THE ROLE OF URBAN GREEN SPACES IN THE URBAN CLIMATE – THE CASE STUDY OF THE CITY OF BRAGANÇA (PORTUGAL)

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WORLD FORUM ON URBAN FOREST

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URBAN CLIMATE AND THE URBAN HEAT ISLAND EFFECT

World Forum on Urban Forests
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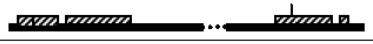
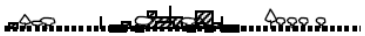
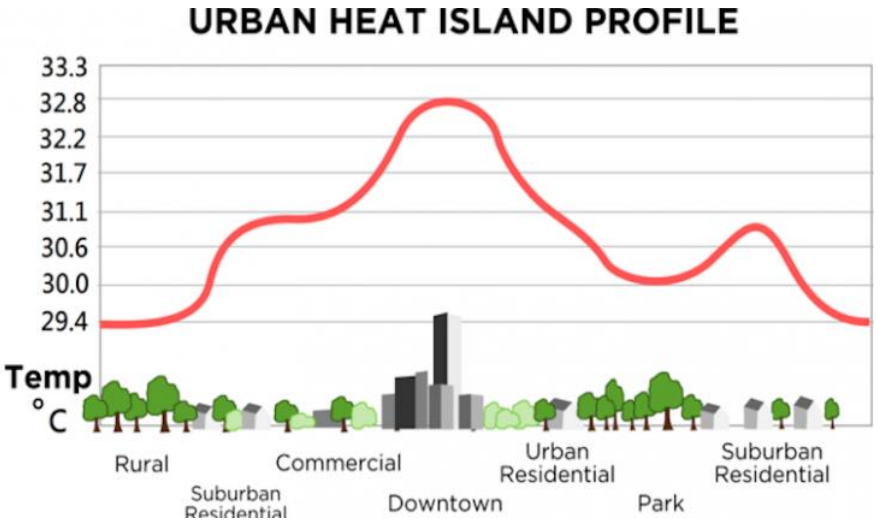
Urban Climate Zone, UCZ [1]	*Image*	*Rough-ness class[2]*	*Aspect ratio[3]*	*% Built (imper-meable)[4]*
1. Intensely developed urban with detached close-set high-rise buildings with cladding, e.g. downtown towers		8	> 2	> 90
2. Intensely developed high density urban with 2 – 5 storey, attached or very close-set buildings often of brick or stone, e.g. old city core		7	1.2 – 2.5	> 85
3. Highly developed, medium density urban with row or detached but close-set houses, stores & apartments e.g. urban housing		7	0.5 – 1.5	70
4. Highly developed, low density urban with large low buildings & paved parking, e.g. shopping mall, warehouses		5	0.05 – 0.2	75 - 95
5. Medium development, low density suburban with 1 or 2 storey houses, e.g. suburban housing		6	0.2 – 0.5, up to >1 with tall trees	35 - 65
6. Mixed use with large buildings in open landscape, e.g. institutions such as hospital, university, airport		5	0.1 – 0.5, depends on trees	< 40
7. Semi-rural development with scattered houses in natural or agri-cultural area, e.g. farms, estates		4	> 0.05, depends on trees	< 10

Key to image symbols: buildings; vegetation; impervious ground; pervious ground

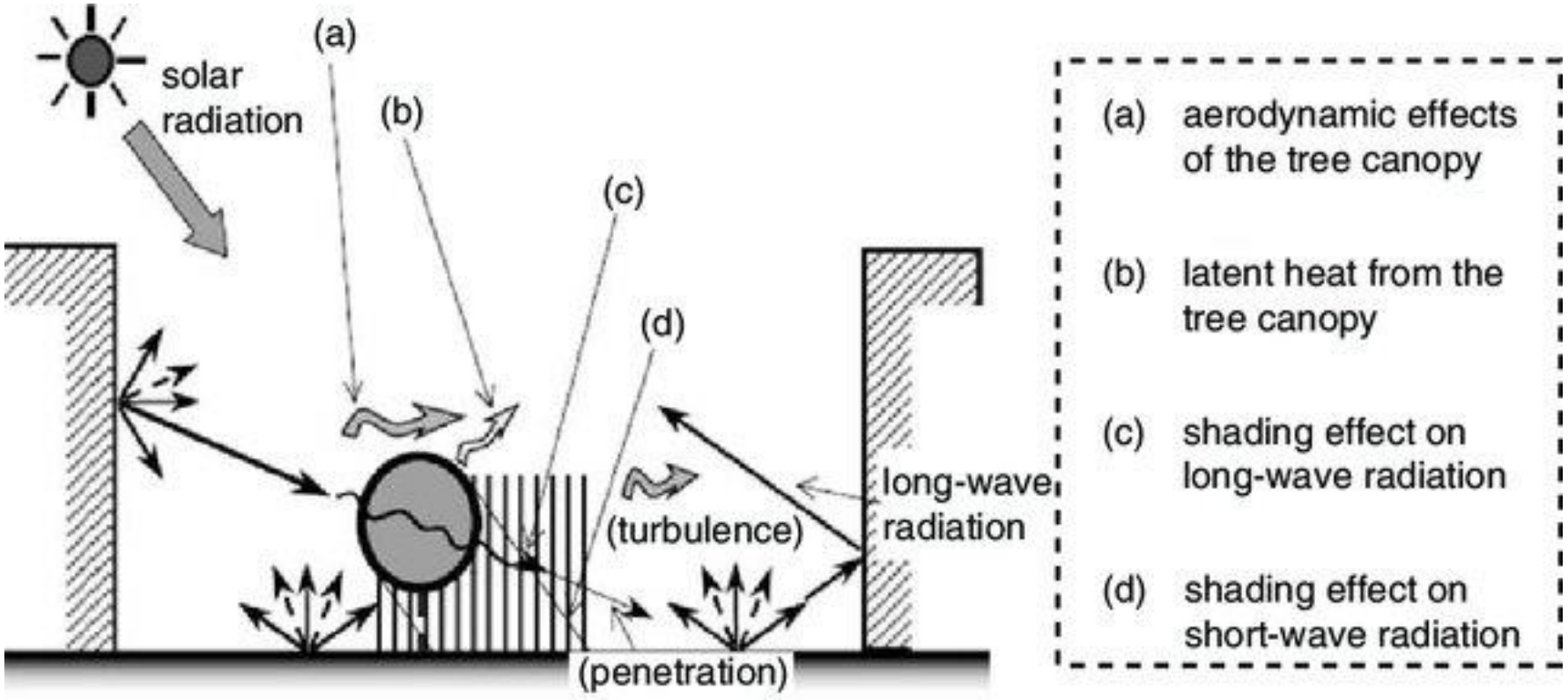


Temperature Differences:

- Buildings Geometry;
- Surfaces Behavior;
- Air Pollution;
- Anthropogenic heat.

