

Urban Heat Island Monitoring under Present and Future Climate (project UCLIMESA)



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1. Project Summary

UCLIMESA is a project financed by the Romanian Space Agency (STAR CDI, contract no 92/2013), and it is being implemented from 2013 to 2015. It investigates the characteristics of the Urban Heat Island (UHI) over the city of Bucharest (Romania), both under the present climate conditions and in the long-term climate change perspective (2021-2050), by integrating data retrieved from satellite imagery, ground-based meteorological stations, and other sources (e.g. urban sensors, field experiments). The project details the potential of satellite remote sensing to investigate UHIs characteristics (e.g. magnitude, intensity, extension) in order to support the adequate monitoring and response to future climate challenges. The project will be carried out over the city of Bucharest, but the results are designed for smooth transfer and application to other urban areas (<http://uclimesa.meteoromania.ro>).

2. Present Climate

The main objectives of this part of the project are to document (1) the characteristics (limits, geometry and intensity) of the surface Bucharest Heat Island (BHI) during the summer months and (2) their relationship with the land cover, based on MODIS (figure 1) and METEOSAT LST products over 2000–2013, and the Corine dataset².

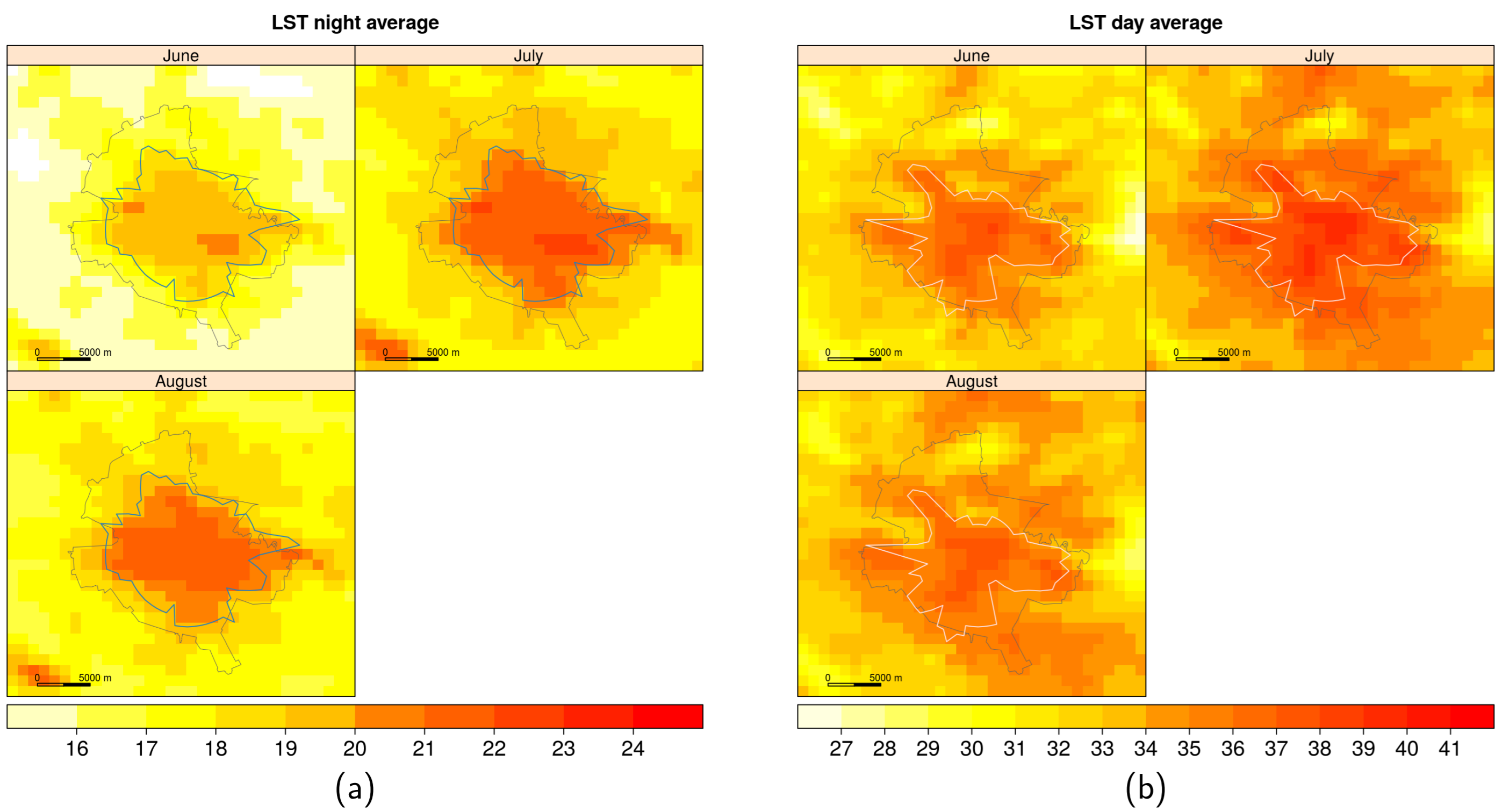


Figure 1: Preliminary results: average LST (°C) values and Bucharest's UHI (blue for night-time and white for daytime), as retrieved from MODIS (MOD11A1 and MYD11A1) images (2000–2013)

