Thermal impact of blue infrastructure: Casestudy Cheonggyecheon Seoul (Korea)

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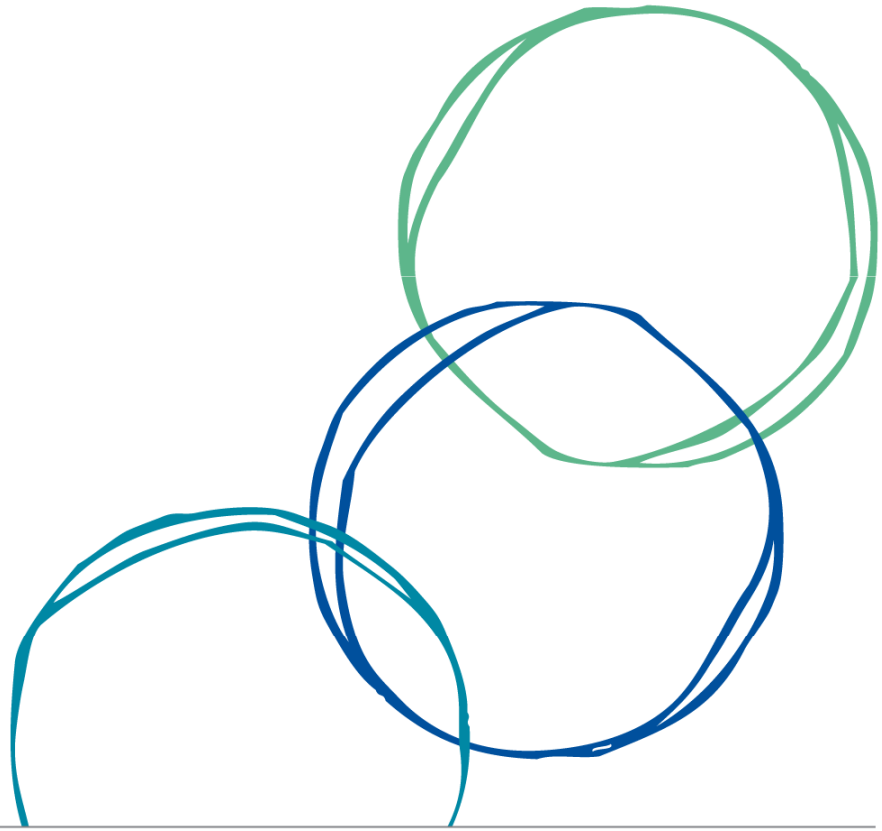
University of South Australia (UniSA)

21 July 2015

9th International Conference on Urban Climate (ICUC9)
Toulouse, France from July 20-24, 2015



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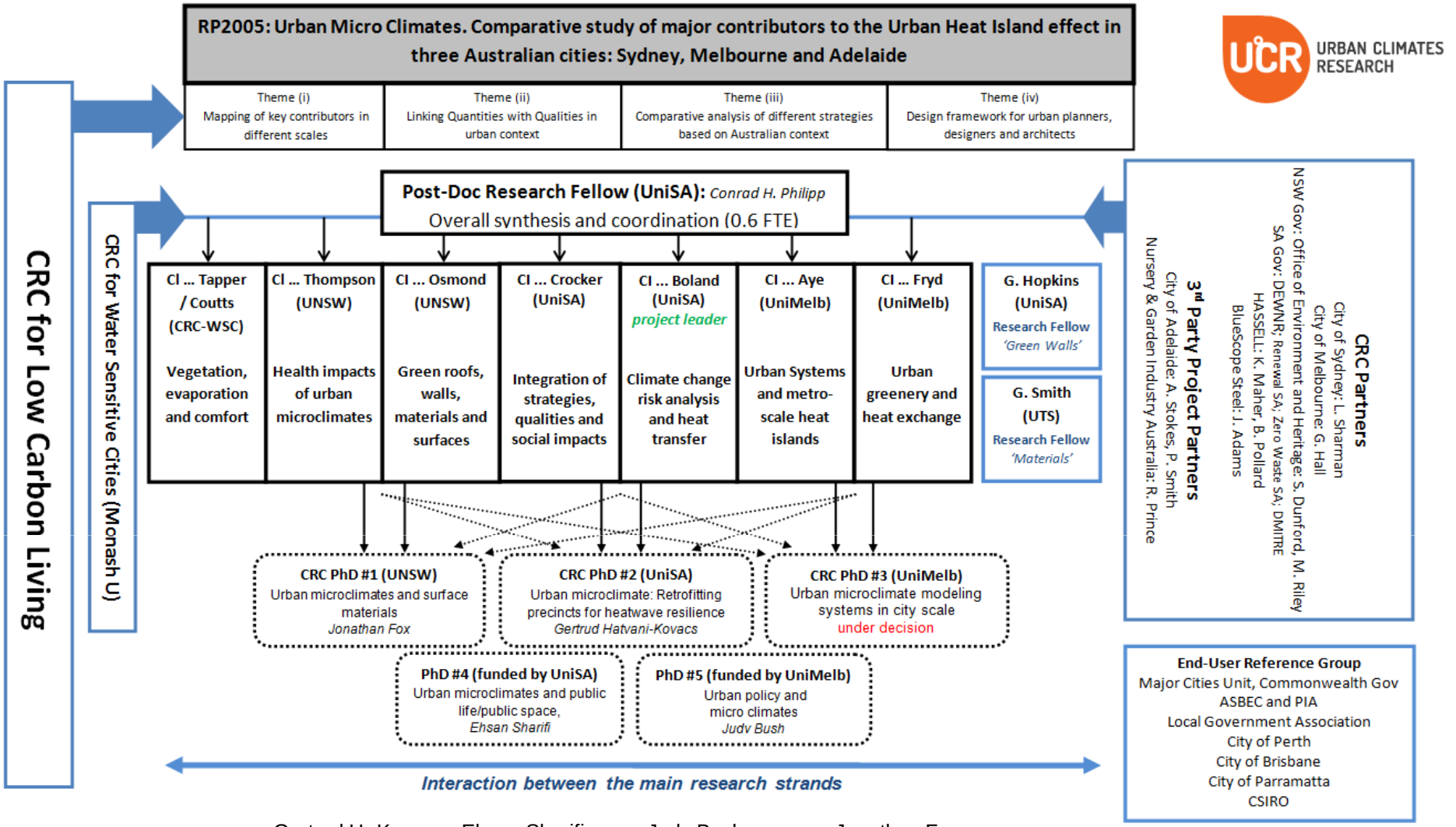
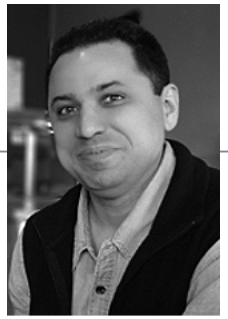


Gertrud H.-Kovacs

Ehsan Sharifi



Judy Bush

Jonathan Fox

LOW CARBON LIVING CRC

Design: C. Thorton

Comparative Study of Urban Heat Islands*

A five scale methodology across three Australian cities on macro & micro levels.