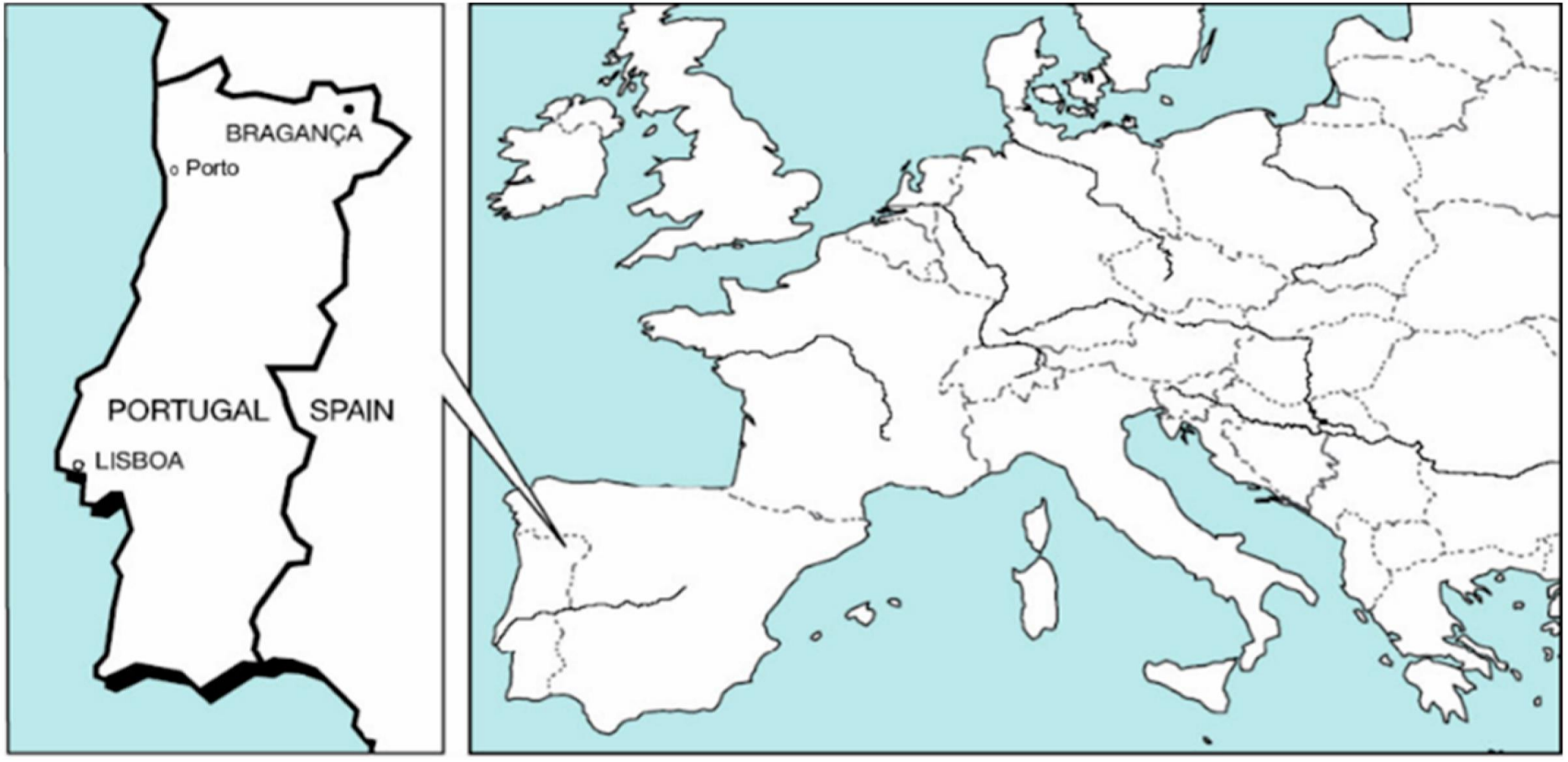
(Oke, 2006)

GREEN SPACES AND THE URBAN CLIMATE



Yochida et al. (2006)

CASE STUDY – BRAGANÇA (PORTUGAL)



CASE STUDY – BRAGANÇA (PORTUGAL)

Csb

Mediterranean climate

Dry Summers

Cold and Wet Winters

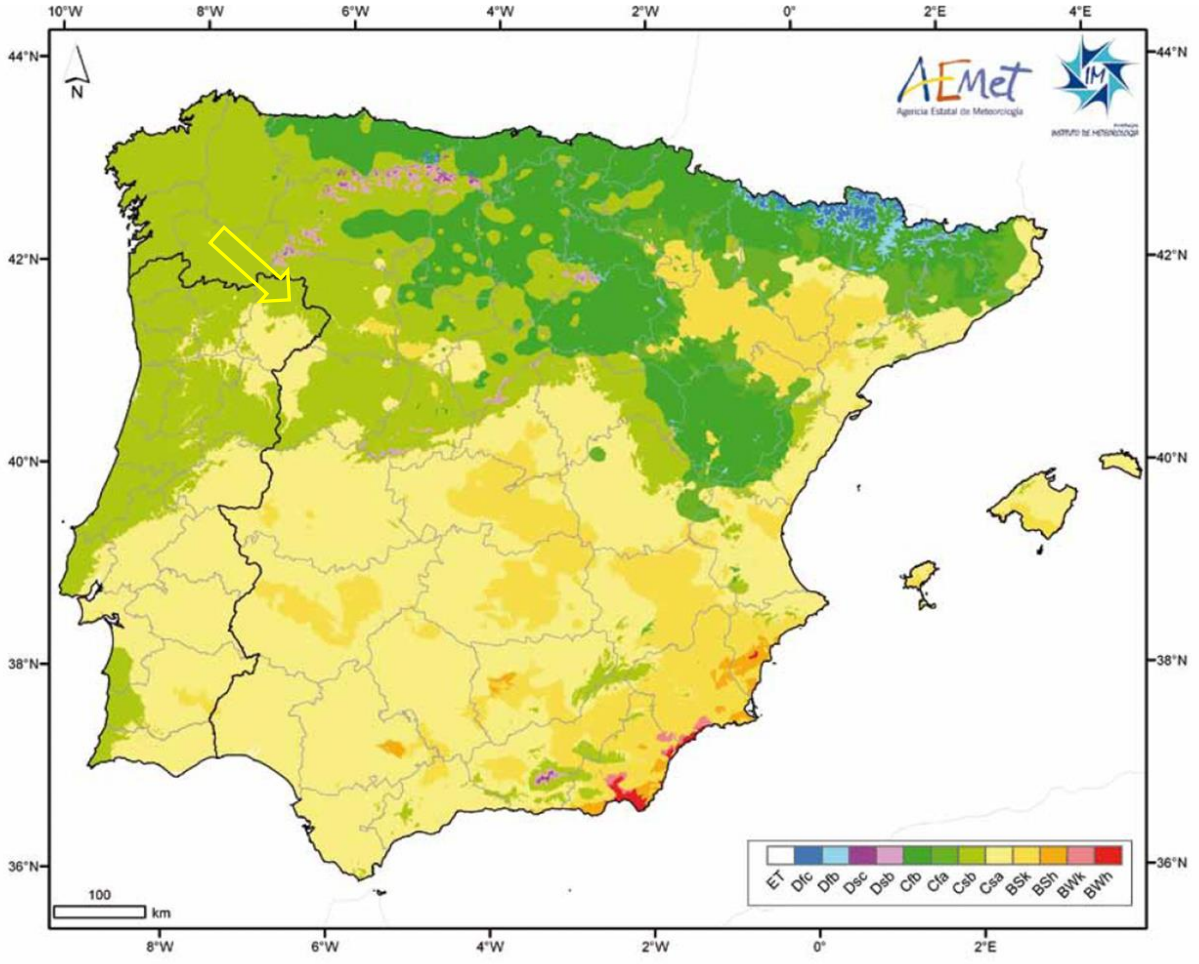
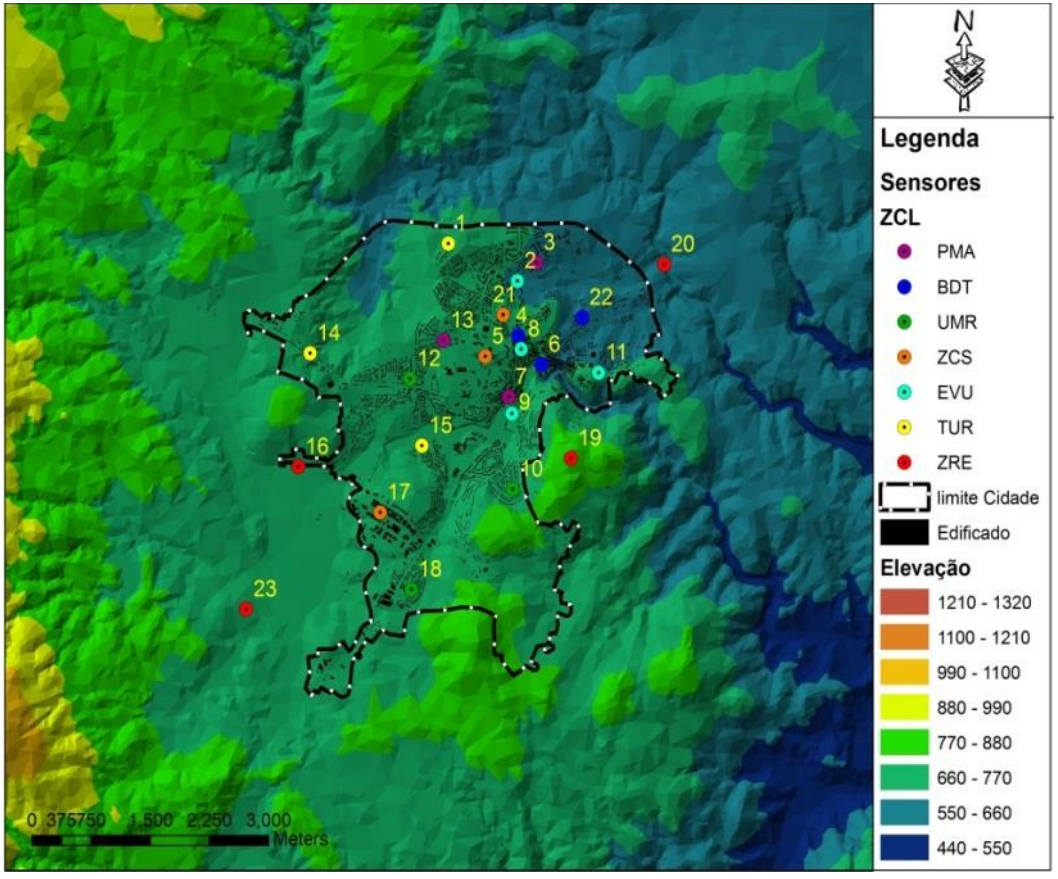


