Instituto Politécnico
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The influence of the roof solution on the Urban Heat Island
LIFE SUPERHERO PROJECT

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Dedicatory

The elaboration of this work would not have been possible without the collaboration, encouragement, and commitment of several people. Thus, I would like to express all my gratitude and appreciation to all those who, directly or indirectly, contributed to make this task a reality. To all of them I want to express my greatest gratitude.

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Abstract

The present internship, elaborated in the context of an Erasmus Internship, is part of the conclusion of the master's degree in Civil Engineering in Sustainable Construction, of the School of Technology of the Polytechnic Institute of Castelo Branco.

Extreme climate events have grown tremendously in the last years, which indicates that climate change is happening, and its impacts will test the quality of life in the world. During the last years, the frequency and intensity of the heatwaves increase all over the EU causing a lot of problems such as the increase of energy use for cooling with adjacent CO_2 emissions and damages in public health. Also combining the Urban Heat Island (UHI) effect, it will result in higher temperatures inside buildings, especially existing ones. Comfort and health problems will occur for weak and disadvantaged people.

A sustainable and low-cost answer for cities and buildings overheating is using "passive cooling" technologies, that allows to reduce the temperatures in buildings envelope – roofs and walls – and the surrounding air, which limits the UHI. The most promising strategy is the use of Ventilated and Permeable Roofs (VPR). The research project LIFE HEROTILE developed "HEROTILES" that have an improved cooling ability compared to another roof technologies.

The aim of the training performed and explained in this report is to assess and define how much the Ventilated Permeable Roof (VPR) and the HEROTILE Roof (HBR) impact on the Urban Heat Island (UHI) effect, and it will be developed within the LIFE SUPERHERO research project. The research project is a partnership between Università Politecnica delle Marche (Italy), Centro Ceramico (Italy), acer (Italy), Comune di Reggio Emilia (Italy), Confindustria Ceramica (Italy), CTMNC (France), Edilians (France), HYSPALYT (Spain), Industrie Cotto Possagno (Italy) and Terreal (Italy).

Keywords

Urban Heat Island, Ventilated Permeable Roof, Herotile based Roof, LIFE SUPERHERO

Resumo

O presente estágio, elaborado no contexto de um Estágio Erasmus, visa a conclusão do mestrado de Engenharia Civil em Construção Sustentável, da Escola Superior de Tecnologia do Instituto Politécnico de Castelo Branco.

Os eventos climáticos extremos têm crescido exponencialmente nos últimos anos, o que indica que as alterações climáticas estão a acontecer, e os seus impactos irão testar a qualidade de vida no mundo. Durante os últimos anos, a frequência e intensidade das ondas de calor aumentam em toda a UE causando muitos problemas, tais como o aumento da utilização de energia para arrefecimento com emissões de CO_2 adjacentes e os danos causados na saúde pública. Combinando também o efeito de Ilha de Calor Urbana (ICU), resultará em temperaturas mais elevadas no interior dos edifícios, especialmente os existentes. O conforto e os problemas de saúde irão ocorrer para pessoas mais fracas e desfavorecidas.

Uma resposta sustentável e de baixo custo para as cidades e edifícios sobreaquecidos é a utilização de tecnologias de "arrefecimento passivo", que permite reduzir as temperaturas no interior dos edifícios - telhados e paredes - e no ar circundante, o que limita a ICU. A estratégia mais promissora é a utilização de Telhados Ventilados e Permeáveis (VPR). O projeto de investigação LIFE HEROTILE desenvolveu "HEROTILES" que têm uma capacidade de refrigeração melhorada em comparação com outras tecnologias de telhados.

O objetivo do estágio realizado e explicado neste relatório é avaliar e definir o impacto do Telhado Ventilado Permeável (VPR) e do Telhado HEROTILE (HBR) no efeito da Ilha de Calor Urbano (ICU), e será desenvolvido no âmbito do projeto de investigação LIFE SUPERHERO. O projeto de investigação é uma parceria entre a Università Politecnica delle Marche (Itália), Centro Ceramico (Itália), acer (Itália), Comune di Reggio Emilia (Itália), Confindustria Ceramica (Itália), CTMNC (França), Edilians (França), HYSPALYT (Espanha), Industrie Cotto Possagno (Itália) e Terreal (Itália).

Palavras-Chave

Ilha de Calor Urbano, Telhados Ventilados Permeáveis, Telhados Herotile, LIFE SUPERHERO

General Index

Figure Index

Index of symbols

ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers

BEM Building Energy Model

EPW EnergyPlus Weather file format

HVAC Heating, Ventilation and Air-Conditioning

HBR Herotile based Roofs

LCZ Local Climate Zone

SENSAPIRO Software Energy Savings Pitched Roofs

RSM Rural Station Model

UBL Urban Boundary Layer

UHI Urban Heat Island

UHII Urban Heat Island Intensity

UWG Urban Weather Generator

VDM Vertical Diffusion Model

VPR Ventilated Permeable Roof

Table List

Graphic Index

1. Introduction

1.1 Scope

This report presents the work developed in the scope of the second year of the Master in Sustainable Construction, within the context of an Erasmus Internship. The internship was developed within the LIFE SUPERHERO research project in Università Politecnica delle Marche.

The research project LIFE SUPERHERO has as topic the Climate Change Adaptations and aims to developed solutions to combat Urban Heat Island (UHI) in cities, that is in urban areas. The solution is the use of "passive cooling" technologies, more specifically on the use of Ventilated and Permeable Roofs (VPR) (Figure 1).

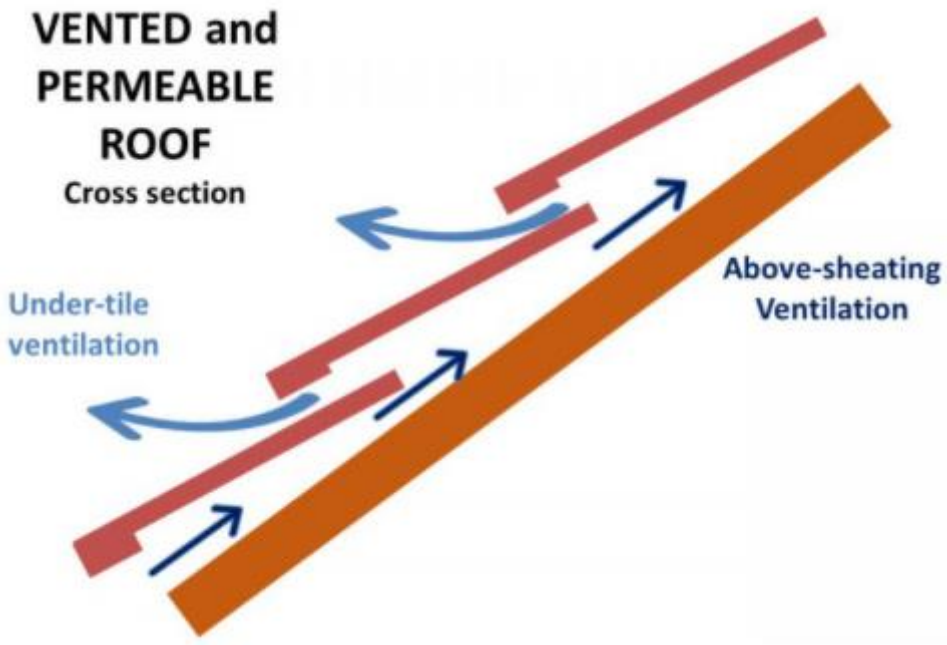


Figure 1 - Ventilated and Permeable Roof cross section (Superhero, n.d.).

In a previous project developed at the same university – LIFE HEROTILE – were designed two new types of tiles (Marseillaise and Portuguese), characterized by a superior air permeability through the overlapping of the tiles, and by a better energy efficiency through the passive disposal of solar radiation through under-tile ventilation. Was also developed a software, that will be addressed further on, - SENSAPIRO – that stands for Software Energy Savings Pitched Roofs, as a free practical and simplified software for architects and technicians that, based on experimental

data, will be able to predict the energy performance of the same building by changing the roof configuration (Herotile, n.d.).

As we know, extreme climate events have grown tremendously in the last years (Figure 2), which indicates that climate change is real, and its impacts will test the quality of life in the world.

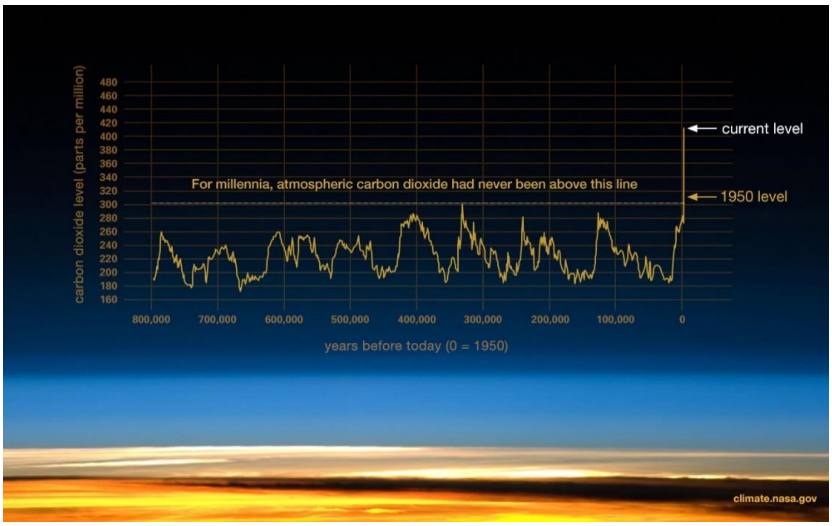


Figure 2 - Comparison of atmospheric samples contained in ice cores and more recent measurements, provides evidence that atmospheric CO_2 has increased since the Industrial Revolution (NASA, n.d.).

During the last couple of years, the frequency and intensity of heatwaves increase all over the EU, exacerbating other problems, such as the energy use for cooling with consequent CO_2 emissions, public health by increasing the air pollution, the ability to work result in lower productivity and possibly the use of public spaces constraining social life and durability of infrastructures. These impact challenge economy and quality of life. The Urban Heat Island (UHI) effect is also aggravating. The combination of these important events will result in higher temperatures inside buildings, especially existing ones. Comfort and health problems will occur for weak and disadvantaged people (Superhero, n.d.).

A real, sustainable and low-cost answer for cities and buildings overheating is using "passive cooling" technologies, which allows to reduce the temperatures in buildings envelope – roofs and walls – and the surrounding air, which limits the Urban Heat Island, rather than increase energy demands from artificial cooling. The most sustainable and promising strategy is the use of Ventilated and Permeable Roofs (VPR), specifically HEROTILE roof (HBR) developed in the previous project, shown on Figure 1.

LIFE SUPERHERO encourages innovative building passive cooling concept and has as a goal the use of the Ventilated and Permeable Roofs (VPR) and HEROTILE-based Roofs (HBR) in existing and new buildings. The strategy is based on four parallel action pillars:

1. Standards and regulations proposal: producing a standardized air permeability test method, proposing to update building green rating systems and public procurement including the VPR environmental benefits, proposing to improve existing CEN standards, to include VPR into building energy calculation;
2. Best practice with municipalities: Developing guidelines on proper roof renovation strategies to be used as climate solutions;
3. Development of a superhero software tool: A decision support tool for building consultants and public administrations, to assess life-cycle environmental and economic benefits of VPR and HBR, to select the best design solutions for their projects and climate plans;
4. Industrial replicability and transferability: This action sets the basis for a strong market penetration of VPR and HBR, amplifying the climate impacts obtained by the project, involving all partners (Superhero, n.d.).

1.2 Main Goals

This report is a result of an internship, and the work developed in this internship was to assess the possible benefits of the Ventilated Permeable Roofs (VPR) on Urban Heat Island (UHI) and compare the results with green and cool roofs.

Nevertheless, there is one big problem and is that the actual urban climate software does not implement the effect of VPR and the previous research on this topic is lacking. So, is necessary to find a way to implement the VPR in Climate software's.

The project includes three actions for monitoring project impacts (action D), one for dissemination (action E1) and another one for management (action F1). For my internship I will work withing the action D – Environmental impact assessment and monitoring, more specifically on action D.1.1 – Assessment of the impact of VPR/HBR on the Urban Heat Island (UHI) effect.

1.3 Organization of the report

The present report is organized in several chapters, one of them is the introduction of the work developed and the scope of the internship with the highlight of the main objectives to be achieved.

In the second chapter, it's highlighted the main problem that gave rise to this project, the solutions studied to mitigate the problem and the software used to analyze the main problem, which is the Urban Heat Island Effect.

Chapter three introduces the experimental work, such as the software's used during the internship and the case studies.

For the chapter four, the results obtained throughout the internship are analyzed and discussed, with graphics and tables.

Chapter 5 makes the general conclusion of the project with emphasis on the knowledge obtained as a result of the different software's used and proposes subjects to be developed in the future.

2. Heat Island Effect and Roof Cooling Strategies

2.1 The Climate Problem: Urban Heat Island (UHI)

Is well known that the urban population is increasing, and the growth is expected to continue, becoming important to work and understand the complex processes found at intersection of urbanization, climate and health.

The rising of anthropogenic heat emissions, reduced evaporative cooling, increase surface roughness, lower surface albedos and narrow urban canyon geometry associated with cities results in the formation of Urban Heat Island (UHI), mostly at night, since urban air temperatures are higher relative to the natural surroundings. This effect is also most noticeable during summer and winter (Figure 3) (Debbage & Shepherd, 2015).

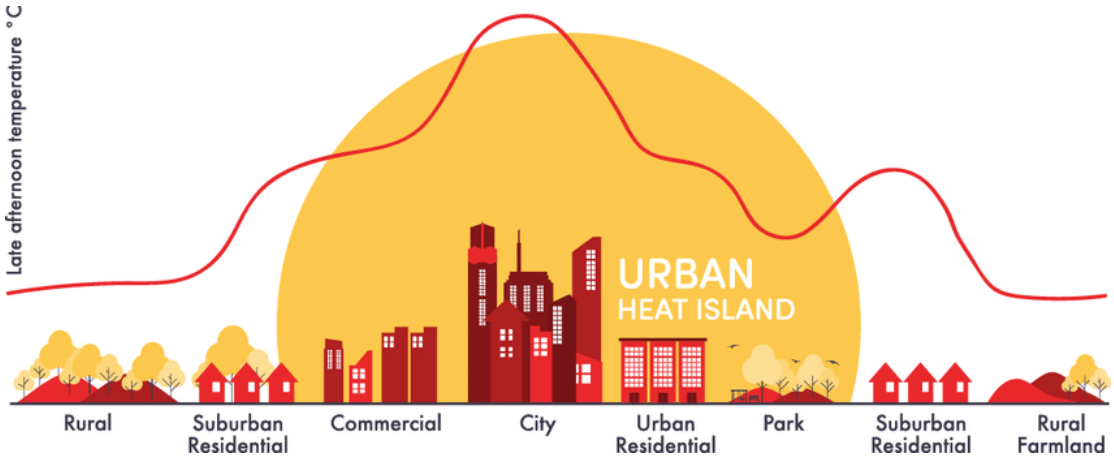


Figure 3 - Urban Heat Island (FULADLU et al., 2018).

Urban Heat Island (UHI) is an urban area or metropolitan area that is significantly warmer than its surroundings rural areas due to human activities. Increasingly warm urban environments pose serious threats to human health, since they intensify near surface ozone concentrations, reduce air quality, enhance anthropogenic energy consumption and increase heat related fatalities by magnifying the severity of heat waves (Debbage & Shepherd, 2015).

The worsening of the UHI effect leads to greater need for summer air conditioning of buildings, especially in existing buildings with low energy performance, with an estimated consequent increase in energy consumption of 25% by the end of the 21st century. The use of air-conditioning systems generates further emission of anthropogenic heat and greenhouse gases in the urban environment, contributing to

the increase of the UHI effect, as in a vicious circle. The sensitivity analysis allowed to understand that the anthropogenic heat originating from cooling systems is the parameter with the greatest influence on UHI (Maracchini et al., 2021).

The Urban Heat Island does not only increase the ambient temperature, but also presents important consequences on the modification of the energy consumption in buildings. The role of the air-conditioning on heat waves is controversial, because in one hand it protects from heat stress the inhabitants but on the other hand it contributes to an increase of the street temperature of air source A/C, which discards condensing heat into the air, is used. Because of this, UHI mitigation resembles to an important challenge and many authors are developing studies and calculations to understand the influence of the air-conditioning on air temperature. So far, they understood that the heat resulting from air-conditioning increases the air temperature and also the energy consumption of a building (Tremeac et al., 2012).

There are three different types of Urban Heat Island:

- Boundary layer UHI: warmer air in urban areas compared with rural areas, they are in the area above rooftops and trees extending upwards as much as 1,6 km;
- Canopy layer UHI: warmer air in urban areas compared with rural areas, they are present in the air layer where we live, from ground level to the tops of trees or buildings;
- Surface layer UHI: higher surface temperatures in urban areas compared with the rural areas (Note, 2009).

2.2 Roofing Technologies as Urban Climate Mitigation Strategies

In European countries, 36% of the total greenhouse gas emissions are attributed to buildings, and with the intensification of the phenomenon Urban Heat Island (UHI) the building sector is in the center of interest regarding the mitigation the role of building on world energy consumption and minimize their relationship with greenhouse gas emissions (Besir & Cuce, 2018).

Roofs are the envelope component subject to the highest solar irradiance. The mitigations strategies are green roofs and cool roofs, that are widely used for restraining summertime UHI, and Ventilated and Permeable roofs (VPR), on which there's a lack of previous research regarding to their benefits on UHI.

In the Table 1, is established the performance of cool and green roofs through literature review, which becomes a starting point, as a "performance target" to compare with VPR and HBR roofs.

Table 1 - Performance of cool and green roofs.

Reference	City	Koppen classification	Roof albedo	Ta change (ºC) Max Ta – aver Ta
(Wang et al., 2016)	Toronto, Canada	Dfb	0,3 to 0,7	0,5 – 0,17 (area)
(Taleghani et al., 2016)	Los Angeles, USA	Csb	0,1 to 0,4	0,5 – 0,3 (area)
(Evola et al., 2017)	Avola, Italy	Csa	0,3 to 0,83	1,5 – 1 (area)
(Farhadi et al., 2019)	Tehran, Iran	Csa	0,3 to 0,6	0,36 (area)
(Kotharkar et al., 2020)	Nagpur, India	Aw	0,3 to 0,8	Negligible
(Wang & Akbari, 2015)	Montreal, Canada	Dfb	0,1 to 0.7	0,5 – 0,2 (diurnal)
(Di Giuseppe et al., 2017)	Rome, Italy	Csa	0,05 to 0,89	1,4 -
(Salata et al., 2017)	Rome, Italy	Csa	0,35 to 0,66	0,1 – negligible
(Ambrosini et al., 2014)	Teramo, Italy	Cfa	0,3 to 0,9	0,9 – 0,5 (area)
(Huynh & Eckert, 2012)	Ho Chi Minh, Vietnam	Aw	0,1 to 0,7	0,1 – 0,1 (area)
(Maciel et al., 2017)	Cuiabá, Brazil	Aw	0,15 to 0,85	3,0 – 0,46 (area)
(Maleki, 2016)	Vienna, Austria	Cfb	0,3 to 0,8	0,5 – 0,3 (area)
(Lynn & Lynn, 2020)	Tel Aviv and Jerusalem, Israel	Csa	0,2 to 0,8	0,6 – 0,9

2.2.1 Cool Roofs

Cool roofs, also known as reflective roofs due to their high solar reflectance, which returns a big part of the incoming solar radiation back to the sky. The absorbed solar radiation turns into heat and emits back in form of infrared radiation due to high thermal emittance property of cool roofs. They have performed better reducing cooling loads within buildings when compared with conventional roofs, causing a decrease in air conditioning needs, and improved indoor thermal comfort (Junjing Yang et al., 2018).

Cool roofs use high albedo materials to reduce urban temperatures by increasing the reflection of incoming solar radiation, as we can see in Figure 4 (Jiachuan Yang & Bou-Zeid, 2019).

For buildings this is a roofing system that can provide high reflectance and high thermal emittance. It can be used as a geo-engineering technique to tackle global warming based on the principle of solar radiation management, provided that the materials used not only reflect solar energy, but also emit infra-red radiation to cool the planet.

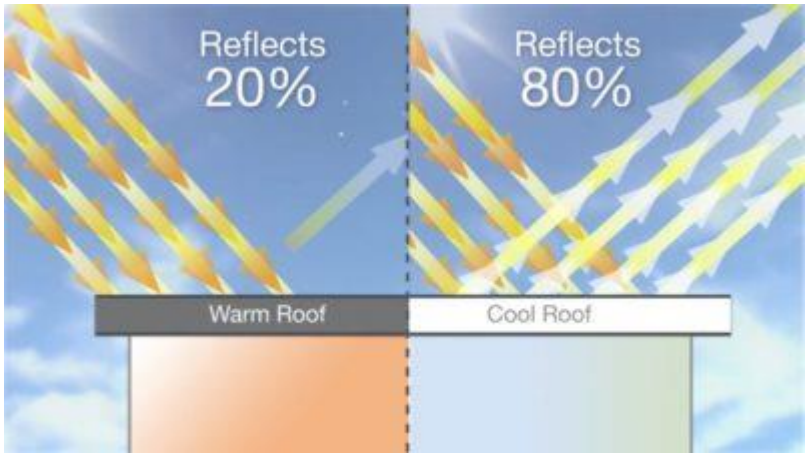


Figure 4 - Cool Roof Energy Reflection (Roofing Tri, n.d.).

These types of roofs offer a long-term saving in building energy costs. They can reduce building heat gain, as a white reflective roof typically increase only from -12ºC to -4ºC above ambient temperature during the day, create savings during summer on air conditioning expenses, enhance the life expectancy of both the roof membrane and the building cooling equipment, improve thermal efficiency of the insulation because of the temperature increase, reduce the demand for electric power, reduce the resulting air pollution and greenhouse gas emission and provide energy savings (Mishra, n.d.).

2.2.2 Green Roofs

Green roofs are considered one of the most appropriate sustainable solutions to resolve the UHI related issues, considering that they account in between of 20% and 25% overall urban surface areas.

They are also known as eco-roofs, and they can be defined as roofs coated with green vegetation and growing medium, as soil, over a waterproof membrane. The use of green roofs has several benefits, such as reducing greenhouse gas emissions, air pollution and urban heat island effects in highly populated areas, preventing the acid rain by escalating pH values, increasing the quality of city water, minimizing the risks of flooding by retaining the excessive water, providing better ecological habitat for urban life and wildlife, absorbing local noise pollution within urban areas and improving the durability of internal membranes. As for the thermal performance and microclimatic conditions, green roofs play a key role in energy savings, thermal insulation, shading and evapotranspiration. In the summer season, heat flow through the roof can be reduce by 80% with green roofs.

As for the design, there are several components, from top to bottom (Figure 5): vegetation (landscape materials), growing medium (substrate), filter, drainage material (moister retention), root barrier, water proofing membrane, insulation layer and structural layer as we can see in Figure 5. There can be some additional components depending on the climatic conditions, such as irrigations systems, that are required for hot and arid regions (Besir & Cuce, 2018).

Figure 5 - Schematics of different layers (Besir & Cuce, 2018).

There are three categories of green roofs, extensive, semi-intensive and intensive (Table 2), with respect to weight, substrate layer, maintenance, cost, plant community and irrigation.

Table 2 – Classification of green roofs according to type of usage, construction factors and maintenance requirements (Besir & Cuce, 2018).

	Extensive green roof	**Semi-intensive green roof**	**Intensive green roof**
			
Maintenance	Low	Periodicaly	High
Irrigation	No	Periodicaly	Regularly
Plant communities	Moss-sedum-herbs and grasses	Grass-Herbs and shrubs	Lawn or perennials, shrubs and trees
Cost	Low	Middle	High
Weight	60-150 kg/m^2	120-200 kg/m^2	180-500 kg/m^2
Use	Ecological protection layer	Designed green roof	Parks like garden
System build-up height	60-200 mm	120-250 mm	150-400 mm underground garages ≥ 1000 mm

Considering the energy savings, research reveal that green roofs (without insulation material) are cooler by 12ºC in comparison with conventional roofs, according to the measured temperatures in summer period. In winter season, the temperature difference is about 4ºC. So, it is clear that buildings with green roofs consume less energy. As for the benefits of green roofs in terms of thermal performance enhancement can be illustrated as thermal insulation, evapotranspiration and shading.

In conclusion, there are some characteristics achieved from the research:

- Heat penetration from the building roof in summer can be mitigated by 80%, using green roofs;
- Green roofs consume 2,2 – 16,7% less energy than traditional roofs in summertime;
- The temperature difference between conventional and green roofs in winter is about 4ºC and in summer 12ºC;
- Bare roof albedo of 0,15, in comparison with 0,30 of green roof, renders 75% higher heat storage.

Generally, green roofs (Figure 6) are sustainable, energy-efficient and eco-friendly structures toward low-zero carbon building standards (Besir & Cuce, 2018).

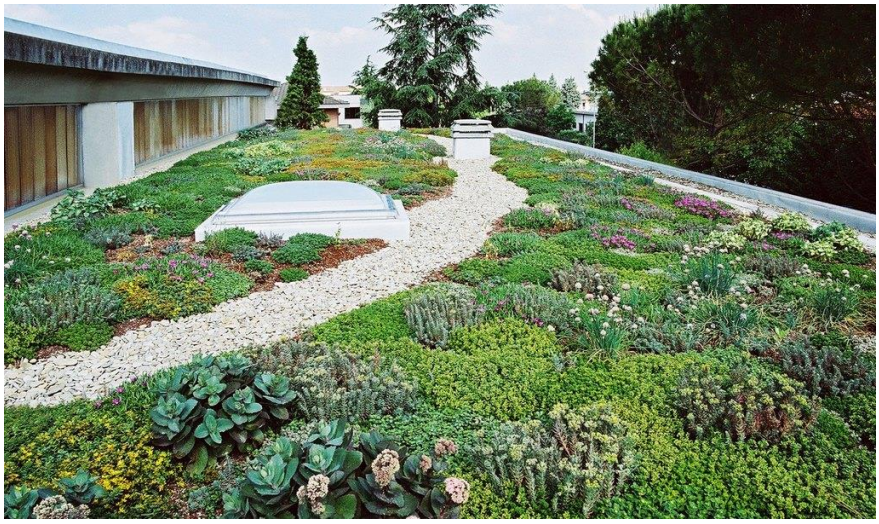


Figure 6 - Green Roof. (Design, n.d.)

2.2.3 The Ventilated Permeable Roofs and Herotile-based Roofs

The Ventilated Permeable Roofs and HEROTILE-based Roofs (Figure 7) are possible solutions used to reduce building overheating, as "passive cooling" technologies, that can reduce roof temperatures. The use of this type of roofs is a more sustainable and low-cost approach that permits the roof to breathe and disperse the accumulated solar heat, with high performance that remains stable over time.

In a previous project – LIFE HEROTILE – new types of clay roof tiles were developed and tested (HEROTILES). They present a shape that allows to reach a higher roof ventilation/air permeability, obtaining like this an increase of roof cooling performance compared with other roof technologies.

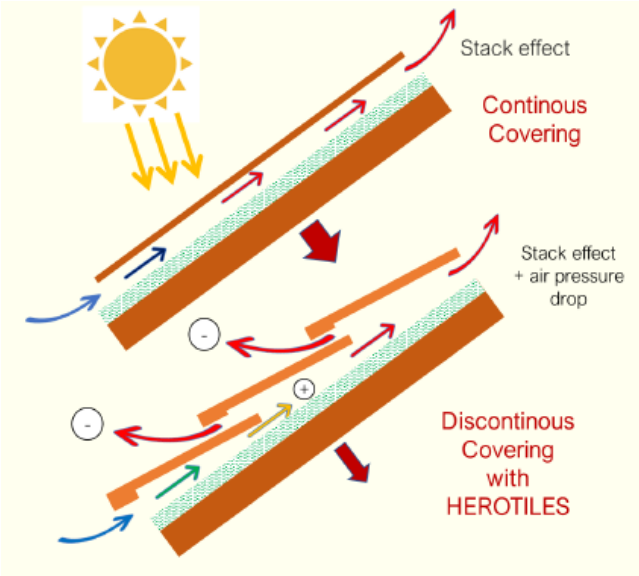


Figure 7 - Schematics of the difference between continuous covering and discontinuous covering with HEROTILES (Di Giuseppe, 2016).

The results obtained during this project and also the technological improvement of VPR obtained with the use of HEROTILE-based roofs encouraged the current project LIFE SUPERHERO to work with the aim of overcome the existing barriers to the diffusion of VPR and HBR. This project also aims to demonstrate that VPR and HBR benefits are related to not only the building comfort/cooling consumption but also to UHI adaptation, related to the roof tile temperature reduction.

There are a couple of barriers regarding VPR and HBR, because there is a lack of consolidated legislative framework for building passive cooling technologies and especially Ventilated Permeable Roofs, and also lack of awareness on the positive outcome of VPR on UHI, indoor comfort and energy savings. Current EU directives on buildings performance, their implementation in national energy codes, building green rating systems and public procurement do not consider properly the benefits of building energy cooling technologies for summer energy saving. More so, there is no methodology for the quantification of vented roofs cooling potential in the international standards, and the EU legislative frameworks are mainly focused on winter heating saving obtained by a highly insulated building envelope.

Also, there isn't a complete understanding of the possible benefits of the roof passive cooling technologies for indoor comfort and energy savings during hot seasons. Policy makers and public administers are not considering possible benefits in their climate adaptation and mitigation policies and plans (Di Giuseppe, 2016).

It is important to talk about the impact of VPR on UHI (Figure 8) because of some results obtained in LIFE HEROTILE project, as reduction of cooling energy then of the heat release by air-conditioning equipment's in the urban canyons, and the reduction of the tiles temperature then of the temperature of the air-conditioning.

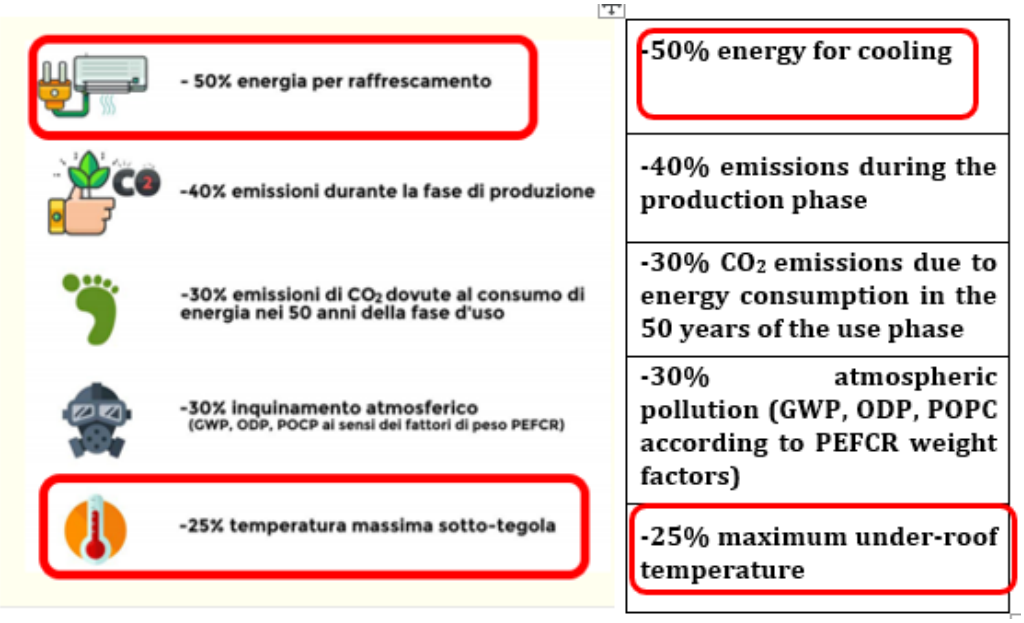


Figure 8 - Impact of VPR on UHI (Di Giuseppe, 2021).

VPR is a low cost, low maintenance, durable solutions, suitable to be applied in European city centers, and it requires a cooling energy reduction (Di Giuseppe, 2021).

2.3 The Urban Climate Tool: Urban Weather Generator

In order to analyze the UHI effect, it is important to differentiate between its mesoscale component, produced by the aggregated effect of the city on the urban boundary layer, and its canopy-scale component due to the urban canyon effect. Building energy simulation programs use meteorological databases obtained from measurements at operational weather stations for annual energy calculations. These stations are located, normally, in open areas outside the city, without nearby obstructions.

The Urban Weather Generator (UWG) calculates urban air temperature using the meteorological information measured at the operational weather stations and accounts for the reciprocal interactions between building and the urban climate. The UWG calculates hourly values and the model is composed by four coupled modules: the Rural Station Model (RSM) – calculates sensible heat fluxes at the weather station -, the Vertical Diffusion Model (VDM) – calculates vertical profiles of air temperature above the rural site -, the Urban Boundary-Layer (UBL) model – calculates air temperatures above the urban canopy layer (above urban canyons) – and finally, the Urban Canopy and Building Energy Model (UC-BEM) – calculates urban sensible heat fluxes and urban canyon air temperature and humidity (Figure 9).

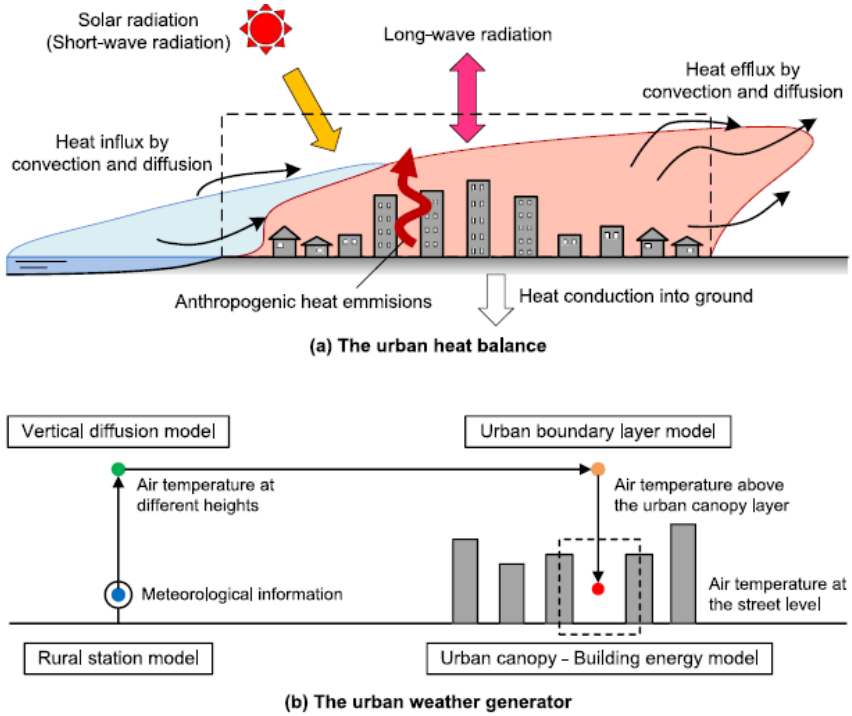


Figure 9 - Concept of the urban microclimate environment: (a) Heat Balance of urban surface layer; (b) The urban weather generator (Mao et al., 2017).

Rural Station Model

The RSM is a rural canopy model that reads hourly values of meteorological fields measured at the rural site and calculates sensible heat fluxes, that are then provided to the VDM and UBL model. This model is based on an energy balance at the soil surface. A transient heat diffusion equation represents the storage and release of the heat from the ground. Dividing the ground in layers, the RSM solves the equations:

$$d_1(\rho c)_1 \frac{\partial T_1}{\partial t} = C_{1,2}(T_2 - T_1) + Q_{surf}$$

[Equation 1]

for the first layer,

$$d_i(\rho c)_i \frac{\partial T_i}{\partial t} = C_{i,i+1}(T_{i+1} - T_i) + C_{i,i-1}(T_{i-1} - T_i)$$

[Equation 2]

for the intermediate layers and

$$d_{n-1}(\rho c)_{n-1} \frac{\partial T_{n-1}}{\partial t} = C_{n-i,n}(T_{deep} - T_{n-1})$$

[Equation 3]

for the deepest layer.

Radiation heat fluxes are measured at the weather station. Surface sensible heat fluxes are computed using convective heat transfer coefficients. Latent heat fluxes due to evapotranspiration of vegetation are calculated as a fraction of the absorbed shortwave radiation. An appropriate model for accuracy requirements of UWG benefits from the fact that the ratio between the latent heat flux and the net radiation is almost constant during daytime. The net radiation is the sum of the net shortwave radiation, which presents small variations during the day. When there is no light, plants stomata are usually closed so that transpiration after sunset is virtually negligible. Some studies show this effect comparing heat fluxes measured in different cities and different vegetations fractions and also some indicate that the evapotranspiration from vegetation is mainly dependent on solar radiation, which means that after the difficulty is determining the fraction of absorbed solar radiation that is converted into latent heat by plants. The current version of the model assumes 50% conversion.

Vertical Diffusion Model

The VDM reads air temperatures and velocities measured at the weather station, as well as sensible heat fluxes calculated by the previous model, and calculates vertical profiles of air temperature above the weather station, that are then provided to the UBL model. This model solves the following equation_

$$\frac{\partial\theta(z)}{\partial t} = -\frac{1}{\rho(z)}\frac{\partial}{\partial z}\left(\rho(z)K_d(z)\frac{\partial\theta(z)}{\partial z}\right),$$

[Equation 4], θ is the potential temperature of air, z is the vertical space component, r is the air density and K_d is a diffusion coefficient.

The lower boundary condition of this equation is the temperature measured at the weather station. The upper boundary condition accounts for the fact that at a certain height, the profile of the potential temperature is uniform and $\frac{d\theta}{dz}|z_{ref} = 0$.

Urban Boundary-Layer Model

The UBL model calculates air temperatures above the urban canopy layer from the temperatures at different heights provided by the VDM and the sensible heat fluxes provided by the RSM and the UC-BEM. It is based on an energy balance for a selected control volume inside the urban boundary layer delimited by the blending height (z_r) and the boundary-layer height (z_i). The energy balance is expressed:

$$V_{CV}\rho c_v\frac{d\theta_{urb}}{dt} = H_{urb} + \int u_{ref}\rho c_p(\theta_{ref} - \theta_{urb})dA_f,$$

[Equation 5], Vcv is the control volume, ρ is the air density, c_v is the air specific heat at constant volume, c_p is the air specific at constant pressure, θ_{urb} is the average potential temperature of the control volume, H_{urb} is the sensible heat flux at the surface of the control volume, θ_{ref} is a reference potential temperature outside the control volume, u_{ref} is a reference air velocity and A_f is the lateral area of heat exchange between the control volume and its surroundings. In this equation, on the left it represents the thermal inertia of the control volume and on the right, the second term represents the advection effect. This model assumes the potential temperature is uniform inside the control volume.

The UBL model distinguishes between night and day urban boundary layers, and between the advection effect determined by geostrophic wind (forced problem) and by urban breeze circulation (buoyancy-driven problem). The problem is assumed to be buoyancy-driven if the circulation velocity is greater than the air velocity measured at the weather station. The circulation velocity is calculated from:

$$u_{circ} = k_w\left(\beta z_i\frac{H_{urb} - H_{rur}}{\rho c_p}\right)^{1/3},$$

[Equation 6], k_w is a constant, β is the buoyancy coefficient, and H_{urb} and H_{rur} are the sensible heat fluxes from the urban and the rural sites.