The BHI limits, geometry and spatial extension were delimited in this stage, based on the significant changes identified over 36 transects that cross Bucharest through its conventional centre (University Square), at a 5° step angle (figure 2).

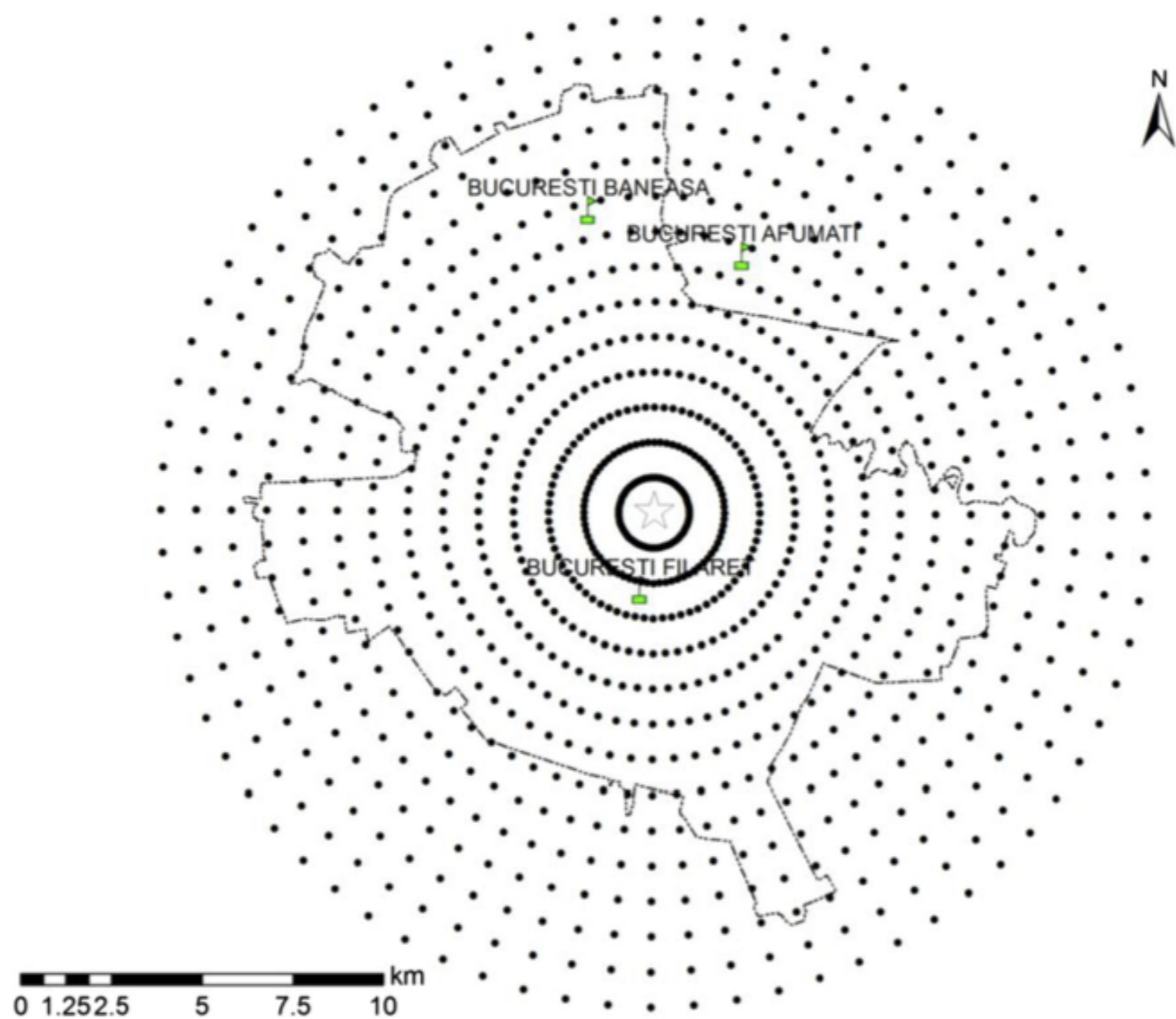


Figure 2: Administrative boundaries, meteorological stations and disposal of the cross profiles around downtown Bucharest (University Square, marked with a white star).

