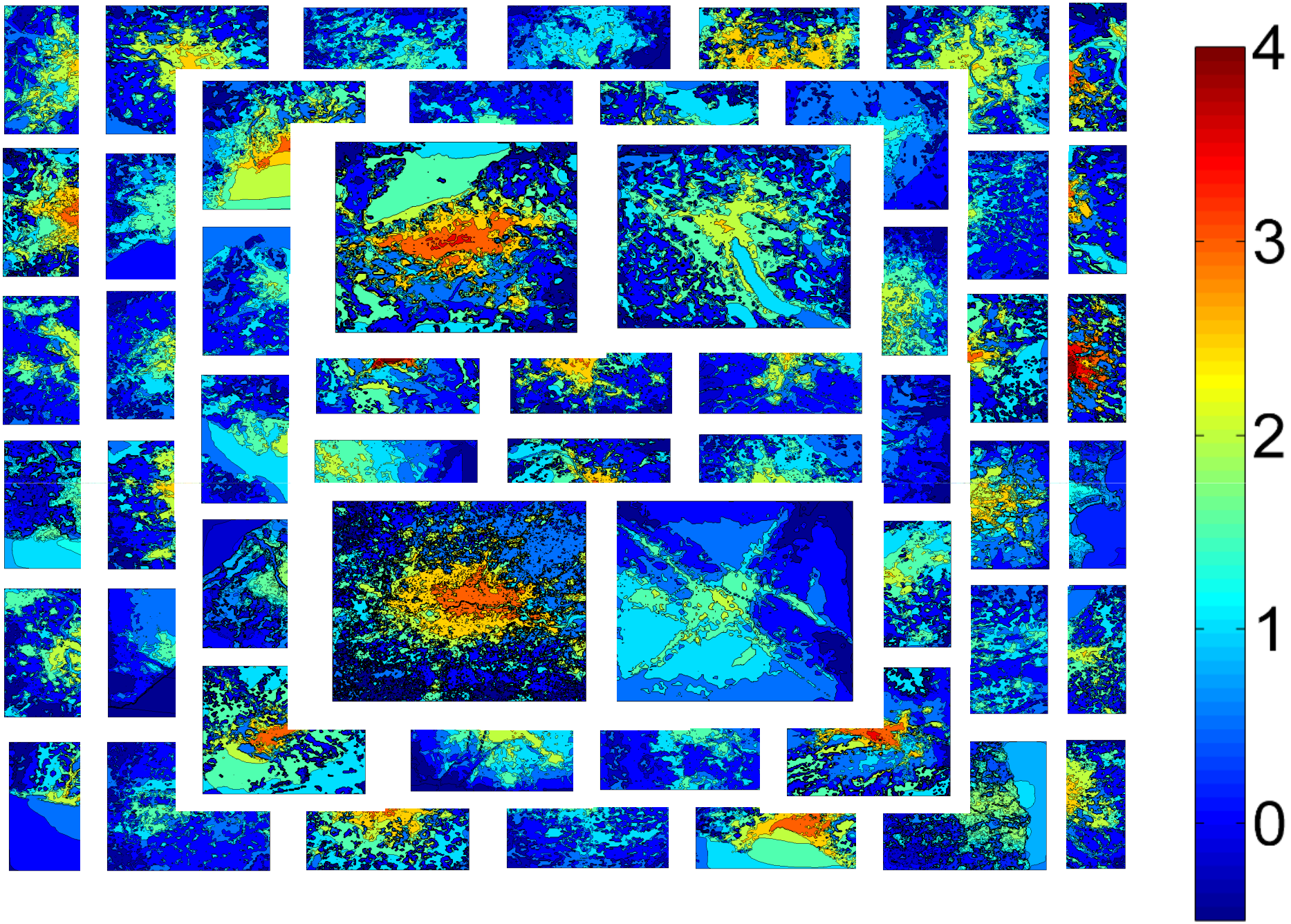


95th percentile of the minimal temperature during
summer months (May - September) for London (1986 – 2010)