Finally, the equation of the energy balance can be expressed as:

$$\theta_{urb} - \theta_{urb}^{-} = C_{surf} + C_{adv}\theta_{eq} - C_{adv}\theta_{urb},$$

[Equation 7], where the values of C_{surf}, C_{adv} and θ_{eq} can be calculated according to the next table.

Table 3 - Calculation of the values C_{surf}, C_{adv} and θ_{eq} (Bueno et al., 2013; Mao et al., 2017).

	C_{surf}	C_{adv}	θ_{eq}
Night			
Forced (first)	$\frac{H_{urb}\delta}{z_i \rho c_v}$	$\frac{u_{wind}(z_m) z_i \delta c_p}{2 z_m dx c_v}$	$\frac{2}{3}\theta_{rur}(z_i) + \frac{1}{3}\theta_{rur}(z_r)$
Forced (rest)			θ_{n-1}
Buoyancy-driven	$\frac{H_{urb}\delta}{z_i \rho c_v}$	$\frac{P_{city} u_{circ} \delta c_p}{A_{city} c_v}$	$\frac{1}{2}\theta_{rur}(z_i) + \frac{1}{2}\theta_{rur}(z_r)$
Day			
Forced	$\frac{H_{urb}\delta}{z_i \rho c_v}$	$\frac{W u_{wind}(z_m) \delta c_p}{A_{city} c_v}$	$\theta_{rur}(z_{ref})$
Buoyancy-driven	$\frac{H_{urb}\delta}{z_i \rho c_v}$	$\frac{P_{city} u_{circ} \delta c_p}{A_{city} c_v}$	$\theta_{rur}(z_{ref})$

Urban Canopy and Building Energy Model

The UC-BEM calculates urban canyon air temperature and humidity from radiation and precipitation data, air velocity and humidity measured at the weather station, and from the air temperature above the urban canopy layer calculated by the UBL model. This model is based on the town energy balance (TEB) scheme, including its building energy model. It assumes that the air inside the urban canopy layer is well mixed. Urban canyon air temperatures are obtained by the heat balance method, considering the heat capacity of the urban canyon air. The urban canyon energy balance accounts for the heat fluxes from walls, windows and the road, the sensible heat exchange between the canyon air and the atmosphere, the heat fluxes due to exfiltration, the waste heat from heating, ventilation and air-conditioning (HVAC) equipment and other anthropogenic heat sources, and the radiant heat exchange between the canyon air and the sky. The urban canyon energy balance is given by:

$$V_{can}\rho c_v \frac{dT_{urb}}{dt} = A_w h_w (T_w - T_{urb}) + A_r h_r (T_r - T_{urb}) + A_r h_{rd,sky}(T_{sky} - T_{urb})$$

$$A_{win} U_{win}(T_{in} - T_{urb}) + \dot{V}_{inf/vent}\rho c_p (T_{in} - T_{urb}) + u_{ex}\rho c_p (T_{ubl} - T_{urb}) + H_{waste} + H_{traffic},$$

[Equation 8], T_{urb}, T_{in} and T_{ubl} are the air temperatures of the urban canyon, the indoor air temperature and the air temperature of the urban boundary layer above the urban canyon. T_{sky} is the effective sky temperature, V_{can} is the volume of the urban canyon air, U_{win} is the U-factor of the windows including heat exchange coefficients at both sides, $V_{ind|vent}$ is the exfiltration airflow rate, H_{waste} is the sensible component of waste heat flux release by

HVAC systems into the urban canyon, $H_{traffic}$ is representing other anthropogenic sources of heat and u_{ex} is the exchange velocity between the in-canopy and above-canopy flows. An analogous latent heat balance is solved to calculate the humidity content of the urban canyon air by computing the latent heat fluxes from the atmosphere, buildings and road. The UWG assumes that the air humidity above urban canyons is the same as the one measured at the weather station for each time step.

The exchange velocity is obtained from:

$$u_{ex} = \frac{u_*}{\frac{u_{atm}}{u_*} - \left(\frac{8}{VH_{urb}}\right)^{1/2}},$$

[Equation 9], where the u* is the friction velocity and the u_{atm} is the reference air velocity above the urban canopy assumed equal to the air velocity measured at the weather station.

In large spaces as urban canyons, the water vapor present in the air participates in the radiant heat exchange. The air emissivity is calculated as a function of the humidity content and the size of the space. On the urban canyon energy balance equation the h_w and h_r are the heat transfer coefficients of walls and roads, which combine convective and radiative effects; and $h_{rd,sky}$ is the radiant heat transfer coefficient between the urban canyon air and the sky.

External surface temperature of walls, road and roof are calculated by solving a similar surface energy balance to the one described for the rural soil. The boundary conditions of the road are the same as for the rural soil. In walls and roof, the indoor boundary condition is a heat flux calculated by the building energy model.

The outdoor surface heat flux is composed of shortwave radiation, longwave radiation, sensible and latent heat components. The solar radiation received by walls and road is calculated by assuming an average urban canyon orientation. The longwave radiation in walls, road, urban canyon air and the sky is computed by linearization of the Stefan-Bolstzmann equation accounting for the transmittance of the urban canyon air and presuming one bounce of radiative heat fluxes between surfaces. Window surfaces are assumed to have the same temperature as wall surfaces. Surface sensible heat fluxes are computed by using CHTC, that are calculated as a function of the air velocity above the urban canopy layer by using the correlation:

$$h_{cv} = 5.8 + 3.7u_{atm}.$$

[Equation 10]

The air velocity inside the urban canyon is used on this equation for the road. This is given by the following equation:

$$u_{can} = u_* \left(\frac{8}{VH_{urb}} \right)^{1/2}$$

[Equation 11]

Urban sensible heat fluxes are calculated as the sum of the heat exchange between the canyon air and the atmosphere and the connective heat flux from building roofs, including the part of waste heat emissions from outdoor HVAC equipment.

For road and roof, the UC-BEM calculates the latent heat flux associated with a thin layer of water, that remains after the precipitation water is run off. The mass balance to the film of water is given by the following equation:

$$\frac{dw_g}{dt} = (P_g - E_g)$$

[Equation 12], P_g and E_g are the precipitation and evaporation mass fluxes.

The water evaporation is calculated by:

$$E_g = \frac{1}{\rho_w R}(q_{sat}(T_{surf}) - q_a)$$

[Equation 13], R is the aerodynamic resistance obtained from the CHTC, ρ_w is the water density, q_{sat} is the saturation specific humidity at surface temperature and q_a is the specific humidity of the air above the surface. If the depth of the layer is bigger than zero, the latent flux is calculated as $L = E_g . \rho_w . l_v$, where l_v is the latent heat of vaporization.

The vegetation model of the UC-BEM obeys the shade-convection approach. The solar radiation that reaches urban canyon is partially blocked by the trees according to the horizontal vegetation density. The solar radiation that is absorbed by the trees is

split into sensible and latent heat fluxes, fluxes that participate in the energy balnce of the urban canyon. The tree canopy reduces the sky view factor of the urban canyon and may reduce the net outgoing radiation, the model assumes that the temperature of urban surfaces is close enough to the one of the tree canopy so the overall effect of trees on the longwave radiation balance is negligible.

The physical and geometric definition of buildings is as simple as possible, maintaining the required features of comprehensive building energy model. The model considers a single thermal zone, where the thermal inertia of building materials associated with multiple levels is represented by a generic thermal mass. Also it accounts for heat gains due to transmitted solar radiation, heat conduction through the enclosure, infiltration, ventilation and internal heat gains, as well as for the dynamical evolution of indoor air temperature and humidity.

To calculate cooling energy consumption, the model resolves the dehumidification of air passing through the cooling system, assuming that the air leaves the cooling coil at 90% relative humidity. It includes the mixture of recirculated air and outdoor air according to the ventilation air flowrate.

Waste heat fluxes are calculated as a function of building energy consumption (Q_{cons}) and building energy demand (Q_{dem}). For a cooling system, the waste heat flux is provided by (Bueno et al., 2013; Mao et al., 2017):

$$Q_{waste} = Q_{cons} + Q_{dem}.$$

[Equation 14]

2.4 General Considerations

This chapter presented the main problem at the level of population increase and climate change - UHI - and the type of roofs that help mitigate this problem. Well studied and with vast literature we have the green roofs and the cool roofs, which we conclude are not always the best solution when we have to consider the local climate, aesthetics or meeting local architectural and landscape limits. The reflectance of "cool" materials and their effectiveness is reduced over time due to aging, atmospheric deterioration and dust, which means that cleaning and maintenance is needed; this maintenance and operation is quite high for green roofs also.

Thus enters the study of new roof types - VPR and HBR. Throughout this report the study of these types of roofs and the simulations performed in different cities will be demonstrated, using the software Urban Weather Generator, and the results obtained will be presented. In this chapter, the part concerning the UWG is merely explanatory and introductory, to give an understanding of how the software works, all this information having been taken from existing research. As for the work done on the software during this internship, it will be demonstrated in the next chapter.

3. Case of Study and Tools

3.1 Introduction

Throughout the internship several informatic software's were used, like SENSAPIRO, DesignBuilder and Urban Weather Generator, to help the study of these new type of tiles and the performance in terms of energy consumption. Simulations were also made, for different scenarios and different data, in order to obtain a considerate number of results, to provide better results.

The first point will present the case studies used throughout the internship followed by the tools in order to provide information about how it works, the input data and the output analyzed.

3.2 Case Studies

3.2.1 First Case Study

For the first software, SENSAPIRO, in order to understand how the software works, some simulations were made in the area of Reggio Emilia (Figure 10), which is where the existing buildings under study are located. The table 4 and 5 show the properties of the HEROTILE based roofs.

Figure 10 - Localization of the building in study – Via Giuseppe Maramotti, 23, 42122 Reggio Emilia RE.

Table 4 - HEROTILE based roof properties.

HeroTile based roof		
Thermal transmittance [W/m²K]	Tickness [m]	Thermal resistance [m²K/W]
0,23	0,209	4,35

Table 5 - HEROTILE based roof properties.

HeroTile based roof						
Layer (indoor-outdoor)	Layer thickness [m]	Layer conductivity [W/mK]	Density [kg/m³]	Thermal resistance [m²K/W]	Specific heat [J/kgK]	Vapor resistance
Vapor-permeable felt	0,002	-	-	0,01	-	(factor) 150
XPS	0,15	0,032	35	-	1400	(resistivity) 600 (MNs/g)
Bitumen	0,002	0,17	1200	-	1000	Non permeable
Air cavity	0,04	0,8	1,23	-	1008	(factor)1
Clay tile	0,025	1	2000	-	800	(resistivity) 1000 (MNs/g)

3.2.2 Second Case Study

For the second software, DesignBuilder, the case study simulated was in Ferrara, where the roof was simulated for the right slope and left slope, and the configuration of the roof was with standard roof and HBR roof. Figure 11 shows the model for the building.

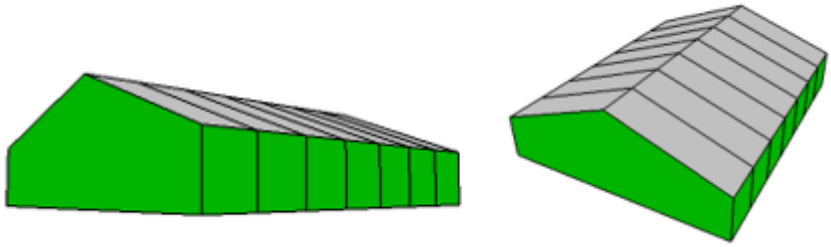


Figure 11 - Building model used for DesignBuilder, from two different perspectives.

3.2.3 Third Case Study

Initially for understanding what needed to be done and to perform different simulations, the HBR roof stratigraphy was used and the location of the building in study for the SUPERHERO project. But, to expand the work and get more results that can be used in the project and can be used for possible literature, it was decided for the UWG simulations, on a typical stratigraphy for a conventional roof without insulation (Table 6) and simulate for HBR tile.

Table 6 - Conventional roof stratigraphy.

	Layer (indoor - Outdoor)	Layer thickness [m]	Layer conductivity [W/mK]	Density [kg/m^3]	Specific heat [J/kgK]	Vol. Capacity (J/(m3-K)	
Conventional roof	Intonaco	0,01	1	1800		0	Without insulation
	Cls Armata	0,15	2,3	2400	1005	2412000	
	Air cavity	0,05	0,8	1,23	1008	1239,84	
	Clay tile	0,07	0,84	1900	800	1520000	

The first goal was to select a couple of European cities to run the simulations, but in the end the weather files were not updated and only Lisbon and Ancona were chosen because they were the most recent ones, for the year 2005.

By the Koppen system (Figure 12), Lisbon is a Csa – Hot summer Mediterranean Climate – and Ancona is a Cfa – Humid Subtropical Climate.

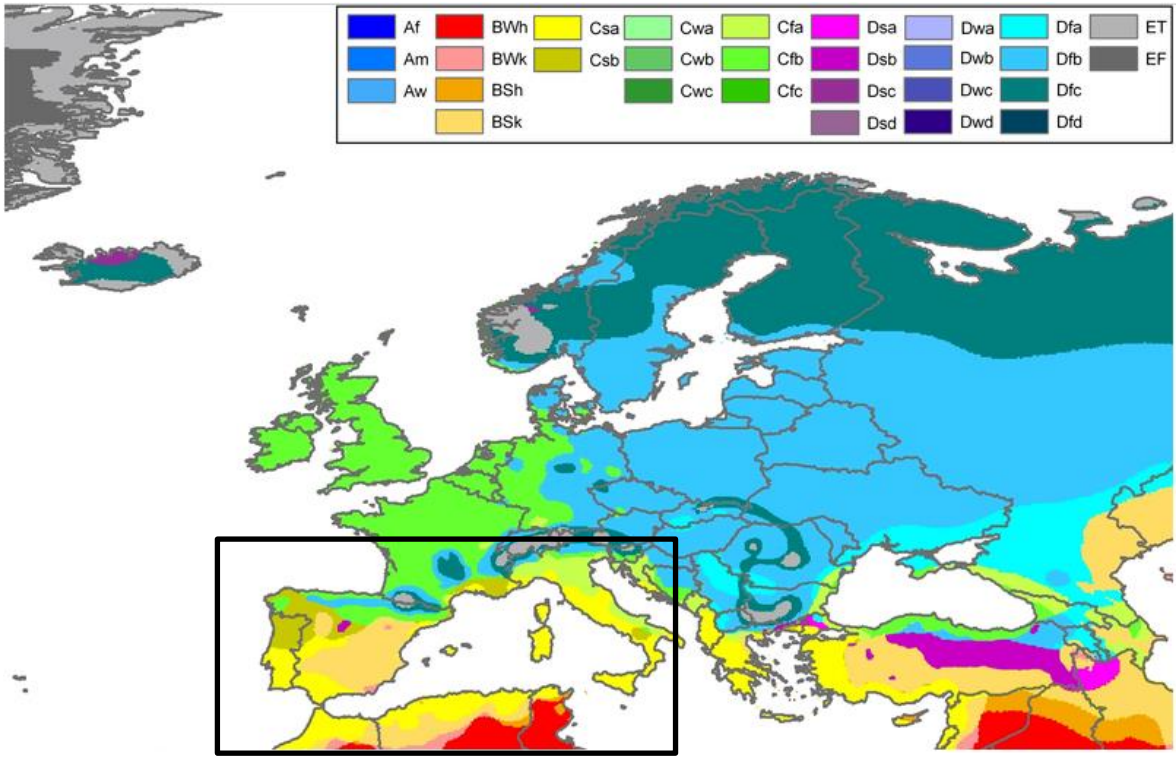


Figure 12 - Koppen-Geiger Classification map for Europe (2071-2100) (Beck et al., 2018).

Simulations were performed in two different cities – Lisbon and Ancona – and for five different LCZ's – LCZ 2,3,4,5 and 6. The highlighted area (Figure 12) was expanded to mark the cities referred (Figure 13).

Figure 13 - Location of the cities used as case study (Plantmaps, 2022).

3.3 Informatic Tools

3.3.1 SENSAPIRO

The sensapiro software (Figure 14) stands for Software Energy Saving Pitched roofs, and it was developed within the LIFE + HEROTILE European project. It can estimate in a simplified form, the performance, in terms of energy consumption for cooling in summer, that some types of roofs and roof covering can provide to buildings.

It is based on the statistical analysis of prolonged instrumental surveys carried out on special constructed experimental buildings, also compared with real cases appropriately monitored. In addition to the performance of standard roofing membranes made with portuguese tiles, marsigliese tiles, metal sheets and others on the market, also allows the evaluation of the performance of two particular types of portuguese and marseille tiles, developed within the HEROTILE project, in order to increase the performance of air circulation in the undercoat for the purposes of passive air conditioning of the attic rooms in summer.

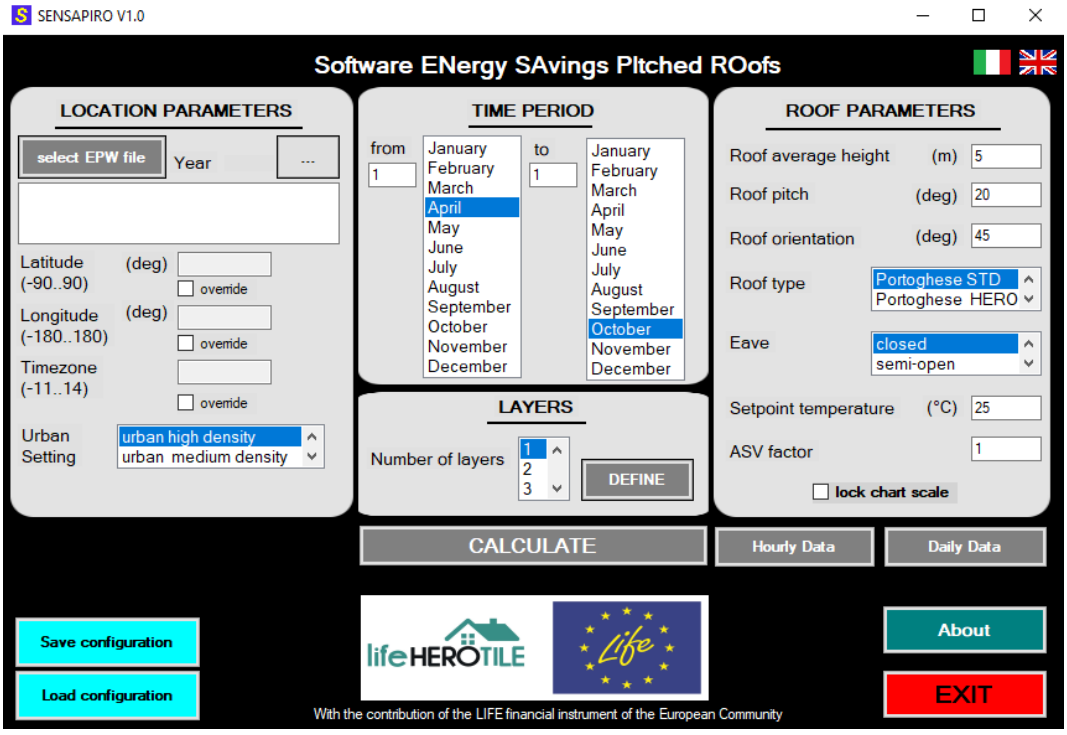


Figure 14 - Software Ene4rgy Saving Pitched Roofs - SENSAPIRO.

Software Execution

To start, the main window (Figure 14) allows us to:

1. Select the weather file (*.EPW) from ENERGYPLUS software database;
2. Specify the urban context withing which building whose roof is being assessed is located;
3. Choose the calculation period;

4. Define the configuration of the "roofing package" and the materials of the layers and relative thickness;
5. Define the roof configurations.

1. Select the weather file: To perform the calculation, first it is necessary to specify the location in which we want to conduct the numerical assessment, which occurs automatically when we select the EPW file.

If the user does not have any EPW file store in the computer, can directly access the official EPW file storage website (NREL; DOE; Academic Institutions; Private Firms, n.d.). The user can search for the weather station of the location of interest and make the download of the EPW file according to the usual methods available. Is the meteorological and climatic station is not available in the area of interest, the user can load the one that is most appropriate and manually modify longitude, latitude and time-zone, for a more precise estimate of the inclination angle of solar radiation.

2. Urban context: the user must specify the urban location of the building whose roof is being study.

3. Calculation period: is defined by the start day and month and the end day. For sensapiro the summer performance is being studied.

4. Definitions of the roof structure: the software allows to define the layers of the structural package below the roof covering by choosing the products. The performances concerning the roof covering are statistically defined based on the experimental measurements carried out during the three years of the LIFE HEROTILE project, the heat transmission in the structural package is resolved according to the UNI EN ISO 13786:2018 standard, through the calculation of the attenuation factor, the phase shift and other quantities. The configuration of the roof structure takes place by indicating in the main window the number of layers making up the roofing package to be evaluated, then a new window will open and on this, a number of records will appear equal to the number of layers that was defined. The insertion of the layers occurs from the internal to the external side of the roof and it is possible to select from the drop-down menu the material or product constituting the layer. The program automatically fills the physical-technical parameters, but we can always change the values. Once the structure configuration is completed, the "CALCULATE" button will calculate and display the decrement factor and other quantities, in accordance with the UNI EN ISO 13876:2018.

5. Configuration of the roof package: for the configuration, the user must define a couple of parameters, such as:

- The reference heigh of the roof relative to the ground [m];
- The roof pitch relative to the horizontal [def];
- The orientation of the roof with the respect to North [deg];
- The type of roof covering;
- The configuration of the eaves;

6. The setpoint temperature [ºC] (Energy & Pitched, 2019).

Example of a simulation

In this simulation, the considerations were:

- Urban setting: urban low density, because is a rural area in Reggio Emilia;
- Time period: summer performance (may-october);
- Number of layers: 3, as we can see on table 2;
- Roof average height: 11,29 m (value that we took from autocad file);
- Roof pitch: 20 deg;
- Roof orientation: 90 deg, because the exposure of a groundwater is to the East;
- Eave: 50%, semi-open;
- Setpoint temperature: 26ºC;
- Type of tiles: Marsigliese HEROTILES.

Then we define the layers of the roof (Figure 15), with the help of the excel file provided by the professor (Table 4 and 5) and calculate them. The software will calculate the decrement factor and other parameters.

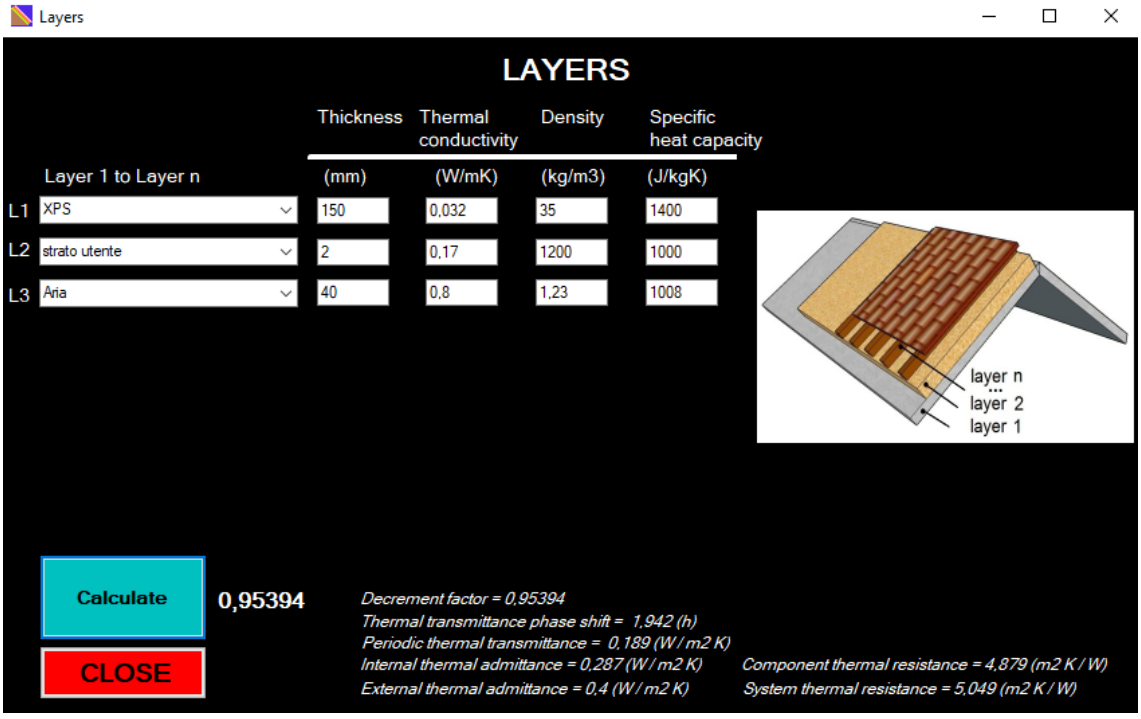


Figure 15 - Definition of the layers in the SENSAPIRO software.

When the roof configuration is complete, the calculation is started by clicking on the button "CALCULATE". This software makes the calculation in hourly values and daily values, representing the results in a numerical and graphical form (Figure 16 and 17).

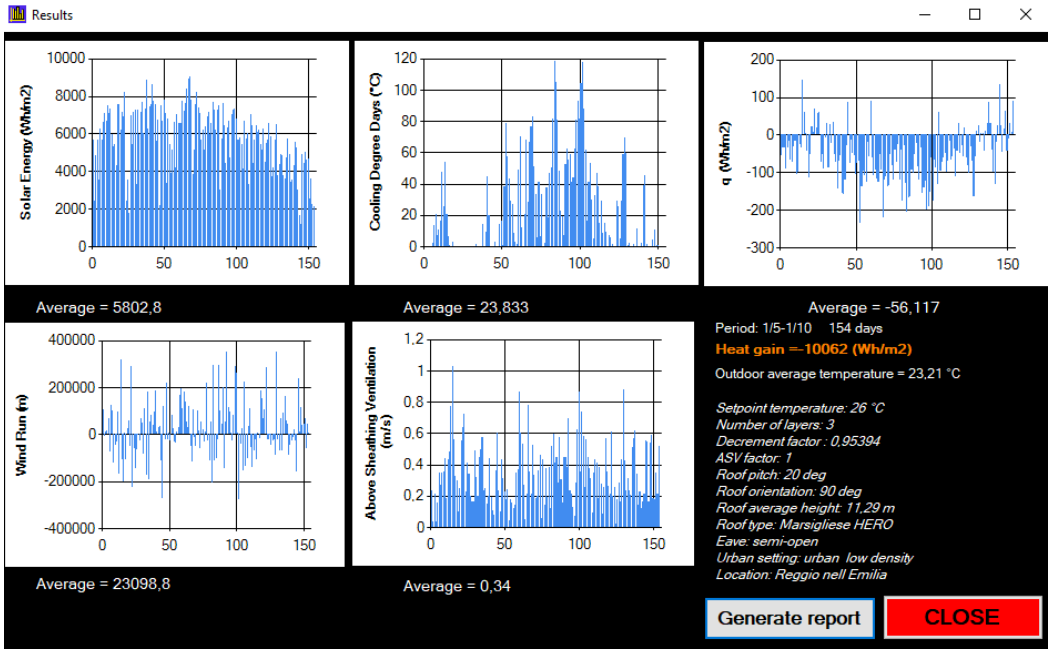


Figure 16 - Graphic results from the SENSAPIRO software.

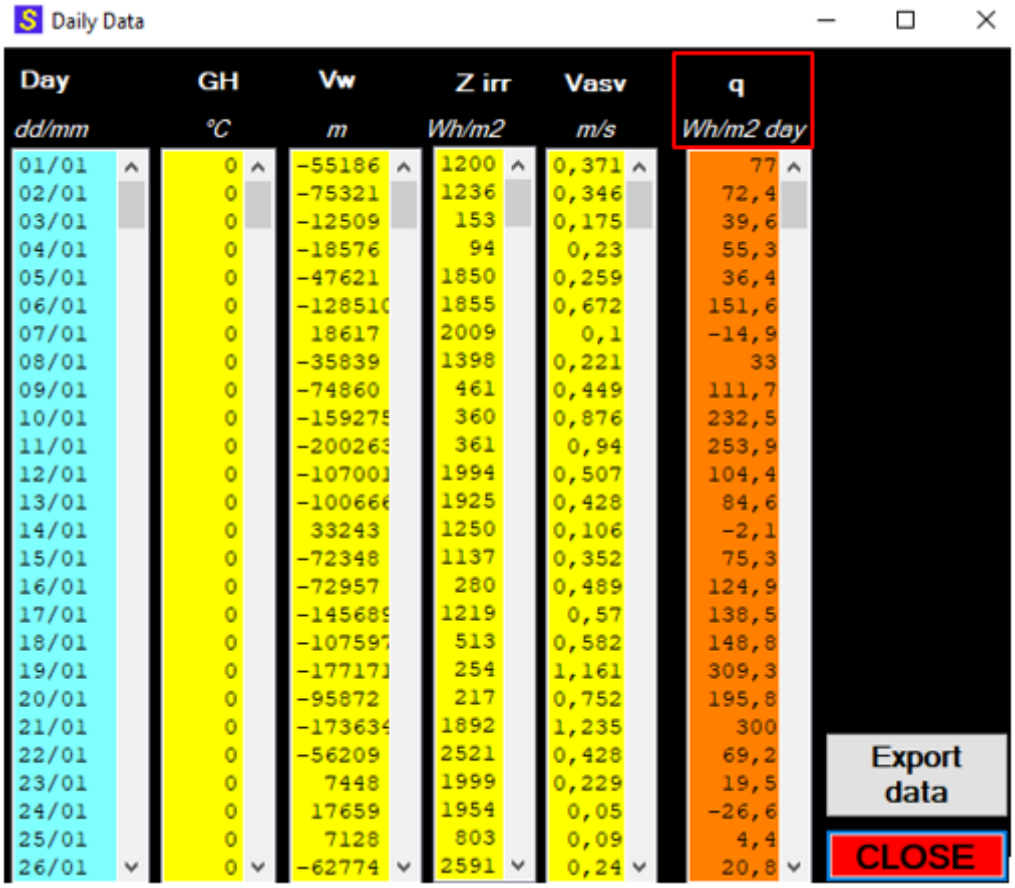


Figure 17 - Numerical results from the SENSAPIRO software.

The result is the values of **q** (Wh/m²day), this is the amount of specific thermal energy that passes through the roof per m².

We ended up not using the results from this software, because there were some problems. The most relevant limitation was related to the q calculation, some shift was found in the hourly data but probably it depends on the .EPW files, also when we calculate and go to the panel with the graphs, the average outdoor temperature is not the real average but the value at 00:00 am, which means that is the first value for the day that we simulate.

3.3.2 DesignBuilder

This software is an advanced graphical user interface that was developed to run EnergyPlus simulations. Typical uses of DesignBuilder are (DesignBuilder, n.d.):

- Calculating the impact of various design options on building energy consumption;
- Evaluating façade options for overheating and visual appearance;
- Thermal simulation of naturally ventilated buildings;
- Reporting savings in electric lighting due to use of natural daylight;
- Prediction of natural daylight distribution through Radiance and Daysim simulations;
- Visualization of site layouts and solar shading;
- Calculating heating and cooling equipment sizes;
- Detailed simulation and design of HVAC and natural ventilation systems including the impact of supply air distribution on temperature and velocity distribution within a room using CED;
- ASHRAE 90.1 and LEED energy models;
- Economic analysis based on constructions costs, utility costs and life cycle costs (LCC);
- UK, Ireland and France Building regulations and certification reports;
- Design optimization with multiple objectives, constraints and design variables;
- Life Cycle Analysis (LCA);
- Communication aid at design meetings;
- An educational tool for teaching building simulation to architectural and engineering students.

Software Execution

To start the execution in DesignBuilder (Figure 18) we can create a new file or open an existing one, and to run the simulation that is needed for the project in question, the professor provided the DesignBuilder file correspondent to the case study in Ferrara.

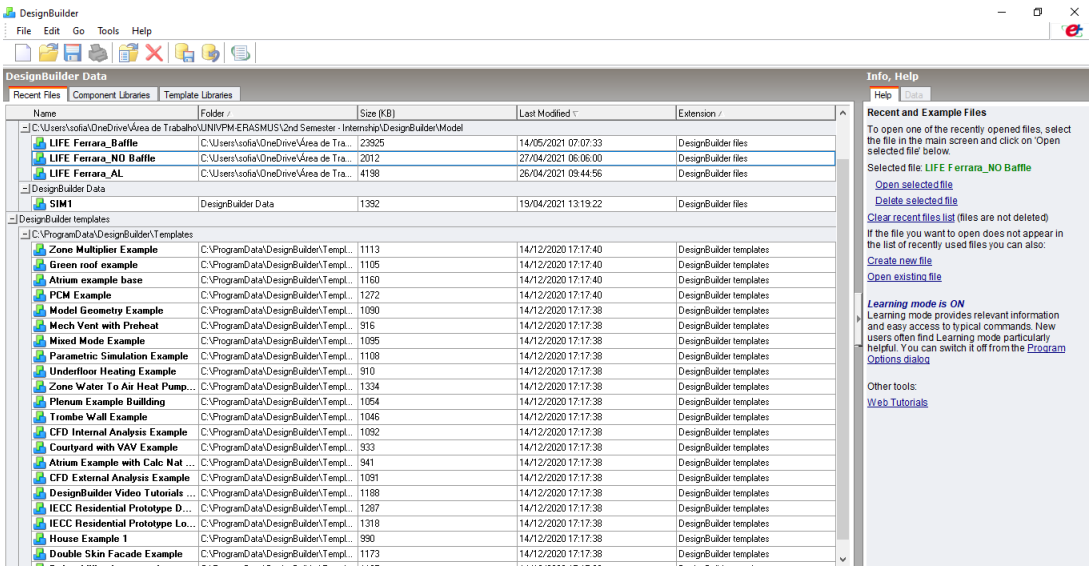


Figure 18 - Main Window of the software DesignBuilder.

In order to proceed with the simulation, it is necessary to estipulate some parameters. It is essential to know which part of the structure we want to simulate, and also which time period. For this case, we want to simulate the roof structure and for the summer season. The software also allows us to choose the time steps for the results and the results can come in monthly, daily, hourly and sub-hourly values, providing more or less data. The results obtained from the program can be seen in form of graph, grid or table, and we can export them in very formats.

Simulations

For this project it was necessary to run some simulations, to analyze the data regarding the HEROTILE based roof of the case of study in Ferrara. It was analyzed the summer performance, so the simulations were runed during the month of July and August. Also, the simulations were made for two different models – baffle model and no baffle model.

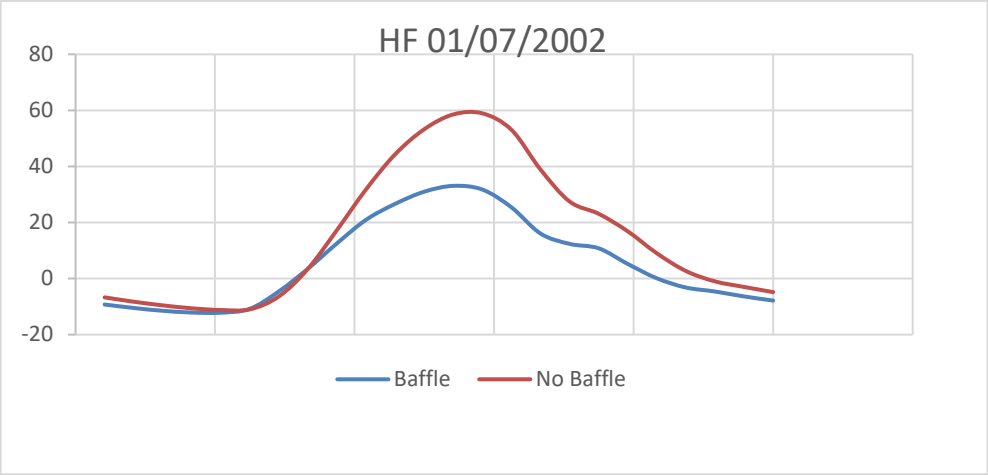
The baffle components consist of an outside baffle surface which is slightly detached from the main wall or roof forming a cavity which exchanges air with the outside environment. They are used to model naturally ventilated rainscreens and/or solar shading of exterior surfaces(DesignBuilder, n.d.).

The first simulation was made to understand how the software works, so it was made for the month of July, for the two models, obtaining like this data about surface gain, solar radiation and outside temperature, as we can see in the table and graph

below – Table 7 and Graphic 1. The data was exported in grid (excel) so it could be analyzed and transformed into graphics to understand the relation in terms of surface gain and exterior surface temperature, between the two different models, since the goal is to understand how we can lower the values of the no baffle model to the ones of the baffle model.

Table 7 - Heat Flux and ratio of the first simulation for the 1st of July.

Date July 2002	Hour	BAFFLE	NO BAFFLE	RATIO	
		W/m2	W/m2		
01/07/2002 01:00	01:00:00	-9,25041	-6,705400982	0,724876	0,724876
01/07/2002 02:00	02:00:00	-10,4859	-8,242389525	0,786043	0,75546
01/07/2002 03:00	03:00:00	-11,4851	-9,556792144	0,832103	0,781007
01/07/2002 04:00	04:00:00	-12,1043	-10,59116203	0,874995	0,831047
01/07/2002 05:00	05:00:00	-12,1679	-11,21538462	0,921717	0,876272
01/07/2002 06:00	06:00:00	-10,7787	-10,96301146	1,017097	0,937937
01/07/2002 07:00	07:00:00	-4,52979	-6,328641571	1,397117	1,111977
01/07/2002 08:00	08:00:00	3,556956	3,537152209	0,994432	1,136216
01/07/2002 09:00	09:00:00	12,62897	17,40294599	1,378018	1,256522
01/07/2002 10:00	10:00:00	21,00376	31,89574468	1,518573	1,297008
01/07/2002 11:00	11:00:00	26,67283	44,3797054	1,663854	1,520148
01/07/2002 12:00	12:00:00	31,00376	53,29394435	1,718951	1,633793
01/07/2002 13:00	13:00:00	33,07512	58,5710311	1,770848	1,717885
01/07/2002 14:00	14:00:00	31,73797	58,93060556	1,856786	1,782195
01/07/2002 15:00	15:00:00	25,38249	53,04042553	2,089646	1,90576
01/07/2002 16:00	16:00:00	16,04124	38,85613748	2,422265	2,122899
01/07/2002 17:00	17:00:00	12,37512	27,46841244	2,219648	2,243853
01/07/2002 18:00	18:00:00	10,7928	23,10229133	2,140528	2,260814
01/07/2002 19:00	19:00:00	5,206383	16,84762684	3,235956	2,532044
01/07/2002 20:00	20:00:00	0,088543	9,005564648	101,7079	35,69481
01/07/2002 21:00	21:00:00	-3,19002	2,695908347	-0,84511	34,6996
01/07/2002 22:00	22:00:00	-4,61097	-1,001800327	0,217265	33,69337
01/07/2002 23:00	23:00:00	-6,37463	-2,985761047	0,468382	-0,05315
01/07/2002	24:00:00	-7,84484	-4,826513912	0,615247	0,433631



Graphic 1 - Comparison of the heat flux of the two models for the 1st of July.