Strong correlations were found between the nocturnal LST and air temperature measured at the Bucharest meteorological stations at the same time as the MODIS data, so that one can assume that similar patterns may be claimed for surface and canopy of BHI (table 1).

	June			July			August		
	Filaret	Baneasa	Afumat	Filaret	Baneasa	Afumat	Filaret	Baneasa	Afumat
Night time	0.92	0.84	0.87	0.93	0.84	0.90	0.93	0.84	0.90
Day time	0.74	0.79	0.78	0.76	0.81	0.81	0.80	0.84	0.80

Table 1: Pearson correlation coefficients (r) between the air temperature measured at the Bucharest meteorological stations and MODIS LST (2000 - 2013) of the corresponding pixel

The shifting points over the cross profiles were determined by the Rodionov test ($p < 0.1$, cut-off = 10), and they represent the BHI limits as demonstrated in a previous findings¹ (figure 3).

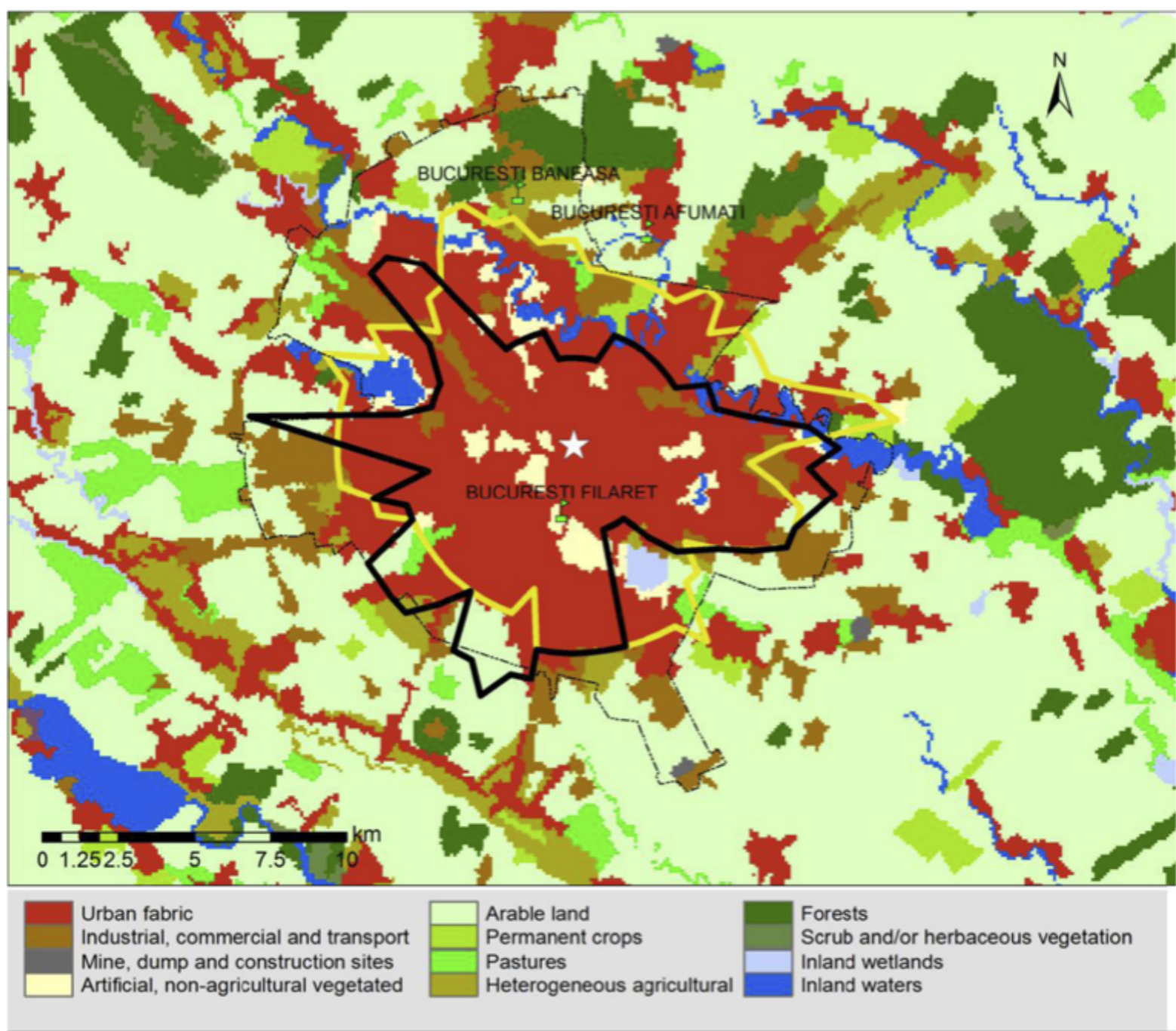


Figure 3: Administrative boundaries of Bucharest, land cover types, night-time and daytime UHI (black and yellow lines, respectively), meteorological stations (flags) and University Square (white star)