Jonathan Fox: PhD Researcher - UNSW.

Thermal analysis, facades & walls.

Aims to establish predictive relations between façade design and their thermal characteristics (i.e. surface and air temperatures) by developing a vertical surface thermal classification tool.

- Individual buildings
- Relationship between vertical surfaces, material and outdoor
- Micrometeorology and thermodynamics

Development of a classification tool will enable architects, planners and decision-makers to make informed choices about the microclimatic effects of building design. Surface, air and mean radiant temperature information will be derived from material selection and façade composition options.

Ehsan Sharifi: PhD Researcher - UniSA.

Socio-behavioural analysis.

Heat stress in higher densities affects the usability of public space and quality of public life. This research investigates correlations between urban microclimate variables of temperature, humidity and shade with the activity patterns of public life in five public spaces of Adelaide, Sydney and Melbourne, with the aim of:

- Highlighing the importance of microclimate modification.
- Underline the need for climate responsive public spaces.
- Identify links across quantities/quality in heat resilient space.
- Explore opportunities for public space adaptation to heat.

Outcomes will include the development of a heat resilient assessment tool and an index system to analyse and mitigate the heat stress in public spaces.

Conrad Philipp: UCR Coordinator & Research Fellow - UniSA.

Satellite thermal imaging.

City-scale calculations are possible using remote thermal images. The Landsat 7 satellite allows the use of data across a timeframe since 1999. Around 90 thermal images will be investigated for each region of Melbourne, Sydney and Adelaide. In relation to the land use types the land surface temperature will be calculated to identify urban heat spots in the CBD and the suburbs for each of these cities.

- Heat studies (CBD and suburbs) in Adel' , Melb' & Syd'.
- Urban remote sensing calculation's (Landsat 7/8)
- Land surface calculations according to varying land use types.

Judy Bush: Phd Researcher - UoM.

Urban greenery & policy.

Examining policy, regulatory and communications approaches and strategies to support strengthened retention, expansion and efficacy of urban greenery in Australian cities, in relation to the urban heat island effect. This research will inform policy development and implementation, as well as improved practices and processes for knowledge translation between distinct communities and disciplines, contributing to trans-disciplinary and 'trans-cultural' endeavours to retain and expand urban greenery.

- City and nationwide research.
- Effective policy to maximise urban greenery.
- Implement science findings in policy.

PhD Researcher - UoM.

Thermal modelling of roof types.

Aims to identify Urban Hot Spots and capture diurnal variation in UHI intensity and spatial distribution of UHI on city-scale (including the urban heat effect in suburbs); To model impact of mitigation scenarios as a percentage increase in Green Roofs & Reflective Surfaces; And, discuss what temperature decreases (spatial and temporal) can be expected. Develop guidance for UHI planning (Building regs, location based mitigation) and **comparison of mitigation costs / benefits.**

- Heat island at urban scale (CBD and suburbs).
- City-scale modelling of diurnal variation and spatial distribution of UHI.
- Find best mitigation for expected drop in outdoor temp'.

Gertrud Hatvani-Kovacs: PhD Researcher - UniSA.

Urban precinct resilience & potential retrofitting.

Using precinct-scale case studies of metropolitan regions of Adelaide and Sydney to define the resilience of each precinct to urban heat waves. Analysis of the most significant factors of precinct resilience will be carried out to determine the best retrofitting techniques for existing precincts. Strategies will be evaluated in terms of energy and carbon efficiency, financial affordability and perceived acceptability by population.

- Precinct scale research on HW resilience in CBD & suburbs.
- Identify best precinct mitigation & adaptation techniques.
- Include population vulnerability in evaluation of potential mitigation adaptation techniques.

Scales of Observation Across All Three Metropolitain Areas:

		Adelaide		Melbourne		Sydney	
	Scale:	CBD	Suburb	CBD	Suburb	CBD	Suburb
Pip	medium			•	•		
Gertrud	medium	•	•				•
Ehsan	medium	•		•		•	
Judy	large			•	•		
Jonathan	fine	•	•	•	•	•	•
Conrad	large	•	•	•	•	•	•

In partnership with:

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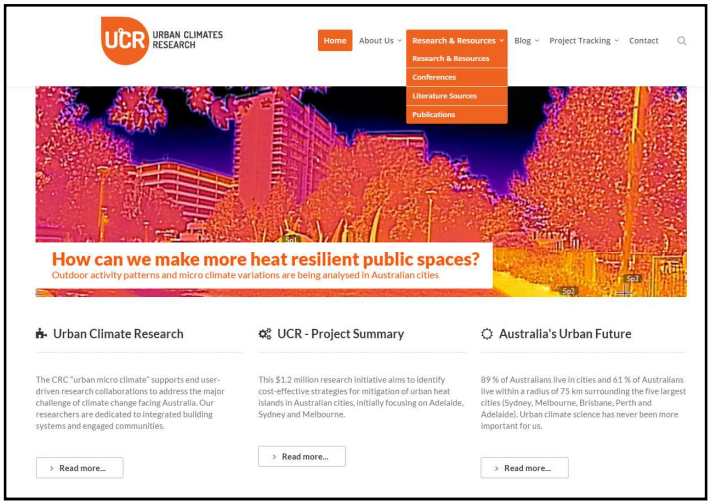
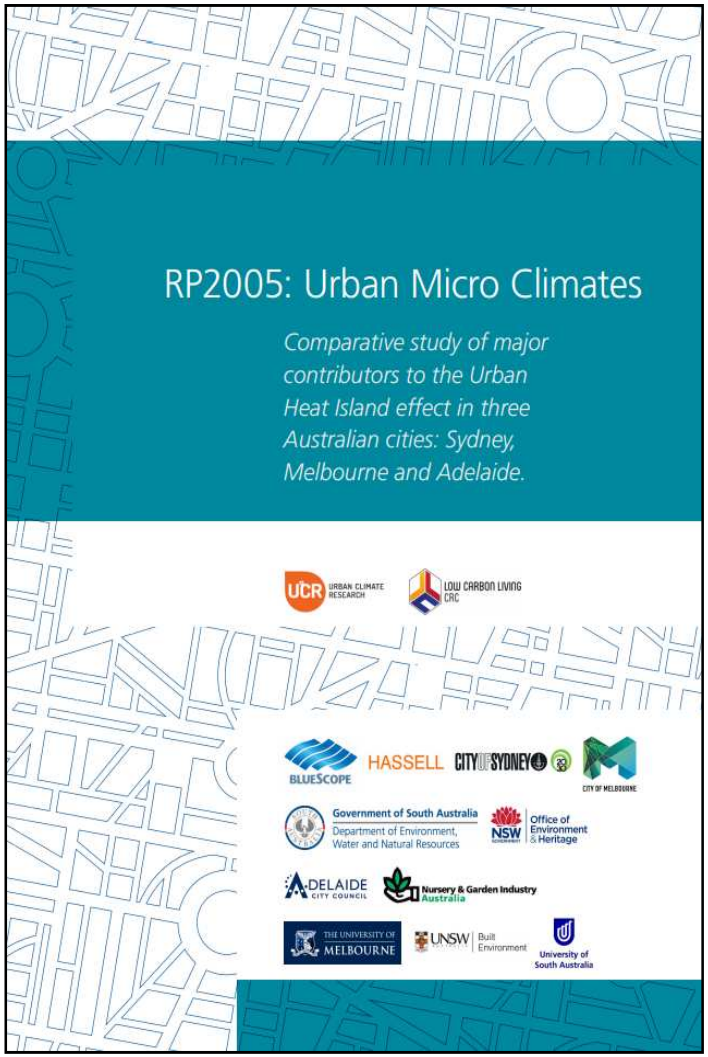
Project website - Article in Newspapers - Booklet