For the second simulation, the summer period was extended to July and August, to try to find a better connection between the models. As the results were in hourly values, the third and final simulation that was performed, the time step was changed to obtain data every 15 minutes for the month of July and August, and to simulate the right and left slope of the roof. For representation of results, only for the first simulation were presented, as the results were wide.

3.3.3 Urban Weather Generator

As shown in the chapter 2, the UWG is an urban heat island effect modeling software, that estimates the hourly urban canopy air temperature and humidity using weather data from a rural weather station. The output is a morphed weather file that captures urban heat island effect and is compatible with many building performance simulation programs (Norford & Reinhart, n.d.). It is important to understand how the heat exchanges work in UGW (Figure 19).

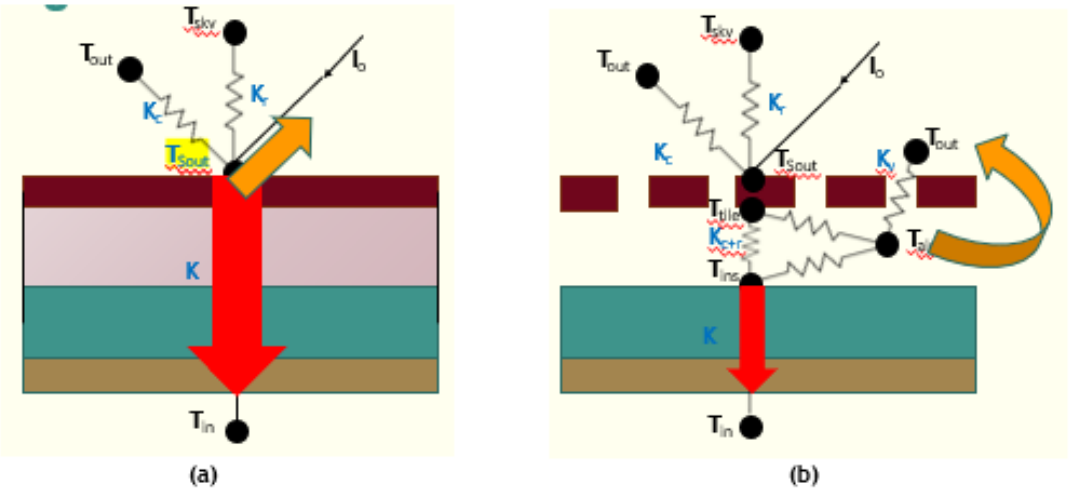


Figure 19 - Heat exchanges in UWG for not ventilated roof (a) and ventilated roof (b) (Di Giuseppe, 2021).

In UWG, the building envelope can be modelled considering several material layers with their thermal properties. The external surface is exposed to convection, long wave radiation and solar radiation. Based also in indoors and outdoors conditions, the software calculates for each hourly time step: the indoor and outdoor surface temperatures, the heat flow rate through the elements (roof and wall), the indoor air temperature, the net absorbed heat flow due to incident solar radiation on the outer material's absorptivity ($I_o=I_{sol}$ x α_{sol}) and the long wave radiation exchange, which depends on the outer material's emissivity, and for the roof is only intended to the sky. However, in a ventilated roof, the heat exchanges are more complicated, because we also have: convection and long wave radiation in the air cavity, ventilation heat flow from the air cavity to the exterior air, through under tile ventilation and air permeability. As result, a reduced heat flux is entering the building in summer. The ventilation heat flow from the air cavity to the exterior air contribute to reduce the tile surface temperature but may release warm air in the environment. In order to model the VPR thermal behavior in UWG, we need to modify the actual heat balance equations at the roof level included in the software to get: the same heat flux entering the building, the same heat release to the external air and the same external temperature (Di Giuseppe, 2021).

For the simulations, it was necessary some research on Local Climate Zones – LCZ (Stewart & Oke, 2012). All classes to emerge from logical division of the landscape universe are called "local climate zones". The name is proper as the classes are local in scale, climatic in nature and zonal in representation. It's formally defined local climate zones as regions of uniform surface cover, structure, material, and human activity that span hundreds of meters to several kilometers in horizontal scale. Each LCZ (Table 8,9 and 10) has a characteristic screen height temperature regime that is most apparent over dry surfaces, on calm, clear nights and in areas of simple relief. These temperature regimes persist year-round and are associated with the homogeneous environments or ecosystems of cities and agricultural lands. Each LCZ is individually named and ordered by one or more distinguishing surface property, which in most cases is the height of roughness objects or the dominant land cover.

Table 8 - Definitions for local climate zones (Stewart & Oke, 2012).

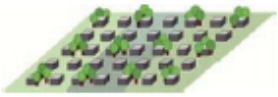
1. Compact high-rise 	Dense mix of tall buildings to tens of stories. Few or no trees. Land cover mostly paved. Concrete, steel, stone, and glass construction materials.
2. Compact midrise 	Dense mix of midrise buildings (3–9 stories). Few or no trees. Land cover mostly paved. Stone, brick, tile, and concrete construction materials.
3. Compact low-rise 	Dense mix of low-rise buildings (1–3 stories). Few or no trees. Land cover mostly paved. Stone, brick, tile, and concrete construction materials.
4. Open high-rise 	Open arrangement of tall buildings to tens of stories. Abundance of pervious land cover (low plants, scattered trees). Concrete, steel, stone, and glass construction materials.
5. Open midrise 	Open arrangement of midrise buildings (3–9 stories). Abundance of pervious land cover (low plants, scattered trees). Concrete, steel, stone, and glass construction materials.
6. Open low-rise 	Open arrangement of low-rise buildings (1–3 stories). Abundance of pervious land cover (low plants, scattered trees). Wood, brick, stone, tile, and concrete construction materials.

Table 9 - Values of geometric and surface cover properties for local climate zones (Stewart & Oke, 2012).

Local climate zone (LCZ)	Sky view factor[a]	Aspect ratio[b]	Building surface fraction[c]	Impervious surface fraction[d]	Pervious surface fraction[e]	Height of roughness elements[f]	Terrain roughness class[g]
LCZ 1	0.2–0.4	> 2	40–60	40–60	< 10	> 25	8
Compact high-rise							
LCZ 2	0.3–0.6	0.75–2	40–70	30–50	< 20	10–25	6–7
Compact midrise							
LCZ 3	0.2–0.6	0.75–1.5	40–70	20–50	< 30	3–10	6
Compact low-rise							
LCZ 4	0.5–0.7	0.75–1.25	20–40	30–40	30–40	>25	7–8
Open high-rise							
LCZ 5	0.5–0.8	0.3–0.75	20–40	30–50	20–40	10–25	5–6
Open midrise							
LCZ 6	0.6–0.9	0.3–0.75	20–40	20–50	30–60	3–10	5–6
Open low-rise							

[a] Ratio of the amount of sky hemisphere visible from ground level to that of an unobstructed hemisphere

[b] Mean height-to-width ratio of street canyons (LCZs 1–7), building spacing (LCZs 8–10), and tree spacing (LCZs A–G)

[c] Ratio of building plan area to total plan area (%)

[d] Ratio of impervious plan area (paved, rock) to total plan area (%)

[e] Ratio of pervious plan area (bare soil, vegetation, water) to total plan area (%)

[f] Geometric average of building heights (LCZs 1–10) and tree/plant heights (LCZs A–F) (m)

[g] Davenport et al.'s (2000) classification of effective terrain roughness (z_0) for city and country landscapes. See Table 5 for class descriptions

Table 10 - Values of thermal, radiative and metabolic properties for local climate zones (Stewart & Oke, 2012).

Local climate zone (LCZ)	Surface admittance[a]	Surface albedo[b]	Anthropogenic heat output[c]
LCZ 1	1,500–1,800	0.10–0.20	50–300
Compact high-rise			
LCZ 2	1,500–2,200	0.10–0.20	<75
Compact midrise			
LCZ 3	1,200–1,800	0.10–0.20	<75
Compact low-rise			
LCZ 4	1,400–1,800	0.12–0.25	<50
Open high-rise			
LCZ 5	1,400–2,000	0.12–0.25	<25
Open midrise			
LCZ 6	1,200–1,800	0.12–0.25	<25
Open low-rise			

For this work, simulations for two different cities were defined – Lisbon and Ancona – and for 5 different LCZ's – LCZ2, 3, 4, 5 and 6 (Table 10).

Table 11 - LCZ data.

	Sky view factor	Aspect ratio	Building surface fraction	Impervious surface fraction	Pervious surface fraction	Heigh [m]	Terrain class
LCZ2	0,3 - 0,6	1,375	55	30 - 50	20	18	6 to 7
LCZ3	0,2 - 0,6	1,125	55	20 - 50	30	6,5	6
LCZ4	0,5 - 0,7	1	30	30 - 40	35	25	7 to 8
LCZ5	0,5 - 0,8	0,525	30	30 - 50	30	18	5 to 6
LCZ6	0,6 - 0,9	0,525	30	20 - 50	45	6,5	5 to 6

Table 12 - LCZ data.

	Horizontal Building density	Surface admittance [J / (m2 s0.5 K)]	Surface albedo	Anthropogenic heat output [W / m2]	verthor
LCZ2	0,55	1500 - 2200	0,10 to 0,20	0 - 75	1,05
LCZ3	0,55	1200 - 1800	0,10 to 0,20	0 - 75	0,86
LCZ4	0,3	1400 - 1800	0,12 to 0,25	0 - 50	0,99
LCZ5	0,3	1400 - 2000	0,12 to 0,25	0 - 25	0,52
LCZ6	0,3	1200 - 1800	0,12 to 0,25	0 - 25	0,52

Label - verthor: value for vertical-to-horizontal urban area ratio, is calculated by dividing the urban facade area by total urban area.

Table 13 - UWG Properties.

	charLength [m]	canAspect [-] = bldHeight/canWidth	bldDensity [-]	bldHeight [m]
LCZ2	1000	1,375	0,55	17,5
LCZ3	1000	1,125	0,55	6,5
LCZ4	1000	1	0,3	25
LCZ5	1000	0,525	0,3	17,5
LCZ6	1000	0,525	0,3	6,5

Table 14 - UWG Properties.

	roadConf (SVF) [-]	grasscover [-]	treecover [-]	vegcover [-] = grasscover + treecover	roadcover [-]
LCZ2	0,33	0,2	0	0,2	0,25
LCZ3	0,38	0,3	0	0,3	0,15
LCZ4	0,41	0,4	0	0,35	0,35
LCZ5	0,6	0,3	0	0,3	0,4
LCZ6	0,6	0,5	0	0,45	0,25

Label - charlength: Value for the urban characteristic length in meters, is the dimension of a square that encompasses the whole neighborhood; **canAspect:** Mean heigh to width ratio of street canyons, building spacing and tree spacing; **bldDensity:** Ratio of building plan area to total plan area. The sum of grasscover, treecover and bldDensity must be less than or equal to 1; **bldHeight:** Average urban building height in meters; **grasscover:** Number of fraction of urban ground covered in grass only; **treecover:** Number of fraction of urban ground covered in trees; **vegcover:** Value between 0 and 1 for fraction of vegetation coverage; **roadcover:** Value between 0 and 1 for fraction of road coverage.

For the simulations it was necessary to download the Mobaxterm (Figure 20) – an application that makes it possible to use operating systems simultaneously - to access the cluster of the university.

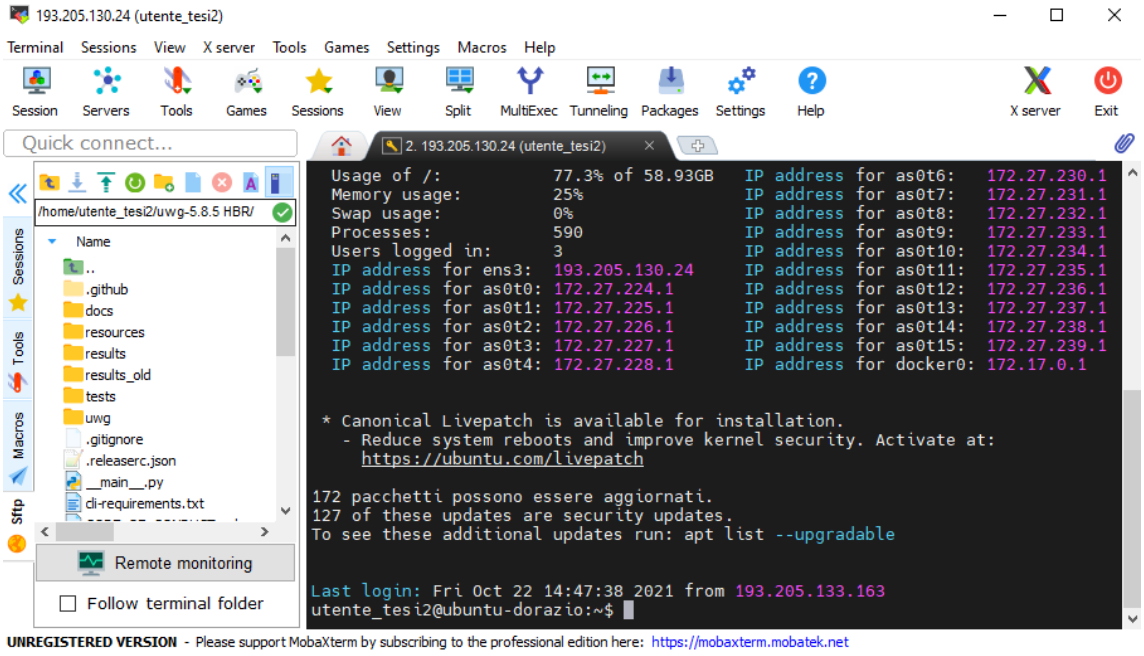


Figure 20 - Main Window of Mobaxterm.

In the cluster, the simulations were runed with UWG, using two files – json file (Figure 21) and weather file (Figure 22). The code (Figure 21) was based on a code provided from the website Urban Microclimate (Norford & Reinhart, n.d.), and adapted to the work of the SUPERHERO Project.

First, the notepad++ was downloaded and the plug-ins to write on json files, this is the file with the code (input parameters) that was necessary to change for every simulation (Table 11 to 14). Then, in the weather file of booth cities from 2005 the program Elements was used (Figure 22) to extract some values – dry bulb temperature, wet bulb temperature, atmospheric pressure, relative humidity, dew point temperature, global solar, normal solar, diffuse solar and wind speed - from the fifteen

of June to the thirty first of August, the summer performance, and use these values for comparison with the results of the simulations.

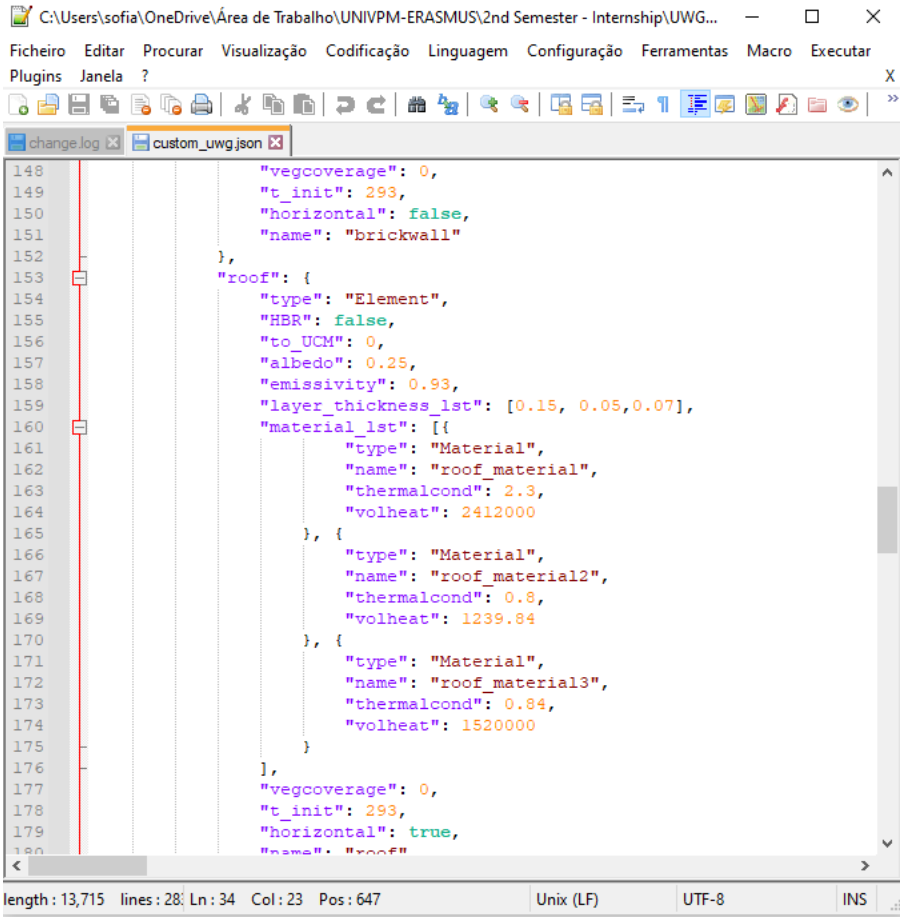


Figure 21 - Code of the UWG simulations.

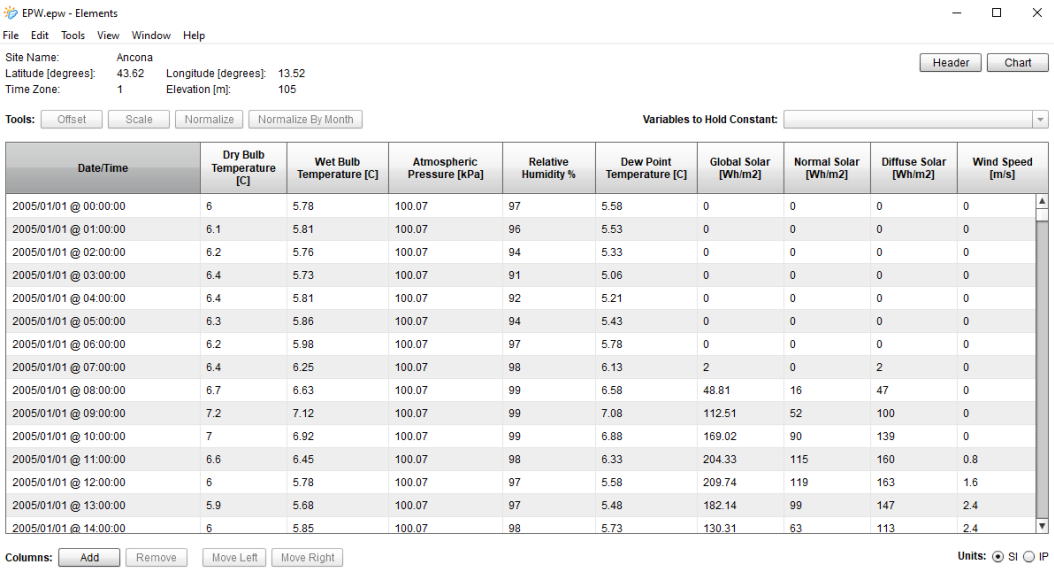


Figure 22 - Program Elements, that opens an epw. File (LLC, 2015).

Before each simulation, that I will be presented in the next chapter, two files outside the cluster were defined, and then uploaded on the cluster and runed the simulation. After each simulation, the results were transferred from the folder results in the cluster and put all the data in excel files, in order to be analyzed by making tables and graphics that will be showed and explained in the next chapter.

4. Results Analysis

In the present chapter, the results obtained through the simulations made on UWG will be presented and analyzed. Only the simulations made with this software will be presented because they consist in the main subject of the training, considering that all the other software's used provide base knowledge for data and inputs necessary, as well as, how simulations should be performed.

4.1 Analyses Performed

The first simulation was performed for understanding how the UWG software works, it was made for the month of August, considering a building with 19,78m with HBR roof (true) and without HBR roof (false), and releasing 100% of the heat in the urban canopy layer (to_UCM 1) and releasing it to the urban boundary layer (to_UCM 0).

After understanding how the software works, other simulations were performed in order to obtain more accurate results. So, a table was organized with the input data, considering the different LCZ's, and the parameters used in the code were showed in sub-chapter 3.3.3 (Table 11, 12, 13 and 14). For the final and most important simulation, twenty simulations were made for each city, Lisbon and Ancona, as can be seen in the next schematic (Figure 23). The simulation was made from the 15th of June until de end of August.

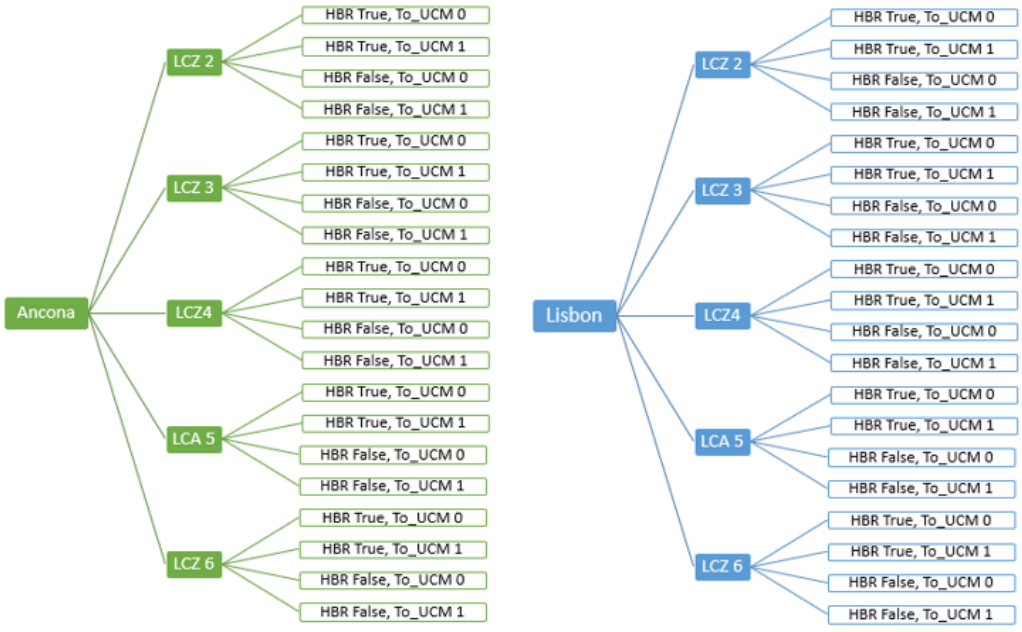


Figure 23 - Schematic of the main simulations performed.

First the weather file (.epw) was the same for the twenty simulations of each city, and the only file that was needed to upload for each simulation was the .json file that contains the code used for performing the simulations. In the code the parameter correspondent for each LCZ, as can be seen in the next tables (Table 15, 16, 17, 18 and 19) was changed for each simulation.

Table 15 - LCZ 2 data input.

UWG parameters LCZ2	
vertohor [-]	1,05
bldDensity [-]	0,55
chLength [m]	1000
grasscover [-]	0,2
treecover [-]	0

Table 16 - LCZ 3 data input.

UWG parameters LCZ 3	
vertohor [-]	0,86
bldDensity [-]	0,55
chLength [m]	1000
grasscover [-]	0,3
treecover [-]	0

Table 17 - LCZ 4 data input.

UWG parameters LCZ 4	
vertohor [-]	0,99
bldDensity [-]	0,3
chLength [m]	1000
grasscover [-]	0,35
treecover [-]	0

Table 18 - LCZ 5 data input.

UWG parameters LCZ 5	
vertohor [-]	0,52
bldDensity [-]	0,3
chLength [m]	1000
grasscover [-]	0,3
treecover [-]	0

Table 19 - LCZ 6 data input.

UWG parameters LCZ 6	
vertohor [-]	0,52
bldDensity [-]	0,3
chLength [m]	1000
grasscover [-]	0,45
treecover [-]	0

Still in the code, in the Figure 24 we can see the roof parameter, where for each simulation the configuration was changed, as explained in the first paragraph.

```
},
"roof": {
    "type": "Element",
    "HBR": false,
    "to_UCM": 1,
    "albedo": 0.25,
    "emissivity": 0.93,
    "layer_thickness_lst": [0.15, 0.05,0.07],
    "material_lst": [{
            "type": "Material",
            "name": "roof_material",
            "thermalcond": 2.3,
            "volheat": 2412000
        }, {
            "type": "Material",
            "name": "roof_material2",
            "thermalcond": 0.8,
            "volheat": 1239.84
        }, {
            "type": "Material",
            "name": "roof_material3",
            "thermalcond": 0.84,
            "volheat": 1520000
        }
```

Figure 24 - Roof parameter in the code used for simulations.

4.2 Results of Simulations

The results of the simulations contained many data output, so the results were organized for one week of August (08/08 to 14/08), considering that is the hottest week, for better understanding the results.

The output results obtained from UWG were canopy layer temperature, urban boundary layer temperature, roof temperature, wall temperature, UCM_ubl, UCM_Qhvac, UCM_Qroof, UCM_Qwall, indoor temperature and BEM_Qroof. UCM_Qhvac is the amount of heat that goes from the building to the canopy layer due to cooling or the heating of the space inside the building, UCM_Qroof is the amount of heat transferred from the roof surface to the exterior ambience, UCM_Qubl is the anthropogenic heat from the canopy layer to the urban boundary layer.

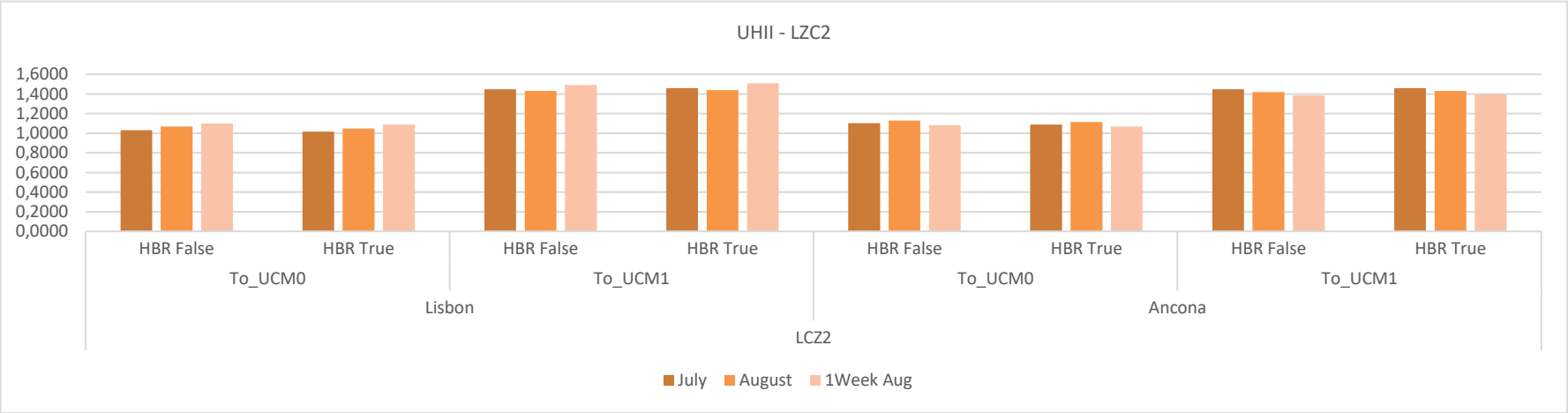
The magnitude of the UHI effect can be expressed by the Urban Heat Island Intensity (UHII), which is defined as the difference in air temperature between an urban area and the surrounding rural area (Liu et al., 2020). This parameter is the one used for analyzing the results.

First, calculate the UHII for each day, and it is the difference of the canopy layer temperature (output) and drybuld (input), then the sum for the hottest week of August was made. Using the equation 15 the calculation of the weekly value of UHII was possible to make.

$$UHII_{month} = \frac{\sum(T_{urb} - T_{rur})}{n} \cdot if\ and\ only\ T_{urb} > T_{rur}$$ [Equation 15]

Table 20 - Calculation of the UHII in LCZ2.

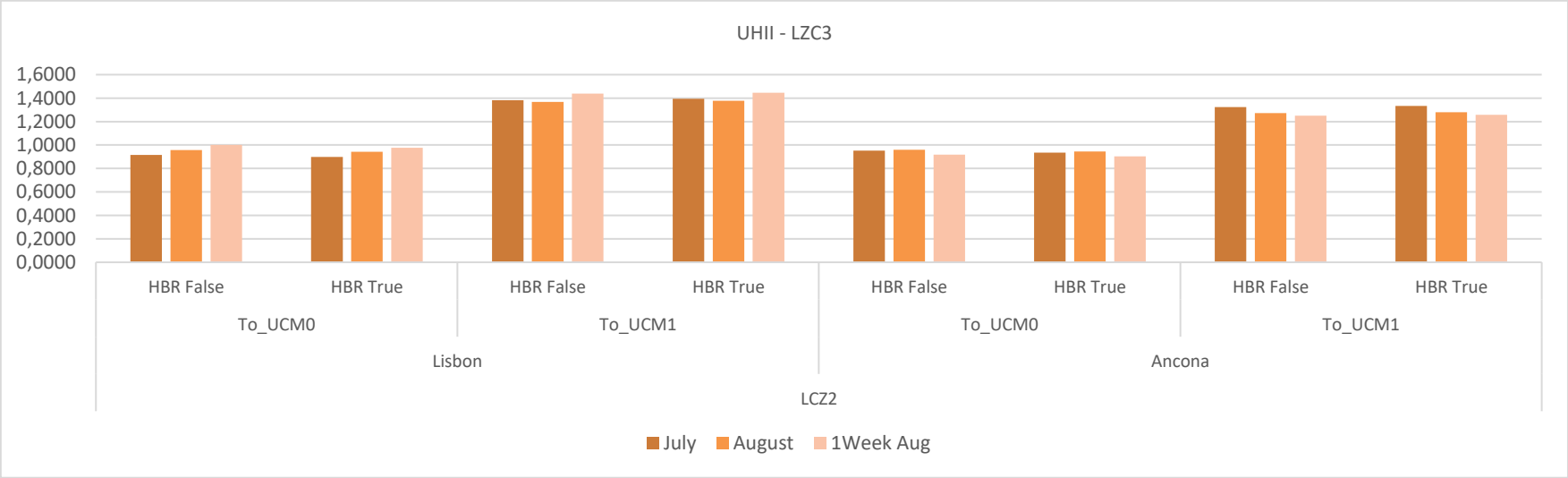
	LCZ2							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
July	1,0316	1,0150	1,4477	1,4603	1,1020	1,0871	1,4474	1,4605
August	1,0685	1,0487	1,4293	1,4381	1,1291	1,1133	1,4204	1,4310
1Week Aug	1,1004	1,0888	1,4911	1,5097	1,0834	1,0680	1,3859	1,3957
Sum July	767,5474	755,1385	1077,0849	1086,4544	819,8703	808,7730	1076,8629	1086,5969
Sum Augs	794,9296	780,2357	1063,3836	1069,9630	840,0456	828,3107	1056,7718	1064,6330
Sum 1W Aug	184,8684	182,9204	250,5098	253,6214	182,0144	179,4316	232,8306	234,4719



Graphic 2 - UHII LCZ2.

Table 21 - Calculation of the UHII in LCZ3.

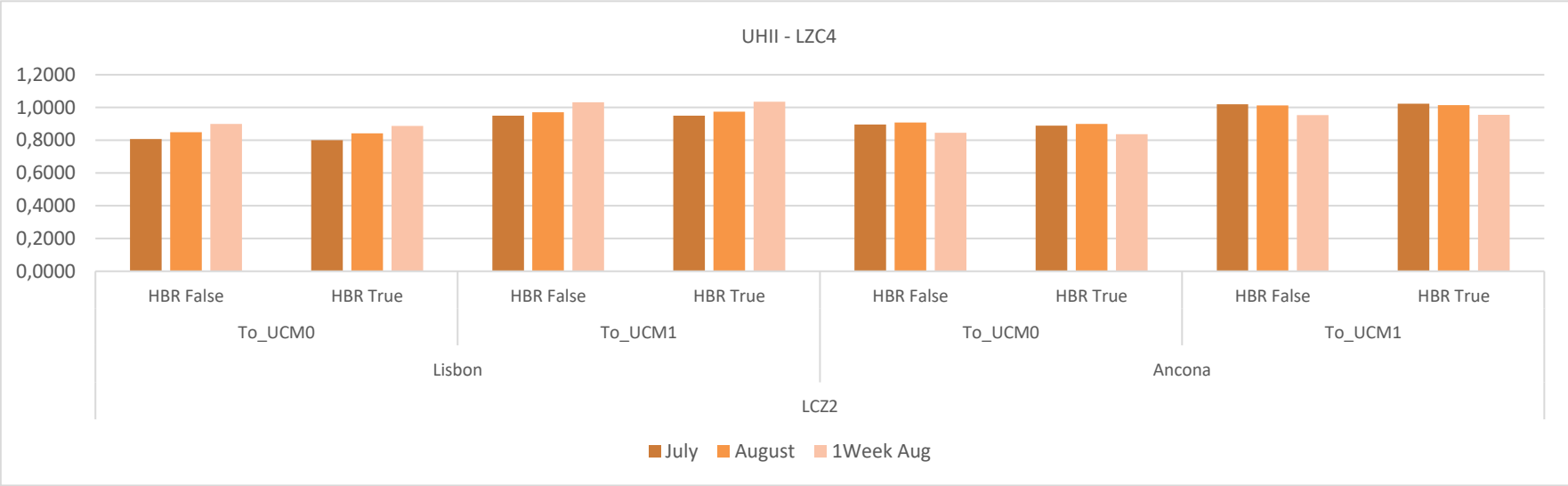
	LCZ3							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
July	0,9146	0,8978	1,3813	1,3933	0,9530	0,9343	1,3230	1,3333
August	0,9571	0,9427	1,3670	1,3763	0,9597	0,9440	1,2712	1,2807
1Week Aug	1,0003	0,9776	1,4375	1,4462	0,9189	0,9026	1,2493	1,2564
Sum July	680,4462	667,9923	1027,7193	1036,5791	709,0333	695,1540	984,3362	991,9855
Sum Augs	712,0479	701,3538	1017,0349	1023,9912	714,0195	702,3179	945,7619	952,8651
Sum 1W Aug	168,0433	164,2440	241,5022	242,9627	154,3750	151,6376	209,8745	211,0741



Graphic 3 - UHII LCZ3.

Table 22 - Calculation of the UHII in LCZ4.

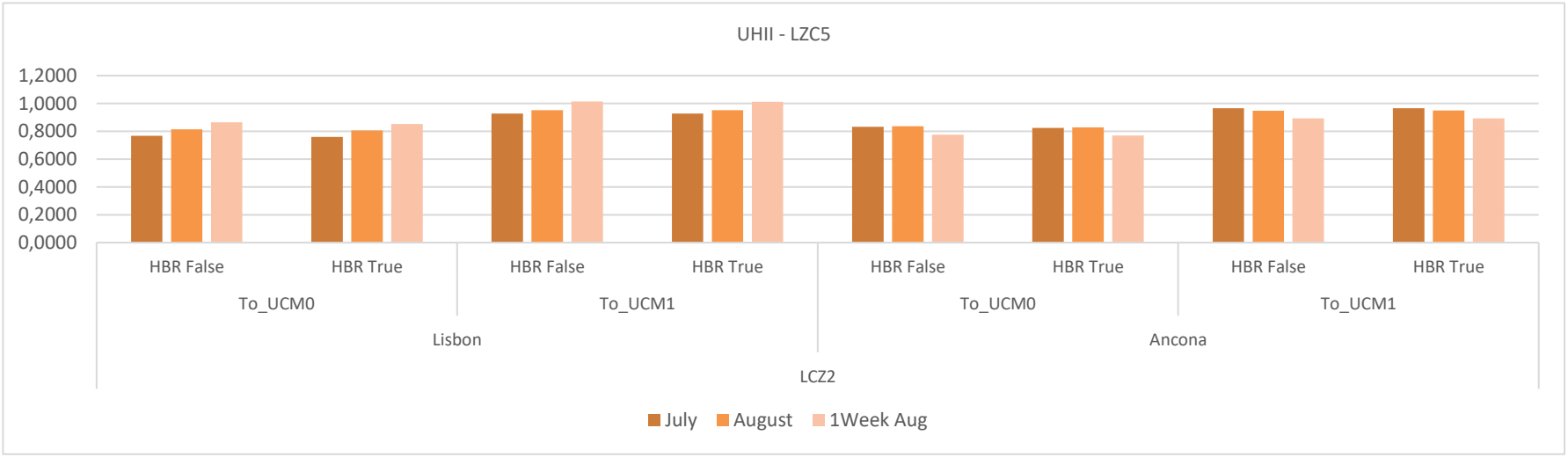
	LCZ4							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
July	0,8075	0,8007	0,9495	0,9504	0,8955	0,8883	1,0203	1,0224
August	0,8486	0,8425	0,9713	0,9735	0,9075	0,8993	1,0130	1,0145
1Week Aug	0,9001	0,8873	1,0326	1,0350	0,8453	0,8369	0,9540	0,9551
Sum July	600,7832	595,7241	706,4091	707,0935	666,9152	660,9152	759,0850	760,6801
Sum Augs	631,3835	626,8119	722,6353	724,3206	675,1438	669,0981	753,6746	754,7795
Sum 1W Aug	151,2178	149,0721	173,4818	173,8743	142,0099	140,6068	160,2692	160,4490



Graphic 4 - UHII LCZ4.

Table 23 - Calculation of the UHII in LCZ5.

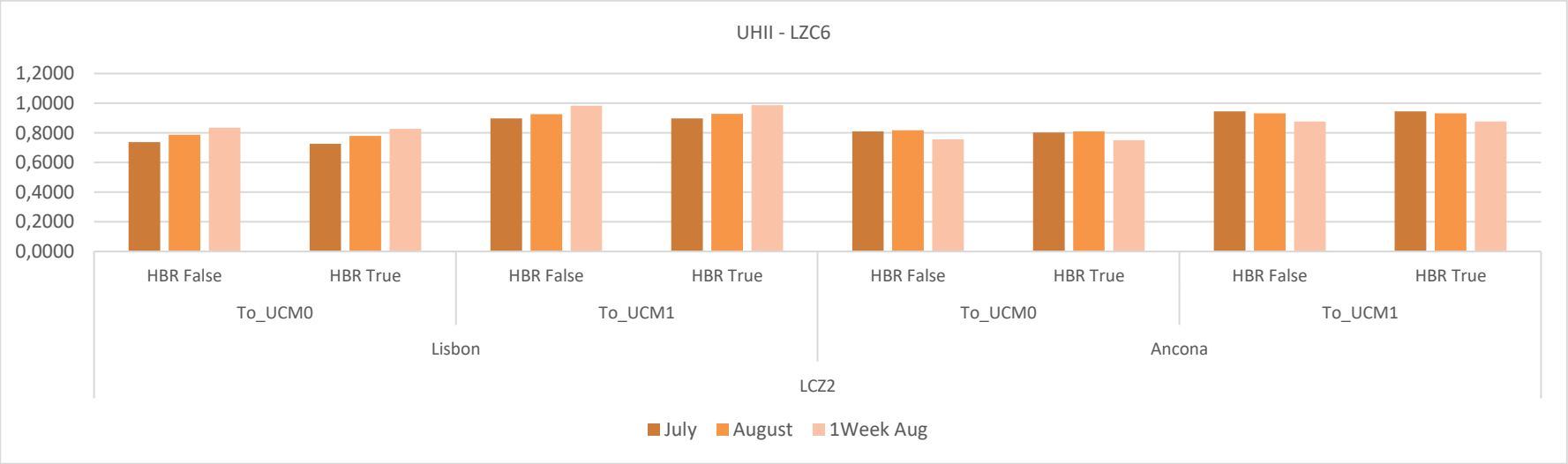
	LCZ5							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
July	0,7687	0,7590	0,9274	0,9268	0,8320	0,8249	0,9655	0,9667
August	0,8139	0,8062	0,9524	0,9524	0,8358	0,8289	0,9482	0,9490
1Week Aug	0,8638	0,8535	1,0141	1,0123	0,7761	0,7700	0,8930	0,8941
Sum July	571,8897	564,6787	689,9594	689,5258	619,0232	613,7361	718,3351	719,2116
Sum Augs	605,4119	599,8270	708,6193	708,5694	621,8582	616,6708	705,4857	706,0441
Sum 1W Aug	145,1173	143,3840	170,3643	170,0650	130,3803	129,3549	150,0194	150,2007



Graphic 5 - UHII LCZ5.