Fig. 1. Clasificación climática de Köppen-Geiger en la Península Ibérica e Islas Baleares.
Classificação climática de Köppen-Geiger na Península Ibérica e Ilhas Baleares.
Köppen-Geiger Climate Classification for the Iberian Peninsula and the Balearic Islands.

METHODOLOGY – MONITORING NETWORK



CRITERIA

- Cover all Local Climate Zones – at least three sensor per location

- Cover topographic effects (from river margins to hilltops)

- Cover rural to urban gradient

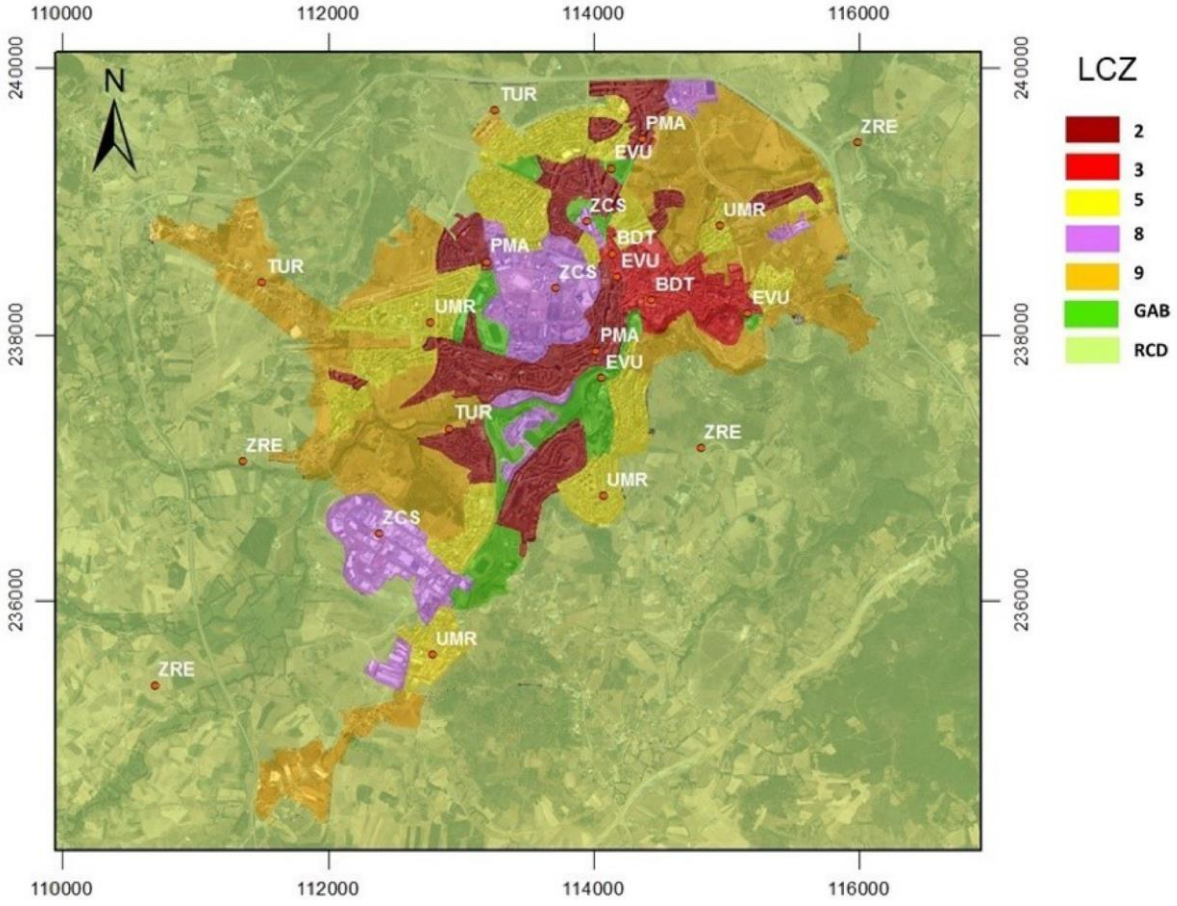
EQUIPMENT

- 23 Temperature and humidity sensors

- Three wind speed and direction sensors

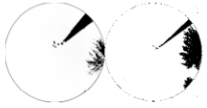
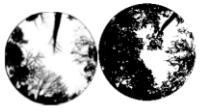
- Two full automatic station