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www.urbanclimates.org

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Measurements of the land surface temperature

Remote sensing technique

Source: C. Philipp

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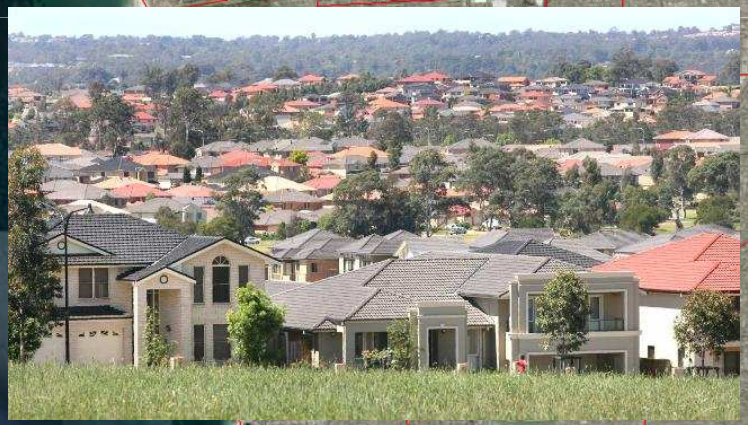
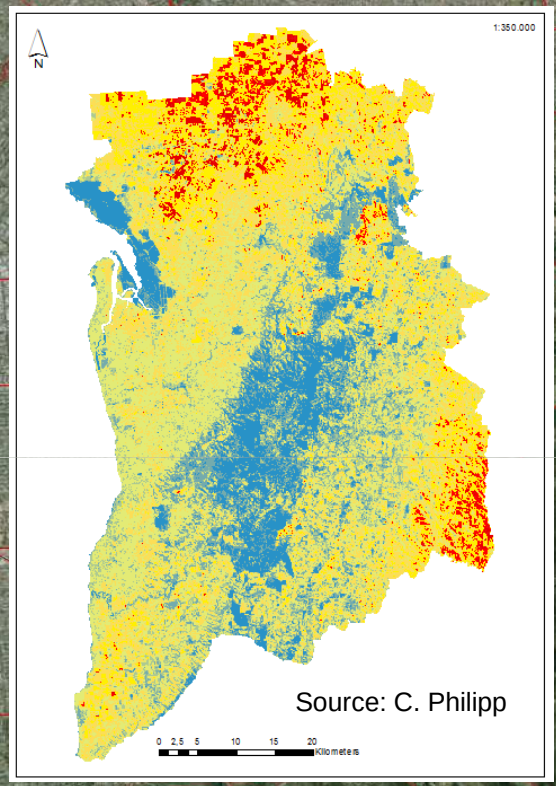
Measurements of the land surface temperature

Thermal conditions of the CBD of Adelaide compared to the suburbs?





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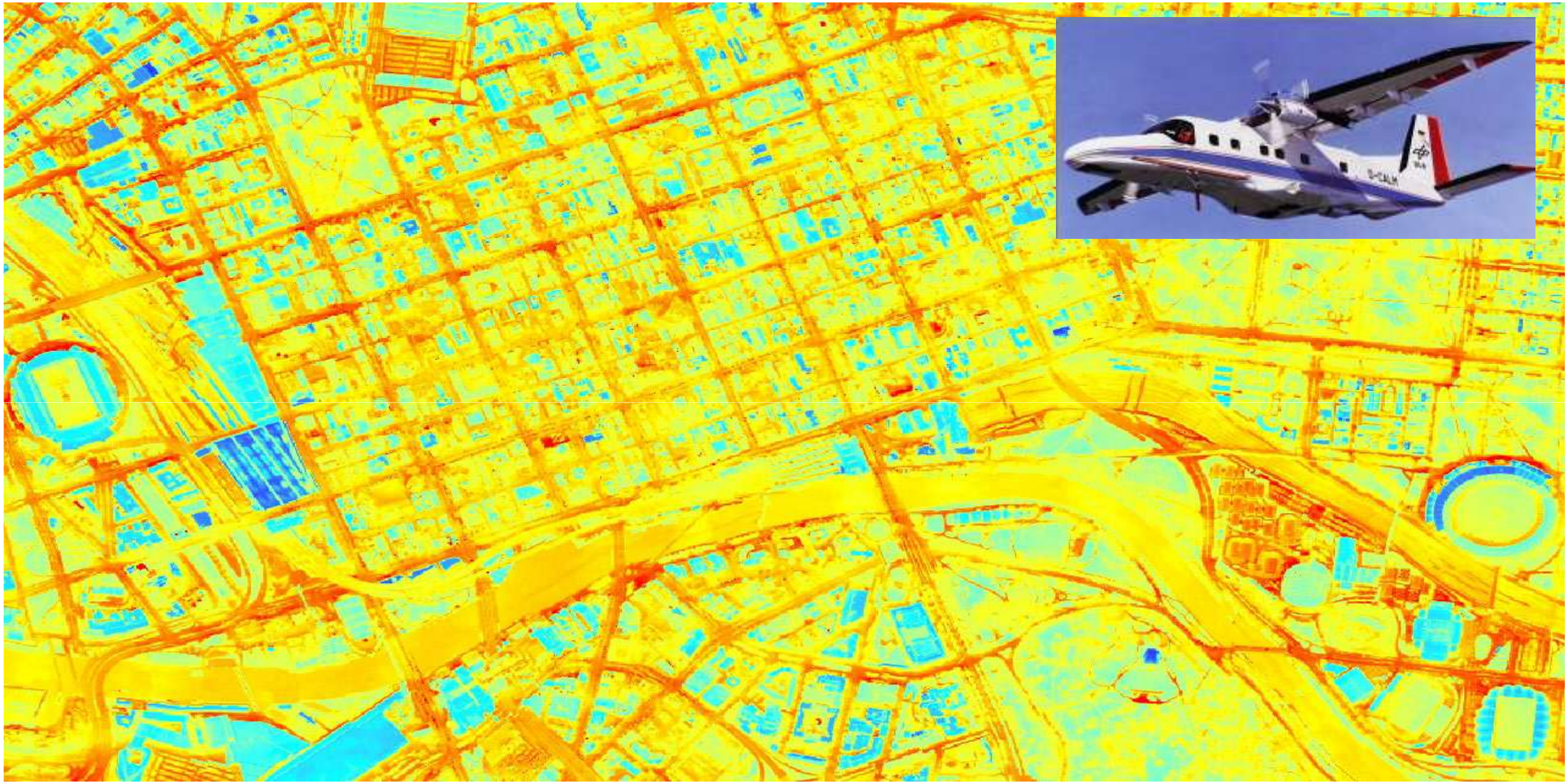
Measurements of the land surface temperature