Current climate assessment

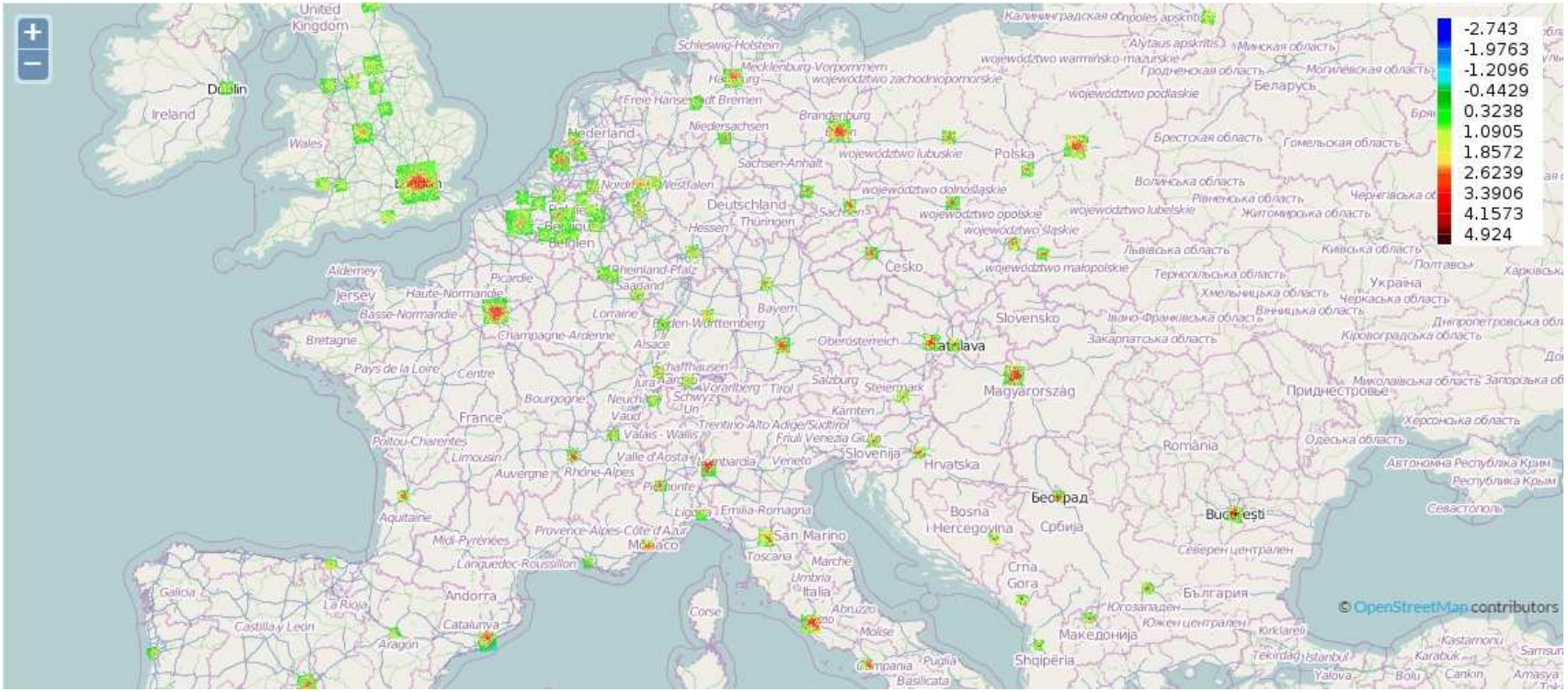
Evolution of the UHI during a day




4
3
2
1
0

Current climate assessment

Analysis of UHI-effect in 102 European cities

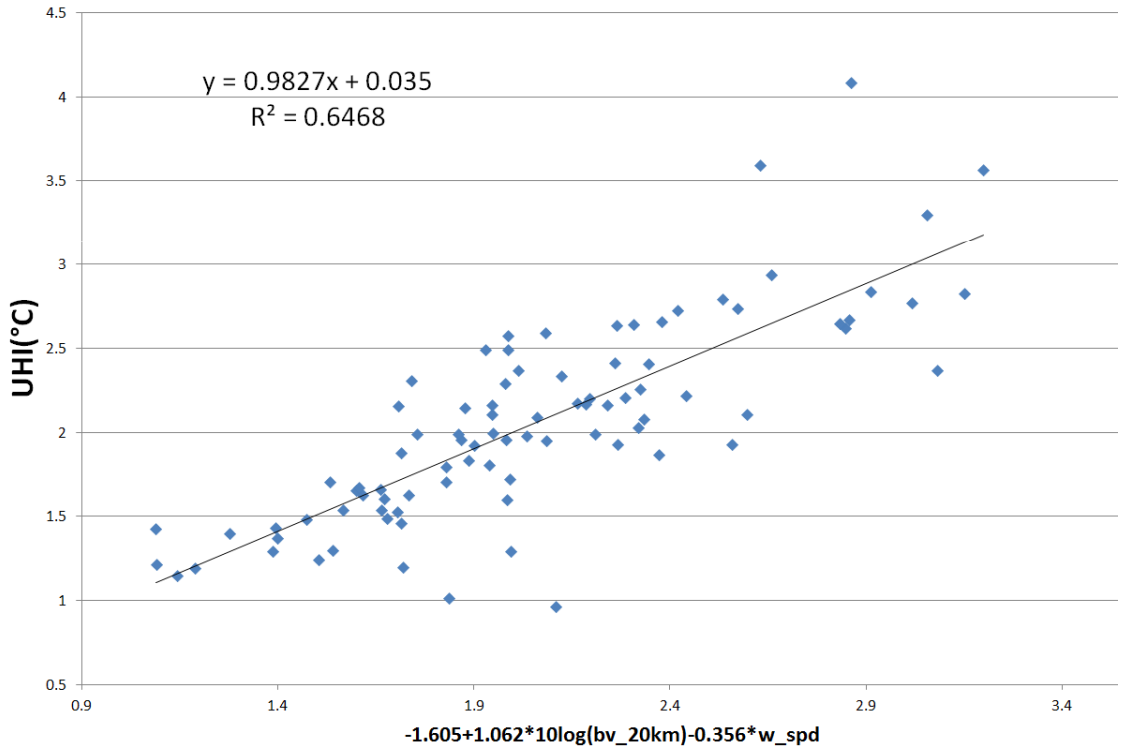


http://www.urban-climate.eu/services/eu_cities/

Current climate assessment

Analysis of UHI-effect in 102 European cities

» Temperature difference between urban and rural location at midnight is explained as a function of the total number of inhabitants of a city (in a 20 km window), in combination with the mean 10m wind speed