Table 24 - Calculation of the UHII in LCZ6.

	LCZ6							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
July	0,7376	0,7268	0,8969	0,8972	0,8089	0,8017	0,9445	0,9453
August	0,7874	0,7793	0,9263	0,9277	0,8171	0,8098	0,9315	0,9316
1Week Aug	0,8345	0,8268	0,9838	0,9864	0,7565	0,7504	0,8767	0,8759
Sum July	548,7562	540,7287	667,2577	667,5008	601,8525	596,4868	702,7405	703,2906
Sum Augs	585,8422	579,8059	689,1673	690,2332	607,9124	602,4953	693,0261	693,0828
Sum 1W Aug	140,1880	138,8941	165,2772	165,7081	127,0922	126,0648	147,2837	147,1451



Graphic 6 - UHII LCZ6.

Graphics 2 to 6 and Tables 20 to 24 show that the values are higher for the parameter to_UCM1 which means that the heat is releasing 100% in the urban canopy layer, which was the expected. Also comparing the two cities, Lisbon exhibited the highest UHII for the "hottest" week of August.

After the calculation of the UHII, the results of the urban canopy layer temperature were organized for the hottest week in August (08/08 to 14/08) and for the different LCZ, as showed in the Tables 25 to 29 and Graphics 7 to 16. These results are organized in hourly values (first column), the four next columns are the values obtained for Lisbon and the last four for Ancona, as HBR False (0), HBR true (0), HBR False (1) and HBR True (1), respectively.

Table 25 - Canopy layer temperature result for LCZ2.

LCZ2								
	Lisbon				**Ancona**			
	To_UCM0		**To_UCM1**		**To_UCM0**		**To_UCM1**	
2005	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**
2005/08/08 @ 00:00:00	18,59433	18,5895	18,74235	18,72457	26,3239	26,32133	26,48443	26,48443
2005/08/08 @ 01:00:00	18,00038	17,9961	18,11451	18,11106	25,9158	25,91377	26,04551	26,04551
2005/08/08 @ 02:00:00	17,59154	17,5876	17,69255	17,68119	25,6459	25,63801	25,76186	25,76186
2005/08/08 @ 03:00:00	17,10511	17,1014	17,19294	17,18339	25,8592	25,85196	25,91866	25,91866
2005/08/08 @ 04:00:00	16,68313	16,6798	16,75616	16,74817	25,9742	25,9675	25,98855	25,98855
2005/08/08 @ 05:00:00	16,70741	16,7050	16,75952	16,76267	26,0973	26,09206	26,09642	26,09642
2005/08/08 @ 06:00:00	17,2074	17,2055	17,27265	17,30453	26,2493	26,23055	26,29856	26,29856
2005/08/08 @ 07:00:00	18,46709	18,4662	18,60367	18,70776	26,5607	26,53225	26,73428	26,73428
2005/08/08 @ 08:00:00	20,14941	20,1488	20,37922	20,49676	27,0327	26,99925	27,33434	27,33434
2005/08/08 @ 09:00:00	22,21361	22,2080	22,51773	22,60891	28,4589	28,40029	28,88116	28,88116
2005/08/08 @ 10:00:00	24,15355	24,1467	24,53062	24,62677	28,9616	28,91108	29,46895	29,46895
2005/08/08 @ 11:00:00	25,89849	25,8942	26,30674	26,36702	29,4300	29,32379	30,06877	30,06877
2005/08/08 @ 12:00:00	27,23343	27,2288	27,64419	27,67464	29,6631	29,53773	30,38093	30,38093
2005/08/08 @ 13:00:00	28,15572	28,1512	28,63422	28,68174	29,7421	29,61061	30,39198	30,39198
2005/08/08 @ 14:00:00	28,45615	28,4510	28,97957	29,00086	29,6508	29,62437	30,37176	30,37176
2005/08/08 @ 15:00:00	28,17202	28,1663	28,68981	28,67526	29,5585	29,54355	30,20541	30,20541
2005/08/08 @ 16:00:00	27,40612	27,3995	27,90586	27,86991	29,4491	29,44355	29,99905	29,99905
2005/08/08 @ 17:00:00	26,06648	26,0592	26,52195	26,45137	29,3435	29,34472	29,78347	29,78347
2005/08/08 @ 18:00:00	24,48934	24,4822	24,89199	24,82988	29,2462	29,25202	29,58	29,58
2005/08/08 @ 19:00:00	23,00064	22,9936	23,35847	23,30357	29,1417	29,4507	29,69538	29,69538
2005/08/08 @ 20:00:00	21,4375	21,4319	21,74914	21,71021	29,1772	29,15127	29,35265	29,35265
2005/08/08 @ 21:00:00	20,34004	20,3366	20,60876	20,58021	28,5379	28,51111	28,6979	28,6979
2005/08/08 @ 22:00:00	19,49245	19,4894	19,71678	19,6947	28,2035	28,18651	28,357	28,357
2005/08/08 @ 23:00:00	18,84631	18,8434	19,03	19,01242	27,9646	27,95082	28,08644	28,08644
2005/08/09 @ 00:00:00	18,38626	18,3833	18,53036	18,51587	27,7458	27,73379	27,84315	27,84315
2005/08/09 @ 01:00:00	17,94005	17,9359	18,04667	18,04586	27,5239	27,51386	27,58899	27,58899
2005/08/09 @ 02:00:00	17,53447	17,5307	17,62935	17,61823	27,3519	27,34455	27,4009	27,4009
2005/08/09 @ 03:00:00	17,06154	17,0579	17,14265	17,13301	27,2238	27,21757	27,26249	27,26249

Table 25 - Canopy layer temperature result for LCZ2 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/09 @ 04:00:00	16,56041	16,5571	16,63003	16,62187	27,1344	27,13111	27,14457	27,14457
2005/08/09 @ 05:00:00	16,60269	16,6004	16,64582	16,64677	27,1273	27,12301	27,14669	27,14669
2005/08/09 @ 06:00:00	17,28676	17,2853	17,35455	17,40059	27,3357	27,31825	27,40779	27,40779
2005/08/09 @ 07:00:00	18,74268	18,7026	18,88139	19,00583	27,2417	27,21885	27,41977	27,41977
2005/08/09 @ 08:00:00	20,79799	20,7965	21,01548	21,14651	27,1941	27,17297	27,52262	27,52262
2005/08/09 @ 09:00:00	23,2509	23,2442	23,53446	23,64253	27,8847	27,81675	28,30564	28,30564
2005/08/09 @ 10:00:00	25,74029	25,7329	26,13136	26,2726	27,6328	27,58082	28,1874	28,1874
2005/08/09 @ 11:00:00	27,98797	27,9843	28,51045	28,66221	27,7490	27,70094	28,41084	28,41084
2005/08/09 @ 12:00:00	29,64838	29,6435	30,22375	30,2907	27,9242	27,88328	28,65611	28,65611
2005/08/09 @ 13:00:00	30,6468	30,6408	31,24327	31,27387	28,1476	28,11537	28,9019	28,9019
2005/08/09 @ 14:00:00	31,02338	31,0173	31,59765	31,59312	28,4731	28,45001	29,18188	29,18188
2005/08/09 @ 15:00:00	30,77781	30,7704	31,3504	31,33711	29,0378	29,02371	29,66218	29,66218
2005/08/09 @ 16:00:00	29,61329	29,6067	30,13386	30,08751	29,3852	29,3779	29,89812	29,89812
2005/08/09 @ 17:00:00	28,05361	28,0465	28,55042	28,49574	29,6099	29,61098	30,0553	30,0553
2005/08/09 @ 18:00:00	26,4081	26,4000	26,87697	26,80973	29,7034	29,70945	30,05386	30,05386
2005/08/09 @ 19:00:00	24,10833	24,1020	24,52953	24,47153	29,6810	29,67202	29,89085	29,89085
2005/08/09 @ 20:00:00	22,56941	22,5633	22,94374	22,89876	29,5512	29,52665	29,71571	29,71571
2005/08/09 @ 21:00:00	21,38103	21,3771	21,71633	21,68093	28,8176	28,78837	28,9575	28,9575
2005/08/09 @ 22:00:00	20,27026	20,2665	20,56175	20,53347	28,4386	28,42034	28,58229	28,58229
2005/08/09 @ 23:00:00	19,50584	19,5022	19,75389	19,73039	28,1778	28,16175	28,30094	28,30094
2005/08/10 @ 00:00:00	18,96818	18,9646	19,17378	19,15367	27,9271	27,91299	28,02751	28,02751
2005/08/10 @ 01:00:00	18,37295	18,3697	18,54044	18,52415	27,6630	27,6512	27,73845	27,73845
2005/08/10 @ 02:00:00	17,975	17,9704	18,11541	18,09943	27,4048	27,39475	27,46173	27,46173
2005/08/10 @ 03:00:00	17,46584	17,4616	17,58606	17,57239	27,1345	27,12627	27,16676	27,16676
2005/08/10 @ 04:00:00	16,89991	16,8960	17,00032	16,99365	26,9460	26,9399	26,96365	26,96365
2005/08/10 @ 05:00:00	17,01628	17,0141	17,0976	17,10759	26,8263	26,82068	26,84911	26,84911
2005/08/10 @ 06:00:00	17,55688	17,5310	17,6897	17,76945	27,3355	27,31913	27,39693	27,39693
2005/08/10 @ 07:00:00	18,71479	18,7131	18,94639	19,09863	27,1032	27,07951	27,27124	27,27124
2005/08/10 @ 08:00:00	20,44126	20,4401	20,78279	20,95182	26,9097	26,8864	27,2279	27,2279
2005/08/10 @ 09:00:00	22,68564	22,6763	23,15419	23,3421	27,8005	27,71745	28,2029	28,2029
2005/08/10 @ 10:00:00	24,80734	24,7815	25,40929	25,59795	28,5484	28,50243	29,07926	29,07926
2005/08/10 @ 11:00:00	26,68109	26,6760	27,36996	27,50212	29,8609	29,81667	30,49496	30,49496
2005/08/10 @ 12:00:00	28,09753	28,0912	28,8807	28,99469	31,5329	31,49736	32,27373	32,27373
2005/08/10 @ 13:00:00	29,01807	29,0105	29,87422	29,96407	32,1531	32,1259	32,91806	32,91806
2005/08/10 @ 14:00:00	29,26667	29,2590	30,10323	30,11578	31,9292	31,91571	32,74883	32,74883
2005/08/10 @ 15:00:00	29,03425	29,0256	29,83832	29,8157	31,1098	31,10353	31,87133	31,87133
2005/08/10 @ 16:00:00	28,15102	28,1419	28,89319	28,83528	30,8172	30,81728	31,45353	31,45353
2005/08/10 @ 17:00:00	26,76549	26,7559	27,43725	27,35734	30,8282	30,83387	31,31357	31,31357
2005/08/10 @ 18:00:00	25,29618	25,2861	25,88535	25,79516	31,0292	31,03744	31,3355	31,3355
2005/08/10 @ 19:00:00	23,46167	23,4530	23,96729	23,8851	30,9793	30,98178	31,19837	31,19837

Table 25 - Canopy layer temperature result for LCZ2 (continued).

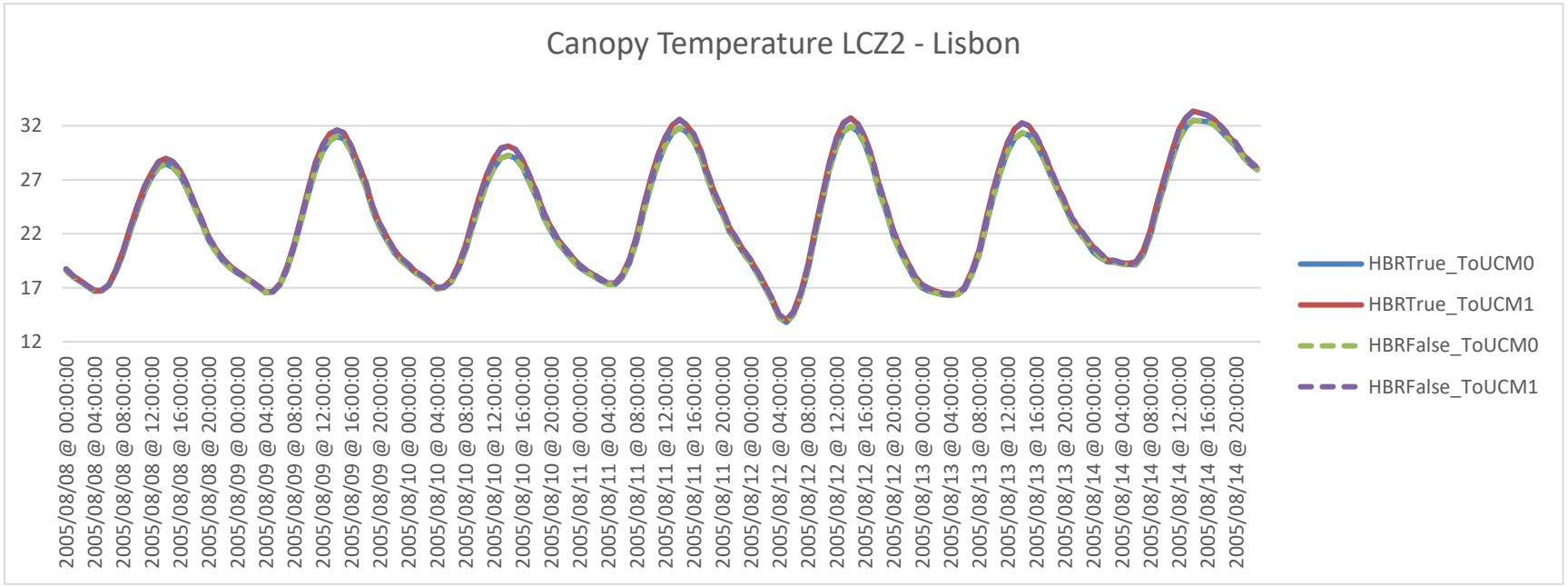
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/10 @ 20:00:00	22,22101	22,2228	22,65808	22,60643	30,4815	30,48219	30,65153	30,65153
2005/08/10 @ 21:00:00	21,13224	21,1345	21,48462	21,4473	29,2676	29,25824	29,46402	29,46402
2005/08/10 @ 22:00:00	20,36985	20,3719	20,66945	20,63884	28,6685	28,6603	28,8424	28,8424
2005/08/10 @ 23:00:00	19,57289	19,5752	19,8536	19,82662	28,2624	28,25363	28,42908	28,42908
2005/08/11 @ 00:00:00	18,88884	18,8866	19,13498	19,10741	27,9322	27,92882	28,05424	28,05424
2005/08/11 @ 01:00:00	18,42143	18,4191	18,62248	18,59967	27,7221	27,71773	27,80984	27,80984
2005/08/11 @ 02:00:00	18,06563	18,0616	18,23398	18,21229	27,5881	27,58137	27,63896	27,63896
2005/08/11 @ 03:00:00	17,6619	17,6581	17,80315	17,78482	27,4319	27,42529	27,47133	27,47133
2005/08/11 @ 04:00:00	17,34298	17,3417	17,44719	17,43473	27,3293	27,32395	27,34694	27,34694
2005/08/11 @ 05:00:00	17,29116	17,2893	17,40618	17,42965	27,3109	27,30611	27,33219	27,33219
2005/08/11 @ 06:00:00	17,94544	17,9450	18,1081	18,20436	27,4285	27,39358	27,47887	27,47887
2005/08/11 @ 07:00:00	19,3371	19,3048	19,5611	19,67964	27,5950	27,57194	27,77536	27,77536
2005/08/11 @ 08:00:00	21,37645	21,3756	21,70111	21,87531	28,5137	28,48143	28,79693	28,79693
2005/08/11 @ 09:00:00	24,04406	24,0332	24,48629	24,68903	31,0884	30,96656	31,40429	31,40429
2005/08/11 @ 10:00:00	26,47896	26,4753	27,02289	27,20992	32,1124	32,06129	32,58931	32,58931
2005/08/11 @ 11:00:00	28,55613	28,5171	29,18872	29,31566	32,7507	32,70677	33,35903	33,35903
2005/08/11 @ 12:00:00	30,22801	30,2204	30,87825	30,94965	32,9222	32,89265	33,67338	33,67338
2005/08/11 @ 13:00:00	31,31796	31,3097	32,00046	32,06226	33,0162	32,99463	33,79978	33,79978
2005/08/11 @ 14:00:00	31,82759	31,8115	32,55972	32,608	32,9988	32,98911	33,78749	33,78749
2005/08/11 @ 15:00:00	31,45152	31,4432	32,12959	32,09922	32,8885	32,87851	33,57896	33,57896
2005/08/11 @ 16:00:00	30,58214	30,5723	31,24593	31,19472	32,6058	32,60433	33,192	33,192
2005/08/11 @ 17:00:00	29,18821	29,1778	29,79649	29,71426	32,2039	32,20525	32,63762	32,63762
2005/08/11 @ 18:00:00	27,0387	27,0297	27,58699	27,49917	31,9850	31,9868	32,24956	32,24956
2005/08/11 @ 19:00:00	25,20952	25,2008	25,70556	25,6295	31,6172	31,57573	31,78852	31,78852
2005/08/11 @ 20:00:00	23,88078	23,8817	24,29364	24,24839	30,8616	30,78816	30,99744	30,99744
2005/08/11 @ 21:00:00	22,21573	22,2120	22,63427	22,58908	29,4357	29,42829	29,71739	29,71739
2005/08/11 @ 22:00:00	21,25209	21,2537	21,59494	21,56631	28,7527	28,74176	28,97716	28,97716
2005/08/11 @ 23:00:00	20,1672	20,1641	20,49327	20,46269	28,8245	28,81372	28,98307	28,98307
2005/08/12 @ 00:00:00	19,33661	19,3371	19,60779	19,588	29,1109	29,10437	29,19051	29,19051
2005/08/12 @ 01:00:00	18,19819	18,1986	18,46075	18,44419	29,2143	29,20518	29,25844	29,25844
2005/08/12 @ 02:00:00	17,04325	17,0435	17,28857	17,27516	29,1869	29,17965	29,19615	29,19615
2005/08/12 @ 03:00:00	15,73322	15,7332	15,98609	15,97451	29,0855	29,07947	29,06935	29,06935
2005/08/12 @ 04:00:00	14,21865	14,2185	14,49418	14,4843	29,0016	28,99787	28,96406	28,96406
2005/08/12 @ 05:00:00	13,79004	13,7871	14,02393	14,02824	28,9229	28,91563	28,8841	28,8841
2005/08/12 @ 06:00:00	14,48654	14,4859	14,71999	14,78866	29,0057	28,98386	29,03639	29,03639
2005/08/12 @ 07:00:00	16,2139	16,1978	16,48156	16,60758	28,9321	28,90665	29,06185	29,06185
2005/08/12 @ 08:00:00	18,66516	18,6274	18,9907	19,14179	29,1181	29,08835	29,34907	29,34907
2005/08/12 @ 09:00:00	21,79412	21,7818	22,17813	22,35041	30,6614	30,56967	30,92232	30,92232
2005/08/12 @ 10:00:00	24,91793	24,8615	25,38708	25,52845	30,7344	30,69422	31,09986	31,09986
2005/08/12 @ 11:00:00	27,86409	27,8584	28,39535	28,53677	30,6666	30,63095	31,12988	31,12988

Table 25 - Canopy layer temperature result for LCZ2 (continued).

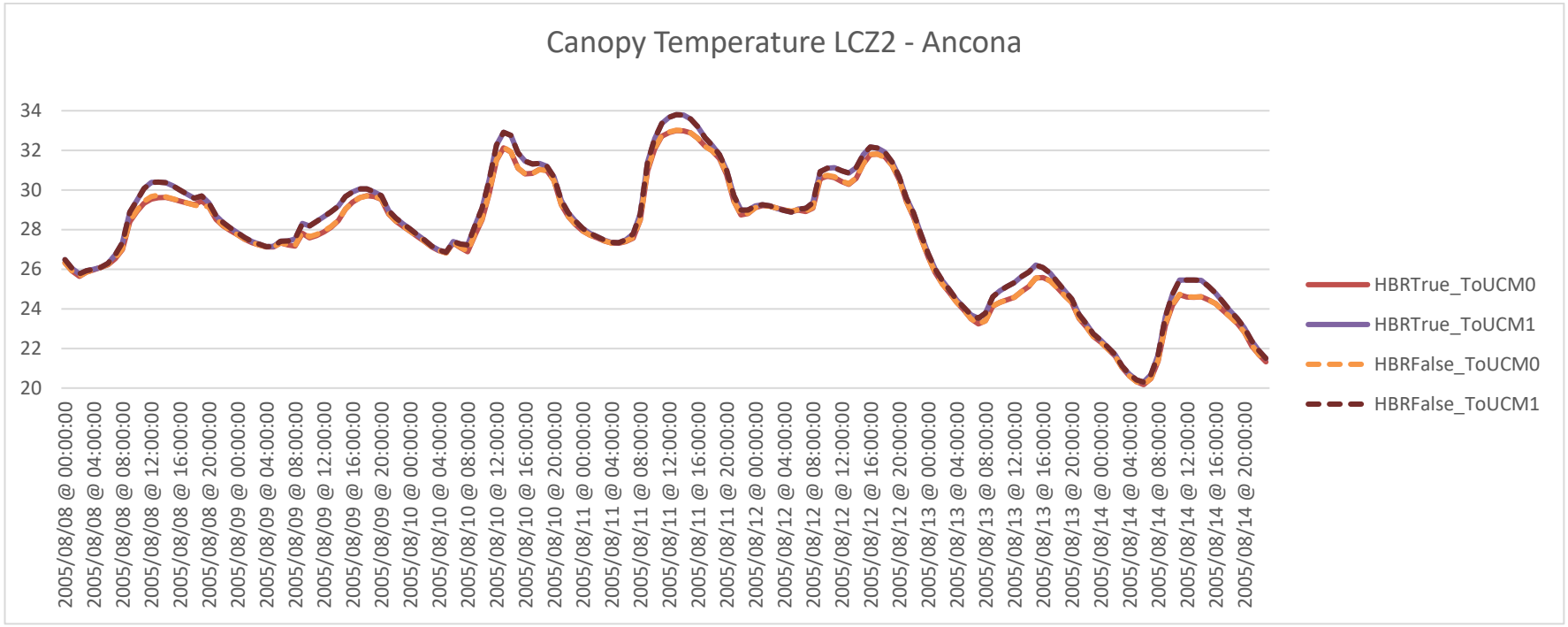
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/12 @ 12:00:00	30,07341	30,0653	30,73823	30,9049	30,4533	30,42175	30,96411	30,96411
2005/08/12 @ 13:00:00	31,44902	31,4393	32,20225	32,31008	30,3095	30,27916	30,85389	30,85389
2005/08/12 @ 14:00:00	31,94128	31,9317	32,71805	32,74246	30,6119	30,58925	31,13059	31,13059
2005/08/12 @ 15:00:00	31,49672	31,4877	32,21914	32,17347	31,3300	31,31344	31,77765	31,77765
2005/08/12 @ 16:00:00	30,29698	30,2870	30,9997	30,93332	31,7913	31,78133	32,16824	32,16824
2005/08/12 @ 17:00:00	28,49505	28,4842	29,1672	29,07968	31,8098	31,80805	32,11722	32,11722
2005/08/12 @ 18:00:00	25,96019	25,9504	26,58679	26,50029	31,6187	31,68474	31,91033	31,91033
2005/08/12 @ 19:00:00	23,97438	23,9772	24,52543	24,46451	31,2616	31,24108	31,40467	31,40467
2005/08/12 @ 20:00:00	21,7762	21,7772	22,3102	22,2611	30,5276	30,52125	30,6641	30,6641
2005/08/12 @ 21:00:00	20,252	20,2537	20,66332	20,6304	29,4209	29,41164	29,58454	29,58454
2005/08/12 @ 22:00:00	18,99066	18,9927	19,3678	19,34065	28,6373	28,62625	28,83684	28,83684
2005/08/12 @ 23:00:00	17,75838	17,7600	18,11302	18,08962	27,6239	27,61617	27,80673	27,80673
2005/08/13 @ 00:00:00	17,00678	17,0083	17,3157	17,29596	26,6440	26,63784	26,81123	26,81123
2005/08/13 @ 01:00:00	16,69149	16,6928	16,92754	16,91154	25,8478	25,84251	26,0059	26,0059
2005/08/13 @ 02:00:00	16,50533	16,5061	16,68502	16,67131	25,2536	25,24788	25,40996	25,40996
2005/08/13 @ 03:00:00	16,34912	16,3499	16,49005	16,47788	24,8128	24,80942	24,94662	24,94662
2005/08/13 @ 04:00:00	16,30989	16,3090	16,40313	16,39245	24,3419	24,33892	24,45434	24,45434
2005/08/13 @ 05:00:00	16,37785	16,3752	16,4561	16,46412	23,9361	23,93283	24,06017	24,06017
2005/08/13 @ 06:00:00	16,88765	16,8650	17,01189	17,09292	23,5069	23,49833	23,68899	23,68899
2005/08/13 @ 07:00:00	18,25041	18,2152	18,46164	18,59597	23,2361	23,23358	23,5235	23,5235
2005/08/13 @ 08:00:00	20,0692	20,0246	20,34621	20,53434	23,3917	23,39017	23,78697	23,78697
2005/08/13 @ 09:00:00	22,77687	22,7024	23,20335	23,37241	24,1489	24,14311	24,60465	24,60465
2005/08/13 @ 10:00:00	25,50305	25,4479	26,03301	26,1967	24,3203	24,31794	24,90292	24,90292
2005/08/13 @ 11:00:00	27,71064	27,6591	28,28864	28,459	24,4526	24,44995	25,12503	25,12503
2005/08/13 @ 12:00:00	29,63363	29,5984	30,39593	30,50686	24,5827	24,57945	25,32018	25,32018
2005/08/13 @ 13:00:00	30,82081	30,7930	31,62406	31,70932	24,8689	24,86472	25,62874	25,62874
2005/08/13 @ 14:00:00	31,35934	31,3442	32,2493	32,27415	25,1358	25,13049	25,84828	25,84828
2005/08/13 @ 15:00:00	31,16447	31,1552	32,01485	32,00329	25,5596	25,55369	26,21226	26,21226
2005/08/13 @ 16:00:00	30,252	30,2496	31,05881	31,00769	25,5827	25,58185	26,08312	26,08312
2005/08/13 @ 17:00:00	29,04611	29,0481	29,73442	29,66614	25,4053	25,41044	25,79665	25,79665
2005/08/13 @ 18:00:00	27,47265	27,4781	28,07605	27,99263	25,0545	25,06217	25,35485	25,35485
2005/08/13 @ 19:00:00	26,06254	26,0678	26,54476	26,46923	24,6634	24,67022	24,90507	24,90507
2005/08/13 @ 20:00:00	24,63898	24,6426	25,06454	25,00305	24,3233	24,32769	24,49637	24,49637
2005/08/13 @ 21:00:00	23,11439	23,1177	23,49468	23,44616	23,5366	23,51381	23,70948	23,70948
2005/08/13 @ 22:00:00	22,07005	22,2113	22,63415	22,48863	23,0989	23,09772	23,2524	23,2524
2005/08/13 @ 23:00:00	21,35299	21,3483	21,65704	21,6187	22,6111	22,61014	22,74014	22,74014
2005/08/14 @ 00:00:00	20,62573	20,3044	20,86025	20,8136	22,3263	22,3238	22,42273	22,42273
2005/08/14 @ 01:00:00	19,80945	19,7838	20,19868	20,14175	21,9825	21,98022	22,06392	22,06392
2005/08/14 @ 02:00:00	19,40532	19,3973	19,58687	19,55858	21,6244	21,62229	21,68861	21,68861
2005/08/14 @ 03:00:00	19,38286	19,3691	19,525	19,49504	21,0368	21,0356	21,11082	21,11082

Table 25 - Canopy layer temperature result for LCZ2 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/14 @ 04:00:00	19,21178	19,1999	19,32537	19,29884	20,6286	20,62738	20,71004	20,71004
2005/08/14 @ 05:00:00	19,16761	19,1621	19,26512	19,26683	20,3221	20,32013	20,40567	20,40567
2005/08/14 @ 06:00:00	19,16895	19,1411	19,3072	19,38821	20,1814	20,17173	20,29936	20,29936
2005/08/14 @ 07:00:00	20,05672	20,0215	20,27426	20,41693	20,4967	20,47715	20,68156	20,68156
2005/08/14 @ 08:00:00	21,84067	21,8003	22,17098	22,34771	21,3875	21,35844	21,66828	21,66828
2005/08/14 @ 09:00:00	24,3651	24,2775	24,78897	24,95833	23,2448	23,16793	23,61014	23,61014
2005/08/14 @ 10:00:00	26,63965	26,5819	27,11241	27,30346	24,2190	24,17478	24,74317	24,74317
2005/08/14 @ 11:00:00	28,79098	28,7346	29,33387	29,52552	24,7418	24,70744	25,4556	25,4556
2005/08/14 @ 12:00:00	30,78693	30,7486	31,53606	31,65023	24,6088	24,60111	25,44617	25,44617
2005/08/14 @ 13:00:00	31,92959	31,8950	32,6663	32,76853	24,5920	24,58389	25,45389	25,45389
2005/08/14 @ 14:00:00	32,5134	32,4910	33,31753	33,36174	24,6157	24,60429	25,44137	25,44137
2005/08/14 @ 15:00:00	32,44177	32,4252	33,1791	33,19066	24,4563	24,44868	25,13953	25,13953
2005/08/14 @ 16:00:00	32,38784	32,3755	33,00363	32,98424	24,2696	24,26592	24,79763	24,79763
2005/08/14 @ 17:00:00	32,04884	32,1264	32,59224	32,56889	23,9157	23,91755	24,34591	24,34591
2005/08/14 @ 18:00:00	31,48056	31,4357	31,93109	31,80854	23,6118	23,61482	23,91543	23,91543
2005/08/14 @ 19:00:00	30,8193	30,7768	31,19174	31,06388	23,2589	23,26296	23,51278	23,51278
2005/08/14 @ 20:00:00	30,14456	30,1062	30,45556	30,34419	22,8235	22,8258	23,04318	23,04318
2005/08/14 @ 21:00:00	29,15382	29,1140	29,4276	29,32738	22,1758	22,12103	22,38562	22,38562
2005/08/14 @ 22:00:00	28,48626	28,4604	28,73124	28,64723	21,6980	21,69554	21,89244	21,89244
2005/08/14 @ 23:00:00	27,95105	27,9300	28,1526	28,07886	21,3304	21,32878	21,48833	21,48833



Graphic 7 - Canopy layer temperature result for LCZ2 – Lisbon.



Graphic 8 - Canopy layer temperature result for LCZ2 – Ancona.

Table 26 - Canopy layer temperature result for LCZ3.

UCL	*LCZ3*							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/08 @ 00:00:00	18,4911	18,4861	18,6718	18,6497	26,2103	26,2083	26,4314	26,3794
2005/08/08 @ 01:00:00	17,9087	17,9047	18,0582	18,0411	25,7962	25,7950	25,9793	25,9339
2005/08/08 @ 02:00:00	17,4943	17,4905	17,6157	17,6014	25,5475	25,5479	25,7253	25,6819
2005/08/08 @ 03:00:00	17,0045	17,0009	17,1094	17,0974	25,7722	25,7663	25,8831	25,8369
2005/08/08 @ 04:00:00	16,5856	16,5824	16,6716	16,6615	25,8924	25,8871	25,9409	25,9015
2005/08/08 @ 05:00:00	16,6187	16,6164	16,6774	16,6810	26,0311	26,0271	26,0394	26,0200
2005/08/08 @ 06:00:00	17,1621	17,1603	17,2340	17,2732	26,1785	26,1577	26,1920	26,2243
2005/08/08 @ 07:00:00	18,4714	18,4706	18,6278	18,7564	26,5130	26,4837	26,6098	26,6889
2005/08/08 @ 08:00:00	20,2063	20,2057	20,4760	20,6216	27,0111	26,9766	27,1756	27,3154
2005/08/08 @ 09:00:00	22,2693	22,2629	22,6324	22,7454	28,1775	28,1053	28,4280	28,5826
2005/08/08 @ 10:00:00	24,2193	24,2117	24,6730	24,7927	28,8267	28,7790	29,1888	29,3652
2005/08/08 @ 11:00:00	25,9515	25,9467	26,4475	26,5228	29,2918	29,2632	29,7832	29,9649
2005/08/08 @ 12:00:00	27,2657	27,2607	27,7677	27,8062	29,5063	29,4865	30,1088	30,2650
2005/08/08 @ 13:00:00	28,2014	28,1965	28,7873	28,8466	29,5608	29,5470	30,2364	30,3518
2005/08/08 @ 14:00:00	28,4772	28,4716	29,1217	29,1487	29,5564	29,4415	30,2597	30,3240
2005/08/08 @ 15:00:00	28,1641	28,1579	28,8049	28,7877	29,3401	29,3318	30,0251	30,0342
2005/08/08 @ 16:00:00	27,3645	27,3577	27,9854	27,9419	29,2141	29,2092	29,8366	29,8067
2005/08/08 @ 17:00:00	25,9820	25,9743	26,5510	26,4645	29,0935	29,0937	29,6280	29,5699
2005/08/08 @ 18:00:00	24,3890	24,3815	24,8927	24,8165	28,9950	28,9989	29,4292	29,3585
2005/08/08 @ 19:00:00	22,8850	22,8774	23,3333	23,2649	29,1275	29,0906	29,4736	29,3661
2005/08/08 @ 20:00:00	21,3374	21,3314	21,7265	21,6777	28,8384	28,8061	29,1281	29,0334
2005/08/08 @ 21:00:00	20,2786	20,2748	20,6120	20,5755	28,3783	28,3496	28,6329	28,5507
2005/08/08 @ 22:00:00	19,4300	19,4266	19,7086	19,6802	28,0959	28,0764	28,3246	28,2551
2005/08/08 @ 23:00:00	18,7855	18,7807	19,0143	18,9892	27,8533	27,8377	28,0407	27,9792
2005/08/09 @ 00:00:00	18,3287	18,3242	18,5071	18,4867	27,6319	27,6193	27,7873	27,7326
2005/08/09 @ 01:00:00	17,8525	17,8483	17,9991	17,9819	27,4038	27,3934	27,5198	27,4699
2005/08/09 @ 02:00:00	17,4402	17,4363	17,5574	17,5426	27,2342	27,2268	27,3266	27,2826
2005/08/09 @ 03:00:00	16,9606	16,9569	17,0601	17,0474	27,1055	27,0995	27,1821	27,1428
2005/08/09 @ 04:00:00	16,4612	16,4578	16,5452	16,5345	27,0154	27,0145	27,0548	27,0206
2005/08/09 @ 05:00:00	16,5190	16,5166	16,5680	16,5686	27,0216	27,0180	27,0474	27,0360
2005/08/09 @ 06:00:00	17,2537	17,2521	17,3293	17,3857	27,2696	27,2495	27,2996	27,3383
2005/08/09 @ 07:00:00	18,6706	18,6300	18,8128	18,9431	27,1891	27,1641	27,2806	27,3699
2005/08/09 @ 08:00:00	20,8685	20,8667	21,1210	21,2827	27,1591	27,1369	27,3599	27,4961
2005/08/09 @ 09:00:00	23,3241	23,3162	23,6597	23,7931	27,5029	27,4595	27,8186	27,9680
2005/08/09 @ 10:00:00	25,8612	25,8527	26,3278	26,5025	27,5243	27,3910	27,9675	28,0355
2005/08/09 @ 11:00:00	28,1377	28,1285	28,7669	28,9545	27,6514	27,5068	28,2092	28,2592
2005/08/09 @ 12:00:00	29,7448	29,7393	30,4478	30,5314	27,7168	27,6761	28,4709	28,4959
2005/08/09 @ 13:00:00	30,7029	30,6962	31,4369	31,4755	27,9223	27,8926	28,6451	28,7286
2005/08/09 @ 14:00:00	31,0502	31,0433	31,7600	31,7551	28,2273	28,2076	28,9973	28,9877

Table 26 - Canopy layer temperature result for LCZ3 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/09 @ 15:00:00	30,7824	30,7742	31,4912	31,4755	28,7685	28,7574	29,4325	29,4398
2005/08/09 @ 16:00:00	29,5863	29,5791	30,2340	30,1773	29,1081	29,1025	29,6908	29,6616
2005/08/09 @ 17:00:00	27,9893	27,9816	28,6096	28,5425	29,3448	29,3413	29,8829	29,8229
2005/08/09 @ 18:00:00	26,2906	26,2876	26,8669	26,7850	29,4450	29,4459	29,9056	29,8264
2005/08/09 @ 19:00:00	24,0059	23,9975	24,5321	24,4573	29,3705	29,3564	29,6943	29,6039
2005/08/09 @ 20:00:00	22,4573	22,4496	22,9254	22,8676	29,2026	29,1732	29,4820	29,3891
2005/08/09 @ 21:00:00	21,2872	21,2873	21,6794	21,6451	28,6466	28,6168	28,8837	28,7996
2005/08/09 @ 22:00:00	20,1952	20,1916	20,5576	20,5221	28,3296	28,3096	28,5504	28,4795
2005/08/09 @ 23:00:00	19,4070	19,4032	19,7265	19,6847	28,0679	28,0512	28,2595	28,1969
2005/08/10 @ 00:00:00	18,8571	18,8548	19,0998	19,0783	27,8128	27,7983	27,9743	27,9179
2005/08/10 @ 01:00:00	18,2835	18,2790	18,4906	18,4690	27,5428	27,5306	27,6718	27,6210
2005/08/10 @ 02:00:00	17,8330	17,8310	17,9929	17,9776	27,2803	27,2702	27,3842	27,3387
2005/08/10 @ 03:00:00	17,3291	17,3274	17,4672	17,4539	27,0017	26,9938	27,0742	27,0334
2005/08/10 @ 04:00:00	16,7845	16,7812	16,9091	16,8958	26,8142	26,8097	26,8647	26,8294
2005/08/10 @ 05:00:00	16,9073	16,9025	16,9951	17,0051	26,7024	26,6975	26,7374	26,7226
2005/08/10 @ 06:00:00	17,4339	17,4081	17,5739	17,6591	27,2649	27,2435	27,2850	27,3211
2005/08/10 @ 07:00:00	18,6855	18,6503	18,9434	19,0705	27,0424	27,0162	27,1252	27,2137
2005/08/10 @ 08:00:00	20,5068	20,4696	20,9123	21,0568	26,8645	26,8399	27,0560	27,1923
2005/08/10 @ 09:00:00	22,7333	22,6777	23,2703	23,4079	27,3910	27,3345	27,6977	27,8410
2005/08/10 @ 10:00:00	24,8005	24,7567	25,4392	25,5792	28,3165	28,2752	28,7339	28,8844
2005/08/10 @ 11:00:00	26,7581	26,7269	27,5747	27,6766	29,6656	29,6254	30,1815	30,3339
2005/08/10 @ 12:00:00	28,1309	28,1052	29,0242	29,1077	31,3532	31,3222	32,0162	32,1300
2005/08/10 @ 13:00:00	28,9845	28,9642	29,9097	29,9710	31,9602	31,9376	32,6839	32,7650
2005/08/10 @ 14:00:00	29,2683	29,2583	30,2789	30,2854	31,7162	31,7065	32,5626	32,5801
2005/08/10 @ 15:00:00	28,9938	28,9876	29,9425	29,9206	30,8702	30,8663	31,6955	31,6763
2005/08/10 @ 16:00:00	28,0785	28,0763	28,9547	28,9032	30,5633	30,5642	31,2909	31,2424
2005/08/10 @ 17:00:00	26,6444	26,6450	27,4145	27,3458	30,5734	30,5795	31,1665	31,0983
2005/08/10 @ 18:00:00	25,1102	25,1127	25,7506	25,6772	30,7776	30,7814	31,1898	31,1185
2005/08/10 @ 19:00:00	23,3137	23,3174	23,9100	23,8360	30,7025	30,7005	31,0330	30,9530
2005/08/10 @ 20:00:00	22,0183	22,0201	22,4951	22,4409	30,2031	30,1998	30,4708	30,4011
2005/08/10 @ 21:00:00	20,9980	21,0016	21,3821	21,3431	29,1954	29,1872	29,4893	29,4246
2005/08/10 @ 22:00:00	20,1156	20,0896	20,5126	20,3873	28,6141	28,6058	28,8774	28,8168
2005/08/10 @ 23:00:00	19,3420	19,3403	19,6566	19,6173	28,1877	28,1852	28,4163	28,3754
2005/08/11 @ 00:00:00	18,7591	18,7589	19,0442	19,0123	27,8354	27,8325	27,9991	27,9657
2005/08/11 @ 01:00:00	18,3044	18,3046	18,5375	18,5115	27,6187	27,6150	27,7397	27,7129
2005/08/11 @ 02:00:00	17,9004	17,9004	18,0845	18,0633	27,4665	27,4605	27,5472	27,5212
2005/08/11 @ 03:00:00	17,4921	17,4922	17,6455	17,6276	27,3065	27,3006	27,3726	27,3485
2005/08/11 @ 04:00:00	17,1493	17,1493	17,2653	17,2513	27,2031	27,1990	27,2420	27,2205
2005/08/11 @ 05:00:00	17,1724	17,1649	17,2947	17,3165	27,1947	27,1905	27,2171	27,2147
2005/08/11 @ 06:00:00	17,8996	17,8918	18,0866	18,1972	27,3549	27,3376	27,3927	27,4358

Table 26 - Canopy layer temperature result for LCZ3 (continued).