Aerial flyovers with thermal sensory equipment

Source: CC Melbourne



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Thermal impact of blue infrastructure: Casestudy Cheonggyecheon, Seoul (Korea)

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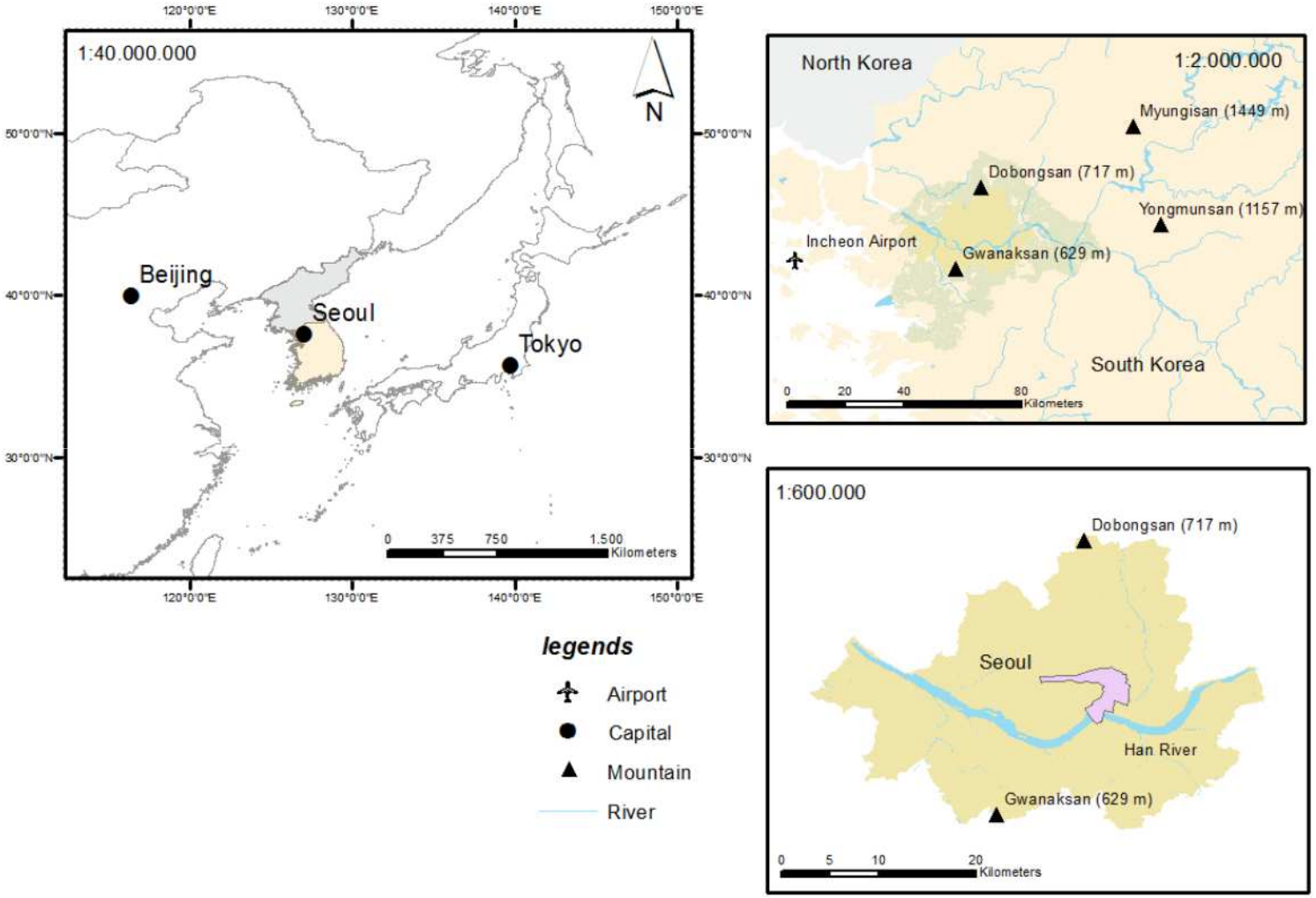
Korea and Seoul
Chengycheon stream



Korea and Seoul (Source: maps created via ArcGIS by C. Philipp)

Megacity Seoul (Korea)

10,3 Mio. inhabitants – 605 km²

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View from the Mt. Namsan (320 m above sea level)
(picture by C. Philipp, July 2013)