3. Future Climate

The objective of this phase is to assess the possibility to downscale extreme temperature from the CORDEX EUR-11 climate simulations grid scale to urban (locale) scale. These datasets are generated with a *Delta downscaling method*³, using MODIS LST climatologies to scale monthly anomaly CORDEX (MPI-CSC-REMO2009) grids (figure 4 and figure 5). At this stage, the prediction of the UHI was performed considering only a warmer regional climate, and no changes in the urban characteristics.

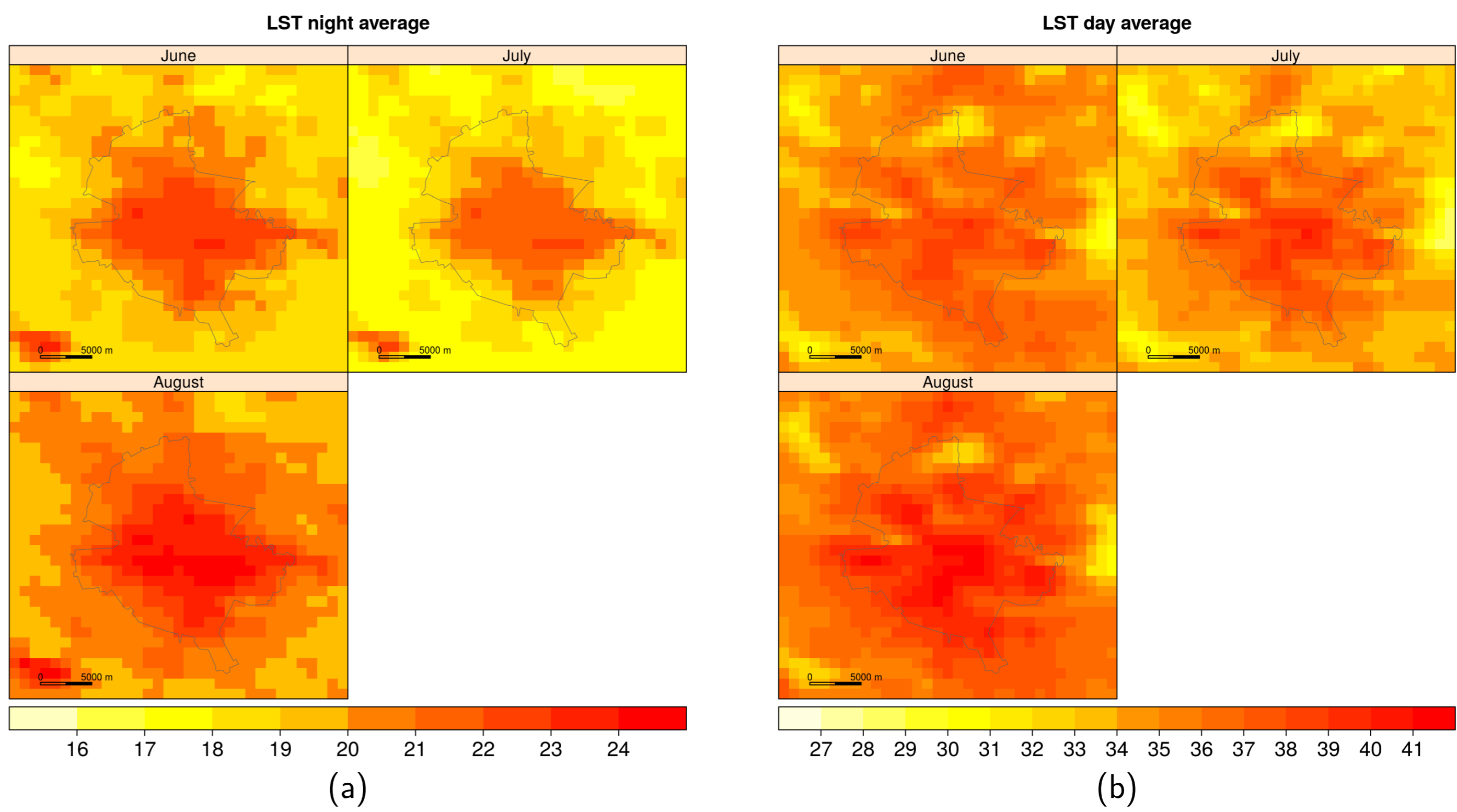


Figure 4: Preliminary results: average CORDEX EUR-11 (MPI-CSC-REMO2009) temperature (°C) simulations (2021–2050) as downscaled using *Delta approach* based on MODIS LST climatologies