METHODOLOGY - MONITORING NETWORK



METHODOLOGY - MONITORING NETWORK

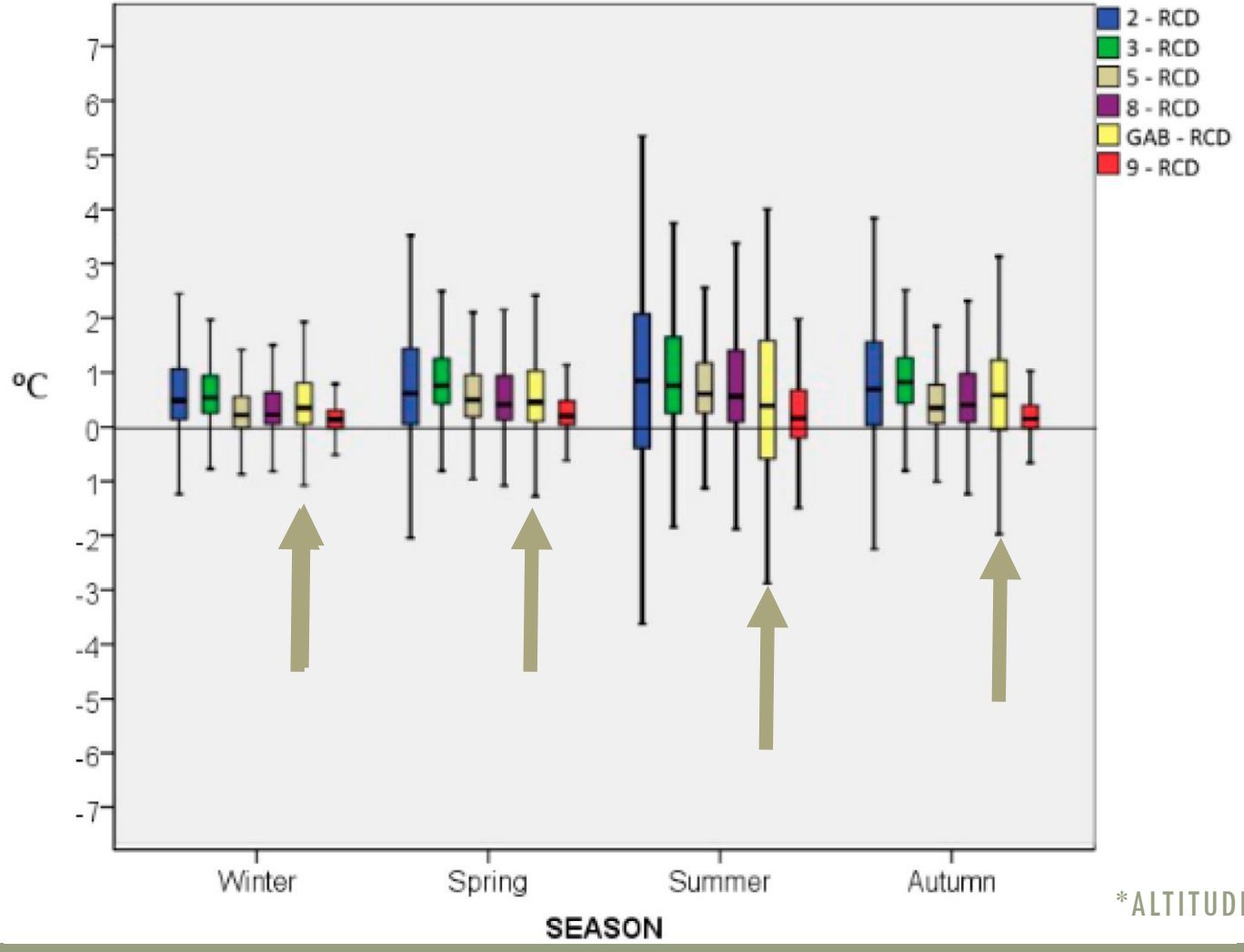
Table 2. Local Climate Zones and their attributes (Based on Stewart and Oke [36]).

LCZ—Description [36]	Fish-Eye [1]	Average Sky View Factor	Roughness Length [43]	Impervious Surface (%) [2]
2–Compact midrise—Dense mix of midrise buildings (3–9 stories). Few or no trees. Land cover mostly paved.		0.43	1.54–2.5	94–99
3–Compact low-rise—Dense mix of low-rise buildings (1–3 stories). Few or no trees. Land cover mostly paved.		0.75	0.93–1.07	88–99
5–Open midrise—Open arrangement of midrise buildings (3–9 stories). Abundance of pervious land cover (low plants, scattered trees).		0.72	0.74–0.76	90–99
8–Large low-rise—Open arrangement of large low-rise buildings (1–3 stories). Few or no trees. Land cover mostly paved.		0.78	0.82–0.99	99
9–Sparsely built—Sparse arrangement of small or medium-sized buildings in a natural setting.		0.92–0.90	0.00–0.15	23–57
GAB—Urban Green Spaces—Heavily wooded landscape of deciduous and/or evergreen trees or lightly wooded landscape of deciduous and/or evergreen.		0.71–0.42	0.08–2.00	2–81
RCD—Rural Areas—Open arrangement of bushes, shrubs, and short, woody trees and featureless landscape of grass or herbaceous plants/crops.		0.88–0.84	0	0–20

[1] Fish-eye photo examples for Sky View Factor (SVF) determination in winter (left) and summer (right); [2] Considering a 25 m radius around the sensors' location.

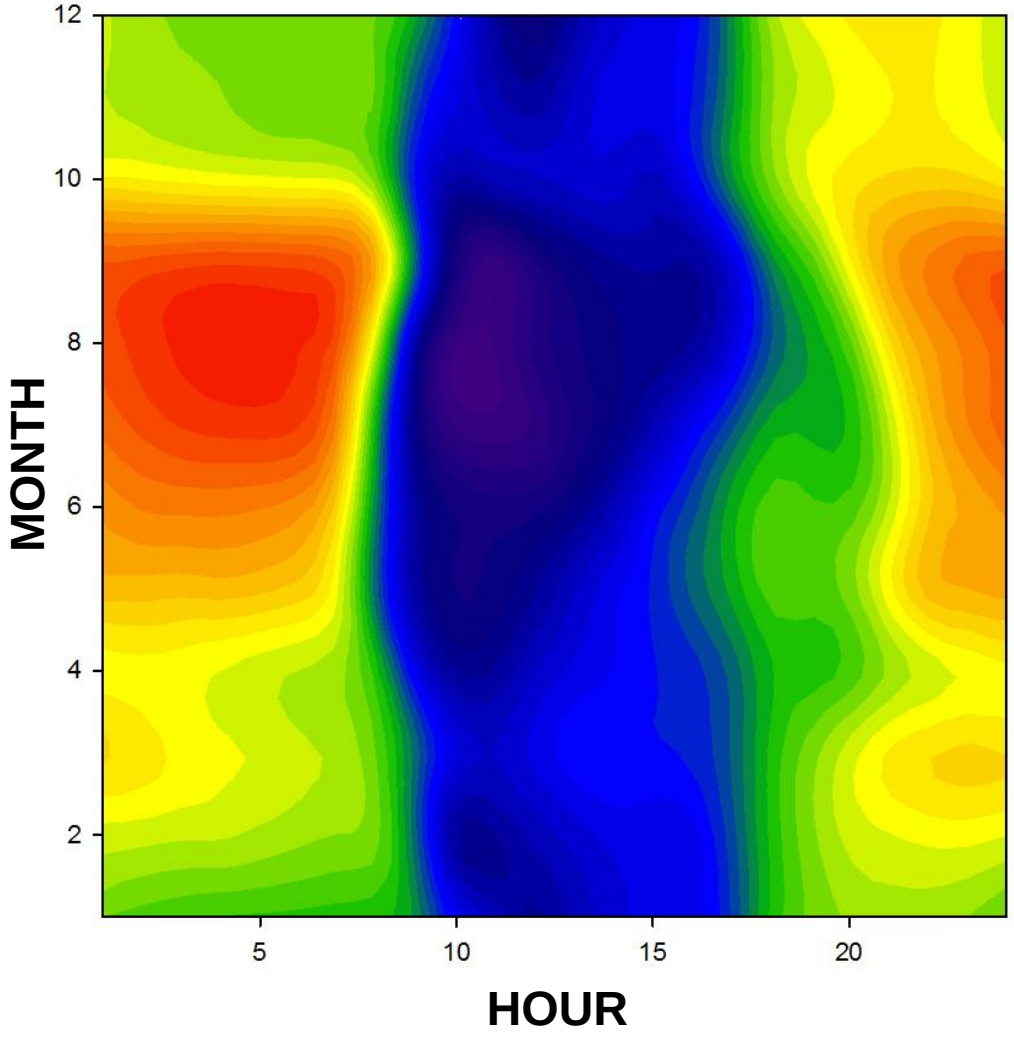
Gonçalves *et al.*, 2018

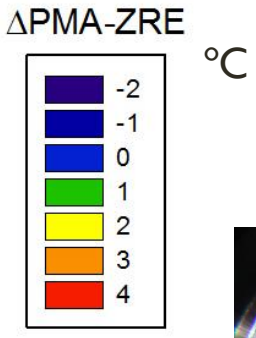
RESULTS – HEAT ISLAND EFFECT* (2012-2016)