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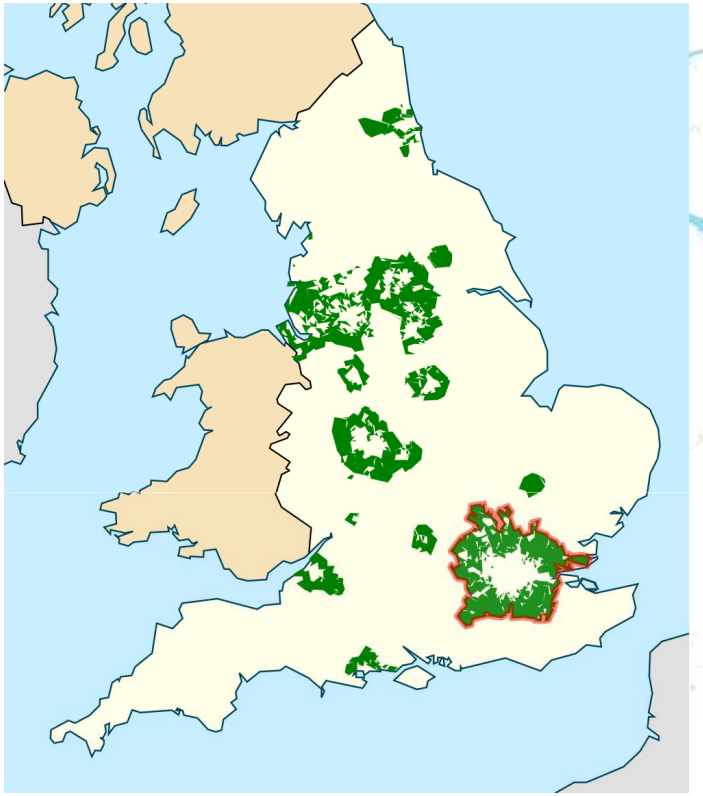
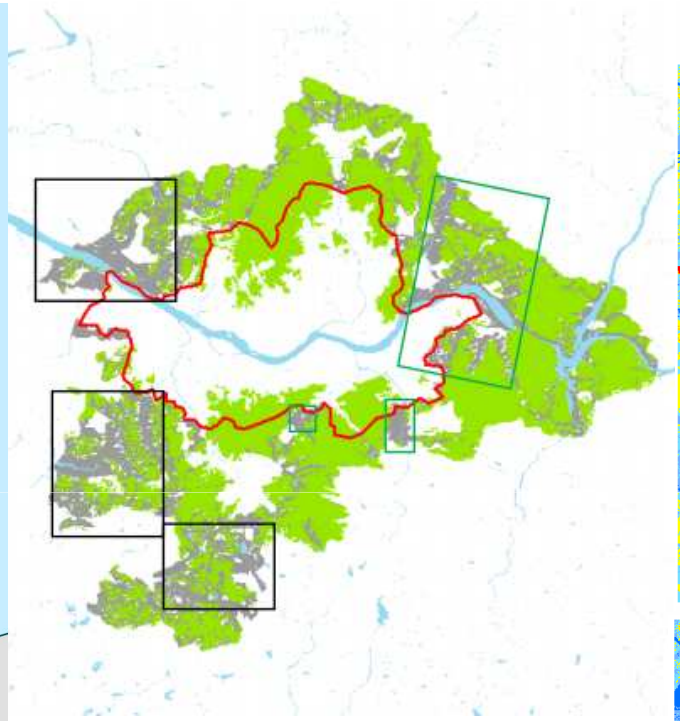
Greenbelt and the land surface temperature

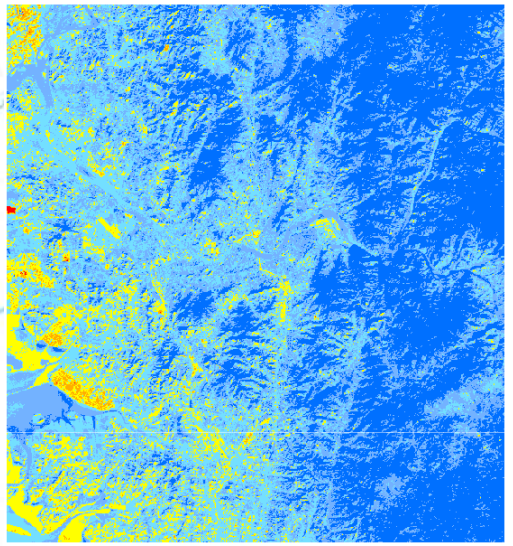
Established for Seoul 1973

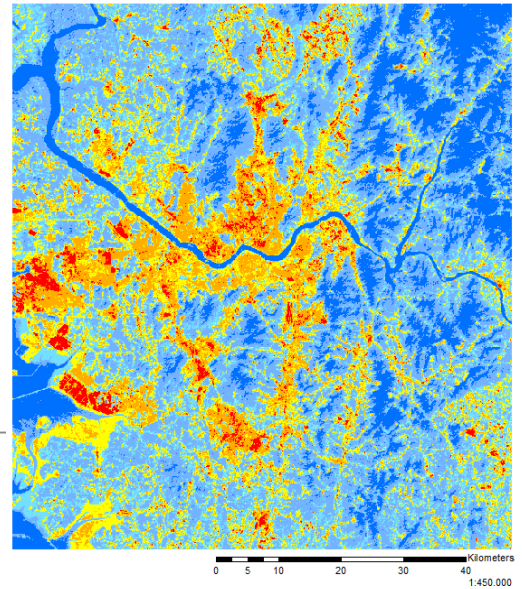


Greenbelts in the UK



Greenbelt of Seoul





Land surface temperature in Seoul
(summer 2014 and winter 2013, Landsat 8)

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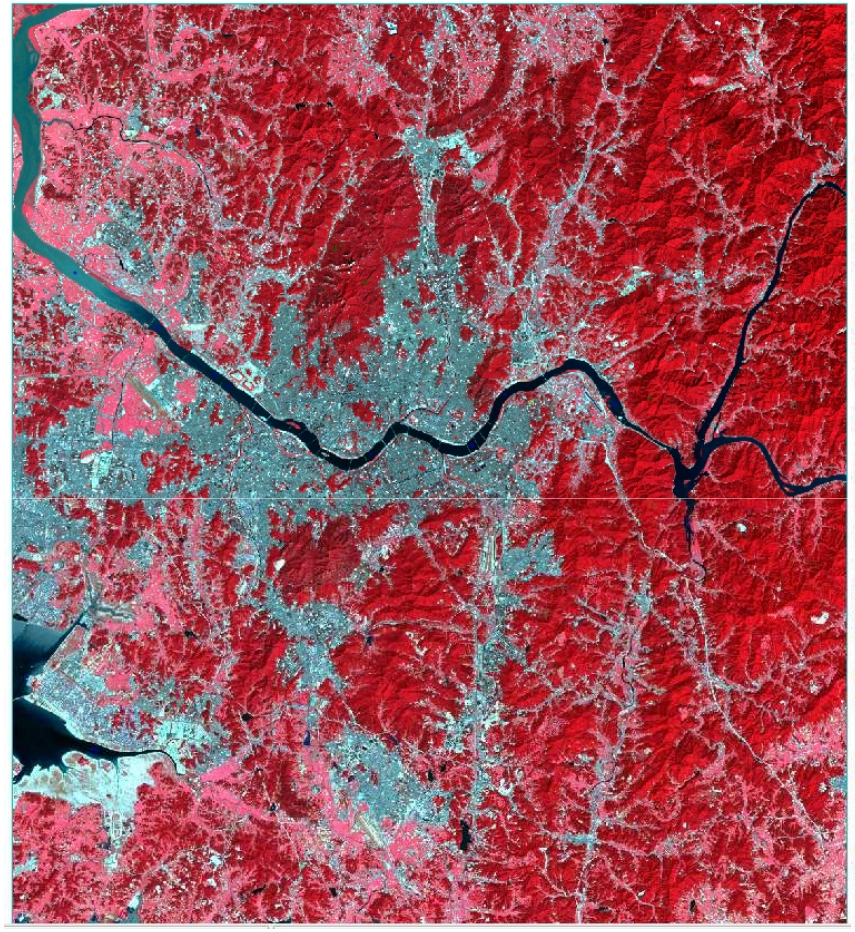
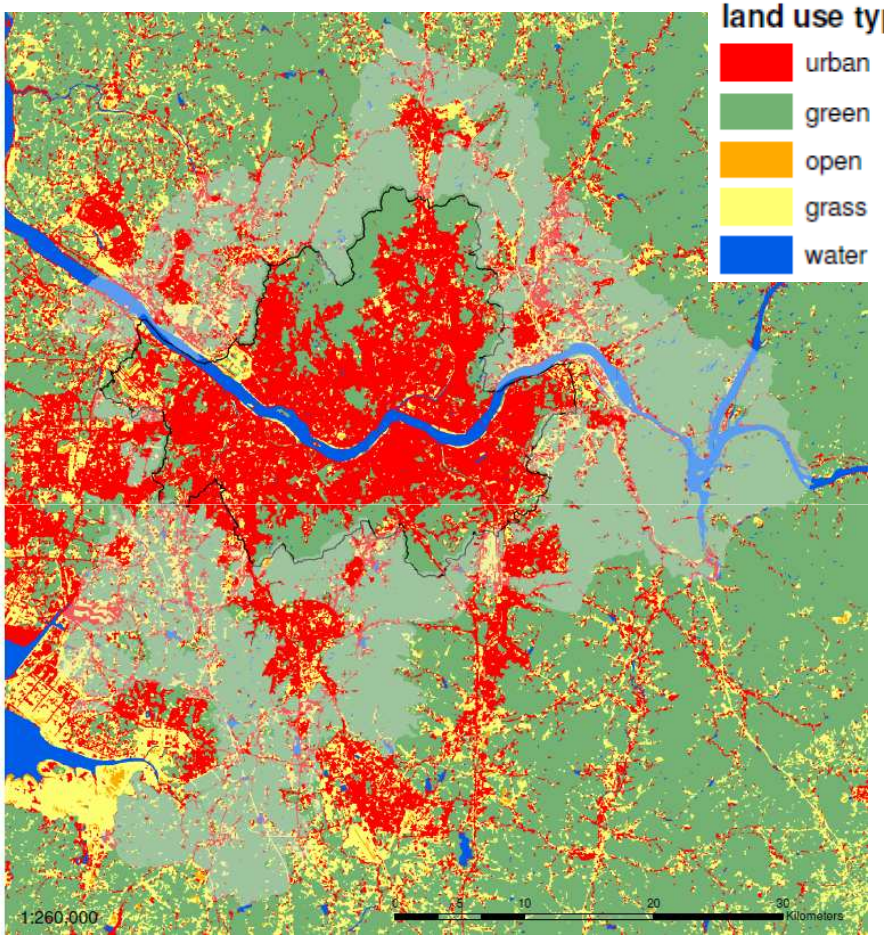
Greenbelt and the land surface temperature