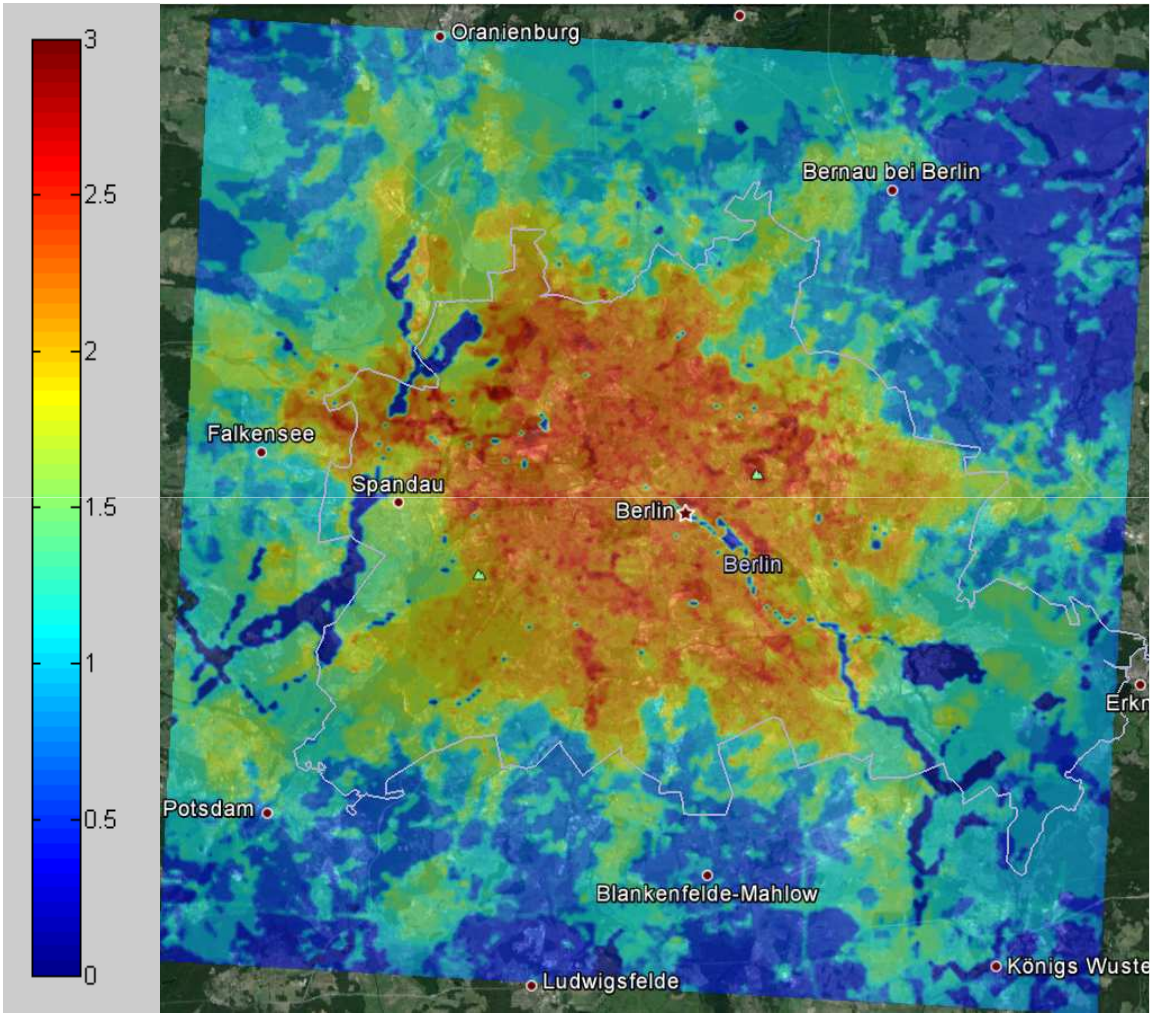


Current climate assessment

Heat-wave days

- Heat-wave day definition:
  - Modified definition of the federal agency for public health in Belgium
  - Both 3day mean minimal and maximal temperature exceed threshold
  - Thresholds for Belgium:
    - Tmin = 18.2 °C
    - Tmax = 29.6 °C
  - Thresholds internationally: 98th percentiles of the summer (may – sep) temperatures

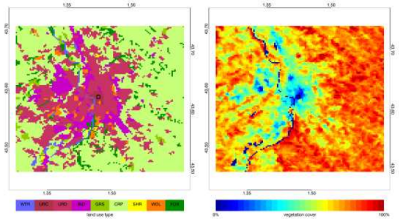
- Cities experience twice as many heat-wave days than surrounding rural areas

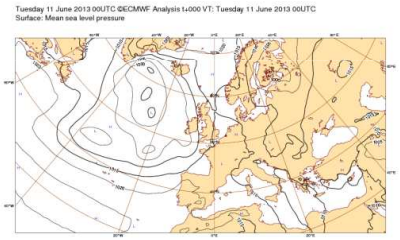


Future urban climate

Assessment

Terrain (Corine/GlobCover)