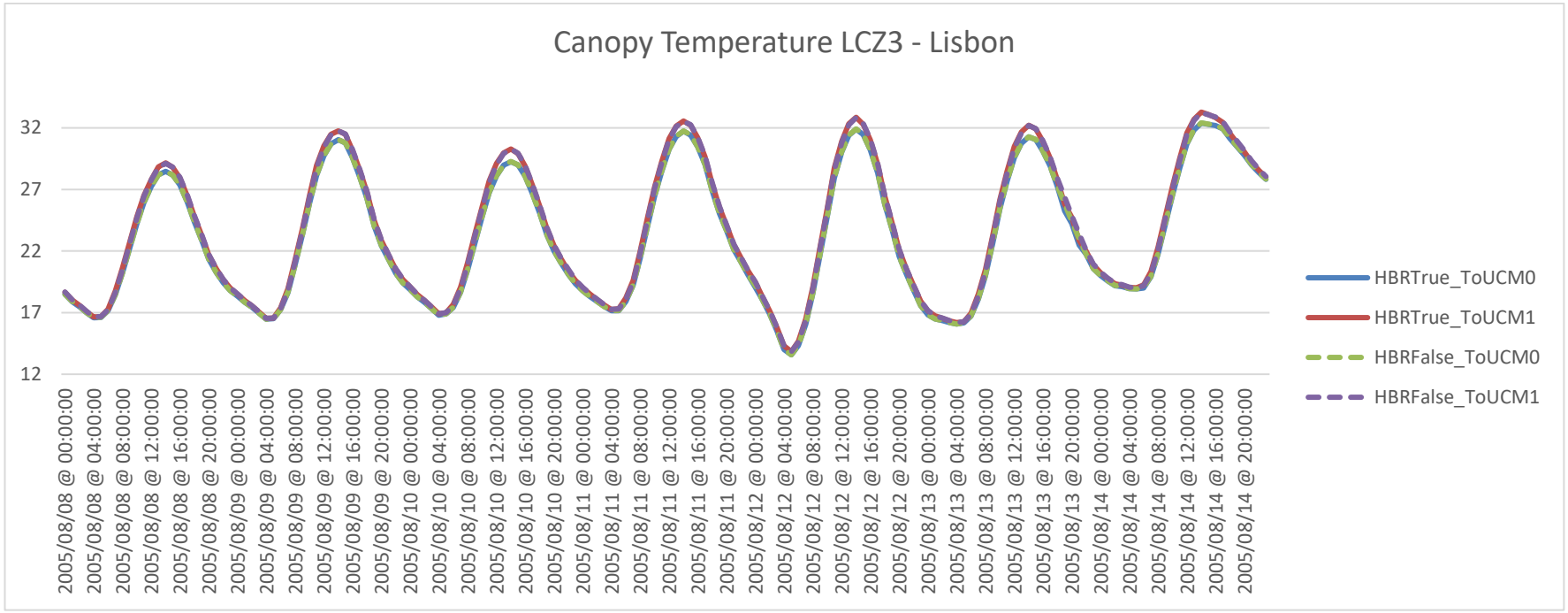
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/11 @ 07:00:00	19,2531	19,2207	19,4832	19,6069	27,5424	27,5189	27,6397	27,7293
2005/08/11 @ 08:00:00	21,4630	21,4284	21,8422	22,0114	28,4964	28,4623	28,6476	28,7815
2005/08/11 @ 09:00:00	24,0888	24,0237	24,5917	24,7352	30,6786	30,5996	30,9179	31,0437
2005/08/11 @ 10:00:00	26,4991	26,4569	27,1008	27,2365	31,9370	31,8903	32,3086	32,4481
2005/08/11 @ 11:00:00	28,5161	28,4767	29,1570	29,2838	32,5808	32,5417	33,0879	33,2238
2005/08/11 @ 12:00:00	30,2730	30,2532	31,0709	31,1306	32,7504	32,7257	33,4437	33,5392
2005/08/11 @ 13:00:00	31,3111	31,2937	32,1092	32,1543	32,8296	32,8125	33,5872	33,6540
2005/08/11 @ 14:00:00	31,7450	31,7301	32,5127	32,5483	32,8042	32,7973	33,6479	33,6624
2005/08/11 @ 15:00:00	31,4265	31,4171	32,2564	32,2169	32,6954	32,6934	33,4877	33,4716
2005/08/11 @ 16:00:00	30,4734	30,4718	31,2368	31,1946	32,3741	32,3744	33,0313	33,0018
2005/08/11 @ 17:00:00	29,0254	29,0274	29,7065	29,6400	31,9520	31,9546	32,4650	32,4250
2005/08/11 @ 18:00:00	26,9061	26,9064	27,5748	27,4846	31,6901	31,6837	32,0308	31,9820
2005/08/11 @ 19:00:00	25,0358	25,0383	25,6085	25,5413	31,2658	31,2567	31,5597	31,4999
2005/08/11 @ 20:00:00	23,6706	23,6711	24,1224	24,0740	30,4944	30,4871	30,7910	30,7308
2005/08/11 @ 21:00:00	22,0920	22,0948	22,5444	22,5051	29,1722	29,1678	29,5469	29,4905
2005/08/11 @ 22:00:00	21,1093	21,1119	21,4766	21,4471	28,6866	28,6804	29,0092	28,9547
2005/08/11 @ 23:00:00	20,0547	20,0576	20,4306	20,4033	28,7419	28,7411	28,9589	28,9199
2005/08/12 @ 00:00:00	19,1761	19,0496	19,4707	19,4505	29,0185	29,0159	29,1345	29,1044
2005/08/12 @ 01:00:00	18,0250	18,0247	18,3111	18,2941	29,1155	29,1107	29,1919	29,1634
2005/08/12 @ 02:00:00	16,8577	16,8580	17,1258	17,1120	29,0876	29,0849	29,1226	29,0959
2005/08/12 @ 03:00:00	15,5347	15,5348	15,8111	15,7992	28,9832	28,9825	28,9867	28,9615
2005/08/12 @ 04:00:00	14,0066	14,0068	14,3073	14,2973	28,9036	28,9090	28,8762	28,8536
2005/08/12 @ 05:00:00	13,5801	13,5777	13,8352	13,8404	28,8363	28,8297	28,7817	28,7817
2005/08/12 @ 06:00:00	14,3502	14,3360	14,6122	14,6742	28,9485	28,9244	28,9274	28,9745
2005/08/12 @ 07:00:00	16,0927	16,0647	16,3772	16,4937	28,8883	28,8617	28,9355	29,0201
2005/08/12 @ 08:00:00	18,5995	18,5594	18,9305	19,0854	29,0905	29,0600	29,2181	29,3248
2005/08/12 @ 09:00:00	21,8188	21,7596	22,2552	22,3840	30,2474	30,1878	30,4531	30,5470
2005/08/12 @ 10:00:00	24,8674	24,8100	25,3403	25,4832	30,5270	30,4909	30,8128	30,9269
2005/08/12 @ 11:00:00	27,9693	27,9481	28,6006	28,7719	30,4538	30,4226	30,8423	30,9539
2005/08/12 @ 12:00:00	30,0659	30,0271	30,7914	30,9055	30,2199	30,1934	30,6638	30,7765
2005/08/12 @ 13:00:00	31,4105	31,3853	32,2470	32,3210	30,1571	30,0600	30,6599	30,6779
2005/08/12 @ 14:00:00	31,9102	31,8984	32,8435	32,8602	30,3833	30,3640	30,9129	30,9457
2005/08/12 @ 15:00:00	31,4627	31,4530	32,3491	32,2914	31,0953	31,0825	31,5521	31,5820
2005/08/12 @ 16:00:00	30,2242	30,2135	31,0910	31,0082	31,5289	31,5214	31,9411	31,9437
2005/08/12 @ 17:00:00	28,3435	28,3450	29,1153	29,0423	31,5130	31,5130	31,8806	31,8583
2005/08/12 @ 18:00:00	25,8043	25,8061	26,5379	26,4624	31,2351	31,2113	31,5417	31,4737
2005/08/12 @ 19:00:00	23,7587	23,7606	24,3556	24,2914	30,8058	30,7845	31,0611	30,9782
2005/08/12 @ 20:00:00	21,5653	21,5668	22,1413	22,0904	30,1860	30,1762	30,4068	30,3471
2005/08/12 @ 21:00:00	20,0992	20,1023	20,5442	20,5102	29,3145	29,3048	29,5580	29,4947
2005/08/12 @ 22:00:00	18,8197	18,8227	19,2249	19,1968	28,5399	28,5360	28,8214	28,7630

Table 26 - Canopy layer temperature result for LCZ3 (continued).

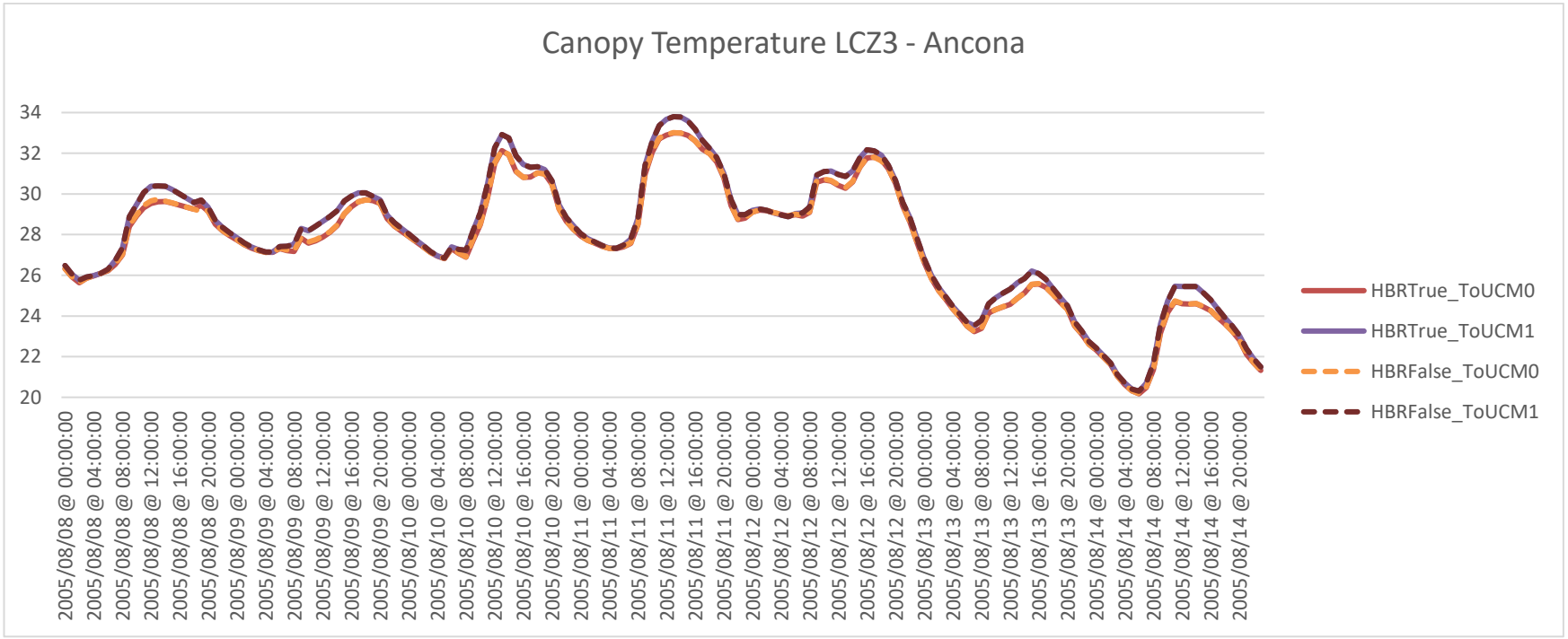
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/12 @ 23:00:00	17,5760	17,5788	17,9585	17,9346	27,5604	27,5519	27,8351	27,7772
2005/08/13 @ 00:00:00	16,8172	16,8197	17,1524	17,1318	26,5809	26,5742	26,8248	26,7815
2005/08/13 @ 01:00:00	16,4981	16,5003	16,7564	16,7396	25,7840	25,7782	26,0089	25,9751
2005/08/13 @ 02:00:00	16,3594	16,3596	16,5571	16,5412	25,1701	25,1675	25,3873	25,3627
2005/08/13 @ 03:00:00	16,1942	16,1946	16,3510	16,3368	24,6768	24,6736	24,8427	24,8247
2005/08/13 @ 04:00:00	16,0880	16,0880	16,1935	16,1821	24,1942	24,1914	24,3358	24,3198
2005/08/13 @ 05:00:00	16,1695	16,1677	16,2567	16,2660	23,7871	23,7839	23,9312	23,9243
2005/08/13 @ 06:00:00	16,7340	16,7116	16,8657	16,9539	23,3746	23,3666	23,5505	23,5724
2005/08/13 @ 07:00:00	18,1441	18,1085	18,3624	18,5039	23,1391	23,1245	23,3881	23,4439
2005/08/13 @ 08:00:00	20,0241	19,9773	20,3032	20,4959	23,3754	23,3556	23,7434	23,8289
2005/08/13 @ 09:00:00	22,7174	22,6468	23,1330	23,3062	24,0401	24,0359	24,4952	24,6008
2005/08/13 @ 10:00:00	25,4735	25,4181	26,0027	26,1683	24,3213	24,3159	24,9332	25,0360
2005/08/13 @ 11:00:00	27,6857	27,6341	28,2638	28,4358	24,4658	24,4606	25,2094	25,2917
2005/08/13 @ 12:00:00	29,6057	29,5718	30,3708	30,4834	24,5849	24,5817	25,4293	25,4932
2005/08/13 @ 13:00:00	30,7676	30,7416	31,5809	31,6678	24,8478	24,8439	25,7384	25,7866
2005/08/13 @ 14:00:00	31,2837	31,2706	32,1902	32,2162	25,0873	25,0803	25,9510	25,9702
2005/08/13 @ 15:00:00	31,0602	31,0518	31,9324	31,9208	25,3572	25,3493	26,0661	26,0624
2005/08/13 @ 16:00:00	30,1150	30,1114	30,9508	30,8975	25,3507	25,3467	25,9262	25,8972
2005/08/13 @ 17:00:00	28,8757	28,8750	29,5992	29,5270	25,1532	25,1540	25,6408	25,5881
2005/08/13 @ 18:00:00	27,2764	27,2393	27,9193	27,7844	24,7916	24,7950	25,1900	25,1319
2005/08/13 @ 19:00:00	25,8496	25,2418	26,3696	25,7921	24,4094	24,4076	24,7413	24,6826
2005/08/13 @ 20:00:00	24,4316	24,2375	24,8915	24,7500	24,0540	24,0511	24,2992	24,2546
2005/08/13 @ 21:00:00	22,9926	22,4822	23,4013	22,8630	23,3738	23,3720	23,6008	23,5653
2005/08/13 @ 22:00:00	21,7444	21,7235	22,0592	21,9961	22,9472	22,9459	23,1398	23,1121
2005/08/13 @ 23:00:00	20,5879	20,5734	20,9544	20,8751	22,4515	22,4503	22,6151	22,5908
2005/08/14 @ 00:00:00	20,0195	20,0058	20,2842	20,2370	22,1539	22,1518	22,2782	22,2593
2005/08/14 @ 01:00:00	19,5839	19,5722	19,8063	19,7655	21,8043	21,8024	21,9107	21,8938
2005/08/14 @ 02:00:00	19,1945	19,1847	19,3835	19,3479	21,4398	21,4381	21,5259	21,5107
2005/08/14 @ 03:00:00	19,1255	19,1090	19,2743	19,2358	20,8546	20,8538	20,9510	20,9363
2005/08/14 @ 04:00:00	18,9559	18,9419	19,0741	19,0401	20,4455	20,4447	20,5473	20,5351
2005/08/14 @ 05:00:00	18,9263	18,9192	19,0262	19,0240	20,1400	20,1384	20,2349	20,2313
2005/08/14 @ 06:00:00	19,0331	19,0033	19,1750	19,2595	20,0274	20,0178	20,1258	20,1539
2005/08/14 @ 07:00:00	19,9574	19,9195	20,1781	20,3275	20,3638	20,3441	20,4898	20,5596
2005/08/14 @ 08:00:00	21,8012	21,7578	22,1310	22,3094	21,2858	21,2565	21,4610	21,5781
2005/08/14 @ 09:00:00	24,2610	24,1799	24,6732	24,8475	23,0249	22,9558	23,2705	23,4072
2005/08/14 @ 10:00:00	26,5776	26,5176	27,0539	27,2535	24,0910	24,0465	24,4916	24,6357
2005/08/14 @ 11:00:00	28,7294	28,6754	29,2995	29,4854	24,6292	24,5949	25,2443	25,3637
2005/08/14 @ 12:00:00	30,7310	30,6933	31,4858	31,6010	24,5553	24,5351	25,4275	25,4921
2005/08/14 @ 13:00:00	31,8476	31,8149	32,5961	32,7017	24,5083	24,4933	25,4400	25,4768
2005/08/14 @ 14:00:00	32,4100	32,3896	33,2320	33,2790	24,4529	24,4407	25,2991	25,3153

Table *26* - Canopy layer temperature result for LCZ3 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**
2005/08/14 @ 15:00:00	32,3078	32,2925	33,0691	33,0808	24,2636	24,2547	24,9920	24,9838
2005/08/14 @ 16:00:00	32,2124	32,2001	32,8717	32,8459	24,0490	24,0432	24,6424	24,6127
2005/08/14 @ 17:00:00	31,9287	31,9194	32,5081	32,4395	23,6732	23,6719	24,1927	24,1387
2005/08/14 @ 18:00:00	31,1825	31,1307	31,6730	31,5376	23,3550	23,3765	23,7439	23,7126
2005/08/14 @ 19:00:00	30,5013	30,4525	30,9102	30,7690	22,9956	22,9880	23,3338	23,2723
2005/08/14 @ 20:00:00	29,8277	29,7843	30,1706	30,0475	22,5177	22,5102	22,8143	22,7611
2005/08/14 @ 21:00:00	29,0156	28,9757	29,3108	29,2029	21,9549	21,9504	22,2280	22,1847
2005/08/14 @ 22:00:00	28,3964	28,3688	28,6535	28,5623	21,5249	21,5228	21,7708	21,7333
2005/08/14 @ 23:00:00	27,8512	27,8290	28,0626	27,9825	21,1522	21,1505	21,3548	21,3222



Graphic 9 - Canopy layer temperature result for LCZ3 – Lisbon.



Graphic 10 - Canopy layer temperature result for LCZ3 – Ancona.

Table 27 - Canopy layer temperature result for LCZ4.

UCL	*LCZ4*							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/08 @ 00:00:00	18,3229	18,32083	18,3692	18,3630	26,1529	26,1508	26,2324	26,2108
2005/08/08 @ 01:00:00	17,7556	17,75402	17,7935	17,7888	25,7372	25,7354	25,8017	25,7832
2005/08/08 @ 02:00:00	17,3420	17,34044	17,3726	17,3687	25,4595	25,4558	25,5126	25,4953
2005/08/08 @ 03:00:00	16,8536	16,85215	16,8802	16,8769	25,6948	25,6914	25,7247	25,7103
2005/08/08 @ 04:00:00	16,4309	16,42965	16,4530	16,4503	25,8135	25,8104	25,8258	25,8136
2005/08/08 @ 05:00:00	16,4575	16,45675	16,4727	16,4740	25,9352	25,9330	25,9369	25,9309
2005/08/08 @ 06:00:00	16,9985	16,99794	17,0180	17,0292	26,0558	26,0542	26,0637	26,0786
2005/08/08 @ 07:00:00	18,2967	18,29682	18,3407	18,3770	26,4249	26,4135	26,4586	26,4873
2005/08/08 @ 08:00:00	20,0689	20,06915	20,1437	20,1842	26,9443	26,9300	27,0007	27,0516
2005/08/08 @ 09:00:00	22,1499	22,14835	22,2493	22,2799	28,1478	28,1274	28,2343	28,2997
2005/08/08 @ 10:00:00	24,1058	24,10393	24,2302	24,2625	28,7741	28,7554	28,8962	28,9581
2005/08/08 @ 11:00:00	25,8828	25,88153	26,0171	26,0366	29,2587	29,1713	29,4264	29,4477
2005/08/08 @ 12:00:00	27,2332	27,23174	27,3678	27,3772	29,4864	29,3783	29,6926	29,7486
2005/08/08 @ 13:00:00	28,1590	28,15764	28,3168	28,3322	29,5453	29,4339	29,7776	29,8190
2005/08/08 @ 14:00:00	28,4209	28,41918	28,5945	28,6008	29,4208	29,4082	29,6690	29,6859
2005/08/08 @ 15:00:00	28,0938	28,0918	28,2655	28,2595	29,2931	29,2865	29,5310	29,5334
2005/08/08 @ 16:00:00	27,2664	27,26403	27,4326	27,4193	29,1627	29,1604	29,3786	29,3676
2005/08/08 @ 17:00:00	25,8683	25,86557	26,0197	25,9945	29,0471	29,0475	29,2316	29,2110
2005/08/08 @ 18:00:00	24,2410	24,2383	24,3745	24,3527	28,9483	28,9504	29,0974	29,0723
2005/08/08 @ 19:00:00	22,7109	22,7083	22,8293	22,8102	29,1108	29,0898	29,2275	29,1813
2005/08/08 @ 20:00:00	21,1693	21,16725	21,2707	21,2574	28,8372	28,8187	28,9337	28,8931
2005/08/08 @ 21:00:00	20,1005	20,09917	20,1870	20,1774	28,3636	28,3462	28,4488	28,4126
2005/08/08 @ 22:00:00	19,2471	19,24597	19,3188	19,3115	28,0439	28,0323	28,1232	28,0932
2005/08/08 @ 23:00:00	18,5983	18,59723	18,6564	18,6506	27,8032	27,7935	27,8679	27,8414
2005/08/09 @ 00:00:00	18,1408	18,13975	18,1856	18,1809	27,5850	27,5764	27,6382	27,6144
2005/08/09 @ 01:00:00	17,6816	17,68004	17,7180	17,7135	27,3580	27,3506	27,3971	27,3757
2005/08/09 @ 02:00:00	17,2715	17,27002	17,3004	17,2966	27,1918	27,1860	27,2225	27,2040
2005/08/09 @ 03:00:00	16,7931	16,79173	16,8178	16,8145	27,0667	27,0616	27,0920	27,0756
2005/08/09 @ 04:00:00	16,2891	16,28782	16,3104	16,3076	26,9613	26,9578	26,9742	26,9601
2005/08/09 @ 05:00:00	16,3510	16,35027	16,3632	16,3637	26,9502	26,9472	26,9594	26,9543
2005/08/09 @ 06:00:00	17,0824	17,08212	17,1028	17,1190	27,1774	27,1706	27,1885	27,2025
2005/08/09 @ 07:00:00	18,5326	18,53205	18,5797	18,6425	27,0992	27,0906	27,1313	27,1644
2005/08/09 @ 08:00:00	20,7345	20,73484	20,8046	20,8502	27,0852	27,0773	27,1547	27,2056
2005/08/09 @ 09:00:00	23,2107	23,20916	23,3028	23,3396	27,4829	27,4626	27,5911	27,6429
2005/08/09 @ 10:00:00	25,7369	25,73522	25,8657	25,9139	27,3553	27,3343	27,5097	27,5575
2005/08/09 @ 11:00:00	28,0219	28,02138	28,1955	28,2470	27,4744	27,4546	27,6686	27,7154
2005/08/09 @ 12:00:00	29,7072	29,70596	29,8977	29,9193	27,6519	27,6346	27,8782	27,9186
2005/08/09 @ 13:00:00	30,6909	30,68912	30,8884	30,8975	27,8728	27,8591	28,1192	28,1490
2005/08/09 @ 14:00:00	31,0315	31,02944	31,2213	31,2184	28,1804	28,1706	28,4251	28,4418

Table 27 - Canopy layer temperature result for LCZ4 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/09 @ 15:00:00	30,7286	30,72617	30,9188	30,9131	28,7302	28,7244	28,9586	28,9615
2005/08/09 @ 16:00:00	29,5211	29,51877	29,6931	29,6763	29,0711	29,0679	29,2718	29,2612
2005/08/09 @ 17:00:00	27,8856	27,88308	28,0505	28,0311	29,3080	29,3086	29,5003	29,4763
2005/08/09 @ 18:00:00	26,1537	26,14885	26,3095	26,2843	29,4106	29,4132	29,5719	29,5431
2005/08/09 @ 19:00:00	23,8351	23,83189	23,9741	23,9533	29,3454	29,3388	29,4523	29,4189
2005/08/09 @ 20:00:00	22,2695	22,26662	22,3923	22,3764	29,2075	29,1927	29,2981	29,2609
2005/08/09 @ 21:00:00	21,1026	21,10053	21,2121	21,1996	28,6409	28,6248	28,7178	28,6826
2005/08/09 @ 22:00:00	19,9846	19,98285	20,0793	20,0695	28,2803	28,2699	28,3554	28,3263
2005/08/09 @ 23:00:00	19,2060	19,20429	19,2862	19,2780	28,0194	28,0102	28,0842	28,0582
2005/08/10 @ 00:00:00	18,6564	18,65477	18,7224	18,7155	27,7651	27,7570	27,8193	27,7961
2005/08/10 @ 01:00:00	18,0783	18,07684	18,1311	18,1255	27,4954	27,4885	27,5381	27,5175
2005/08/10 @ 02:00:00	17,6480	17,64584	17,6922	17,6866	27,2343	27,2283	27,2682	27,2499
2005/08/10 @ 03:00:00	17,1409	17,13898	17,1786	17,1737	26,9553	26,9502	26,9783	26,9620
2005/08/10 @ 04:00:00	16,5879	16,5862	16,6199	16,6160	26,7558	26,7517	26,7719	26,7578
2005/08/10 @ 05:00:00	16,6918	16,69111	16,7167	16,7205	26,6272	26,6242	26,6388	26,6329
2005/08/10 @ 06:00:00	17,2517	17,25144	17,2970	17,3356	27,1679	27,1612	27,1751	27,1886
2005/08/10 @ 07:00:00	18,4800	18,48025	18,5565	18,6102	26,9464	26,9377	26,9751	27,0081
2005/08/10 @ 08:00:00	20,3163	20,31676	20,4288	20,4877	26,7819	26,7732	26,8478	26,8987
2005/08/10 @ 09:00:00	22,5571	22,55496	22,7124	22,7769	27,3687	27,3458	27,4732	27,5248
2005/08/10 @ 10:00:00	24,7119	24,71067	24,9132	24,9810	28,2792	28,2621	28,4185	28,4712
2005/08/10 @ 11:00:00	26,6284	26,62746	26,8580	26,9022	29,6417	29,6239	29,8164	29,8697
2005/08/10 @ 12:00:00	28,0598	28,05825	28,3210	28,3588	31,3714	31,3561	31,6003	31,6399
2005/08/10 @ 13:00:00	28,9622	28,96006	29,2486	29,2778	31,9908	31,9789	32,2434	32,2712
2005/08/10 @ 14:00:00	29,1751	29,1727	29,4539	29,4563	31,7308	31,7253	32,0357	32,0401
2005/08/10 @ 15:00:00	28,8901	28,88723	29,1578	29,1482	30,8530	30,8509	31,1523	31,1431
2005/08/10 @ 16:00:00	27,9553	27,95205	28,2017	28,1801	30,5321	30,5311	30,7955	30,7713
2005/08/10 @ 17:00:00	26,5120	26,5085	26,7345	26,7057	30,5084	30,5034	30,7076	30,6733
2005/08/10 @ 18:00:00	24,9759	24,97222	25,1709	25,1388	30,7334	30,7367	30,8743	30,8480
2005/08/10 @ 19:00:00	23,1273	23,12415	23,2930	23,2643	30,6601	30,6508	30,7705	30,7315
2005/08/10 @ 20:00:00	21,8644	21,86124	22,0107	21,9874	30,1599	30,1517	30,2458	30,2136
2005/08/10 @ 21:00:00	20,8674	20,86686	20,9960	20,9803	29,1221	29,1171	29,2022	29,1793
2005/08/10 @ 22:00:00	20,0915	19,98747	20,1999	20,0857	28,5180	28,5138	28,5875	28,5690
2005/08/10 @ 23:00:00	19,2688	19,26646	19,3660	19,3526	28,0888	28,0845	28,1554	28,1388
2005/08/11 @ 00:00:00	18,5807	18,5789	18,6596	18,6493	27,7574	27,7530	27,8123	27,7966
2005/08/11 @ 01:00:00	18,1130	18,12491	18,1765	18,1681	27,5457	27,5429	27,5840	27,5733
2005/08/11 @ 02:00:00	17,7402	17,73774	17,7929	17,7848	27,3996	27,3954	27,4233	27,4128
2005/08/11 @ 03:00:00	17,3350	17,33268	17,3788	17,3719	27,2455	27,2414	27,2647	27,2548
2005/08/11 @ 04:00:00	17,0281	17,02578	17,0647	17,0590	27,1315	27,1280	27,1420	27,1333
2005/08/11 @ 05:00:00	16,9716	16,97053	17,0076	17,0158	27,1090	27,1067	27,1149	27,1139
2005/08/11 @ 06:00:00	17,6767	17,67648	17,7288	17,7625	27,2488	27,2417	27,2605	27,2753

Table 27 - Canopy layer temperature result for LCZ4 (continued).

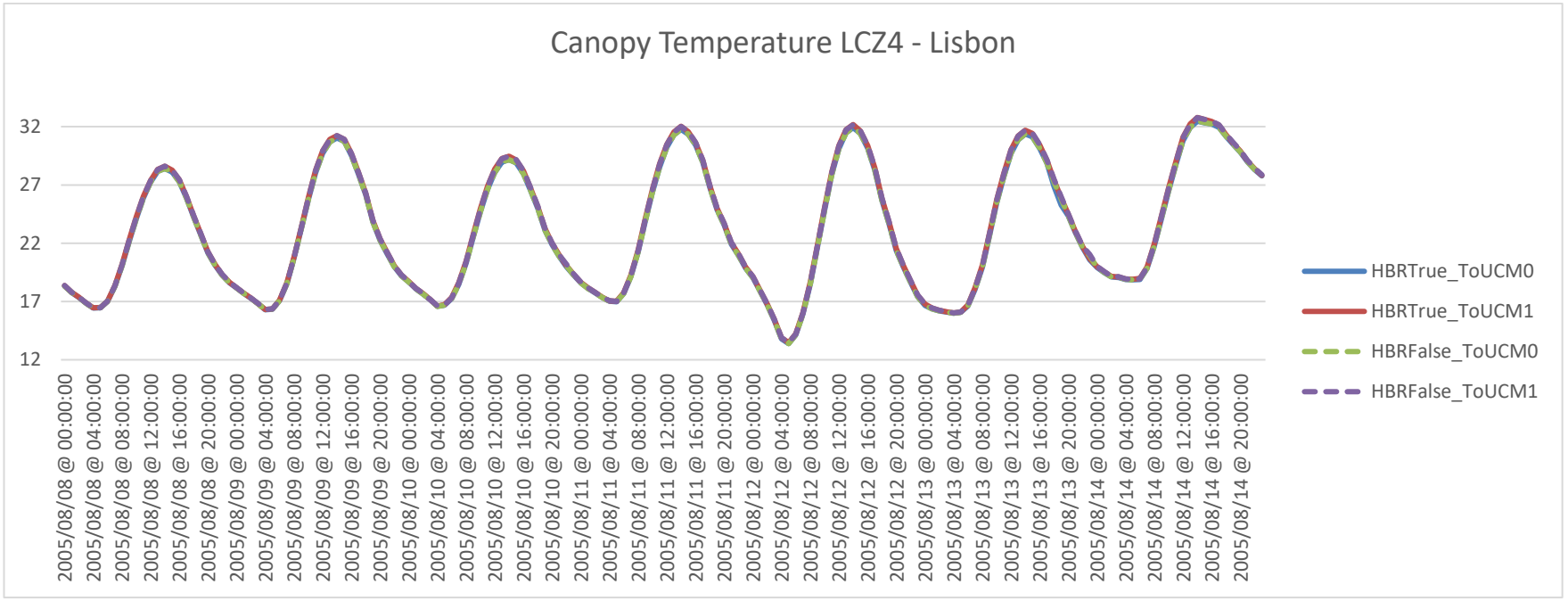
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/11 @ 07:00:00	19,1232	19,12221	19,1993	19,2584	27,4431	27,4349	27,4757	27,5089
2005/08/11 @ 08:00:00	21,2873	21,28772	21,3928	21,4536	28,4242	28,4103	28,4755	28,5246
2005/08/11 @ 09:00:00	23,9297	23,92689	24,0752	24,1448	30,7033	30,6673	30,7839	30,8276
2005/08/11 @ 10:00:00	26,4143	26,41372	26,5947	26,6586	31,9353	31,9147	32,0591	32,1076
2005/08/11 @ 11:00:00	28,5520	28,53387	28,7711	28,8169	32,5913	32,5728	32,7633	32,8108
2005/08/11 @ 12:00:00	30,2215	30,21906	30,4368	30,4596	32,7720	32,7590	33,0143	33,0475
2005/08/11 @ 13:00:00	31,2988	31,29606	31,5253	31,5448	32,8504	32,8409	33,1182	33,1410
2005/08/11 @ 14:00:00	31,7627	31,75967	32,0059	32,0228	32,7398	32,7363	33,0036	33,0077
2005/08/11 @ 15:00:00	31,3600	31,35693	31,5849	31,5727	32,6028	32,5992	32,8447	32,8353
2005/08/11 @ 16:00:00	30,4088	30,40518	30,6303	30,6110	32,3267	32,3225	32,5512	32,5343
2005/08/11 @ 17:00:00	28,9497	28,94579	29,1527	29,1229	31,9079	31,9085	32,0870	32,0707
2005/08/11 @ 18:00:00	26,7609	26,75746	26,9429	26,9118	31,6451	31,6397	31,7573	31,7368
2005/08/11 @ 19:00:00	24,8752	24,87195	25,0397	25,0131	31,2156	31,2102	31,3120	31,2873
2005/08/11 @ 20:00:00	23,5633	23,55978	23,7153	23,6928	30,4402	30,4372	30,5372	30,5145
2005/08/11 @ 21:00:00	21,9319	21,93016	22,0696	22,0534	29,0766	29,0720	29,3180	29,1678
2005/08/11 @ 22:00:00	20,9761	20,97441	21,1017	21,0877	28,5572	28,5534	28,6449	28,6265
2005/08/11 @ 23:00:00	19,8600	19,85853	19,9665	19,9558	28,6313	28,6274	28,6944	28,6779
2005/08/12 @ 00:00:00	19,0311	19,02952	19,1301	19,1205	28,9416	28,9390	28,9774	28,9646
2005/08/12 @ 01:00:00	17,8703	17,86885	17,9651	17,9572	29,0461	29,0421	29,0674	29,0553
2005/08/12 @ 02:00:00	16,7056	16,70523	16,7958	16,7904	29,0199	29,0166	29,0270	29,0157
2005/08/12 @ 03:00:00	15,3715	15,37018	15,4640	15,4584	28,9162	28,9133	28,9129	28,9023
2005/08/12 @ 04:00:00	13,8017	13,80057	13,8965	13,8920	28,8262	28,8244	28,8139	28,8045
2005/08/12 @ 05:00:00	13,3858	13,38479	13,4684	13,4703	28,7395	28,7368	28,7200	28,7197
2005/08/12 @ 06:00:00	14,1240	14,12371	14,2009	14,2249	28,8573	28,8497	28,8487	28,8659
2005/08/12 @ 07:00:00	15,9150	15,91535	16,0028	16,0532	28,8027	28,7936	28,8176	28,8487
2005/08/12 @ 08:00:00	18,5118	18,49587	18,6220	18,6800	29,0113	28,9991	29,0544	29,0934
2005/08/12 @ 09:00:00	21,6686	21,66535	21,7919	21,8511	30,2509	30,2198	30,3206	30,3485
2005/08/12 @ 10:00:00	24,8453	24,84145	24,9965	25,0693	30,4809	30,4656	30,5765	30,6158
2005/08/12 @ 11:00:00	27,8690	27,86767	28,0423	28,0903	30,4114	30,3976	30,5430	30,5818
2005/08/12 @ 12:00:00	30,0981	30,09621	30,3177	30,3743	30,1802	30,1687	30,3309	30,3693
2005/08/12 @ 13:00:00	31,4622	31,45945	31,7127	31,7483	30,0320	30,0196	30,2061	30,2327
2005/08/12 @ 14:00:00	31,9066	31,90345	32,1654	32,1717	30,3310	30,3219	30,5045	30,5232
2005/08/12 @ 15:00:00	31,4287	31,42556	31,6679	31,6503	31,0573	31,0509	31,2136	31,2237
2005/08/12 @ 16:00:00	30,1469	30,14339	30,3805	30,3561	31,5061	31,5023	31,6463	31,6465
2005/08/12 @ 17:00:00	28,2554	28,25147	28,4797	28,4483	31,4970	31,4965	31,6209	31,6122
2005/08/12 @ 18:00:00	25,6656	25,66202	25,8743	25,8437	31,2859	31,2717	31,3870	31,3568
2005/08/12 @ 19:00:00	23,6362	23,63243	23,8302	23,8007	30,8366	30,8228	30,9201	30,8845
2005/08/12 @ 20:00:00	21,3969	21,39368	21,5771	21,5549	30,1552	30,1500	30,2281	30,2036
2005/08/12 @ 21:00:00	19,9512	19,95161	20,1029	20,0896	29,2630	29,2574	29,3453	29,3198
2005/08/12 @ 22:00:00	18,6684	18,66896	18,8070	18,7962	28,4466	28,4410	28,5346	28,5098

Table 27 - Canopy layer temperature result for LCZ4 (continued).