Established for Seoul 1973





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Landsat 8 image 10.07.2014 (left)
Land use map (right)

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Cheonggyecheon stream: Length: 5.8 km

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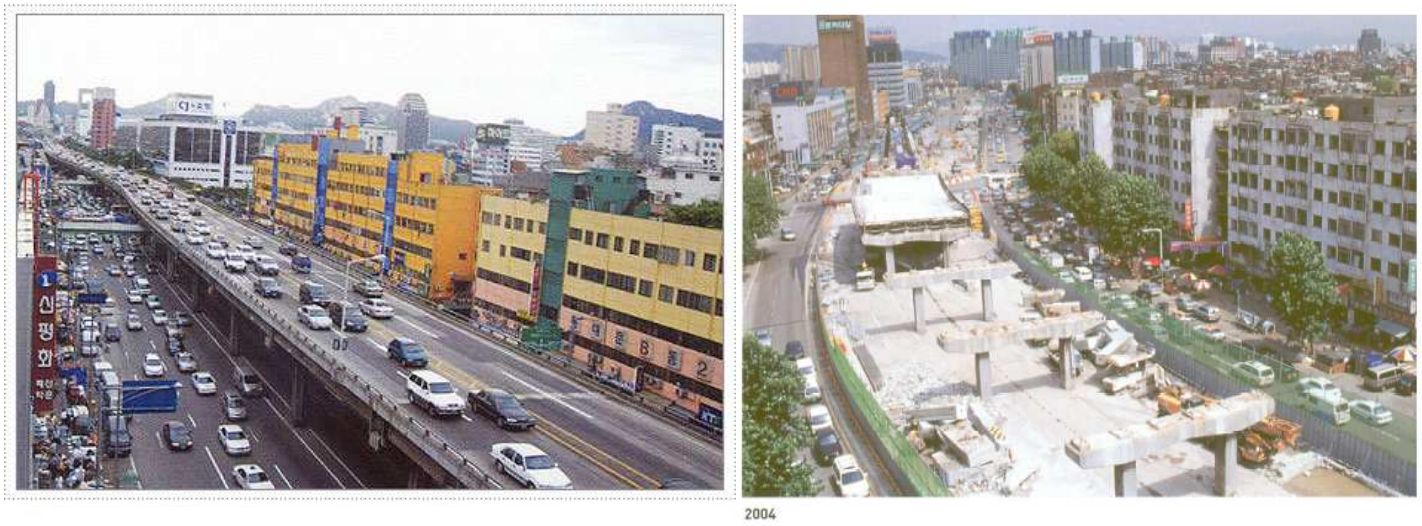
Cheonggyecheon stream (into a expressway – 1970s)

1970s

Chengycheon stream (Source: SMG 2014).

Cheonggyecheon stream (reconstruction process 1970s)



Chengycheon stream (Source: SMG 2014).

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Cheonggyecheon stream

Keyfacts

Length: 5.8 km
Cost: US $280million
Dates: 2000-2005

Delivered through: Government funded

Mayor Lee Myung Bak

The Cheonggyecheon stream before the reconstruction (2001, left) and after the reconstruction (2005, right) (KIM & HAN 2012:152) and SMG (2014).

Cheonggyecheon stream profile
With up to 113 m

Source: SMG 2014

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Cheonggyecheon stream at the City Hall
No natural stream – use of a pumping system

Beginning of the Chengycheon strream
(Source: SMG 2014).

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Cheonggyecheon stream (upper area)
Detour of 170,000 cars daily

Chengycheon stream 2014 (Source: SMG 2014).

Cheonggyecheon stream (upper area)

Tourist attraction: 64,000 visitors daily, 23.4 million visitors annually

Chengycheon stream 2014 (Source: SMG 2014).

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Cheonggyecheon stream (upper area)

Increasing housing price

Chengycheon stream 2014 (Source: SMG 2014).