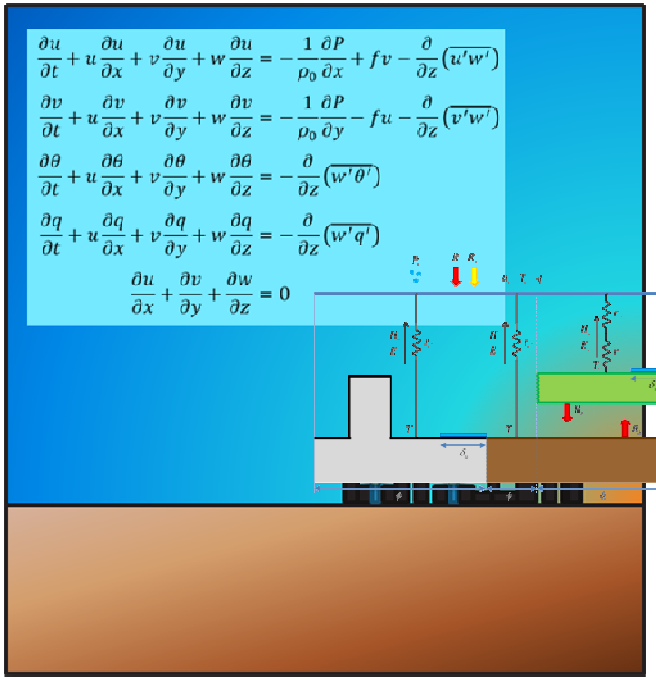




~~ERA-Interim data (ECMWF)~~

Global climate models

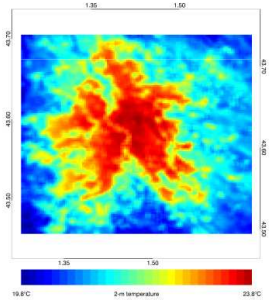
Input



UrbClim

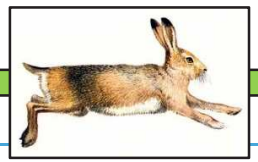
hourly gridded (250-m)

- temperature
- humidity
- wind speed



UHI maps

Output

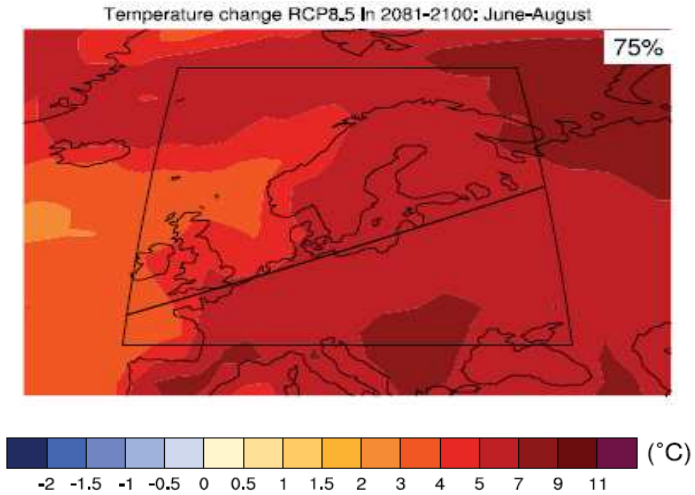


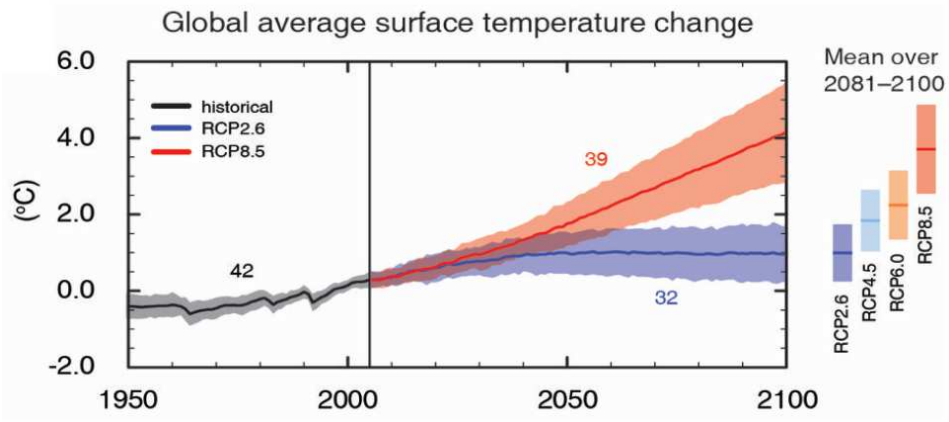
De Ridder K., et al., 2015. Urban Climate, 12, p. 21.