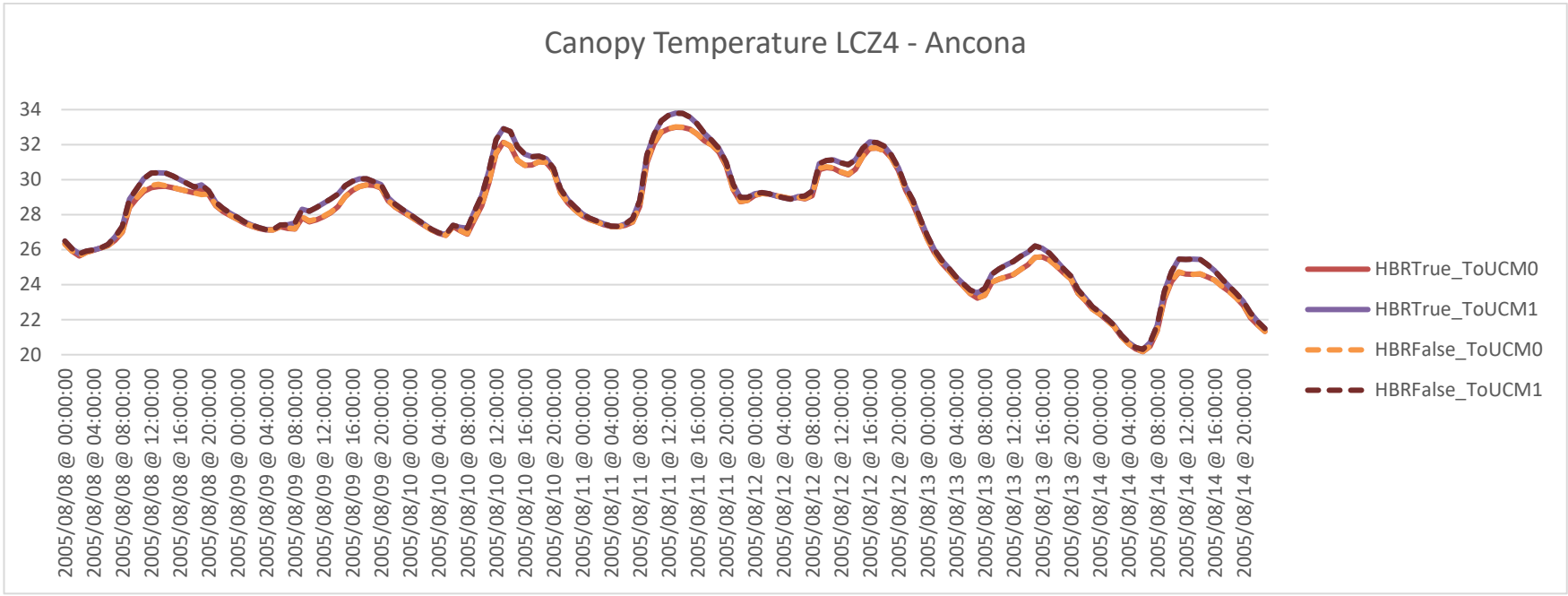
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/12 @ 23:00:00	17,4211	17,42157	17,5516	17,5424	27,4439	27,4400	27,5190	27,5017
2005/08/13 @ 00:00:00	16,6670	16,66742	16,7801	16,7724	26,4557	26,4527	26,5213	26,5088
2005/08/13 @ 01:00:00	16,3572	16,35755	16,4422	16,4360	25,6480	25,6455	25,7081	25,6985
2005/08/13 @ 02:00:00	16,1793	16,17945	16,2429	16,2376	25,0080	25,0054	25,0679	25,0593
2005/08/13 @ 03:00:00	16,0859	16,08526	16,1345	16,1292	24,5632	24,5614	24,6188	24,6122
2005/08/13 @ 04:00:00	15,9892	15,98843	16,0206	16,0163	24,0787	24,0771	24,1258	24,1200
2005/08/13 @ 05:00:00	16,0724	16,07153	16,0984	16,1018	23,6712	23,6697	23,7195	23,7173
2005/08/13 @ 06:00:00	16,6237	16,61504	16,6664	16,6974	23,2504	23,2472	23,3108	23,3195
2005/08/13 @ 07:00:00	18,0544	18,03964	18,1275	18,1781	22,9666	22,9660	23,0426	23,0659
2005/08/13 @ 08:00:00	19,9636	19,94398	20,0565	20,1256	23,1663	23,1661	23,2685	23,3013
2005/08/13 @ 09:00:00	22,6856	22,65457	22,8260	22,8869	23,8190	23,8174	23,9459	23,9747
2005/08/13 @ 10:00:00	25,4802	25,45602	25,6593	25,7177	24,0710	24,0705	24,2390	24,2674
2005/08/13 @ 11:00:00	27,7264	27,70322	27,9210	27,9823	24,2122	24,2116	24,4154	24,4375
2005/08/13 @ 12:00:00	29,6988	29,68177	29,9652	30,0051	24,3317	24,3308	24,5611	24,5778
2005/08/13 @ 13:00:00	30,8787	30,86498	31,1670	31,1978	24,5963	24,5951	24,8371	24,8494
2005/08/13 @ 14:00:00	31,3669	31,36205	31,6858	31,6976	24,8291	24,8273	25,0615	25,0655
2005/08/13 @ 15:00:00	31,1249	31,11962	31,4417	31,4332	25,1922	25,1897	25,4101	25,4081
2005/08/13 @ 16:00:00	30,1402	30,13459	30,4376	30,4078	25,2491	25,2459	25,4427	25,4283
2005/08/13 @ 17:00:00	28,8825	28,8844	29,1475	29,1186	25,0405	25,0370	25,1964	25,1719
2005/08/13 @ 18:00:00	27,2523	26,86512	27,4839	27,4093	24,6650	24,6616	24,7864	24,7608
2005/08/13 @ 19:00:00	25,8022	25,28385	25,9854	25,8952	24,2607	24,2793	24,3585	24,3577
2005/08/13 @ 20:00:00	24,3577	24,33566	24,5178	24,4827	23,9726	23,9711	24,0484	24,0318
2005/08/13 @ 21:00:00	22,8939	22,88986	23,0354	23,0097	23,2842	23,2823	23,3559	23,3420
2005/08/13 @ 22:00:00	21,6430	21,63236	21,7490	21,7230	22,8535	22,8522	22,9159	22,9051
2005/08/13 @ 23:00:00	20,9162	20,57625	21,0275	20,6792	22,3574	22,3562	22,4099	22,4006
2005/08/14 @ 00:00:00	19,9174	19,90767	20,0082	19,9867	22,0680	22,0662	22,1067	22,0992
2005/08/14 @ 01:00:00	19,4870	19,47934	19,5620	19,5443	21,7211	21,7194	21,7539	21,7473
2005/08/14 @ 02:00:00	19,1033	19,09689	19,1662	19,1511	21,3585	21,3570	21,3847	21,3788
2005/08/14 @ 03:00:00	19,0731	19,06274	19,1212	19,1036	20,7669	20,7659	20,7976	20,7922
2005/08/14 @ 04:00:00	18,9022	18,89321	18,9401	18,9248	20,3502	20,3493	20,3836	20,3791
2005/08/14 @ 05:00:00	18,8681	18,86387	18,9004	18,8984	20,0328	20,0318	20,0645	20,0633
2005/08/14 @ 06:00:00	18,9036	18,8917	18,9516	18,9804	19,8991	19,8954	19,9330	19,9429
2005/08/14 @ 07:00:00	19,8454	19,83039	19,9205	19,9733	20,2422	20,2346	20,2857	20,3105
2005/08/14 @ 08:00:00	21,7345	21,71575	21,8472	21,9115	21,1915	21,1796	21,2516	21,2936
2005/08/14 @ 09:00:00	24,1943	24,15955	24,3343	24,3955	22,9404	22,9117	23,0254	23,0709
2005/08/14 @ 10:00:00	26,5579	26,53312	26,7174	26,7871	24,0287	24,0105	24,1649	24,2163
2005/08/14 @ 11:00:00	28,7490	28,72581	28,9406	29,0056	24,5806	24,5656	24,7952	24,8381
2005/08/14 @ 12:00:00	30,8019	30,78361	31,0638	31,1049	24,4025	24,4000	24,6598	24,6864
2005/08/14 @ 13:00:00	31,9274	31,91101	32,1892	32,2265	24,3577	24,3551	24,6335	24,6485

Table 27 - Canopy layer temperature result for LCZ4 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/14 @ 14:00:00	32,4736	32,46325	32,7721	32,7874	24,3471	24,3439	24,6241	24,6312
2005/08/14 @ 15:00:00	32,3438	32,33675	32,6207	32,6234	24,1922	24,1895	24,4518	24,4483
2005/08/14 @ 16:00:00	32,2341	32,22879	32,4633	32,4542	23,9756	23,9746	24,1835	24,1722
2005/08/14 @ 17:00:00	31,9468	31,94359	32,1483	32,1226	23,6040	23,6050	23,7843	23,7643
2005/08/14 @ 18:00:00	31,1753	31,14926	31,3453	31,2869	23,2816	23,2828	23,4126	23,3931
2005/08/14 @ 19:00:00	30,4932	30,46777	30,6340	30,5731	22,9263	22,9332	23,0384	23,0308
2005/08/14 @ 20:00:00	29,8300	29,80707	29,9467	29,8935	22,4693	22,4660	22,5666	22,5463
2005/08/14 @ 21:00:00	28,9965	28,974	29,0970	29,0489	21,8945	21,8918	21,9848	21,9679
2005/08/14 @ 22:00:00	28,3345	28,31967	28,4260	28,3861	21,4575	21,4560	21,5405	21,5261
2005/08/14 @ 23:00:00	27,7902	27,77771	27,8648	27,8298	21,0850	21,0838	21,1525	21,1403



Graphic 11 - Canopy layer temperature result for LCZ4 – Lisbon.



Graphic 12 - Canopy layer temperature result for LCZ4 – Ancona.

Table 28 - Canopy layer temperature result for LCZ5.

UCL	*LCZ5*							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/08 @ 00:00:00	18,20152	18,1990	18,2573	18,2495	26,0269	26,0247	26,1065	26,0859
2005/08/08 @ 01:00:00	17,6429	17,6409	17,6882	17,6824	25,6057	25,6020	25,6708	25,6510
2005/08/08 @ 02:00:00	17,2259	17,2241	17,2624	17,2576	25,3516	25,3483	25,4041	25,3872
2005/08/08 @ 03:00:00	16,73653	16,7349	16,7682	16,7642	25,5928	25,5898	25,6191	25,6049
2005/08/08 @ 04:00:00	16,31775	16,3162	16,3438	16,3404	25,7171	25,7144	25,7234	25,7115
2005/08/08 @ 05:00:00	16,35856	16,3576	16,3759	16,3773	25,8553	25,8534	25,8495	25,8445
2005/08/08 @ 06:00:00	16,96044	16,9597	16,9816	16,9950	26,0175	26,0160	26,0186	26,0382
2005/08/08 @ 07:00:00	18,35953	18,3595	18,4078	18,4514	26,4211	26,4088	26,4497	26,4801
2005/08/08 @ 08:00:00	20,20679	20,2069	20,2912	20,3400	26,9950	26,9815	27,0526	27,1015
2005/08/08 @ 09:00:00	22,29683	22,2949	22,4119	22,4488	28,1176	28,1069	28,2139	28,2783
2005/08/08 @ 10:00:00	24,28651	24,2841	24,4316	24,4703	28,8158	28,7999	28,9561	29,0126
2005/08/08 @ 11:00:00	26,06688	26,0652	26,2247	26,2481	29,2432	29,2224	29,4396	29,4856
2005/08/08 @ 12:00:00	27,40843	27,4067	27,5674	27,5786	29,4464	29,4286	29,6872	29,7242
2005/08/08 @ 13:00:00	28,37048	28,3689	28,5568	28,5753	29,4935	29,4801	29,7616	29,7870
2005/08/08 @ 14:00:00	28,61312	28,6112	28,8197	28,8272	29,4479	29,4396	29,7255	29,7373
2005/08/08 @ 15:00:00	28,21075	28,2084	28,4173	28,4100	29,2706	29,2668	29,5348	29,5333
2005/08/08 @ 16:00:00	27,33006	27,3273	27,5309	27,5148	29,1011	29,1008	29,3383	29,3250
2005/08/08 @ 17:00:00	25,87224	25,8692	26,0563	26,0260	28,9564	28,9584	29,1560	29,1339
2005/08/08 @ 18:00:00	24,20657	24,2036	24,3693	24,3430	28,8377	28,8412	28,9957	28,9694
2005/08/08 @ 19:00:00	22,56517	22,5440	22,6998	22,6699	28,9139	28,8959	29,0355	28,9890
2005/08/08 @ 20:00:00	21,08666	21,0830	21,2095	21,1918	28,6318	28,6163	28,7304	28,6901
2005/08/08 @ 21:00:00	19,99126	19,9865	20,0963	20,0808	28,2023	28,1877	28,2882	28,2524
2005/08/08 @ 22:00:00	19,13776	19,1345	19,2242	19,2130	27,9083	27,8991	27,9878	27,9582
2005/08/08 @ 23:00:00	18,49287	18,4902	18,5625	18,5538	27,6548	27,6472	27,7189	27,6925
2005/08/09 @ 00:00:00	18,0415	18,0391	18,0948	18,0878	27,4366	27,4304	27,4881	27,4646
2005/08/09 @ 01:00:00	17,55903	17,5568	17,6027	17,5967	27,1975	27,1932	27,2336	27,2123
2005/08/09 @ 02:00:00	17,1457	17,1437	17,1803	17,1752	27,0464	27,0433	27,0721	27,0537
2005/08/09 @ 03:00:00	16,66497	16,6631	16,6945	16,6901	26,9322	26,9296	26,9516	26,9353
2005/08/09 @ 04:00:00	16,16412	16,1624	16,1894	16,1857	26,8344	26,8386	26,8361	26,8236
2005/08/09 @ 05:00:00	16,24683	16,2457	16,2605	16,2608	26,8454	26,8433	26,8443	26,8410
2005/08/09 @ 06:00:00	17,05268	17,0521	17,0746	17,0938	27,1270	27,1183	27,1307	27,1461
2005/08/09 @ 07:00:00	18,56207	18,5451	18,6082	18,6554	27,0784	27,0692	27,1088	27,1423
2005/08/09 @ 08:00:00	20,89181	20,8914	20,9697	21,0239	27,1217	27,1147	27,1968	27,2452
2005/08/09 @ 09:00:00	23,38201	23,3796	23,4873	23,5310	27,4410	27,4273	27,5638	27,6151
2005/08/09 @ 10:00:00	25,97444	25,9719	26,1231	26,1806	27,3567	27,3382	27,5367	27,5807
2005/08/09 @ 11:00:00	28,31567	28,3146	28,5178	28,5794	27,4771	27,4599	27,7030	27,7448
2005/08/09 @ 12:00:00	29,98365	29,9819	30,2081	30,2338	27,6582	27,6435	27,9194	27,9540
2005/08/09 @ 13:00:00	30,94995	30,9477	31,1840	31,1947	27,8808	27,8695	28,1614	28,1854
2005/08/09 @ 14:00:00	31,23607	31,2336	31,4628	31,4591	28,1698	28,1620	28,4442	28,4560

Table 28 - Canopy layer temperature result for LCZ5 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/09 @ 15:00:00	30,88542	30,8825	31,1137	31,1066	28,6901	28,6856	28,9422	28,9413
2005/08/09 @ 16:00:00	29,60528	29,6026	29,8133	29,7929	28,9919	28,9897	29,2100	29,1970
2005/08/09 @ 17:00:00	27,91767	27,9147	28,1177	28,0942	29,2194	29,2201	29,4013	29,3796
2005/08/09 @ 18:00:00	25,95658	25,9197	26,1505	26,0894	29,3125	29,3150	29,4655	29,4388
2005/08/09 @ 19:00:00	23,76846	23,7637	23,9378	23,9106	29,1927	29,1873	29,3061	29,2702
2005/08/09 @ 20:00:00	22,17639	22,1727	22,3263	22,3059	29,0227	29,0093	29,1173	29,0788
2005/08/09 @ 21:00:00	20,91081	20,9066	21,0460	21,0285	28,4743	28,4593	28,5535	28,5171
2005/08/09 @ 22:00:00	19,81576	19,8123	19,9310	19,9174	28,1535	28,1442	28,2303	28,2005
2005/08/09 @ 23:00:00	19,05165	19,0486	19,1485	19,1373	27,8877	27,8798	27,9537	27,9274
2005/08/10 @ 00:00:00	18,50721	18,5044	18,5867	18,5771	27,6253	27,6189	27,6801	27,6569
2005/08/10 @ 01:00:00	17,94105	17,9386	18,0041	17,9964	27,3448	27,3397	27,3871	27,3665
2005/08/10 @ 02:00:00	17,48941	17,4869	17,5426	17,5356	27,0820	27,0779	27,1142	27,0959
2005/08/10 @ 03:00:00	16,98382	16,9816	17,0290	17,0230	26,7924	26,7897	26,8118	26,7953
2005/08/10 @ 04:00:00	16,44215	16,4403	16,4803	16,4755	26,6100	26,6096	26,6198	26,6067
2005/08/10 @ 05:00:00	16,56445	16,5636	16,5934	16,5978	26,4964	26,4942	26,5012	26,4967
2005/08/10 @ 06:00:00	17,20266	17,1911	17,2519	17,2842	27,1140	27,1048	27,1138	27,1286
2005/08/10 @ 07:00:00	18,56402	18,5521	18,6499	18,7017	26,9155	26,9059	26,9430	26,9767
2005/08/10 @ 08:00:00	20,4916	20,4914	20,6197	20,6901	26,8060	26,7979	26,8781	26,9268
2005/08/10 @ 09:00:00	22,74227	22,7199	22,9189	22,9688	27,3150	27,2992	27,4345	27,4859
2005/08/10 @ 10:00:00	24,87443	24,8557	25,0856	25,1351	28,2780	28,2615	28,4323	28,4832
2005/08/10 @ 11:00:00	26,89955	26,8857	27,1721	27,2091	29,6810	29,6652	29,8736	29,9234
2005/08/10 @ 12:00:00	28,32549	28,3135	28,6243	28,6535	31,4411	31,4260	31,6563	31,6975
2005/08/10 @ 13:00:00	29,20903	29,1993	29,5196	29,5404	32,0641	32,0524	32,3040	32,3327
2005/08/10 @ 14:00:00	29,42068	29,4166	29,7525	29,7535	31,7854	31,7798	32,0800	32,0851
2005/08/10 @ 15:00:00	29,04775	29,0436	29,3690	29,3562	30,8455	30,8433	31,1439	31,1351
2005/08/10 @ 16:00:00	28,03973	28,0354	28,3371	28,3101	30,4704	30,4710	30,7410	30,7208
2005/08/10 @ 17:00:00	26,53868	26,5342	26,8082	26,7727	30,4434	30,4462	30,6670	30,6389
2005/08/10 @ 18:00:00	24,94435	24,9397	25,1814	25,1421	30,6264	30,6302	30,7785	30,7508
2005/08/10 @ 19:00:00	23,05504	23,0511	23,2570	23,2217	30,5383	30,5383	30,6583	30,6259
2005/08/10 @ 20:00:00	21,76185	21,7278	21,9403	21,8135	30,0263	30,0252	30,1226	30,0943
2005/08/10 @ 21:00:00	20,59361	20,5907	20,7418	20,7223	29,0397	29,0353	29,1323	29,1061
2005/08/10 @ 22:00:00	19,79221	19,7901	19,9185	19,9027	28,4371	28,4333	28,5174	28,4964
2005/08/10 @ 23:00:00	19,03985	19,0362	19,1585	19,1416	28,0007	27,9969	28,0779	28,0590
2005/08/11 @ 00:00:00	18,42995	18,4273	18,5239	18,5111	27,6381	27,6341	27,7023	27,6844
2005/08/11 @ 01:00:00	17,97291	17,9704	18,0483	18,0377	27,4214	27,4193	27,4660	27,4544
2005/08/11 @ 02:00:00	17,58185	17,5794	17,6443	17,6351	27,2409	27,2376	27,2693	27,2574
2005/08/11 @ 03:00:00	17,17651	17,1743	17,2284	17,2206	27,0926	27,0894	27,1146	27,1036
2005/08/11 @ 04:00:00	16,85515	16,8541	16,8972	16,8915	26,9840	26,9821	26,9944	26,9850
2005/08/11 @ 05:00:00	16,86775	16,8668	16,9090	16,9191	26,9812	26,9790	26,9850	26,9843
2005/08/11 @ 06:00:00	17,65246	17,6523	17,7113	17,7520	27,1882	27,1813	27,1998	27,2164

Table 28 - Canopy layer temperature result for LCZ5 (continued).

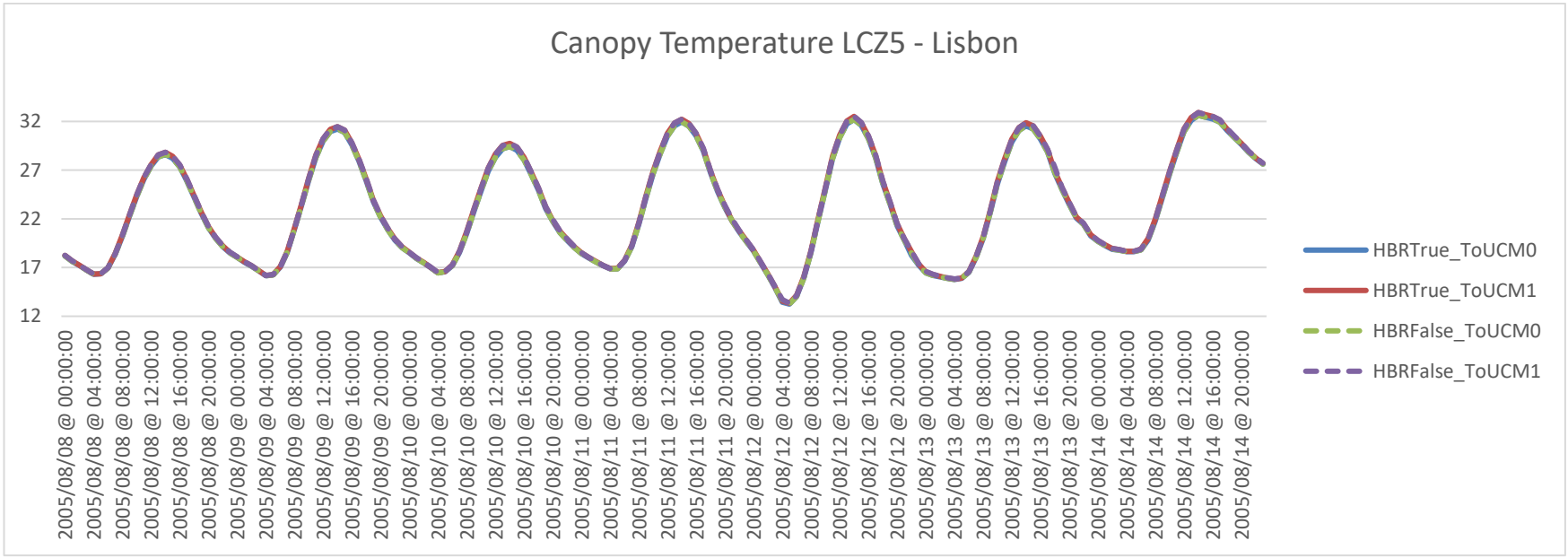
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/11 @ 07:00:00	19,14954	19,1351	19,2256	19,2709	27,4237	27,4154	27,4598	27,4927
2005/08/11 @ 08:00:00	21,48189	21,4817	21,6004	21,6730	28,4629	28,4497	28,5165	28,5637
2005/08/11 @ 09:00:00	24,1167	24,0911	24,2774	24,3289	30,6654	30,6407	30,7383	30,7889
2005/08/11 @ 10:00:00	26,61506	26,5970	26,8093	26,8572	31,9865	31,9674	32,1044	32,1537
2005/08/11 @ 11:00:00	28,68894	28,6717	28,8936	28,9378	32,6580	32,6408	32,8230	32,8708
2005/08/11 @ 12:00:00	30,49731	30,4929	30,7489	30,7745	32,8420	32,8295	33,0767	33,1098
2005/08/11 @ 13:00:00	31,5661	31,5578	31,8278	31,8426	32,9155	32,9063	33,1766	33,1992
2005/08/11 @ 14:00:00	31,96589	31,9587	32,2208	32,2322	32,8601	32,8559	33,1613	33,1644
2005/08/11 @ 15:00:00	31,52544	31,5214	31,7937	31,7779	32,6897	32,6884	32,9795	32,9704
2005/08/11 @ 16:00:00	30,51722	30,5127	30,7829	30,7588	32,3086	32,3085	32,5506	32,5374
2005/08/11 @ 17:00:00	28,99134	28,9865	29,2363	29,1997	31,8342	31,8351	32,0239	32,0068
2005/08/11 @ 18:00:00	26,74029	26,7354	26,9611	26,9220	31,5182	31,5126	31,6553	31,6292
2005/08/11 @ 19:00:00	24,81038	24,8061	25,0105	24,9774	31,0676	31,0623	31,1840	31,1548
2005/08/11 @ 20:00:00	23,21651	23,1618	23,3937	23,3193	30,2771	30,2744	30,3833	30,3595
2005/08/11 @ 21:00:00	21,82583	21,7761	21,9921	21,8263	28,9869	28,9826	29,1199	29,0938
2005/08/11 @ 22:00:00	20,66042	20,6568	20,8052	20,7882	28,4574	28,4539	28,5596	28,5389
2005/08/11 @ 23:00:00	19,67608	19,6719	19,8043	19,7882	28,5261	28,5224	28,5991	28,5805
2005/08/12 @ 00:00:00	18,68236	18,6801	18,7985	18,7872	28,8217	28,8196	28,8636	28,8493
2005/08/12 @ 01:00:00	17,44466	17,4429	17,5590	17,5498	28,9142	28,9111	28,9384	28,9244
2005/08/12 @ 02:00:00	16,23493	16,2334	16,3423	16,3348	28,8804	28,8807	28,8851	28,8703
2005/08/12 @ 03:00:00	14,91255	14,9112	15,0230	15,0166	28,7771	28,7685	28,7618	28,7438
2005/08/12 @ 04:00:00	13,60197	13,4480	13,7115	13,5578	28,7011	28,6937	28,6743	28,6527
2005/08/12 @ 05:00:00	13,24945	13,2480	13,3437	13,3453	28,6749	28,6633	28,6051	28,6053
2005/08/12 @ 06:00:00	14,02855	14,0278	14,1163	14,1446	28,8018	28,7915	28,7874	28,8057
2005/08/12 @ 07:00:00	15,92613	15,9131	16,0221	16,0652	28,7747	28,7650	28,7899	28,8212
2005/08/12 @ 08:00:00	18,56052	18,5427	18,6661	18,7214	29,0190	29,0069	29,0637	29,1024
2005/08/12 @ 09:00:00	21,82892	21,8047	21,9664	22,0118	30,1670	30,1412	30,2357	30,2678
2005/08/12 @ 10:00:00	24,96717	24,9441	25,1140	25,1635	30,4711	30,4564	30,5692	30,6098
2005/08/12 @ 11:00:00	28,15824	28,1547	28,3565	28,4120	30,4077	30,3948	30,5490	30,5871
2005/08/12 @ 12:00:00	30,34921	30,3324	30,5738	30,6131	30,1732	30,1636	30,3527	30,3854
2005/08/12 @ 13:00:00	31,75368	31,7414	32,0168	32,0413	30,0200	30,0098	30,2244	30,2460
2005/08/12 @ 14:00:00	32,2096	32,2045	32,5140	32,5194	30,3032	30,2958	30,5034	30,5176
2005/08/12 @ 15:00:00	31,60021	31,5960	31,8859	31,8636	31,0119	31,0068	31,1881	31,1945
2005/08/12 @ 16:00:00	30,24562	30,2411	30,5264	30,4961	31,4474	31,4445	31,6028	31,6003
2005/08/12 @ 17:00:00	28,29133	28,2865	28,5622	28,5236	31,4180	31,4184	31,5543	31,5437
2005/08/12 @ 18:00:00	25,63664	25,6323	25,8897	25,8523	31,1009	31,0867	31,2128	31,1798
2005/08/12 @ 19:00:00	23,54111	23,5420	23,7702	23,7433	30,6273	30,6143	30,7190	30,6812
2005/08/12 @ 20:00:00	21,28591	21,2826	21,5053	21,4785	29,9787	29,9741	30,0579	30,0317
2005/08/12 @ 21:00:00	19,79988	19,8005	19,9710	19,9565	29,1486	29,1436	29,2309	29,2061
2005/08/12 @ 22:00:00	18,49914	18,2414	18,6569	18,6364	28,3479	28,3430	28,4411	28,4161

Table 28 - Canopy layer temperature result for LCZ5 (continued).

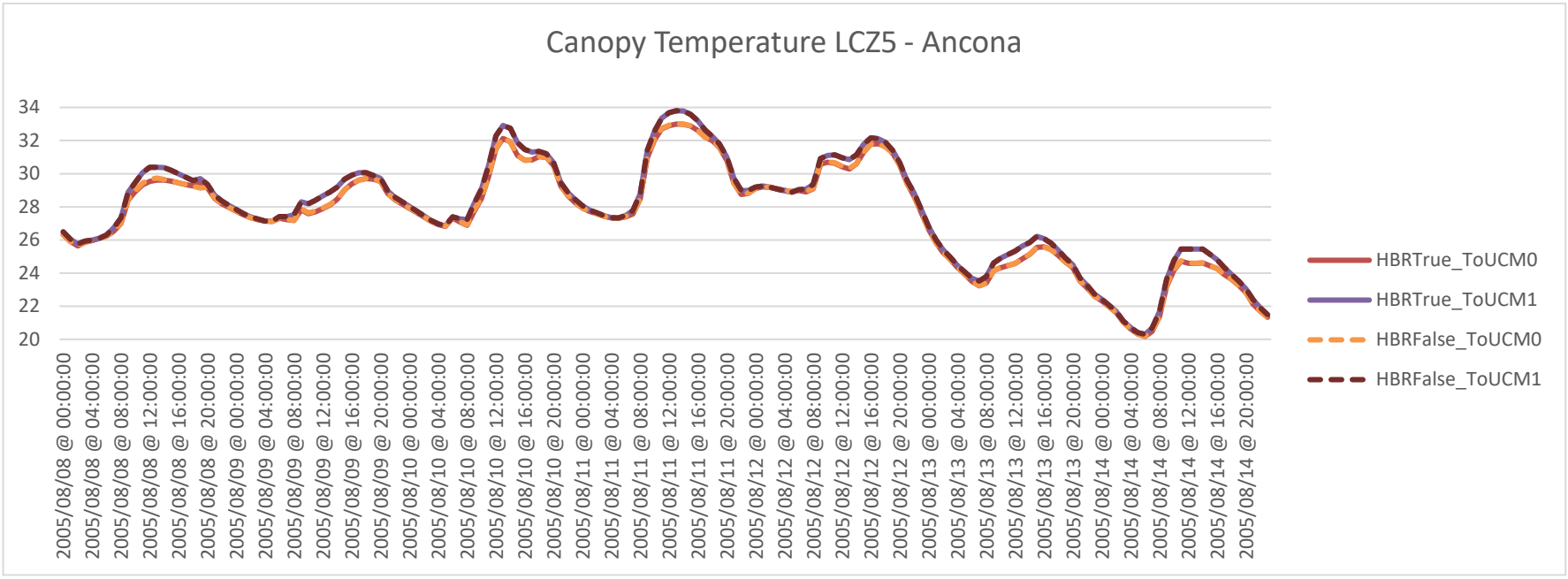
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/12 @ 23:00:00	17,24051	17,2391	17,3900	17,3783	27,3500	27,3467	27,4315	27,4142
2005/08/13 @ 00:00:00	16,45976	16,4568	16,5906	16,5789	26,3572	26,3546	26,4300	26,4174
2005/08/13 @ 01:00:00	16,19897	16,1970	16,2979	16,2886	25,5481	25,5460	25,6160	25,6063
2005/08/13 @ 02:00:00	16,03076	16,0290	16,1056	16,0976	24,8894	24,8871	24,9581	24,9493
2005/08/13 @ 03:00:00	15,88194	15,8806	15,9405	15,9335	24,4178	24,4163	24,4803	24,4739
2005/08/13 @ 04:00:00	15,78284	15,7814	15,8207	15,8150	23,9185	23,9172	23,9729	23,9673
2005/08/13 @ 05:00:00	15,89342	15,8917	15,9238	15,9270	23,5235	23,5221	23,5780	23,5763
2005/08/13 @ 06:00:00	16,53028	16,5199	16,5756	16,6085	23,1332	23,1295	23,2002	23,2100
2005/08/13 @ 07:00:00	18,05341	18,0373	18,1251	18,1762	22,9163	22,9156	23,0043	23,0328
2005/08/13 @ 08:00:00	20,03679	20,0176	20,1317	20,1978	23,1970	23,1968	23,3151	23,3550
2005/08/13 @ 09:00:00	22,74702	22,7192	22,8766	22,9384	23,8616	23,8598	24,0105	24,0456
2005/08/13 @ 10:00:00	25,59176	25,5686	25,7592	25,8164	24,1549	24,1544	24,3534	24,3878
2005/08/13 @ 11:00:00	27,86417	27,8438	28,0578	28,1147	24,3107	24,3100	24,5522	24,5790
2005/08/13 @ 12:00:00	29,8717	29,8554	30,1138	30,1525	24,4395	24,4385	24,7132	24,7334
2005/08/13 @ 13:00:00	31,07823	31,0650	31,3367	31,3661	24,7084	24,7070	24,9961	25,0109
2005/08/13 @ 14:00:00	31,55665	31,5497	31,8605	31,8676	24,9167	24,9148	25,1952	25,2001
2005/08/13 @ 15:00:00	31,23166	31,2281	31,5380	31,5312	25,2158	25,2137	25,4738	25,4720
2005/08/13 @ 16:00:00	30,19195	30,1917	30,4968	30,4740	25,1750	25,1750	25,3864	25,3748
2005/08/13 @ 17:00:00	28,86927	28,8706	29,1372	29,1072	24,9568	24,9591	25,1376	25,1168
2005/08/13 @ 18:00:00	26,77068	26,6796	27,2942	26,8908	24,5725	24,5694	24,7193	24,6893
2005/08/13 @ 19:00:00	25,03931	25,0312	25,2442	25,2024	24,1644	24,1587	24,2824	24,2530
2005/08/13 @ 20:00:00	23,51272	23,5068	23,6963	23,6629	23,8070	23,8059	23,8947	23,8766
2005/08/13 @ 21:00:00	22,07501	22,0709	22,2388	22,2125	23,1555	23,1540	23,2374	23,2222
2005/08/13 @ 22:00:00	21,43031	21,4257	21,5563	21,5338	22,7174	22,7165	22,7892	22,7774
2005/08/13 @ 23:00:00	20,2716	20,2696	20,4026	20,3842	22,2061	22,2053	22,2679	22,2576
2005/08/14 @ 00:00:00	19,69666	19,6943	19,7959	19,7807	21,9076	21,9062	21,9544	21,9458
2005/08/14 @ 01:00:00	19,26699	19,2650	19,3510	19,3376	21,5543	21,5530	21,5939	21,5864
2005/08/14 @ 02:00:00	18,88543	18,8837	18,9562	18,9446	21,1842	21,1830	21,2158	21,2093
2005/08/14 @ 03:00:00	18,79373	18,7888	18,8492	18,8358	20,6026	20,6019	20,6394	20,6334
2005/08/14 @ 04:00:00	18,63352	18,6294	18,6762	18,6645	20,1960	20,1954	20,2352	20,2303
2005/08/14 @ 05:00:00	18,62923	18,6288	18,6642	18,6664	19,8815	19,8807	19,9183	19,9171
2005/08/14 @ 06:00:00	18,81797	18,8066	18,8714	18,9032	19,7849	19,7807	19,8226	19,8337
2005/08/14 @ 07:00:00	19,84041	19,8266	19,9234	19,9765	20,1670	20,1586	20,2129	20,2395
2005/08/14 @ 08:00:00	21,8066	21,7895	21,9191	21,9828	21,1804	21,1680	21,2400	21,2830
2005/08/14 @ 09:00:00	24,2286	24,2014	24,3763	24,4360	22,9021	22,8771	22,9850	23,0336
2005/08/14 @ 10:00:00	26,64815	26,6288	26,8283	26,8891	24,0626	24,0449	24,1955	24,2474
2005/08/14 @ 11:00:00	28,86729	28,8499	29,0808	29,1352	24,6351	24,6204	24,8446	24,8875
2005/08/14 @ 12:00:00	30,95863	30,9416	31,1954	31,2391	24,5723	24,5636	24,8757	24,9045
2005/08/14 @ 13:00:00	32,1042	32,0914	32,3641	32,3956	24,5229	24,5171	24,8502	24,8680
2005/08/14 @ 14:00:00	32,63094	32,6217	32,9034	32,9197	24,4215	24,4167	24,7264	24,7319

Table 28 - Canopy layer temperature result for LCZ5 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**
2005/08/14 @ 15:00:00	32,42688	32,4215	32,7019	32,7017	24,1671	24,1643	24,4335	24,4297
2005/08/14 @ 16:00:00	32,26941	32,2653	32,5223	32,5045	23,9064	23,9052	24,1248	24,1129
2005/08/14 @ 17:00:00	31,93821	31,9355	32,1569	32,1254	23,5017	23,5027	23,6957	23,6743
2005/08/14 @ 18:00:00	31,09739	31,0702	31,2807	31,2167	23,1758	23,1721	23,3192	23,2937
2005/08/14 @ 19:00:00	30,36015	30,3353	30,5108	30,4466	22,7798	22,7765	22,9044	22,8789
2005/08/14 @ 20:00:00	29,66534	29,6437	29,7891	29,7339	22,3016	22,2984	22,4107	22,3887
2005/08/14 @ 21:00:00	28,854	28,8329	28,9599	28,9102	21,7564	21,7538	21,8578	21,8394
2005/08/14 @ 22:00:00	28,19295	28,1791	28,2904	28,2491	21,3103	21,3090	21,4052	21,3894
2005/08/14 @ 23:00:00	27,62964	27,6183	27,7094	27,6730	20,9271	20,9262	21,0059	20,9923



Graphic 13 - Canopy layer temperature result for LCZ5 – Lisbon.