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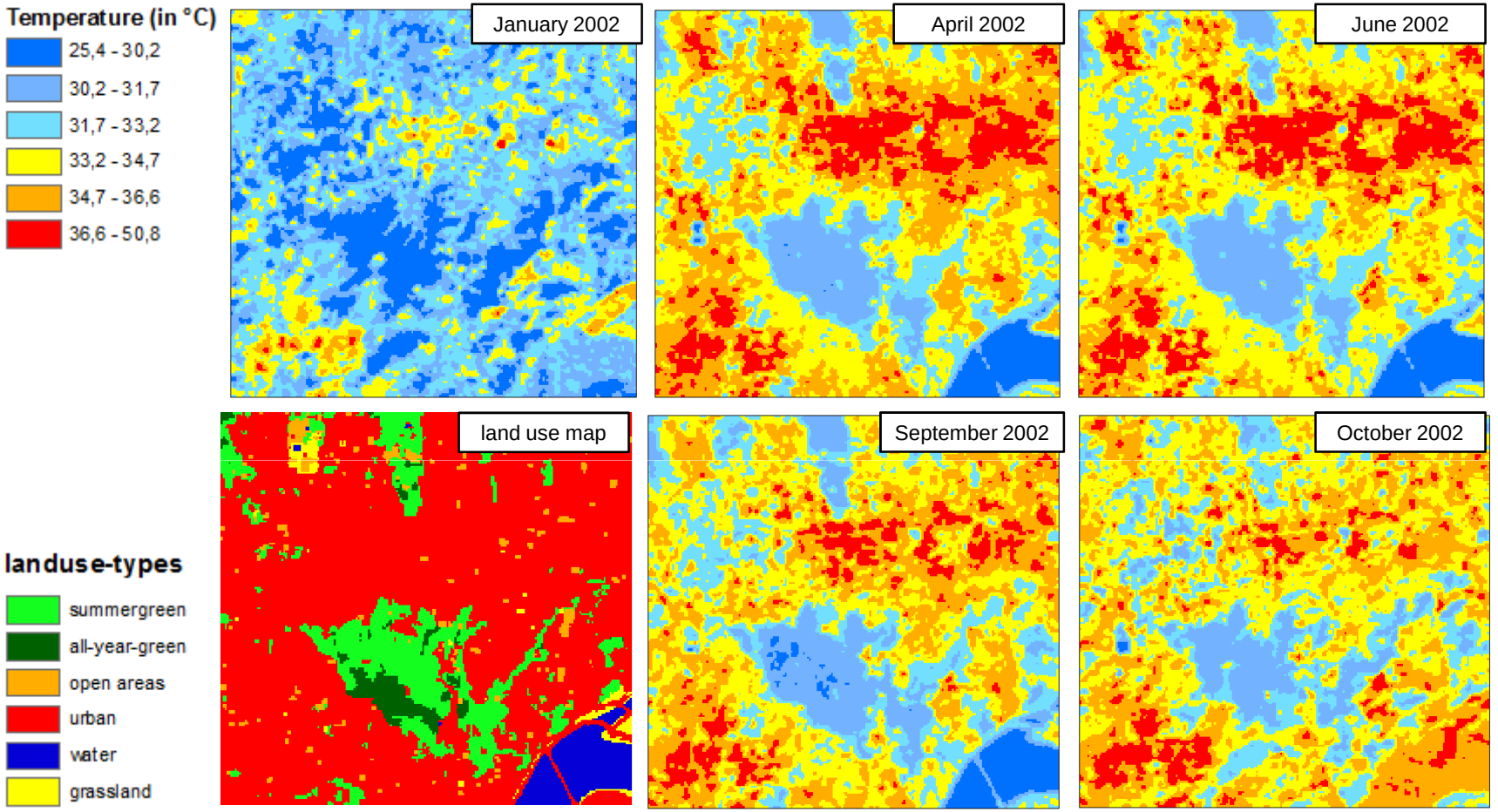
Cheonggyecheon stream at the City Hall
Heritage of Building history

Beginning of the Chengycheon strream
(Source: SMG 2014).

Seasonal land surface temperature change central Seoul



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Reconstructed LUT/LST of the greater Cheongycheon area by using the software ENVI and ATCOR (Source: calculated via ArcGIS 10.1 by & Philipp, C.).

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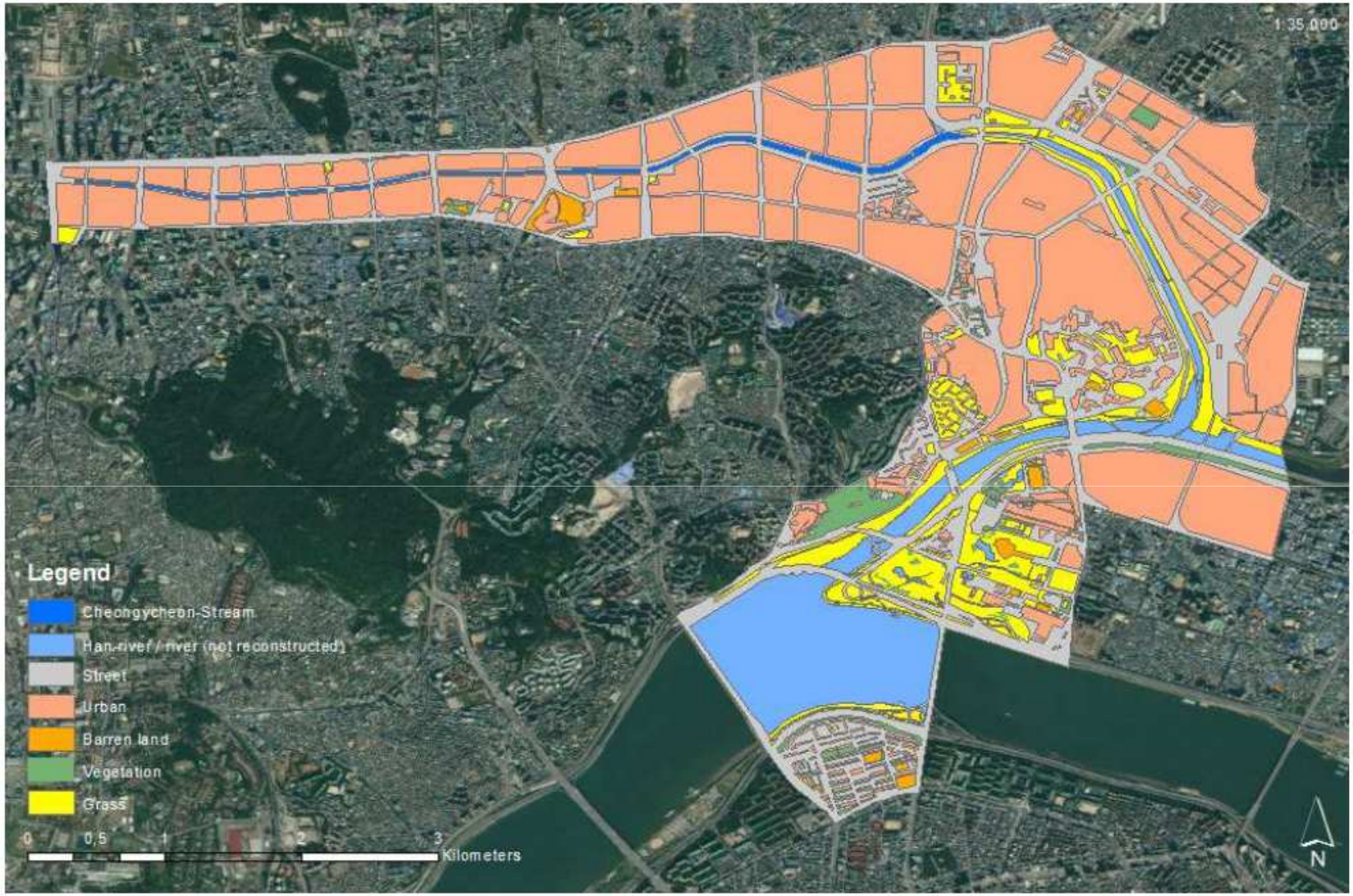
Reconstruction of the land use types (via ENVI)