Future urban climate

Details of assessment

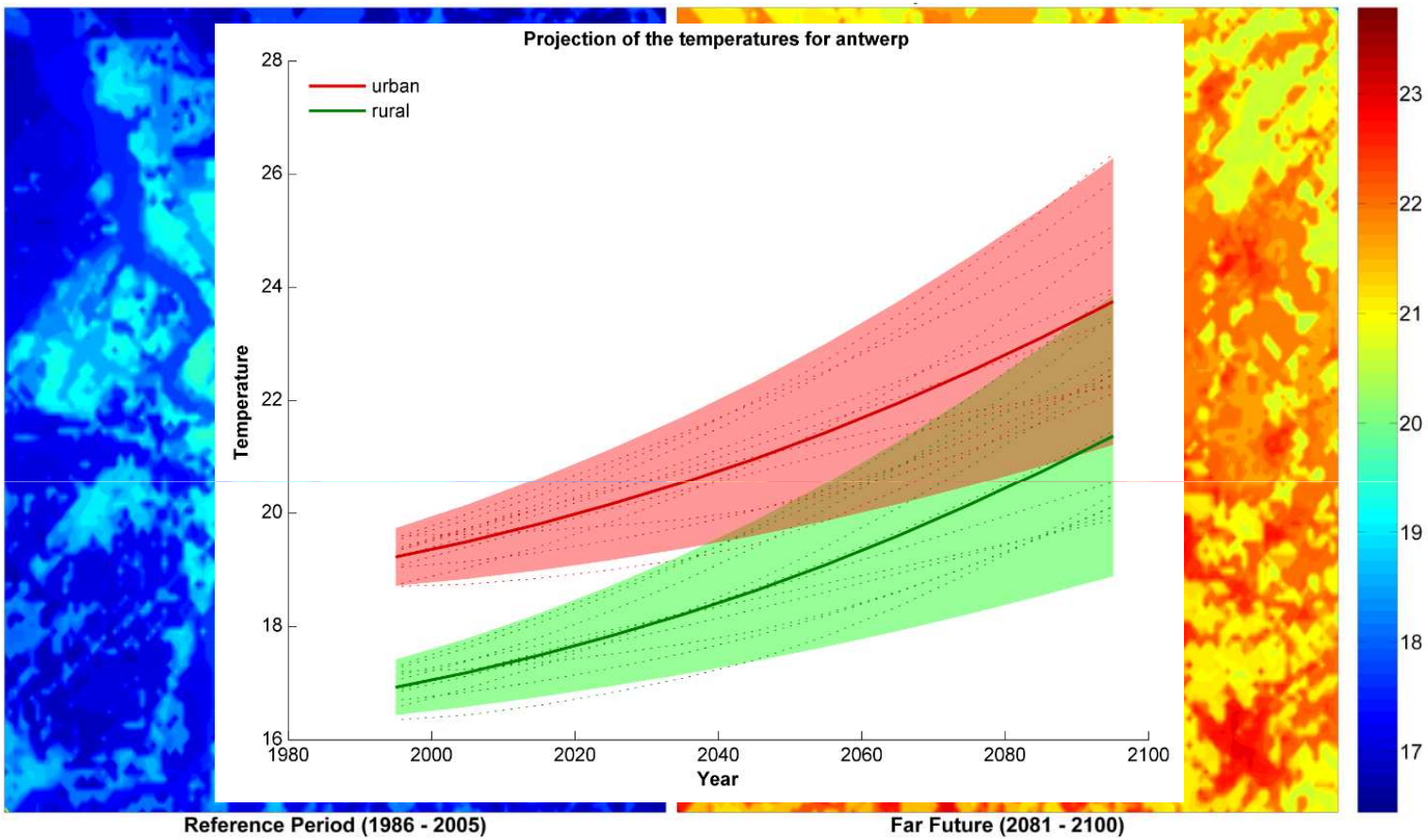
- UrbClim is coupled to the output of 11 global climate models (incl. bias-correction)
- Time frames:
  - Reference period (1986 – 2005)
  - Near future (2026 – 2045)
  - Far future (2081 – 2100)
- Scenario: RCP8.5
  - Strongest scenario, but assumes emissions well below what the current energy mix would produce in the future