Graphic 14 - Canopy layer temperature result for LCZ5 – Ancona.

Table 29 - Canopy layer temperature result for LCZ6.

UCL	*LCZ6*							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/08 @ 00:00:00	18,1899	18,1877	18,2455	18,2380	26,0094	26,0047	26,0921	26,0675
2005/08/08 @ 01:00:00	17,6337	17,6319	17,6788	17,6732	25,5888	25,5840	25,6567	25,6340
2005/08/08 @ 02:00:00	17,2175	17,2159	17,2539	17,2493	25,3377	25,3341	25,3911	25,3737
2005/08/08 @ 03:00:00	16,7290	16,7275	16,7606	16,7567	25,5804	25,5771	25,6074	25,5928
2005/08/08 @ 04:00:00	16,3112	16,3098	16,3371	16,3339	25,7059	25,7029	25,7128	25,7004
2005/08/08 @ 05:00:00	16,3533	16,3525	16,3706	16,3721	25,8469	25,8447	25,8416	25,8362
2005/08/08 @ 06:00:00	16,9572	16,9566	16,9783	16,9918	26,0186	26,0168	26,0198	26,0391
2005/08/08 @ 07:00:00	18,3632	18,3632	18,4113	18,4550	26,4273	26,4142	26,4556	26,4850
2005/08/08 @ 08:00:00	20,2019	20,2021	20,2865	20,3353	27,0031	26,9883	27,0606	27,1079
2005/08/08 @ 09:00:00	22,2765	22,2746	22,3921	22,4290	28,1216	28,1095	28,2180	28,2810
2005/08/08 @ 10:00:00	24,2600	24,2576	24,4056	24,4444	28,8067	28,7896	28,9477	29,0033
2005/08/08 @ 11:00:00	26,0273	26,0257	26,1859	26,2093	29,2232	29,2010	29,4886	29,4663
2005/08/08 @ 12:00:00	27,3655	27,3638	27,5252	27,5364	29,4164	29,3971	29,7552	29,6959
2005/08/08 @ 13:00:00	28,3261	28,3245	28,5131	28,5316	29,4565	29,4420	29,8292	29,7528
2005/08/08 @ 14:00:00	28,5628	28,5608	28,7700	28,7776	29,4069	29,3983	29,6897	29,7002
2005/08/08 @ 15:00:00	28,1629	28,1606	28,3699	28,3626	29,2302	29,2265	29,4993	29,4972
2005/08/08 @ 16:00:00	27,2910	27,2883	27,4921	27,4760	29,0649	29,0650	29,3067	29,2928
2005/08/08 @ 17:00:00	25,8386	25,8355	26,0227	25,9924	28,9251	28,9274	29,1290	29,1060
2005/08/08 @ 18:00:00	24,1810	24,1780	24,3436	24,3173	28,8103	28,8140	28,9722	28,9450
2005/08/08 @ 19:00:00	22,5269	22,5203	22,6726	22,6460	28,8737	28,8559	28,9995	28,9515
2005/08/08 @ 20:00:00	21,0704	21,0677	21,1928	21,1762	28,5984	28,5830	28,7007	28,6589
2005/08/08 @ 21:00:00	19,9751	19,9722	20,0795	20,0663	28,1712	28,1564	28,2605	28,2230
2005/08/08 @ 22:00:00	19,1247	19,1224	19,2107	19,2007	27,8805	27,8712	27,9638	27,9329
2005/08/08 @ 23:00:00	18,4816	18,4796	18,5509	18,5430	27,6293	27,6215	27,6972	27,6694
2005/08/09 @ 00:00:00	18,0316	18,0298	18,0847	18,0783	27,4135	27,4072	27,4684	27,4437
2005/08/09 @ 01:00:00	17,5499	17,5481	17,5933	17,5879	27,1759	27,1715	27,2153	27,1928
2005/08/09 @ 02:00:00	17,1372	17,1356	17,1717	17,1670	27,0273	27,0244	27,0558	27,0362
2005/08/09 @ 03:00:00	16,6572	16,6556	16,6866	16,6826	26,9151	26,9126	26,9368	26,9195
2005/08/09 @ 04:00:00	16,1573	16,1558	16,1824	16,1791	26,8222	26,8295	26,8247	26,8118
2005/08/09 @ 05:00:00	16,2413	16,2405	16,2549	16,2555	26,8377	26,8355	26,8374	26,8336
2005/08/09 @ 06:00:00	17,0501	17,0497	17,0720	17,0914	27,1276	27,1186	27,1318	27,1465
2005/08/09 @ 07:00:00	18,5730	18,5551	18,6184	18,6644	27,0841	27,0742	27,1148	27,1471
2005/08/09 @ 08:00:00	20,8881	20,8880	20,9661	21,0205	27,1276	27,1195	27,2030	27,2499
2005/08/09 @ 09:00:00	23,3635	23,3613	23,4692	23,5132	27,4409	27,4262	27,5643	27,6145
2005/08/09 @ 10:00:00	25,9522	25,9498	26,1015	26,1591	27,3449	27,3256	27,5259	27,5694
2005/08/09 @ 11:00:00	28,2792	28,2783	28,4823	28,5440	27,4554	27,4374	27,6827	27,7243
2005/08/09 @ 12:00:00	29,9207	29,9191	30,1465	30,1724	27,6271	27,6118	27,8904	27,9251
2005/08/09 @ 13:00:00	30,8848	30,8826	31,1201	31,1308	27,8435	27,8318	28,1268	28,1511
2005/08/09 @ 14:00:00	31,1755	31,1730	31,4030	31,3993	28,1300	28,1221	28,4075	28,4198

Table 29 - Canopy layer temperature result for LCZ6 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/09 @ 15:00:00	30,8329	30,8300	31,0617	31,0546	28,6472	28,6429	28,9028	28,9023
2005/08/09 @ 16:00:00	29,5619	29,5592	29,7700	29,7496	28,9545	28,9525	29,1760	29,1632
2005/08/09 @ 17:00:00	27,8809	27,8780	28,0810	28,0575	29,1882	29,1888	29,3732	29,3526
2005/08/09 @ 18:00:00	25,8886	25,8824	26,0833	26,0522	29,2846	29,2873	29,4423	29,4150
2005/08/09 @ 19:00:00	23,7418	23,7391	23,9100	23,8858	29,1616	29,1564	29,2777	29,2414
2005/08/09 @ 20:00:00	22,1551	22,1520	22,3042	22,2847	28,9914	28,9779	29,0884	29,0494
2005/08/09 @ 21:00:00	20,8898	20,8862	21,0244	21,0078	28,4435	28,4282	28,5251	28,4879
2005/08/09 @ 22:00:00	19,7983	19,7954	19,9131	19,9001	28,1260	28,1166	28,2059	28,1753
2005/08/09 @ 23:00:00	19,0360	19,0334	19,1325	19,1218	27,8629	27,8548	27,9318	27,9048
2005/08/10 @ 00:00:00	18,4927	18,4904	18,5719	18,5629	27,6029	27,5963	27,6603	27,6364
2005/08/10 @ 01:00:00	17,9288	17,9267	17,9916	17,9843	27,3242	27,3191	27,3690	27,3478
2005/08/10 @ 02:00:00	17,4773	17,4752	17,5304	17,5237	27,0634	27,0593	27,0977	27,0788
2005/08/10 @ 03:00:00	16,9729	16,9709	17,0179	17,0123	26,7754	26,7729	26,7966	26,7795
2005/08/10 @ 04:00:00	16,4329	16,4312	16,4709	16,4664	26,5965	26,5968	26,6073	26,5940
2005/08/10 @ 05:00:00	16,5580	16,5573	16,5868	16,5914	26,4878	26,4855	26,4932	26,4885
2005/08/10 @ 06:00:00	17,2068	17,1948	17,2555	17,2875	27,1146	27,1052	27,1147	27,1290
2005/08/10 @ 07:00:00	18,5734	18,5586	18,6589	18,7076	26,9220	26,9117	26,9495	26,9822
2005/08/10 @ 08:00:00	20,4932	20,4929	20,6213	20,6918	26,8129	26,8038	26,8851	26,9325
2005/08/10 @ 09:00:00	22,7363	22,7122	22,9137	22,9624	27,3154	27,2986	27,4352	27,4856
2005/08/10 @ 10:00:00	24,8523	24,8325	25,0659	25,1148	28,2677	28,2504	28,4228	28,4731
2005/08/10 @ 11:00:00	26,8562	26,8482	27,1269	27,1766	29,6598	29,6432	29,8537	29,9033
2005/08/10 @ 12:00:00	28,2760	28,2638	28,5813	28,6107	31,4105	31,3948	31,6290	31,6701
2005/08/10 @ 13:00:00	29,1511	29,1414	29,4696	29,4908	32,0246	32,0126	32,2690	32,2979
2005/08/10 @ 14:00:00	29,3444	29,3409	29,6776	29,6793	31,7401	31,7348	32,0408	32,0463
2005/08/10 @ 15:00:00	28,9762	28,9725	29,2986	29,2862	30,8003	30,7984	31,1050	31,0964
2005/08/10 @ 16:00:00	27,9816	27,9776	28,2795	28,2529	30,4318	30,4327	30,7078	30,6877
2005/08/10 @ 17:00:00	26,4911	26,4868	26,7608	26,7255	30,4109	30,4140	30,6391	30,6108
2005/08/10 @ 18:00:00	24,9015	24,8956	25,1387	25,0976	30,5983	30,6022	30,7538	30,7258
2005/08/10 @ 19:00:00	23,0218	23,0168	23,2236	23,1868	30,5103	30,5104	30,6331	30,6002
2005/08/10 @ 20:00:00	21,6321	21,5956	21,8136	21,7526	30,0028	29,9966	30,1012	30,0683
2005/08/10 @ 21:00:00	20,5688	20,5642	20,7187	20,6963	29,0185	29,0140	29,1114	29,0851
2005/08/10 @ 22:00:00	19,7707	19,7675	19,8984	19,8807	28,4191	28,4153	28,4996	28,4785
2005/08/10 @ 23:00:00	19,0189	19,0144	19,1374	19,1190	27,9830	27,9792	28,0604	28,0415
2005/08/11 @ 00:00:00	18,4130	18,4095	18,5069	18,4926	27,6199	27,6159	27,6841	27,6664
2005/08/11 @ 01:00:00	17,9578	17,9546	18,0331	18,0213	27,4057	27,4036	27,4516	27,4397
2005/08/11 @ 02:00:00	17,5675	17,5644	17,6299	17,6197	27,2241	27,2208	27,2532	27,2412
2005/08/11 @ 03:00:00	17,1633	17,1605	17,2152	17,2065	27,0769	27,0737	27,0995	27,0884
2005/08/11 @ 04:00:00	16,8443	16,8424	16,8867	16,8804	26,9708	26,9691	26,9814	26,9721
2005/08/11 @ 05:00:00	16,8616	16,8603	16,9027	16,9123	26,9732	26,9710	26,9771	26,9763
2005/08/11 @ 06:00:00	17,6549	17,6545	17,7134	17,7537	27,1887	27,1814	27,2001	27,2164

Table 29 - Canopy layer temperature result for LCZ6 (continued).

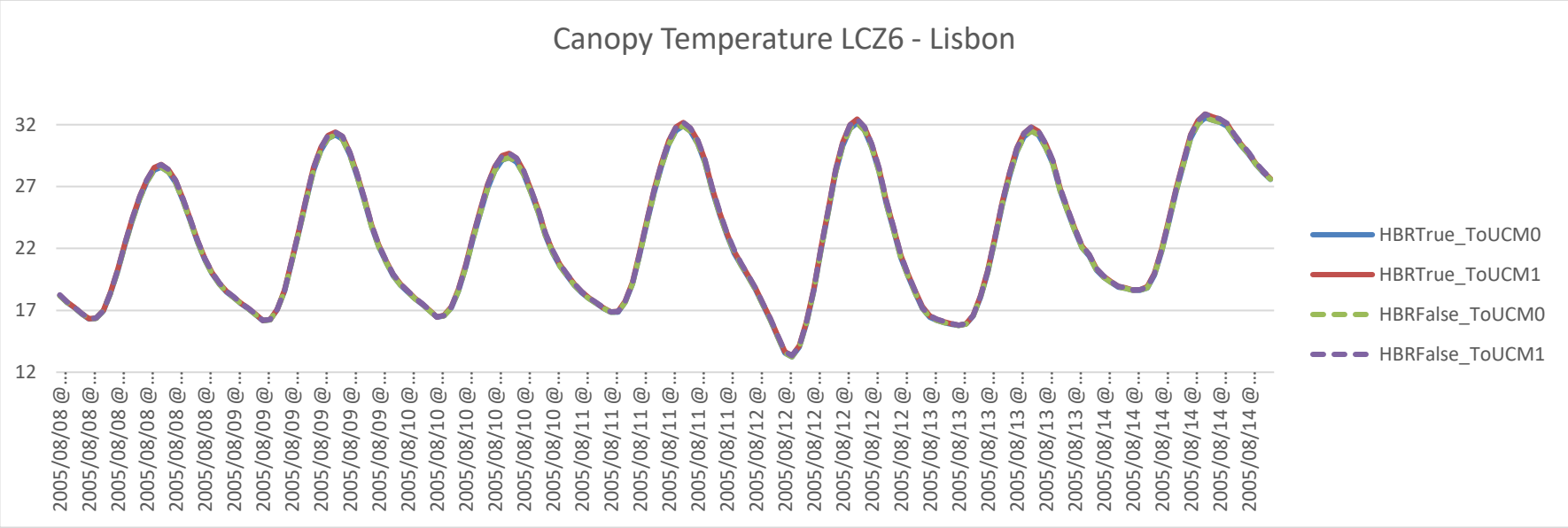
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/11 @ 07:00:00	19,1569	19,1412	19,2323	19,2762	27,4282	27,4192	27,4640	27,4961
2005/08/11 @ 08:00:00	21,4873	21,4871	21,6056	21,6781	28,4700	28,4556	28,5232	28,5690
2005/08/11 @ 09:00:00	24,1135	24,0858	24,2747	24,3245	30,6699	30,6440	30,7424	30,7917
2005/08/11 @ 10:00:00	26,5937	26,5743	26,7903	26,8373	31,9800	31,9598	32,0985	32,1470
2005/08/11 @ 11:00:00	28,6541	28,6356	28,8626	28,9064	32,6401	32,6220	32,8069	32,8542
2005/08/11 @ 12:00:00	30,4386	30,4351	30,6916	30,7179	32,8125	32,7997	33,0506	33,0838
2005/08/11 @ 13:00:00	31,5183	31,5098	31,7870	31,8020	32,8785	32,8692	33,1441	33,1669
2005/08/11 @ 14:00:00	31,9149	31,9076	32,1773	32,1889	32,8190	32,8151	33,1259	33,1293
2005/08/11 @ 15:00:00	31,4616	31,4578	31,7309	31,7154	32,6447	32,6410	32,9338	32,9225
2005/08/11 @ 16:00:00	30,4639	30,4595	30,7303	30,7063	32,2726	32,2727	32,5193	32,5061
2005/08/11 @ 17:00:00	28,9442	28,9396	29,1896	29,1531	31,8031	31,8041	31,9964	31,9792
2005/08/11 @ 18:00:00	26,7017	26,6841	26,9208	26,8700	31,4822	31,4768	31,6208	31,5950
2005/08/11 @ 19:00:00	24,7792	24,7582	24,9784	24,9277	31,0362	31,0311	31,1541	31,1249
2005/08/11 @ 20:00:00	23,1343	23,1253	23,3179	23,2820	30,2536	30,2510	30,3619	30,3378
2005/08/11 @ 21:00:00	21,7564	21,6198	21,9224	21,7701	28,9664	28,9621	29,0998	29,0737
2005/08/11 @ 22:00:00	20,6388	20,6336	20,7842	20,7651	28,4399	28,4364	28,5424	28,5217
2005/08/11 @ 23:00:00	19,6573	19,6518	19,7845	19,7667	28,5089	28,5052	28,5822	28,5636
2005/08/12 @ 00:00:00	18,6665	18,6633	18,7830	18,7705	28,8041	28,8020	28,8476	28,8329
2005/08/12 @ 01:00:00	17,4309	17,4284	17,5456	17,5354	28,8951	28,8921	28,9203	28,9061
2005/08/12 @ 02:00:00	16,2229	16,2206	16,3306	16,3223	28,8616	28,8616	28,8665	28,8502
2005/08/12 @ 03:00:00	14,9021	14,9002	15,0128	15,0058	28,7477	28,7397	28,7394	28,7155
2005/08/12 @ 04:00:00	13,5590	13,5562	13,6691	13,6617	28,6741	28,6668	28,6481	28,6267
2005/08/12 @ 05:00:00	13,2418	13,2396	13,3357	13,3364	28,6714	28,6668	28,6010	28,6013
2005/08/12 @ 06:00:00	14,0272	14,0260	14,1146	14,1422	28,8041	28,7933	28,7893	28,8071
2005/08/12 @ 07:00:00	15,9316	15,9174	16,0269	16,0688	28,7785	28,7680	28,7934	28,8238
2005/08/12 @ 08:00:00	18,5631	18,5435	18,6682	18,7220	29,0213	29,0083	29,0659	29,1037
2005/08/12 @ 09:00:00	21,8237	21,7978	21,9618	22,0057	30,1677	30,1409	30,2364	30,2677
2005/08/12 @ 10:00:00	24,9498	24,9251	25,0981	25,1466	30,4629	30,4475	30,5615	30,6017
2005/08/12 @ 11:00:00	28,1182	28,1151	28,3175	28,3734	30,3924	30,3790	30,5346	30,5726
2005/08/12 @ 12:00:00	30,3054	30,2872	30,5351	30,5739	30,1505	30,1406	30,3313	30,3643
2005/08/12 @ 13:00:00	31,6976	31,6848	31,9685	31,9931	29,9952	29,9847	30,2013	30,2231
2005/08/12 @ 14:00:00	32,1304	32,1260	32,4362	32,4424	30,2763	30,2688	30,4783	30,4930
2005/08/12 @ 15:00:00	31,5299	31,5260	31,8166	31,7946	30,9842	30,9791	31,1624	31,1693
2005/08/12 @ 16:00:00	30,1883	30,1840	30,4696	30,4395	31,4219	31,4192	31,5795	31,5772
2005/08/12 @ 17:00:00	28,2438	28,2390	28,5149	28,4764	31,3951	31,4149	31,5342	31,5420
2005/08/12 @ 18:00:00	25,5978	25,5927	25,8509	25,8125	31,0609	31,0473	31,1753	31,1425
2005/08/12 @ 19:00:00	23,5114	23,5118	23,7439	23,7160	30,5927	30,5801	30,6866	30,6488
2005/08/12 @ 20:00:00	21,2596	21,2559	21,4788	21,4515	29,9563	29,9519	30,0372	30,0107
2005/08/12 @ 21:00:00	19,7798	19,7801	19,9526	19,9376	29,1285	29,1233	29,2131	29,1877
2005/08/12 @ 22:00:00	18,3988	18,3929	18,5580	18,5385	28,3306	28,3257	28,4248	28,3996

Table 29 - Canopy layer temperature result for LCZ6 (continued).

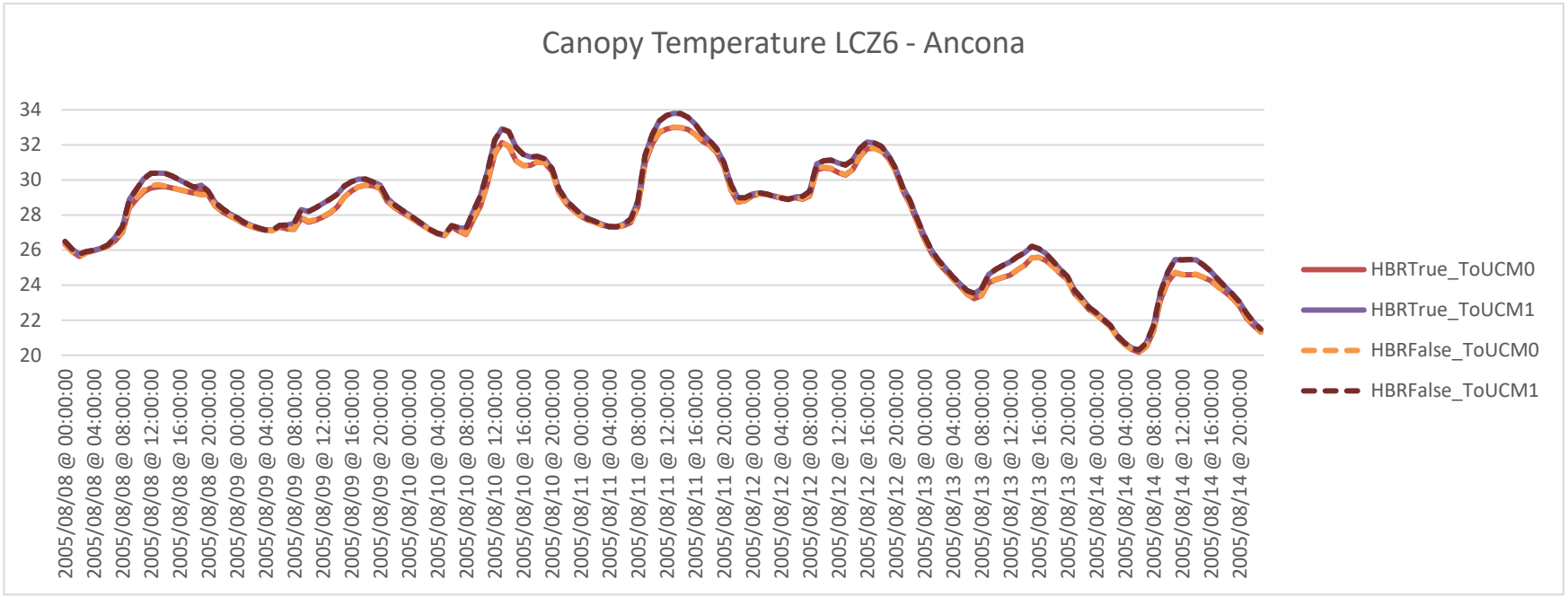
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/12 @ 23:00:00	17,1676	17,1624	17,2020	17,3009	27,3378	27,3345	27,4199	27,4025
2005/08/13 @ 00:00:00	16,4423	16,4389	16,5734	16,5600	26,3476	26,3451	26,4208	26,4081
2005/08/13 @ 01:00:00	16,1840	16,1816	16,2831	16,2726	25,5399	25,5378	25,6080	25,5982
2005/08/13 @ 02:00:00	16,0173	16,0153	16,0923	16,0834	24,8808	24,8785	24,9497	24,9409
2005/08/13 @ 03:00:00	15,8700	15,8683	15,9286	15,9208	24,4098	24,4083	24,4729	24,4665
2005/08/13 @ 04:00:00	15,7716	15,7700	15,8095	15,8032	23,9112	23,9099	23,9662	23,9605
2005/08/13 @ 05:00:00	15,8867	15,8847	15,9168	15,9195	23,5180	23,5167	23,5729	23,5712
2005/08/13 @ 06:00:00	16,5333	16,5223	16,5780	16,6101	23,1323	23,1286	23,1995	23,2091
2005/08/13 @ 07:00:00	18,0609	18,0436	18,1318	18,1814	22,9204	22,9197	23,0083	23,0367
2005/08/13 @ 08:00:00	20,0398	20,0189	20,1345	20,1987	23,2006	23,2004	23,3187	23,3586
2005/08/13 @ 09:00:00	22,7420	22,7122	22,8720	22,9320	23,8528	23,8510	24,0020	24,0370
2005/08/13 @ 10:00:00	25,5715	25,5468	25,7407	25,7970	24,1335	24,1330	24,3325	24,3670
2005/08/13 @ 11:00:00	27,8294	27,8074	28,0249	28,0816	24,2762	24,2755	24,5185	24,5453
2005/08/13 @ 12:00:00	29,8236	29,8067	30,0715	30,1103	24,3971	24,3960	24,6716	24,6918
2005/08/13 @ 13:00:00	31,0202	31,0067	31,2863	31,3160	24,6624	24,6610	24,9509	24,9657
2005/08/13 @ 14:00:00	31,4917	31,4853	31,8058	31,8135	24,8693	24,8674	25,1484	25,1533
2005/08/13 @ 15:00:00	31,1676	31,1645	31,4849	31,4784	25,1765	25,1744	25,4393	25,4374
2005/08/13 @ 16:00:00	30,1376	30,1378	30,4518	30,4290	25,1406	25,1406	25,3560	25,3443
2005/08/13 @ 17:00:00	28,8239	28,8256	29,0992	29,0689	24,9283	24,9307	25,1124	25,0913
2005/08/13 @ 18:00:00	26,6377	26,6332	26,8924	26,8500	24,5440	24,5406	24,6911	24,6607
2005/08/13 @ 19:00:00	24,9966	24,9917	25,2062	25,1670	24,1385	24,1326	24,2567	24,2271
2005/08/13 @ 20:00:00	23,4797	23,4756	23,6664	23,6346	23,7884	23,7874	23,8773	23,8589
2005/08/13 @ 21:00:00	22,0470	22,0443	22,2131	22,1880	23,1384	23,1367	23,2212	23,2057
2005/08/13 @ 22:00:00	21,4037	21,4005	21,5307	21,5095	22,7021	22,7012	22,7749	22,7629
2005/08/13 @ 23:00:00	20,2508	20,2497	20,3836	20,3659	22,1926	22,1917	22,2553	22,2447
2005/08/14 @ 00:00:00	19,6775	19,6760	19,7777	19,7636	21,8948	21,8933	21,9419	21,9332
2005/08/14 @ 01:00:00	19,2497	19,2484	19,3343	19,3217	21,5428	21,5414	21,5827	21,5751
2005/08/14 @ 02:00:00	18,8698	18,8688	18,9412	18,9302	21,1739	21,1727	21,2058	21,1991
2005/08/14 @ 03:00:00	18,7752	18,7710	18,8314	18,8186	20,5940	20,5932	20,6312	20,6251
2005/08/14 @ 04:00:00	18,6170	18,6136	18,6602	18,6492	20,1885	20,1879	20,2280	20,2230
2005/08/14 @ 05:00:00	18,6192	18,6193	18,6545	18,6572	19,8759	19,8750	19,9129	19,9116
2005/08/14 @ 06:00:00	18,8202	18,8086	18,8735	18,9050	19,7841	19,7797	19,8217	19,8327
2005/08/14 @ 07:00:00	19,8464	19,8318	19,9291	19,9813	20,1712	20,1624	20,2167	20,2429
2005/08/14 @ 08:00:00	21,8084	21,7900	21,9210	21,9834	21,1878	21,1745	21,2469	21,2889
2005/08/14 @ 09:00:00	24,2226	24,1937	24,3707	24,4293	22,9072	22,8810	22,9900	23,0373
2005/08/14 @ 10:00:00	26,6259	26,6052	26,8073	26,8677	24,0554	24,0367	24,1889	24,2400
2005/08/14 @ 11:00:00	28,8307	28,8121	29,0462	29,1009	24,6140	24,5986	24,8257	24,8683
2005/08/14 @ 12:00:00	30,9113	30,8933	31,1511	31,1956	24,5313	24,5287	24,8356	24,8677
2005/08/14 @ 13:00:00	32,0467	32,0334	32,3107	32,3436	24,4725	24,4697	24,8009	24,8190
2005/08/14 @ 14:00:00	32,5682	32,5589	32,8459	32,8639	24,3769	24,3725	24,6876	24,6932

Table 29 - Canopy layer temperature result for LCZ6 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**
2005/08/14 @ 15:00:00	32,3651	32,3601	32,6460	32,6473	24,1233	24,1207	24,3952	24,3915
2005/08/14 @ 16:00:00	32,2113	32,2079	32,4699	32,4531	23,8692	23,8682	24,0920	24,0801
2005/08/14 @ 17:00:00	31,8890	31,8870	32,1132	32,0821	23,4710	23,4722	23,6685	23,6469
2005/08/14 @ 18:00:00	31,0281	31,0019	31,2172	31,1532	23,1450	23,1414	23,2911	23,2653
2005/08/14 @ 19:00:00	30,3006	30,2762	30,4565	30,3917	22,7539	22,7508	22,8807	22,8549
2005/08/14 @ 20:00:00	29,6162	29,5947	29,7444	29,6884	22,2804	22,2772	22,3911	22,3688
2005/08/14 @ 21:00:00	28,8075	28,7857	28,9176	28,8665	21,7375	21,7350	21,8403	21,8217
2005/08/14 @ 22:00:00	28,1492	28,1343	28,2531	28,2101	21,2940	21,2928	21,3903	21,3743
2005/08/14 @ 23:00:00	27,5898	27,5773	27,6756	27,6374	20,9127	20,9118	20,9926	20,9788



Graphic 15 - Canopy layer temperature result for LCZ6 – Lisbon.



Graphic 16 - Canopy layer temperature result for LCZ6 – Ancona.

The values expected from the simulations in terms of variation were between the to_UCM 0 and to_UCM 1, and as can be observed in the graphics, even with a small difference, the values for to_UCM 1 are higher than to_UCM 0.

The final graphics and tables show the difference in the roof temperatures on the different scenarios simulated for the hottest week in August (08/08 to 14/08), as showed in the tables 30 to 35 and graphics 17 to 26. Also, the results are organized in hourly values (first column), the four next columns are the values obtained for Lisbon and the last four for Ancona, as HBR False (0), HBR true (0), HBR False (1) and HBR True (1), respectively.

Table 30 - Roof Temperature result for LCZ2.

Roof Temp	***LCZ2***							
	Lisbon				**Ancona**			
	To_UCM0		**To_UCM1**		**To_UCM0**		**To_UCM1**	
2005	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**
2005/08/08 @ 00:00:00	19,8864	19,7412	20,1005	19,9377	28,4334	27,7800	28,6686	27,9945
2005/08/08 @ 01:00:00	19,1024	18,9876	19,2912	19,1667	27,5479	27,0027	27,7663	27,1991
2005/08/08 @ 02:00:00	18,4243	18,3356	18,5889	18,4914	26,9856	26,5444	27,1875	26,7228
2005/08/08 @ 03:00:00	17,8103	17,7409	17,9540	17,8769	26,4714	26,1123	26,6522	26,2696
2005/08/08 @ 04:00:00	17,2424	17,1882	17,3677	17,3069	26,0230	25,7294	26,1780	25,8618
2005/08/08 @ 05:00:00	17,0217	16,9425	17,1288	17,0462	25,8175	25,5501	25,9458	25,6590
2005/08/08 @ 06:00:00	17,7636	17,5252	17,8560	17,6249	26,1791	25,8275	26,2875	25,9266
2005/08/08 @ 07:00:00	19,9612	19,3147	20,0541	19,4387	27,4519	26,8894	27,5514	26,9972
2005/08/08 @ 08:00:00	22,8782	21,7681	22,9933	21,9371	29,3883	28,4521	29,4895	28,5800
2005/08/08 @ 09:00:00	25,8204	24,3428	25,9765	24,5634	32,1161	30,6723	32,2290	30,8351
2005/08/08 @ 10:00:00	28,5677	26,7895	28,7669	27,0611	35,0428	33,0170	35,1756	33,2227
2005/08/08 @ 11:00:00	30,7094	28,8085	30,9539	29,1200	38,1538	35,5618	38,3227	35,8293
2005/08/08 @ 12:00:00	31,9878	30,1282	32,2661	30,4601	40,5506	37,5200	40,7696	37,8589
2005/08/08 @ 13:00:00	33,7369	31,7667	34,0488	32,1317	41,9799	38,7148	42,2541	39,1165
2005/08/08 @ 14:00:00	34,5366	32,5855	34,8882	32,9834	42,3980	39,1477	42,7249	39,5824
2005/08/08 @ 15:00:00	34,1398	32,3824	34,5245	32,7975	41,5058	38,4768	41,8710	38,9251
2005/08/08 @ 16:00:00	32,9851	31,4834	33,3831	31,8964	40,0151	37,3411	40,3987	37,7828
2005/08/08 @ 17:00:00	31,0246	29,8537	31,4220	30,2488	38,0447	35,7814	38,4280	36,1998
2005/08/08 @ 18:00:00	28,8001	27,9565	29,1834	28,3226	35,9356	34,0712	36,3029	34,4552
2005/08/08 @ 19:00:00	26,7501	26,1474	27,1123	26,4853	34,2950	32,8009	34,6368	33,1377
2005/08/08 @ 20:00:00	24,7620	24,3443	25,0989	24,6551	32,9458	31,7031	33,2578	32,0056
2005/08/08 @ 21:00:00	23,1729	22,8680	23,4819	23,1527	31,8958	30,8415	32,1797	31,1135
2005/08/08 @ 22:00:00	21,7993	21,5735	22,0783	21,8312	31,0346	30,1243	31,2970	30,3730
2005/08/08 @ 23:00:00	20,6654	20,4944	20,9134	20,7242	30,0880	29,2957	30,3291	29,5223
2005/08/09 @ 00:00:00	19,7320	19,6004	19,9489	19,8017	29,3602	28,6666	29,5806	28,8724

Table 30 - Roof Temperature result for LCZ2 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/09 @ 01:00:00	18,9617	18,8536	19,1499	19,0323	28,5222	27,9132	28,7225	28,0993
2005/08/09 @ 02:00:00	18,2833	18,1968	18,4466	18,3519	28,0386	27,5033	28,2199	27,6711
2005/08/09 @ 03:00:00	17,6693	17,5995	17,8115	17,7344	27,7185	27,2478	27,8825	27,3991
2005/08/09 @ 04:00:00	17,0687	17,0129	17,1928	17,1305	27,1539	26,7394	27,3020	26,8755
2005/08/09 @ 05:00:00	16,8102	16,7319	16,9145	16,8328	27,0372	26,6442	27,1702	26,7675
2005/08/09 @ 06:00:00	17,8943	17,5887	17,9831	17,6886	27,4805	27,0067	27,5994	27,1240
2005/08/09 @ 07:00:00	20,1734	19,4299	20,2632	19,5571	28,4078	27,7236	28,5175	27,8442
2005/08/09 @ 08:00:00	23,3506	22,1251	23,4610	22,2971	30,3439	29,3024	30,4545	29,4421
2005/08/09 @ 09:00:00	26,5477	24,9419	26,6923	25,1598	32,8012	31,2715	32,9289	31,4498
2005/08/09 @ 10:00:00	30,3047	28,2468	30,4923	28,5243	35,5653	33,5041	35,7231	33,7319
2005/08/09 @ 11:00:00	34,1029	31,6138	34,3491	31,9644	37,9776	35,4114	38,1819	35,7003
2005/08/09 @ 12:00:00	36,4567	33,8801	36,7761	34,2912	39,9548	37,0057	40,2142	37,3563
2005/08/09 @ 13:00:00	37,5697	35,0856	37,9458	35,5341	41,1693	38,0272	41,4840	38,4305
2005/08/09 @ 14:00:00	37,5940	35,3577	38,0070	35,8193	41,1238	38,0011	41,4837	38,4385
2005/08/09 @ 15:00:00	37,0771	35,0768	37,5050	35,5374	40,5299	37,6100	40,9164	38,0577
2005/08/09 @ 16:00:00	35,4582	33,8562	35,8951	34,3018	39,1000	36,5063	39,4936	36,9425
2005/08/09 @ 17:00:00	33,5057	32,2474	33,9376	32,6720	37,3836	35,2015	37,7727	35,6167
2005/08/09 @ 18:00:00	31,3627	30,4089	31,7816	30,8085	35,6689	33,8923	36,0438	34,2772
2005/08/09 @ 19:00:00	28,6978	28,0397	29,1021	28,4160	34,0595	32,6032	34,4020	32,9463
2005/08/09 @ 20:00:00	26,5334	26,0532	26,9156	26,4063	33,0501	31,8310	33,3605	32,1360
2005/08/09 @ 21:00:00	24,8518	24,4776	25,2088	24,8071	31,7751	30,7407	32,0559	31,0129
2005/08/09 @ 22:00:00	23,2786	22,9892	23,6086	23,2941	31,0601	30,1653	31,3188	30,4130
2005/08/09 @ 23:00:00	21,9709	21,7418	22,2728	22,0214	30,3393	29,5607	30,5774	29,7863
2005/08/10 @ 00:00:00	20,8985	20,7130	21,1717	20,9665	29,6147	28,9351	29,8332	29,1404
2005/08/10 @ 01:00:00	19,9162	19,7691	20,1586	19,9944	28,8546	28,2604	29,0542	28,4467
2005/08/10 @ 02:00:00	19,1294	19,0075	19,3466	19,2086	28,2407	27,7204	28,4222	27,8890
2005/08/10 @ 03:00:00	18,4205	18,3204	18,6130	18,4990	27,5274	27,0710	27,6917	27,2230
2005/08/10 @ 04:00:00	17,7308	17,6483	17,9047	17,8132	27,0869	26,6860	27,2352	26,8226
2005/08/10 @ 05:00:00	17,5615	17,4290	17,7120	17,5756	26,8215	26,4454	26,9548	26,5691
2005/08/10 @ 06:00:00	18,8516	18,4121	18,9890	18,5663	27,3251	26,8773	27,4437	26,9927
2005/08/10 @ 07:00:00	21,2545	20,3563	21,3986	20,5455	28,1117	27,4553	28,2203	27,5732
2005/08/10 @ 08:00:00	24,4076	22,9880	24,5804	23,2328	29,8821	28,8632	29,9906	28,9996
2005/08/10 @ 09:00:00	28,0119	26,0536	28,2320	26,3700	32,5014	30,9837	32,6261	31,1589
2005/08/10 @ 10:00:00	31,7038	29,2466	31,9848	29,6466	35,1629	33,1434	35,3158	33,3644
2005/08/10 @ 11:00:00	34,7106	31,9626	35,0681	32,4391	38,3550	35,8462	38,5444	36,1182
2005/08/10 @ 12:00:00	37,0911	34,1521	37,5203	34,6963	40,6947	37,8942	40,9471	38,2360
2005/08/10 @ 13:00:00	38,6457	35,6296	39,1388	36,2313	42,0019	39,0816	42,3119	39,4794
2005/08/10 @ 14:00:00	38,7485	35,9269	39,2997	36,5618	42,0048	39,2605	42,3962	39,7234
2005/08/10 @ 15:00:00	37,9654	35,4321	38,5490	36,0738	40,9075	38,4754	41,3565	38,9749

Table 30 - Roof Temperature result for LCZ2 (continued).