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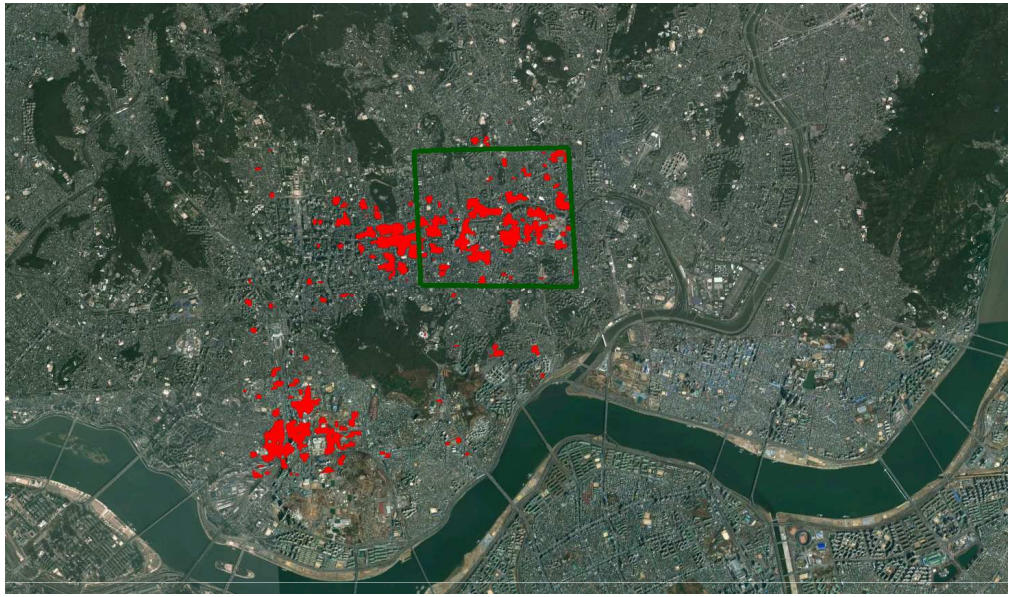
Reconstruction of the land use types (via ENVI)

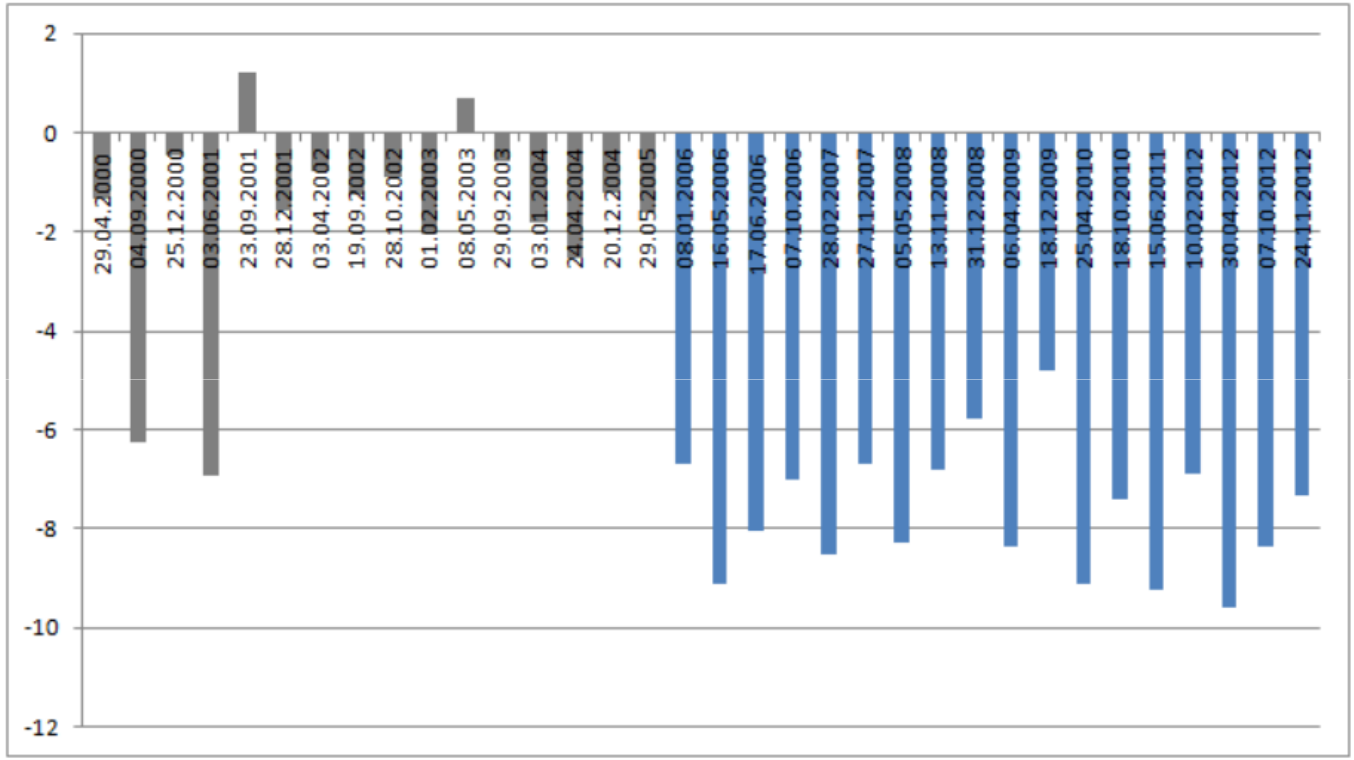


Reconstructed building heights of the greater Chengycheon area
(Source: calculated via ArcGIS 10.1 by & Philipp, C.).

Land surface temperature: Cheonggyecheon vs. surroundings

Reduction in air and surface temperature in surrounding area

less in winter, stronger in spring and autumn, rare image for summer



Land surface temperature decrease after the reconstruction of the Cheonggyecheon (34 images, gray: covered by a expressway, green: open water stream) (Source: calculated via ArcGIS 10.1 based on Landsat 7 images by Wannous, J. & Philipp, C.).

Thank you

To find out more, contact:

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