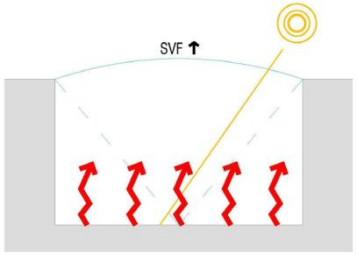


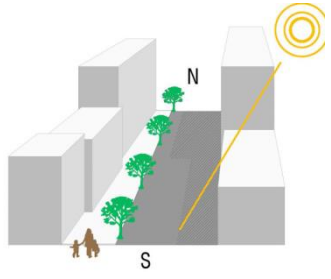
*ALTITUDE CORRECTION

RESULTS – UHI – MEAN URBAN MIDRISE

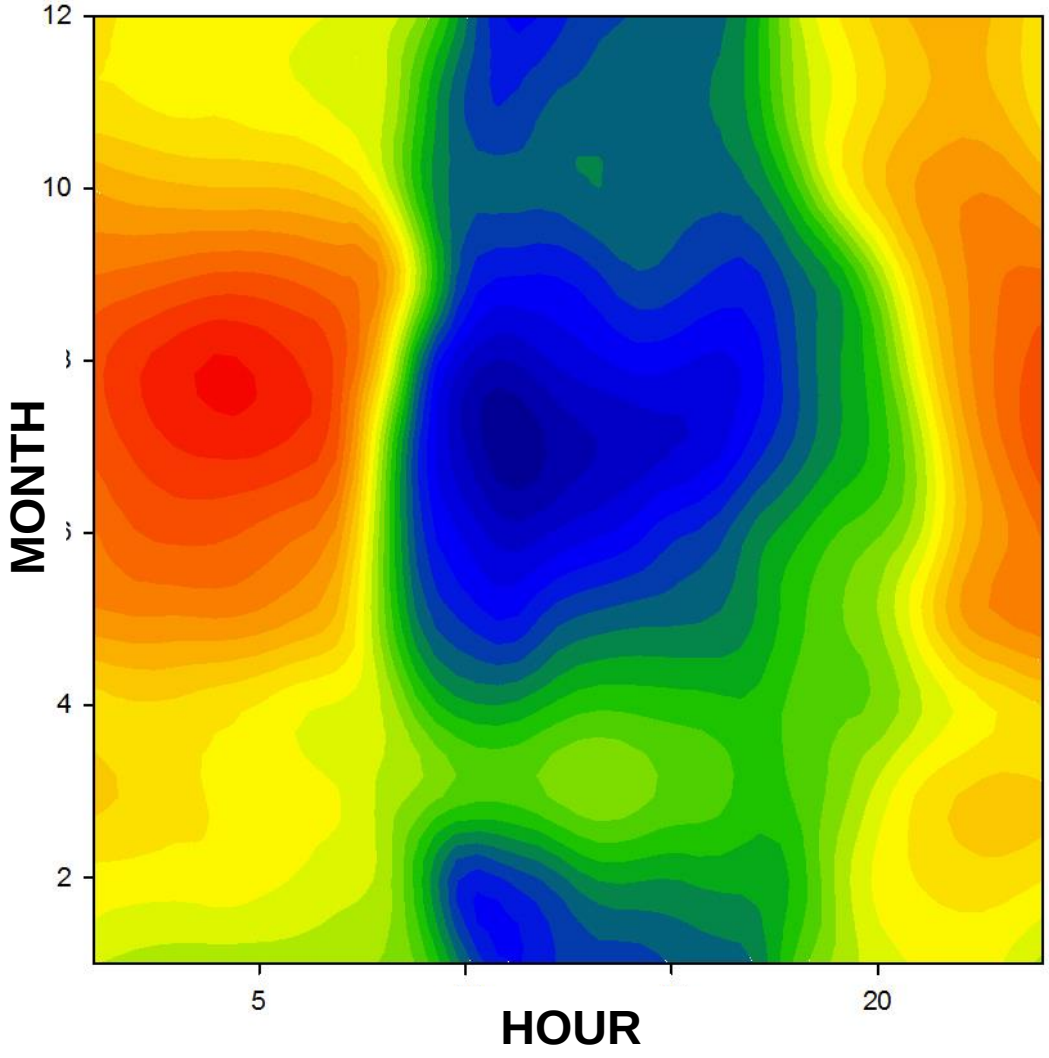


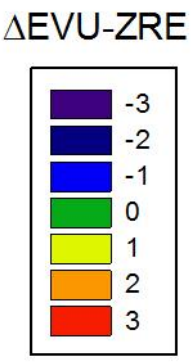


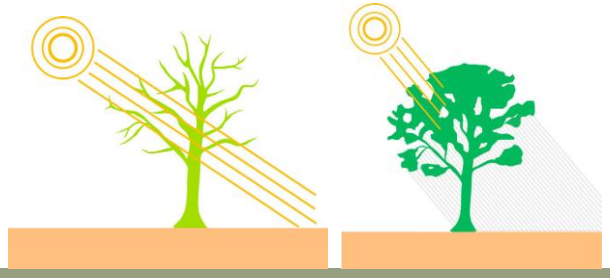




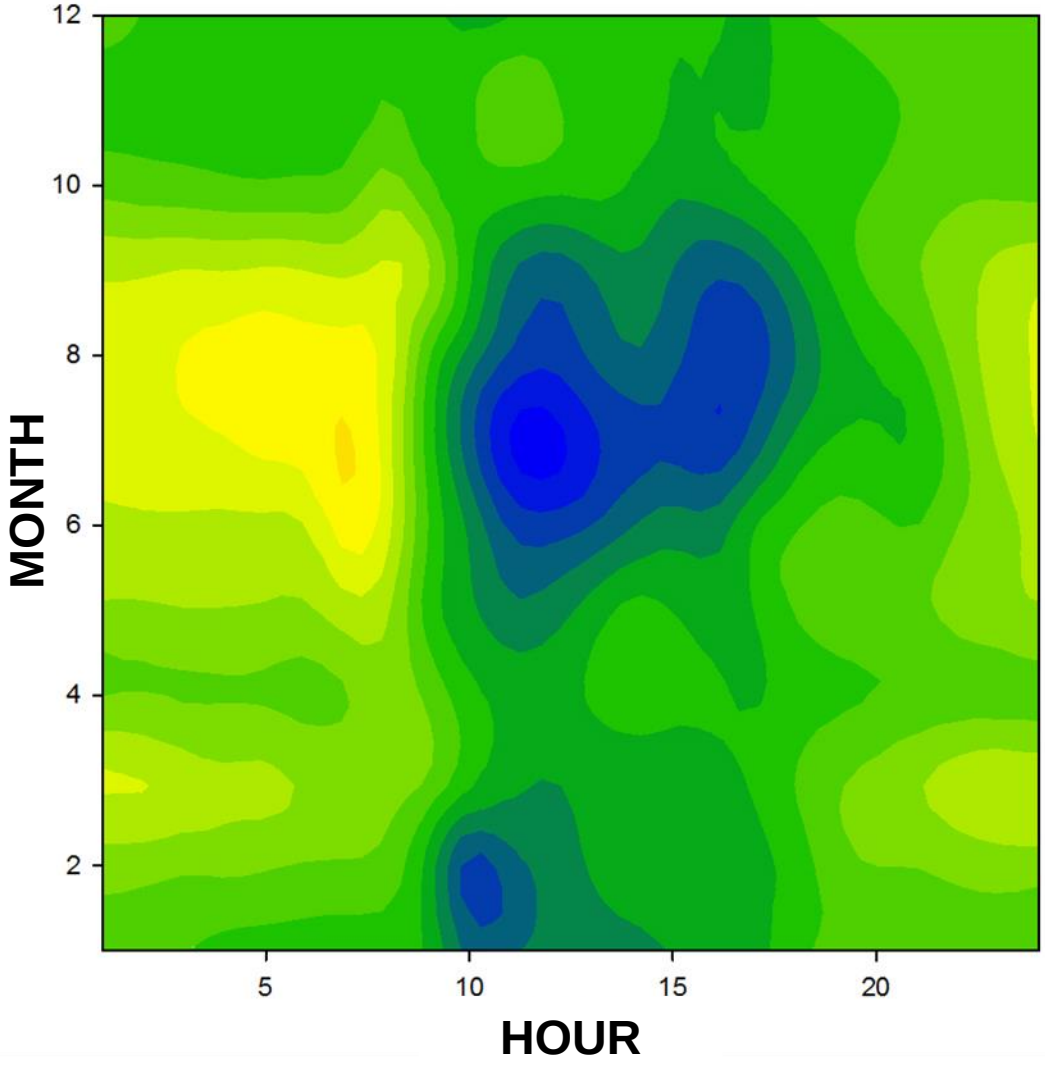
RESULTS – UHI – MEAN URBAN GREEN SPACES