Future urban climate

Results for nightly temperatures



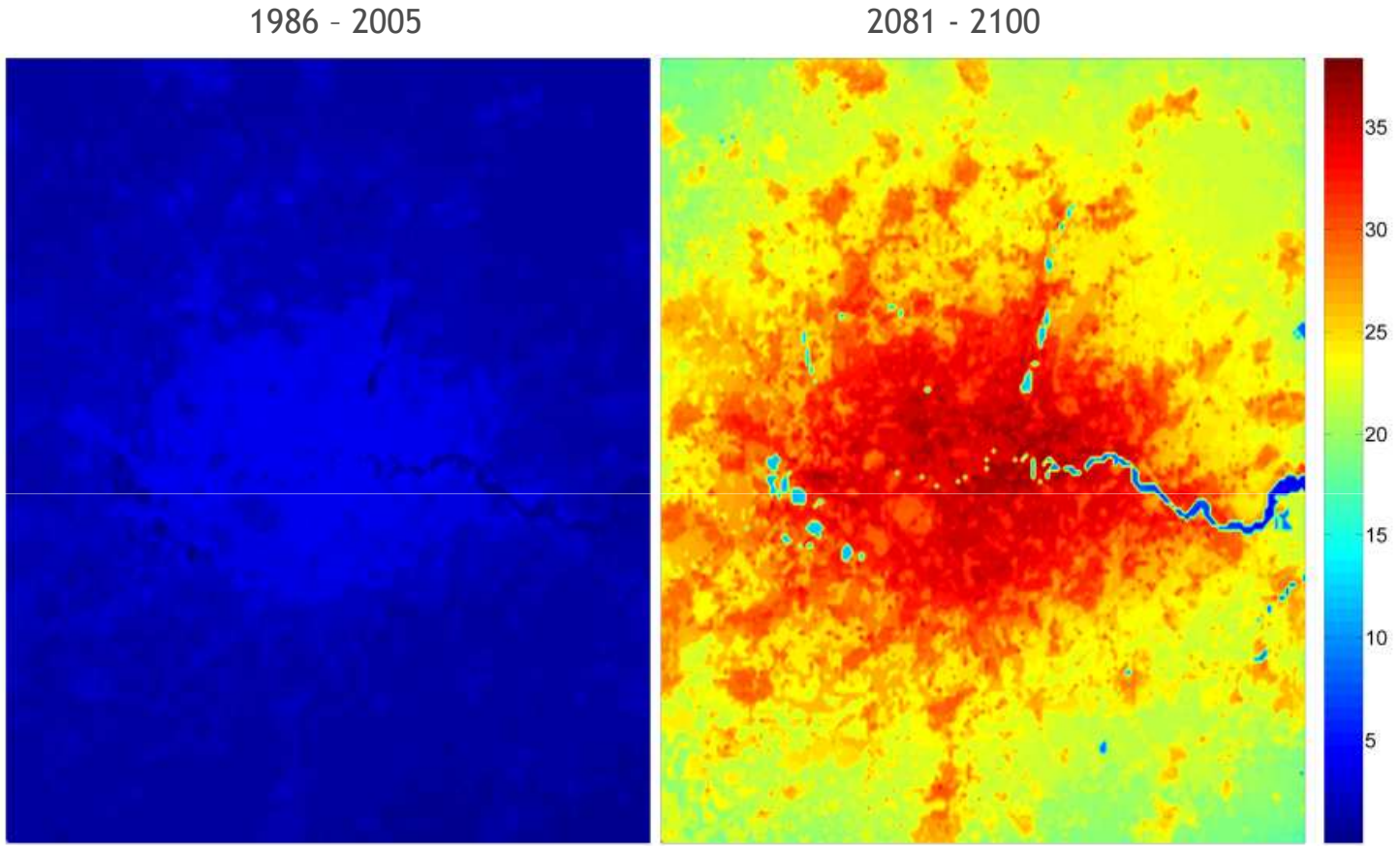
95th percentile of the minimal temperature for Antwerp