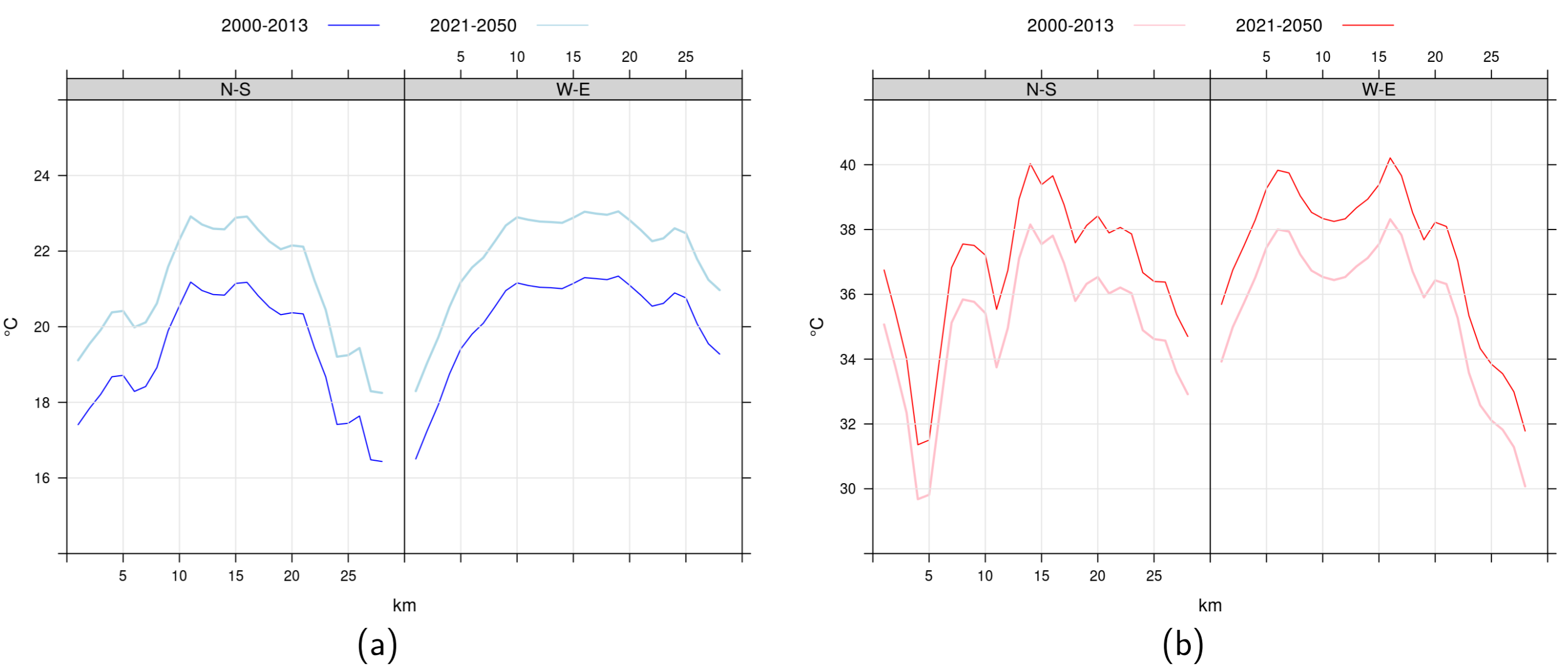


Figure 5: Preliminary results: night-time (a) and daytime (b) average LST (°C) in summer along N-S and W-E cross profiles through Bucharest.

References

- CHEVAL, S., AND DUMITRESCU, A. The July urban heat island of Bucharest as derived from MODIS images. *Theoretical and Applied Climatology* 96, 1-2 (2009), 145–153.
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- HEMPEL, S., FRIELER, K., WARSZAWSKI, L., SCHEWE, J., AND PIONTEK, F. A trend-preserving bias correction – the ISI-MIP approach. *Earth System Dynamics Discussions* 4, 1 (2013), 49–92.