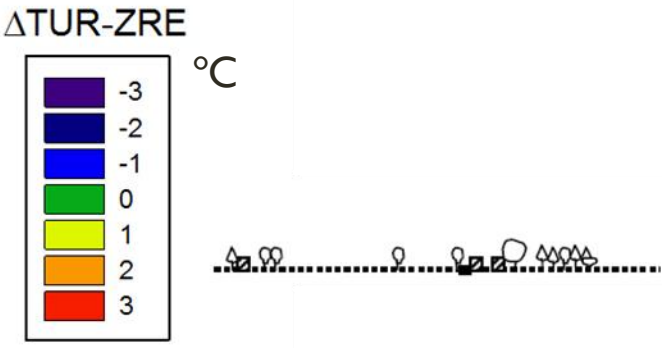




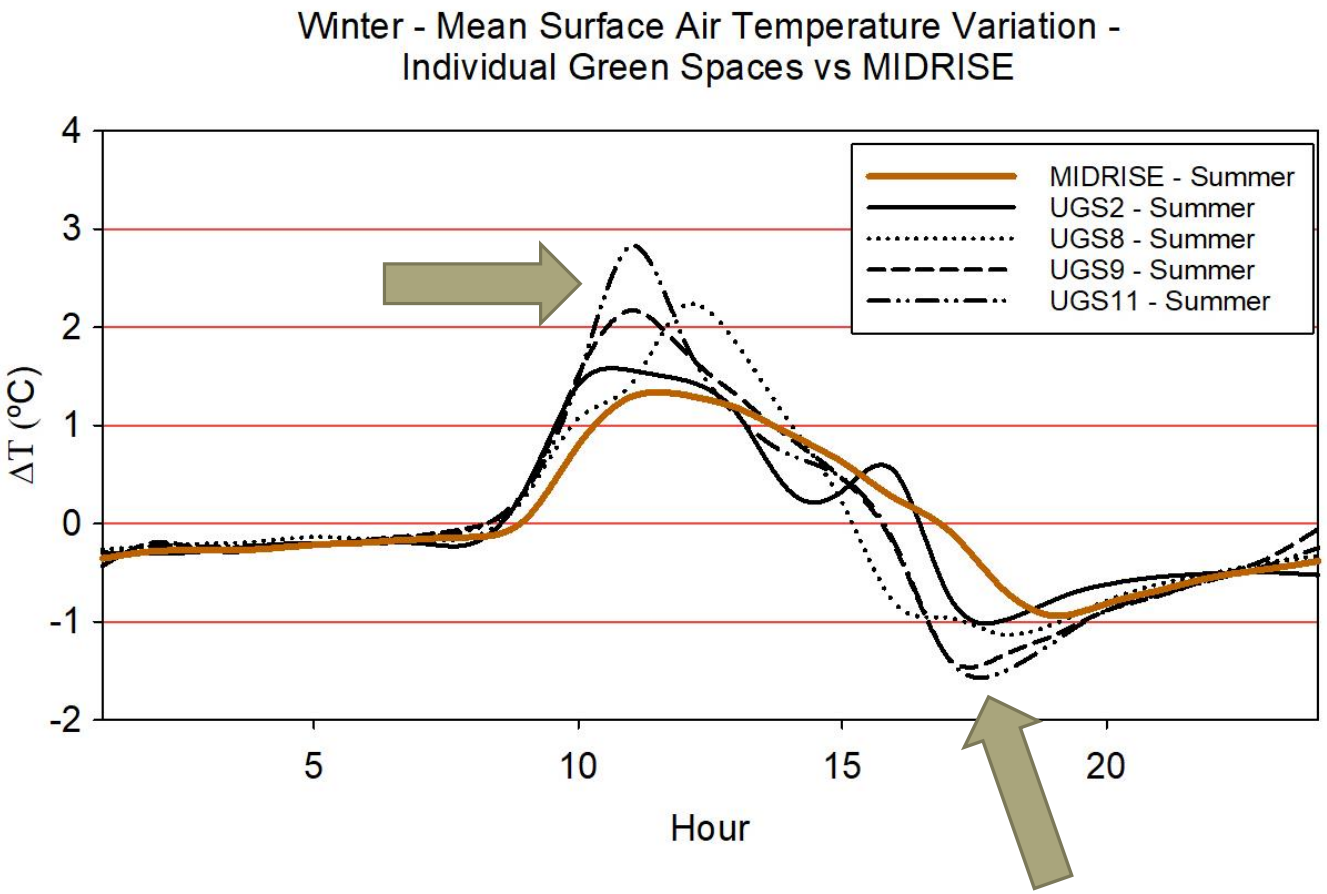


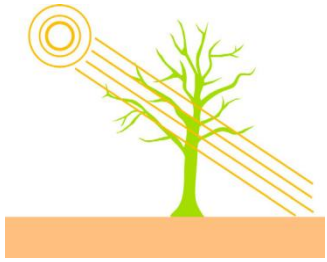
RESULTS – MEAN UHI –SEMIRURAL



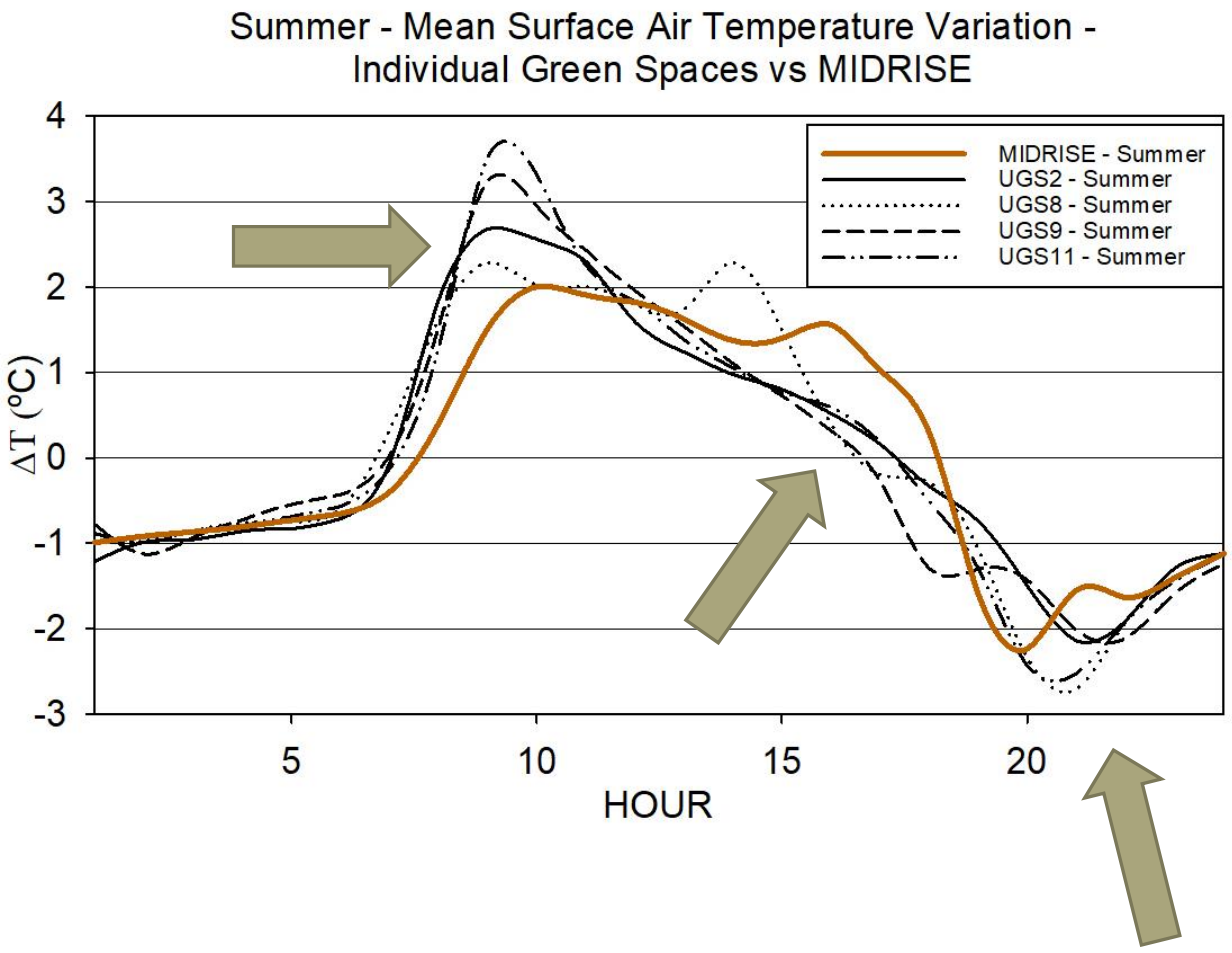


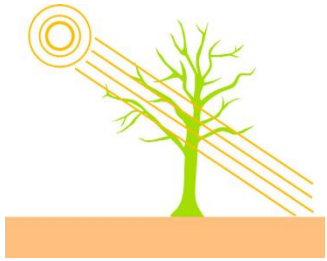
RESULTS – HEATING AND COOLING - WINTER



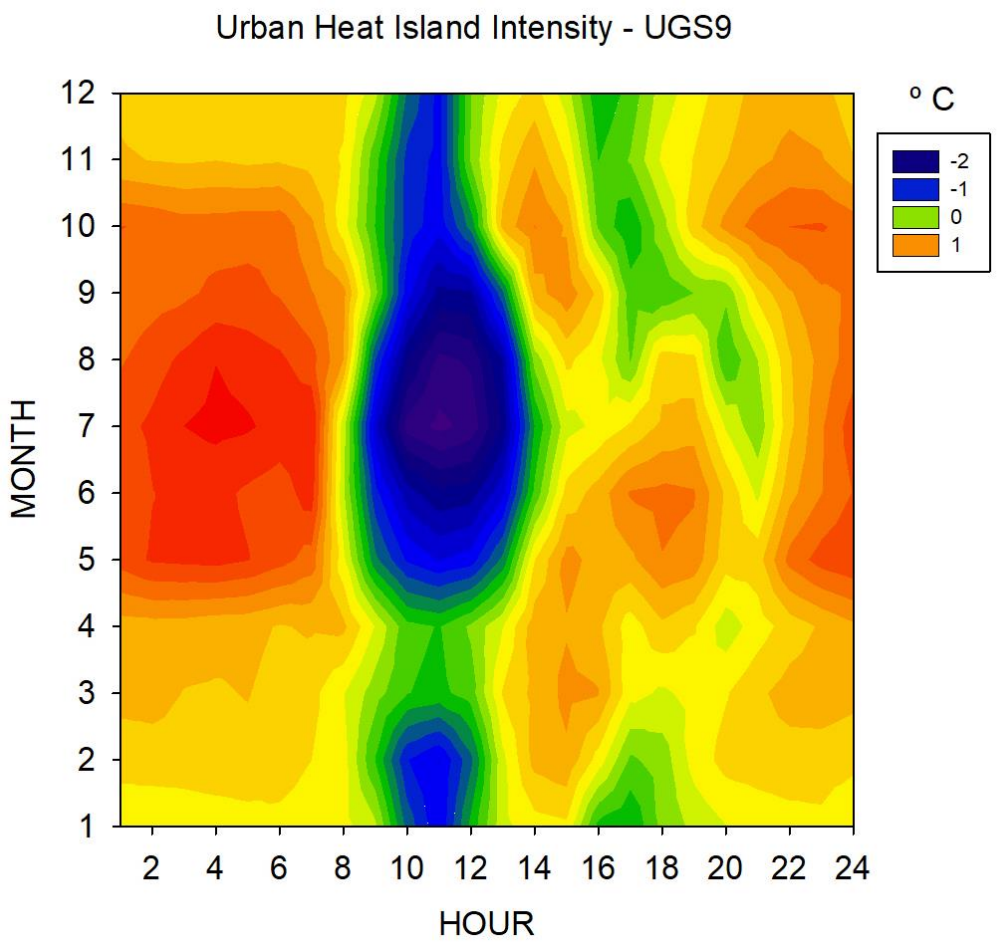


RESULTS - HEATING AND COOLING - SUMMER

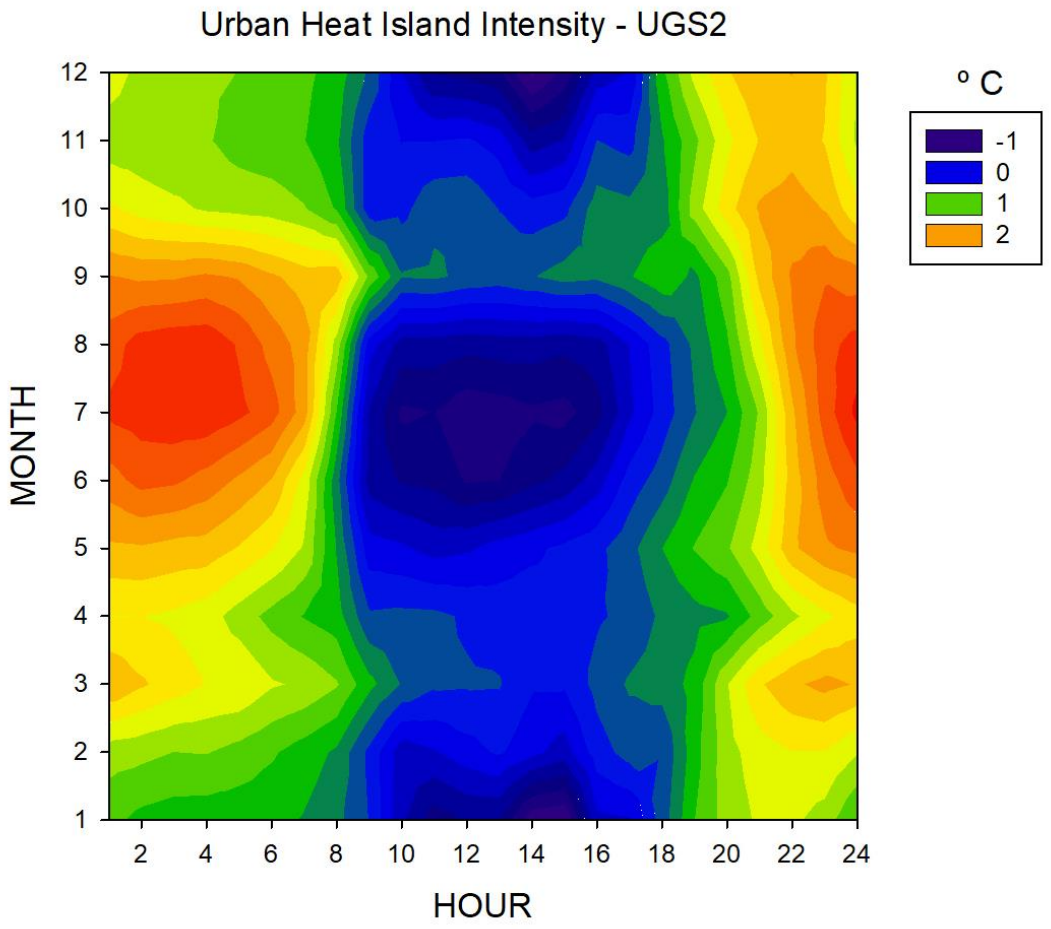