Temperature difference between urban and rural is more or less unchanged

Lauwaet D., et al., 2015. Climate. *Climate*, 2015, 3(2), 391-415.

Future urban climate

Heat-wave days

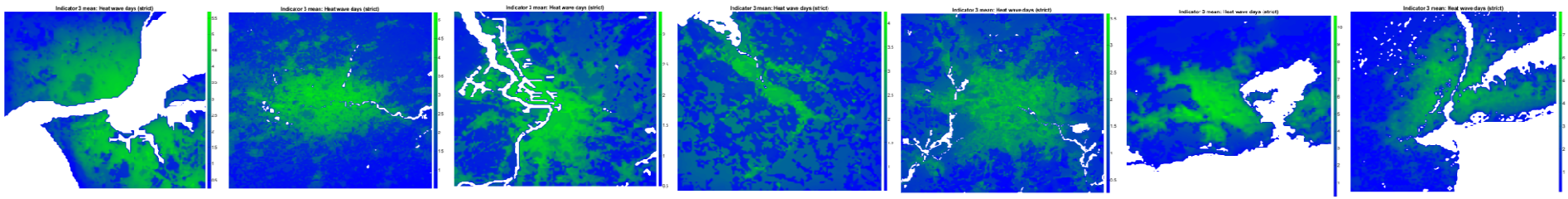


Number of heat wave days in London for 11 global climate models
Scenario: RCP8.5

Number of heat wave days increases by a factor ~ 10, both in urban and rural areas

Lauwaet D., et al., 2015. Climate. *Climate*, 2015, 3(2), 391-415.

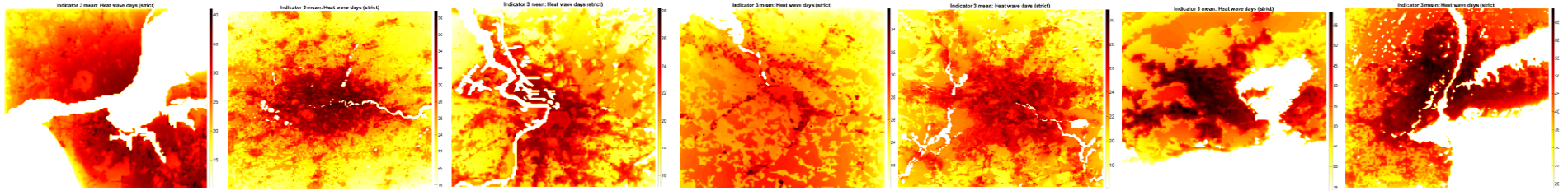
Lisbon London Antwerp Bilbao Berlin Rio New York



1986-2005

Number of heat wave days increases by a factor ~ 10, both in urban and rural areas

2081-2100



Conclusions

- Cities tend to be warmer than their rural surroundings (UHI-effect)
- UrbClim model provides hourly temperature maps and number of heat-wave days for current and future urban climate
- Cities experience twice as many heat-wave days than rural areas
- Future climate
  - Temperature difference between urban and rural remains approximately the same
  - Number of heat-wave days increases by a factor 10, both in urban and rural areas

Thank you!

» Questions?