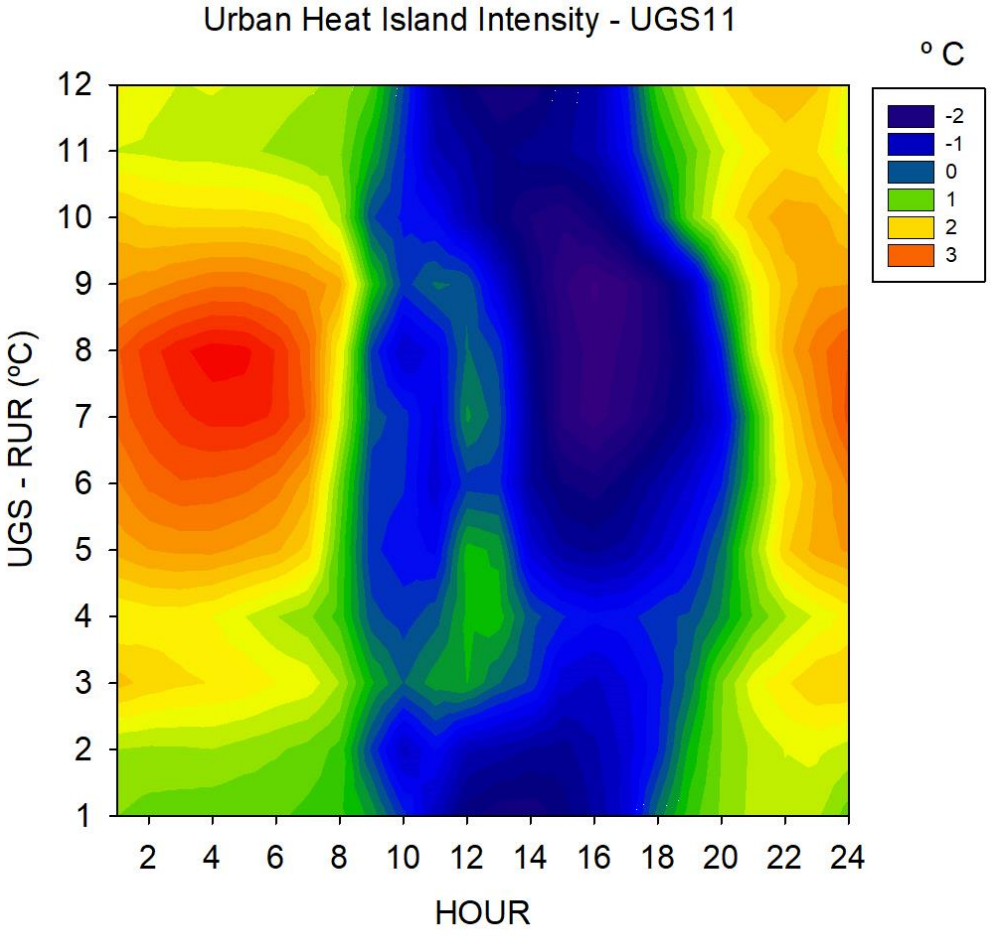
RESULTS – UHI EFFECT UGS 9



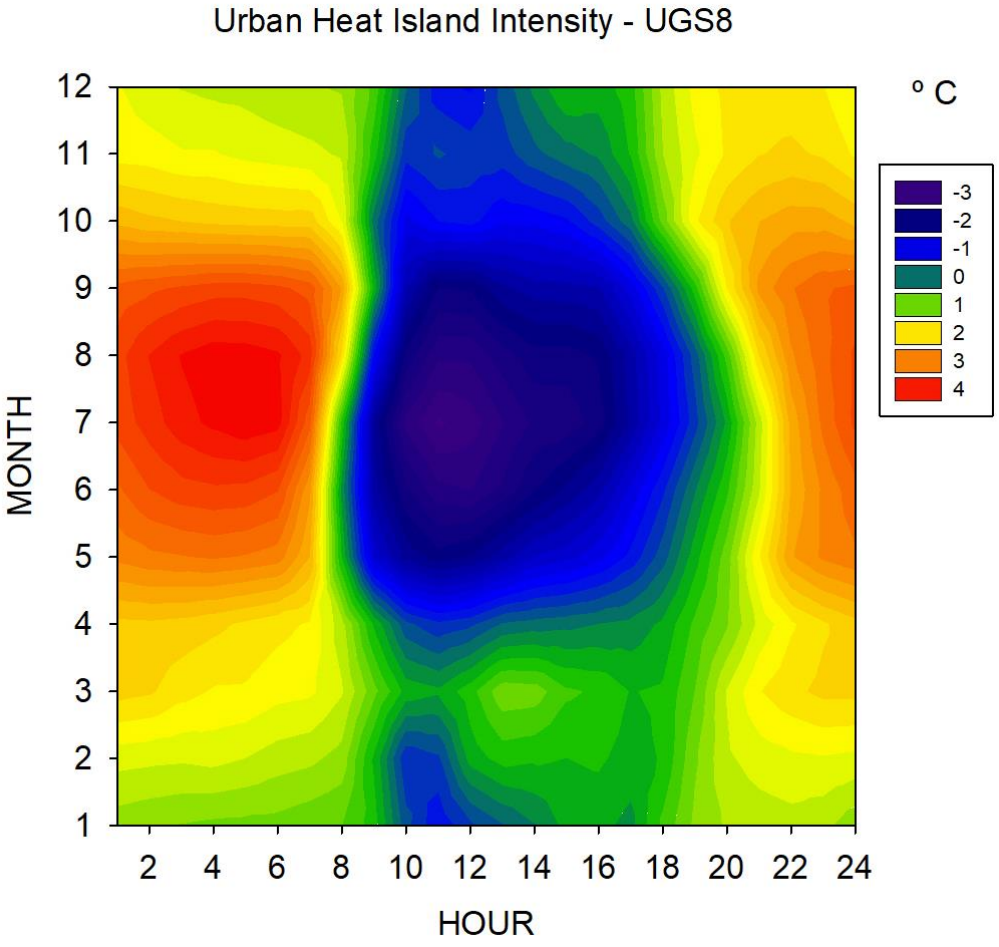
RESULTS – UHI EFFECT UGS 2



RESULTS – UHI EFFECT UGS 11



RESULTS – UHI EFFECT UGS 8



FINAL REMARKS

- The Urban Heat Island Effect is present in a Small Size City.
- UGS have a differentiated effect in the Local Urban Climate.
- Among the climate benefits of UGS there is an extended cooling effect more intense in higher canopy cover in urbanized context.
- The local monitoring network is being kept since 2012, future developments include modelling and land change impact on Local Climate.

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CIMO

THANK YOU!

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