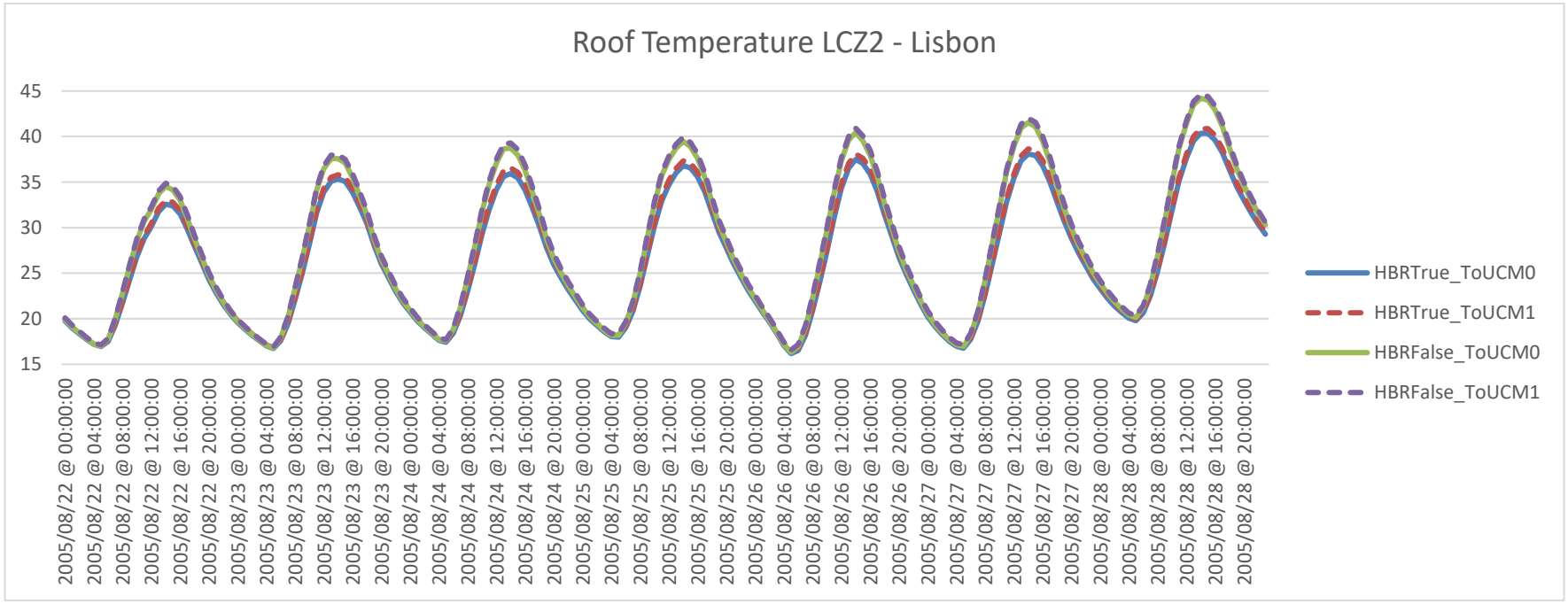
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/10 @ 16:00:00	36,2763	34,1324	36,8706	34,7579	38,9769	36,9390	39,4537	37,4439
2005/08/10 @ 17:00:00	33,9655	32,2486	34,5506	32,8400	36,8199	35,1953	37,2927	35,6750
2005/08/10 @ 18:00:00	31,3878	30,0800	31,9477	30,6259	35,0698	33,7741	35,5029	34,2008
2005/08/10 @ 19:00:00	28,7160	27,7777	29,2409	28,2744	33,8325	32,8214	34,2188	33,1915
2005/08/10 @ 20:00:00	26,6714	25,9590	27,1553	26,4115	32,5851	31,7842	32,9267	32,1033
2005/08/10 @ 21:00:00	25,0514	24,4830	25,4899	24,8914	31,6104	30,9892	31,9152	31,2672
2005/08/10 @ 22:00:00	23,6766	23,2112	24,0735	23,5801	30,6552	30,1669	30,9340	30,4177
2005/08/10 @ 23:00:00	22,3984	22,0249	22,7594	22,3594	30,0278	29,6249	30,2850	29,8548
2005/08/11 @ 00:00:00	21,2045	20,9119	21,5313	21,2140	29,1948	28,8510	29,4290	29,0600
2005/08/11 @ 01:00:00	20,2162	19,9842	20,5084	20,2539	28,7165	28,4126	28,9283	28,6018
2005/08/11 @ 02:00:00	19,4298	19,2411	19,6938	19,4820	28,0343	27,7622	28,2245	27,9328
2005/08/11 @ 03:00:00	18,7400	18,5864	18,9735	18,7997	27,6961	27,4530	27,8668	27,6065
2005/08/11 @ 04:00:00	18,1564	18,0282	18,3618	18,2161	27,2592	27,0425	27,4123	27,1804
2005/08/11 @ 05:00:00	18,1894	17,9947	18,3700	18,1660	27,0842	26,8643	27,2210	26,9890
2005/08/11 @ 06:00:00	19,5405	19,0405	19,7060	19,2189	27,6383	27,3117	27,7596	27,4292
2005/08/11 @ 07:00:00	21,7121	20,8021	21,8773	21,0048	28,8413	28,2858	28,9535	28,4072
2005/08/11 @ 08:00:00	25,0505	23,6108	25,2355	23,8628	30,6038	29,6986	30,7153	29,8366
2005/08/11 @ 09:00:00	28,8892	26,8974	29,1119	27,2148	33,3318	32,0006	33,4579	32,1769
2005/08/11 @ 10:00:00	32,5643	30,1349	32,8374	30,5203	36,2906	34,5203	36,4396	34,7416
2005/08/11 @ 11:00:00	35,7274	32,9422	36,0468	33,3789	39,0535	36,8699	39,2437	37,1474
2005/08/11 @ 12:00:00	37,4673	34,6979	37,8462	35,1788	40,8757	38,4641	41,1432	38,8221
2005/08/11 @ 13:00:00	38,7150	35,9918	39,1349	36,5016	41,8032	39,3097	42,1433	39,7348
2005/08/11 @ 14:00:00	39,4855	36,8193	39,9378	37,3540	41,6117	39,2862	42,0326	39,7740
2005/08/11 @ 15:00:00	38,8891	36,5469	39,3753	37,0873	40,6836	38,6343	41,1521	39,1475
2005/08/11 @ 16:00:00	37,6130	35,6051	38,1119	36,1348	39,5333	37,7648	40,0053	38,2647
2005/08/11 @ 17:00:00	35,5084	33,9192	36,0061	34,4225	38,0334	36,5373	38,4789	36,9982
2005/08/11 @ 18:00:00	32,8413	31,6866	33,3288	32,1574	36,7095	35,4392	37,1091	35,8465
2005/08/11 @ 19:00:00	30,3499	29,5052	30,8182	29,9458	35,5044	34,4518	35,8621	34,8106
2005/08/11 @ 20:00:00	28,4244	27,7647	28,8601	28,1717	34,0329	33,1566	34,3665	33,4825
2005/08/11 @ 21:00:00	26,5648	26,0549	26,9776	26,4384	32,8660	32,1851	33,1827	32,4882
2005/08/11 @ 22:00:00	25,0279	24,6140	25,4118	24,9708	31,4010	30,8750	31,7034	31,1585
2005/08/11 @ 23:00:00	23,4797	23,1566	23,8385	23,4900	30,5044	30,0758	30,7814	30,3327
2005/08/12 @ 00:00:00	22,2427	21,9766	22,5718	22,2830	29,9578	29,5809	30,2053	29,8098
2005/08/12 @ 01:00:00	21,0109	20,7933	21,3148	21,0772	29,5438	29,2063	29,7637	29,4101
2005/08/12 @ 02:00:00	19,8010	19,6217	20,0833	19,8864	28,9738	28,6711	29,1692	28,8526
2005/08/12 @ 03:00:00	18,5477	18,4022	18,8144	18,6533	28,5129	28,2409	28,6867	28,4028
2005/08/12 @ 04:00:00	17,1957	17,0806	17,4552	17,3263	28,1698	27,9252	28,3244	28,0697
2005/08/12 @ 05:00:00	16,3238	16,1723	16,5728	16,4129	27,8592	27,6111	27,9963	27,7408
2005/08/12 @ 06:00:00	16,9289	16,5221	17,1655	16,7684	28,4235	28,0768	28,5439	28,1971
2005/08/12 @ 07:00:00	19,0521	18,1998	19,2812	18,4653	29,3711	28,8307	29,4790	28,9497

Table 30 - Roof Temperature result for LCZ2 (continued).

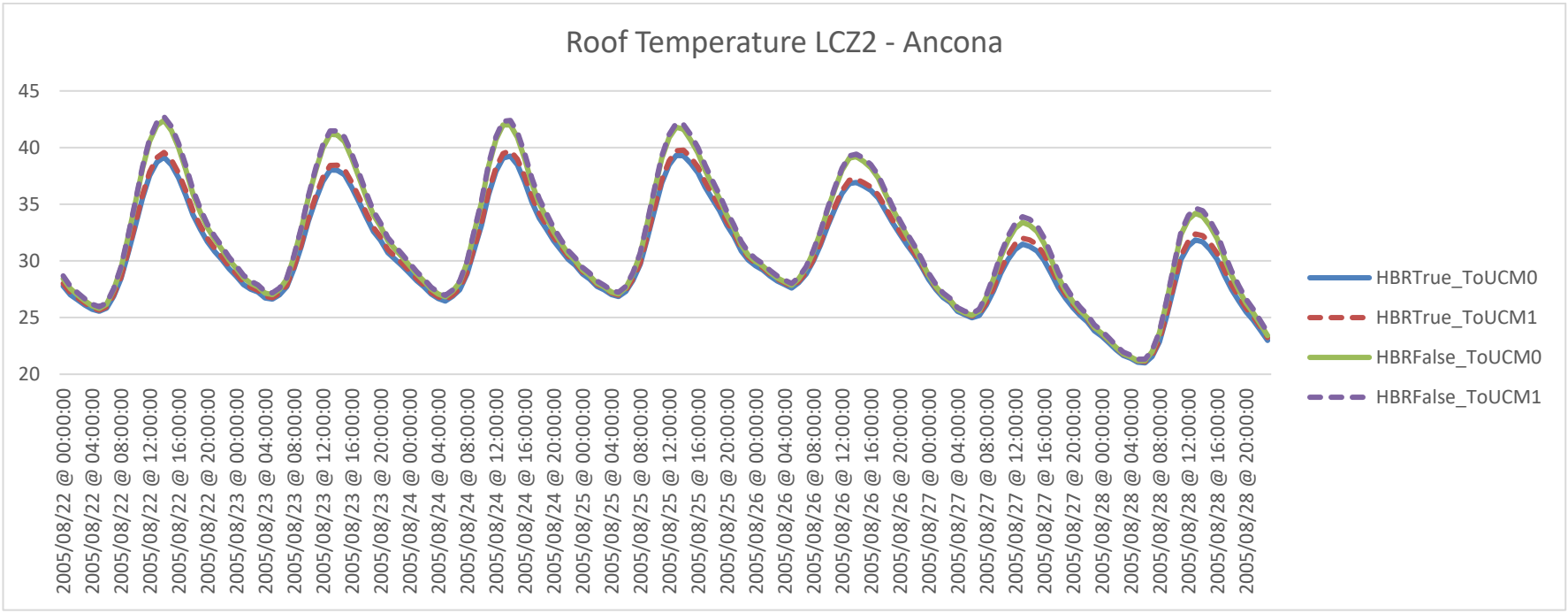
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/12 @ 08:00:00	22,3063	20,8939	22,5374	21,1891	30,7637	29,9549	30,8677	30,0848
2005/08/12 @ 09:00:00	25,8727	23,9889	26,1212	24,3248	32,5243	31,4125	32,6395	31,5708
2005/08/12 @ 10:00:00	29,8251	27,4582	30,0968	27,8357	34,5015	33,0547	34,6275	33,2375
2005/08/12 @ 11:00:00	33,8115	31,1119	34,1224	31,5357	36,3532	34,5905	36,5027	34,8065
2005/08/12 @ 12:00:00	37,2958	34,2948	37,6519	34,7741	38,0015	35,9403	38,1773	36,1893
2005/08/12 @ 13:00:00	39,6153	36,5169	40,0269	37,0476	39,0707	36,8374	39,2809	37,1208
2005/08/12 @ 14:00:00	40,4435	37,5064	40,9125	38,0716	39,1948	36,9250	39,4362	37,2336
2005/08/12 @ 15:00:00	39,5528	37,0615	40,0697	37,6342	38,7777	36,5890	39,0371	36,9062
2005/08/12 @ 16:00:00	37,9431	35,8663	38,4795	36,4297	38,2353	36,2173	38,4990	36,5273
2005/08/12 @ 17:00:00	35,6342	33,9764	36,1728	34,5184	37,3222	35,5427	37,5818	35,8356
2005/08/12 @ 18:00:00	32,6893	31,4626	33,2220	31,9778	35,9548	34,4717	36,2033	34,7401
2005/08/12 @ 19:00:00	30,0043	29,0884	30,5165	29,5746	34,5709	33,3547	34,8022	33,5963
2005/08/12 @ 20:00:00	27,4817	26,7950	27,9757	27,2588	33,3990	32,3904	33,6132	32,6076
2005/08/12 @ 21:00:00	25,4911	24,9383	25,9479	25,3671	32,2278	31,4111	32,4305	31,6094
2005/08/12 @ 22:00:00	23,6934	23,2431	24,1164	23,6404	31,2094	30,5638	31,4154	30,7574
2005/08/12 @ 23:00:00	22,0203	21,6554	22,4143	22,0257	29,9863	29,5093	30,1929	29,6978
2005/08/13 @ 00:00:00	20,5465	20,2510	20,9121	20,5950	28,7296	28,3845	28,9311	28,5663
2005/08/13 @ 01:00:00	19,3943	19,1494	19,7262	19,4619	27,7394	27,4844	27,9317	27,6579
2005/08/13 @ 02:00:00	18,4822	18,2767	18,7790	18,5560	26,9875	26,7805	27,1707	26,9466
2005/08/13 @ 03:00:00	17,7190	17,5485	17,9810	17,7947	26,5155	26,3349	26,6864	26,4908
2005/08/13 @ 04:00:00	17,1310	16,9855	17,3591	17,1997	25,7217	25,5651	25,8810	25,7112
2005/08/13 @ 05:00:00	16,9566	16,7745	17,1549	16,9636	25,4156	25,2632	25,5644	25,4013
2005/08/13 @ 06:00:00	18,2119	17,7367	18,3883	17,9225	25,2114	24,9836	25,3554	25,1243
2005/08/13 @ 07:00:00	20,6833	19,7304	20,8538	19,9376	25,5888	25,1739	25,7392	25,3353
2005/08/13 @ 08:00:00	24,1926	22,6057	24,3667	22,8419	26,8161	26,0962	26,9876	26,2978
2005/08/13 @ 09:00:00	28,1548	25,9395	28,3551	26,2277	28,4575	27,3818	28,6722	27,6429
2005/08/13 @ 10:00:00	32,2038	29,4456	32,4469	29,7965	30,3392	28,9024	30,6149	29,2363
2005/08/13 @ 11:00:00	36,1144	32,8390	36,3894	33,2342	31,8343	30,1245	32,1921	30,5433
2005/08/13 @ 12:00:00	38,9613	35,4572	39,3037	35,9197	32,8721	31,0000	33,3100	31,4956
2005/08/13 @ 13:00:00	40,9486	37,3431	41,3457	37,8545	33,3994	31,4671	33,8959	32,0160
2005/08/13 @ 14:00:00	41,5362	38,0979	42,0033	38,6612	33,1482	31,2898	33,6762	31,8603
2005/08/13 @ 15:00:00	41,0745	37,9272	41,5865	38,5142	32,6082	30,8798	33,1371	31,4419
2005/08/13 @ 16:00:00	39,5175	36,8020	40,0595	37,3930	31,5617	30,0581	32,0633	30,5807
2005/08/13 @ 17:00:00	37,3018	35,0513	37,8427	35,6175	30,0709	28,8672	30,5380	29,3397
2005/08/13 @ 18:00:00	34,5778	32,8211	35,1042	33,3497	28,5453	27,6329	28,9704	28,0495
2005/08/13 @ 19:00:00	32,1012	30,7247	32,5944	31,2067	27,3759	26,6973	27,7563	27,0599
2005/08/13 @ 20:00:00	29,9635	28,8687	30,4214	29,3080	26,4041	25,8700	26,7388	26,1848
2005/08/13 @ 21:00:00	28,0824	27,1974	28,5061	27,5990	25,6428	25,2111	25,9369	25,4917
2005/08/13 @ 22:00:00	26,6112	25,8274	27,0047	26,2045	24,9840	24,6246	25,2503	24,8775
2005/08/13 @ 23:00:00	25,1030	24,4350	25,4718	24,8013	24,1232	23,8232	24,3641	24,0507

Table 30 - Roof Temperature result for LCZ2 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/14 @ 00:00:00	23,8829	23,2888	24,2194	23,6390	23,6126	23,3518	23,8307	23,5571
2005/08/14 @ 01:00:00	22,8112	22,2845	23,1311	22,6150	23,0136	22,7882	23,2106	22,9730
2005/08/14 @ 02:00:00	21,8579	21,4078	22,1564	21,7069	22,3629	22,1688	22,5399	22,3344
2005/08/14 @ 03:00:00	21,0739	20,6858	21,3415	20,9522	21,8098	21,6495	21,9675	21,7963
2005/08/14 @ 04:00:00	20,3997	20,0642	20,6395	20,3017	21,5373	21,4045	21,6801	21,5372
2005/08/14 @ 05:00:00	20,1210	19,7735	20,3357	19,9874	21,1951	21,0679	21,3259	21,1904
2005/08/14 @ 06:00:00	21,2784	20,6490	21,4724	20,8559	21,2165	21,0040	21,3369	21,1226
2005/08/14 @ 07:00:00	23,6388	22,5265	23,8251	22,7458	21,9950	21,5710	22,1100	21,6967
2005/08/14 @ 08:00:00	26,8887	25,1851	27,0835	25,4377	23,6504	22,8682	23,7666	23,0134
2005/08/14 @ 09:00:00	30,7683	28,4120	30,9808	28,7057	26,3502	25,0789	26,4773	25,2573
2005/08/14 @ 10:00:00	34,8645	31,8754	35,0975	32,2089	29,4550	27,6688	29,6114	27,8991
2005/08/14 @ 11:00:00	38,7085	35,1341	38,9723	35,5149	32,3397	30,1353	32,5656	30,4494
2005/08/14 @ 12:00:00	41,4129	37,6194	41,7373	38,0619	33,6540	31,3093	33,9950	31,7355
2005/08/14 @ 13:00:00	43,4717	39,5254	43,8319	40,0017	34,2102	31,8659	34,6497	32,3797
2005/08/14 @ 14:00:00	44,2065	40,3595	44,6119	40,8692	33,9318	31,6769	34,4303	32,2365
2005/08/14 @ 15:00:00	43,9921	40,3569	44,4188	40,8737	33,1050	31,0373	33,6137	31,5929
2005/08/14 @ 16:00:00	42,9488	39,6233	43,3839	40,1268	31,9483	30,1313	32,4357	30,6520
2005/08/14 @ 17:00:00	41,0737	38,1984	41,5059	38,6716	30,2453	28,7540	30,7066	29,2327
2005/08/14 @ 18:00:00	38,7368	36,3523	39,1493	36,7841	28,6949	27,4823	29,1165	27,9106
2005/08/14 @ 19:00:00	36,5038	34,5434	36,8888	34,9329	27,4439	26,4758	27,8271	26,8571
2005/08/14 @ 20:00:00	34,6333	32,9971	34,9876	33,3471	26,2921	25,5112	26,6394	25,8512
2005/08/14 @ 21:00:00	33,0225	31,6385	33,3464	31,9530	25,4296	24,7878	25,7451	25,0988
2005/08/14 @ 22:00:00	31,5949	30,4019	31,8944	30,6885	24,4192	23,8918	24,7102	24,1759
2005/08/14 @ 23:00:00	30,3214	29,2846	30,5963	29,5448	23,4076	22,9723	23,6739	23,2294



Graphic 17 - Roof temperature result for LCZ2 – Lisbon.



Graphic 18 - Roof temperature result for LCZ2 – Ancona.

Table 31 - Roof temperature result for LCZ3.

Roof Temp	*LCZ3*							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/08 @ 00:00:00	19,7536	19,5999	20,0159	19,8413	28,2590	27,6162	28,5144	27,8473
2005/08/08 @ 01:00:00	18,9695	18,8519	19,1987	19,0632	27,3875	26,8497	27,6241	27,0608
2005/08/08 @ 02:00:00	18,2926	18,2002	18,4923	18,3847	26,8396	26,4038	27,0587	26,5957
2005/08/08 @ 03:00:00	17,6767	17,6033	17,8508	17,7645	26,3369	25,9809	26,5339	26,1503
2005/08/08 @ 04:00:00	17,1059	17,0477	17,2572	17,1882	25,8966	25,6040	26,0655	25,7457
2005/08/08 @ 05:00:00	16,8826	16,7994	17,0111	16,9215	25,6981	25,4304	25,8367	25,5453
2005/08/08 @ 06:00:00	17,6338	17,3917	17,7429	17,5080	26,0640	25,7105	26,1790	25,8141
2005/08/08 @ 07:00:00	19,8479	19,1978	19,9560	19,3430	27,3433	26,7785	27,4477	26,8904
2005/08/08 @ 08:00:00	22,7947	21,6811	22,9283	21,8804	29,2889	28,3491	29,3942	28,4817
2005/08/08 @ 09:00:00	25,7753	24,2944	25,9583	24,5565	32,0300	30,5695	32,1471	30,7398
2005/08/08 @ 10:00:00	28,5399	26,7581	28,7756	27,0826	34,9299	32,8919	35,0713	33,1103
2005/08/08 @ 11:00:00	30,6944	28,7898	30,9867	29,1644	38,0000	35,4150	38,1835	35,6930
2005/08/08 @ 12:00:00	31,9760	30,1126	32,3112	30,5139	40,3437	37,3461	40,5849	37,6888
2005/08/08 @ 13:00:00	33,7368	31,7627	34,1140	32,2054	41,7186	38,5129	42,0231	38,9149
2005/08/08 @ 14:00:00	34,5387	32,5836	34,9664	33,0682	42,1093	38,9090	42,4715	39,3703
2005/08/08 @ 15:00:00	34,1376	32,3759	34,6078	32,8835	41,1904	38,2123	41,6035	38,6973
2005/08/08 @ 16:00:00	32,9727	31,4664	33,4612	31,9730	39,6893	37,0685	40,1210	37,5472
2005/08/08 @ 17:00:00	30,9955	29,8194	31,4851	30,3057	37,7264	35,5149	38,1559	35,9690
2005/08/08 @ 18:00:00	28,7522	27,9033	29,2261	28,3554	35,6374	33,8204	36,0478	34,2375
2005/08/08 @ 19:00:00	26,6860	26,0712	27,1349	26,4886	34,0558	32,5652	34,4354	32,9405
2005/08/08 @ 20:00:00	24,6879	24,2593	25,1060	24,6439	32,7143	31,4702	33,0611	31,8066
2005/08/08 @ 21:00:00	23,0894	22,7740	23,4732	23,1264	31,6677	30,6138	31,9836	30,9160
2005/08/08 @ 22:00:00	21,7202	21,4847	22,0664	21,8030	30,8245	29,9178	31,1145	30,1921
2005/08/08 @ 23:00:00	20,5807	20,3946	20,8935	20,6817	29,8948	29,1075	30,1601	29,3561
2005/08/09 @ 00:00:00	19,6411	19,4972	19,9137	19,7480	29,1826	28,4938	29,4243	28,7187
2005/08/09 @ 01:00:00	18,8590	18,7442	19,0959	18,9624	28,3582	27,7519	28,5773	27,9546
2005/08/09 @ 02:00:00	18,1745	18,0815	18,3798	18,2708	27,8854	27,3499	28,0834	27,5323
2005/08/09 @ 03:00:00	17,5525	17,4766	17,7305	17,6410	27,5731	27,0999	27,7521	27,2641
2005/08/09 @ 04:00:00	16,9440	16,8824	17,0984	17,0253	27,0134	26,5940	27,1748	26,7417
2005/08/09 @ 05:00:00	16,6812	16,5978	16,8099	16,7194	26,9001	26,5007	27,0449	26,6342
2005/08/09 @ 06:00:00	17,7754	17,4654	17,8829	17,5842	27,3495	26,8693	27,4784	26,9944
2005/08/09 @ 07:00:00	20,0463	19,2981	20,1519	19,4428	28,2835	27,5948	28,4015	27,7226
2005/08/09 @ 08:00:00	23,2587	22,0290	23,3870	22,2278	30,2215	29,1798	30,3398	29,3274
2005/08/09 @ 09:00:00	26,4987	24,8889	26,6674	25,1444	32,6674	31,1454	32,8038	31,3339
2005/08/09 @ 10:00:00	30,2877	28,2256	30,5079	28,5541	35,4142	33,3484	35,5856	33,5948
2005/08/09 @ 11:00:00	34,1185	31,6249	34,4099	32,0434	37,8002	35,2197	38,0239	35,5346
2005/08/09 @ 12:00:00	36,4869	33,9058	36,8701	34,4013	39,7271	36,7733	40,0283	37,1572
2005/08/09 @ 13:00:00	37,6003	35,1117	38,0557	35,6559	40,8895	37,7577	41,2554	38,2007
2005/08/09 @ 14:00:00	37,6172	35,3764	38,1210	35,9397	40,8077	37,7067	41,2301	38,1881

Table 31 - Roof temperature result for LCZ3 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/09 @ 15:00:00	37,0918	35,0873	37,6156	35,6510	40,1964	37,3062	40,6456	37,7992
2005/08/09 @ 16:00:00	35,4594	33,8537	35,9967	34,4014	38,7682	36,2081	39,2211	36,6888
2005/08/09 @ 17:00:00	33,4896	32,2279	34,0228	32,7515	37,0905	34,9322	37,5322	35,3885
2005/08/09 @ 18:00:00	31,3237	30,3281	31,8335	30,8187	35,4017	33,6417	35,8246	34,0651
2005/08/09 @ 19:00:00	28,6417	27,9563	29,1376	28,4195	33,8117	32,3656	34,1990	32,7442
2005/08/09 @ 20:00:00	26,4641	25,9650	26,9352	26,4007	32,8094	31,5993	33,1605	31,9365
2005/08/09 @ 21:00:00	24,7642	24,3773	25,1995	24,7802	31,5402	30,5123	31,8581	30,8138
2005/08/09 @ 22:00:00	23,1976	22,8979	23,6014	23,2715	30,8468	29,9594	31,1377	30,2323
2005/08/09 @ 23:00:00	21,8891	21,6372	22,2586	21,9868	30,1449	29,3735	30,4111	29,6211
2005/08/10 @ 00:00:00	20,7975	20,5943	21,1306	20,9083	29,4368	28,7626	29,6801	28,9872
2005/08/10 @ 01:00:00	19,8056	19,6442	20,1027	19,9235	28,6905	28,0989	28,9121	28,3023
2005/08/10 @ 02:00:00	19,0071	18,8735	19,2693	19,1196	28,0870	27,5667	28,2883	27,7505
2005/08/10 @ 03:00:00	18,2891	18,1794	18,5199	18,3959	27,3811	26,9222	27,5631	27,0878
2005/08/10 @ 04:00:00	17,5923	17,5044	17,7957	17,6950	26,9451	26,5394	27,1093	26,6882
2005/08/10 @ 05:00:00	17,4170	17,2786	17,5935	17,4489	26,6826	26,3004	26,8301	26,4349
2005/08/10 @ 06:00:00	18,7000	18,2548	18,8594	18,4304	27,1924	26,7352	27,3232	26,8603
2005/08/10 @ 07:00:00	21,1191	20,2083	21,2843	20,4211	27,9869	27,3235	28,1057	27,4503
2005/08/10 @ 08:00:00	24,3101	22,8716	24,5108	23,1504	29,7613	28,7393	29,8792	28,8853
2005/08/10 @ 09:00:00	27,9552	25,9729	28,2105	26,3295	32,3755	30,8582	32,5108	31,0455
2005/08/10 @ 10:00:00	31,6540	29,1722	31,9692	29,6035	35,0228	33,0042	35,1894	33,2413
2005/08/10 @ 11:00:00	34,6885	31,9151	35,0991	32,4418	38,2177	35,7096	38,4220	35,9992
2005/08/10 @ 12:00:00	37,0785	34,1148	37,5701	34,7170	40,5628	37,7624	40,8319	38,1234
2005/08/10 @ 13:00:00	38,6267	35,5882	39,1783	36,2410	41,8745	38,9541	42,2033	39,3729
2005/08/10 @ 14:00:00	38,7342	35,8953	39,3681	36,6065	41,8752	39,1313	42,2891	39,6182
2005/08/10 @ 15:00:00	37,9470	35,4013	38,6239	36,1315	40,7730	38,3411	41,2480	38,8674
2005/08/10 @ 16:00:00	36,2483	34,0967	36,9413	34,8174	38,8354	36,7973	39,3409	37,3312
2005/08/10 @ 17:00:00	33,9194	32,1987	34,5987	32,8822	36,6705	35,0445	37,1739	35,5549
2005/08/10 @ 18:00:00	31,3139	30,0053	31,9539	30,6310	34,9145	33,6160	35,3793	34,0741
2005/08/10 @ 19:00:00	28,6275	27,6913	29,2325	28,2666	33,6690	32,6527	34,0883	33,0538
2005/08/10 @ 20:00:00	26,5608	25,8489	27,1129	26,3680	32,4111	31,6049	32,7852	31,9542
2005/08/10 @ 21:00:00	24,9263	24,3575	25,4234	24,8228	31,4345	30,8094	31,7736	31,1187
2005/08/10 @ 22:00:00	23,5405	23,0543	23,9989	23,4839	30,5159	30,0239	30,8289	30,3045
2005/08/10 @ 23:00:00	22,2394	21,8417	22,6679	22,2287	29,9077	29,5015	30,1946	29,7573
2005/08/11 @ 00:00:00	21,0428	20,7315	21,4323	21,0810	29,0845	28,7361	29,3443	28,9675
2005/08/11 @ 01:00:00	20,0582	19,8115	20,4047	20,1236	28,6112	28,3017	28,8458	28,5106
2005/08/11 @ 02:00:00	19,2694	19,0689	19,5749	19,3445	27,9303	27,6520	28,1406	27,8399
2005/08/11 @ 03:00:00	18,5747	18,4114	18,8431	18,6537	27,5921	27,3422	27,7807	27,5110
2005/08/11 @ 04:00:00	17,9818	17,8446	18,2177	18,0579	27,1540	26,9300	27,3232	27,0816
2005/08/11 @ 05:00:00	18,0179	17,8143	18,2239	18,0077	26,9776	26,7502	27,1287	26,8870
2005/08/11 @ 06:00:00	19,3874	18,8792	19,5766	19,0832	27,5336	27,2024	27,6687	27,3309

Table 31 - Roof temperature result for LCZ3 (continued).

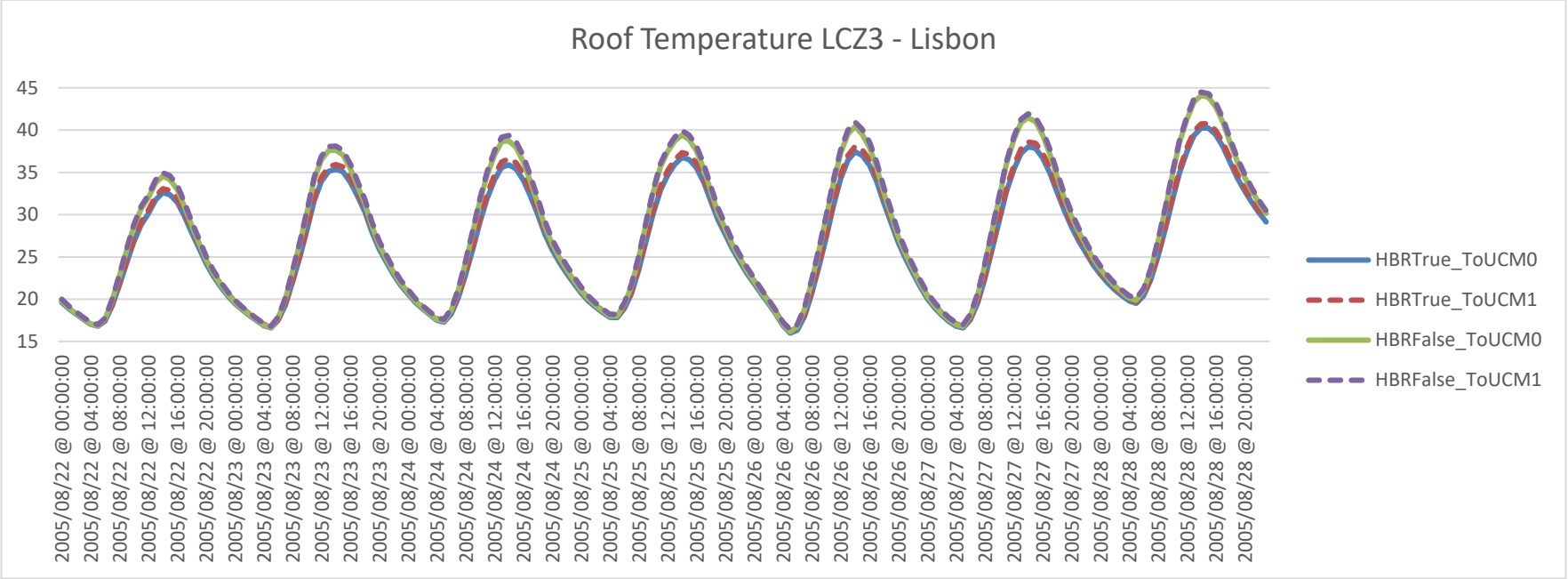
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/11 @ 07:00:00	21,5632	20,6455	21,7489	20,8713	28,7406	28,1832	28,8646	28,3152
2005/08/11 @ 08:00:00	24,9457	23,4933	25,1558	23,7798	30,5154	29,6068	30,6368	29,7553
2005/08/11 @ 09:00:00	28,8311	26,8189	29,0848	27,1746	33,2660	31,9317	33,3994	32,1165
2005/08/11 @ 10:00:00	32,5184	30,0636	32,8258	30,4861	36,2010	34,4296	36,3614	34,6644
2005/08/11 @ 11:00:00	35,6780	32,8723	36,0254	33,3387	38,9590	36,7747	39,1627	37,0683
2005/08/11 @ 12:00:00	37,4348	34,6464	37,8651	35,1792	40,7764	38,3644	41,0606	38,7413
2005/08/11 @ 13:00:00	38,6870	35,9462	39,1683	36,5161	41,6997	39,2062	42,0597	39,6528
2005/08/11 @ 14:00:00	39,4476	36,7674	39,9532	37,3513	41,5012	39,1756	41,9532	39,6946
2005/08/11 @ 15:00:00	38,8574	36,5047	39,4176	37,1143	40,5689	38,5208	41,0776	39,0740
2005/08/11 @ 16:00:00	37,5707	35,5560	38,1470	36,1600	39,4120	37,6442	39,9226	38,1824
2005/08/11 @ 17:00:00	35,4454	33,8534	36,0169	34,4290	37,9046	36,4084	38,3870	36,9056
2005/08/11 @ 18:00:00	32,7654	31,6000	33,3360	32,1487	36,5714	35,3024	37,0067	35,7441
2005/08/11 @ 19:00:00	30,2558	29,4059	30,8033	29,9213	35,3497	34,3059	35,7412	34,6966
2005/08/11 @ 20:00:00	28,3100	27,6458	28,8129	28,1162	33,8429	32,9960	34,2017	33,3476
2005/08/11 @ 21:00:00	26,4341	25,9223	26,9047	26,3608	32,6118	31,9671	32,9574	32,2958
2005/08/11 @ 22:00:00	24,9027	24,4867	25,3354	24,8901	31,2023	30,7027	31,5356	31,0144
2005/08/11 @ 23:00:00	23,3634	23,0392	23,7699	23,4181	30,3388	29,9305	30,6422	30,2115
2005/08/12 @ 00:00:00	22,1224	21,8406	22,4933	22,2000	29,8112	29,4498	30,0819	29,6997
2005/08/12 @ 01:00:00	20,8825	20,6379	21,2234	20,9805	29,4099	29,0842	29,6501	29,3064
2005/08/12 @ 02:00:00	19,6624	19,4621	19,9780	19,7755	28,8489	28,5547	29,0626	28,7527
2005/08/12 @ 03:00:00	18,3967	18,2346	18,6940	18,5271	28,3933	28,1264	28,5838	28,3037
2005/08/12 @ 04:00:00	17,0301	16,9020	17,3184	17,1841	28,0519	27,8108	28,2224	27,9687
2005/08/12 @ 05:00:00	16,1446	15,9824	16,4207	16,2557	27,7418	27,4956	27,8939	27,6379
2005/08/12 @ 06:00:00	16,7514	16,3329	17,0142	16,6109	28,3121	27,9671	28,4454	28,0983
2005/08/12 @ 07:00:00	18,8776	18,0144	19,1302	18,3087	29,2683	28,7304	29,3870	28,8593
2005/08/12 @ 08:00:00	22,1457	20,7234	22,3970	21,0441	30,6726	29,8658	30,7858	30,0047
2005/08/12 @ 09:00:00	25,7577	23,8568	26,0304	24,2218	32,4501	31,3399	32,5728	31,5062
2005/08/12 @ 10:00:00	29,7212	27,3395	30,0128	27,7411	34,4037	32,9594	34,5404	33,1543
2005/08/12 @ 11:00:00	33,7582	31,0422	34,1038	31,5134	36,2453	34,4849	36,4076	34,7158
2005/08/12 @ 12:00:00	37,2504	34,2295	37,6433	34,7500	37,8659	35,8074	38,0603	36,0773
2005/08/12 @ 13:00:00	39,5717	36,4526	40,0255	37,0241	38,9161	36,6774	39,1502	36,9875
2005/08/12 @ 14:00:00	40,4057	37,4512	40,9399	38,0792	39,0152	36,7441	39,2893	37,0836
2005/08/12 @ 15:00:00	39,5205	37,0170	40,1265	37,6745	38,5824	36,3989	38,8777	36,7486
2005/08/12 @ 16:00:00	37,9059	35,8199	38,5448	36,4796	38,0386	36,0283	38,3387	36,3710
2005/08/12 @ 17:00:00	35,5767	33,9143	36,2139	34,5508	37,1321	35,3611	37,4281	35,6862
2005/08/12 @ 18:00:00	32,6132	31,3856	33,2442	31,9958	35,7778	34,2803	36,0615	34,5805
2005/08/12 @ 19:00:00	29,9021	28,9845	30,4962	29,5497	34,3835	33,1540	34,6504	33,4263
2005/08/12 @ 20:00:00	27,3575	26,6700	27,9205	27,2009	33,2115	32,1838	33,4596	32,4320
2005/08/12 @ 21:00:00	25,3554	24,8014	25,8716	25,2877	32,0332	31,1990	32,2693	31,4274
2005/08/12 @ 22:00:00	23,5592	23,1075	24,0334	23,5541	31,0454	30,3853	31,2813	30,6057

Table 31 - Roof temperature result for LCZ3 (continued).

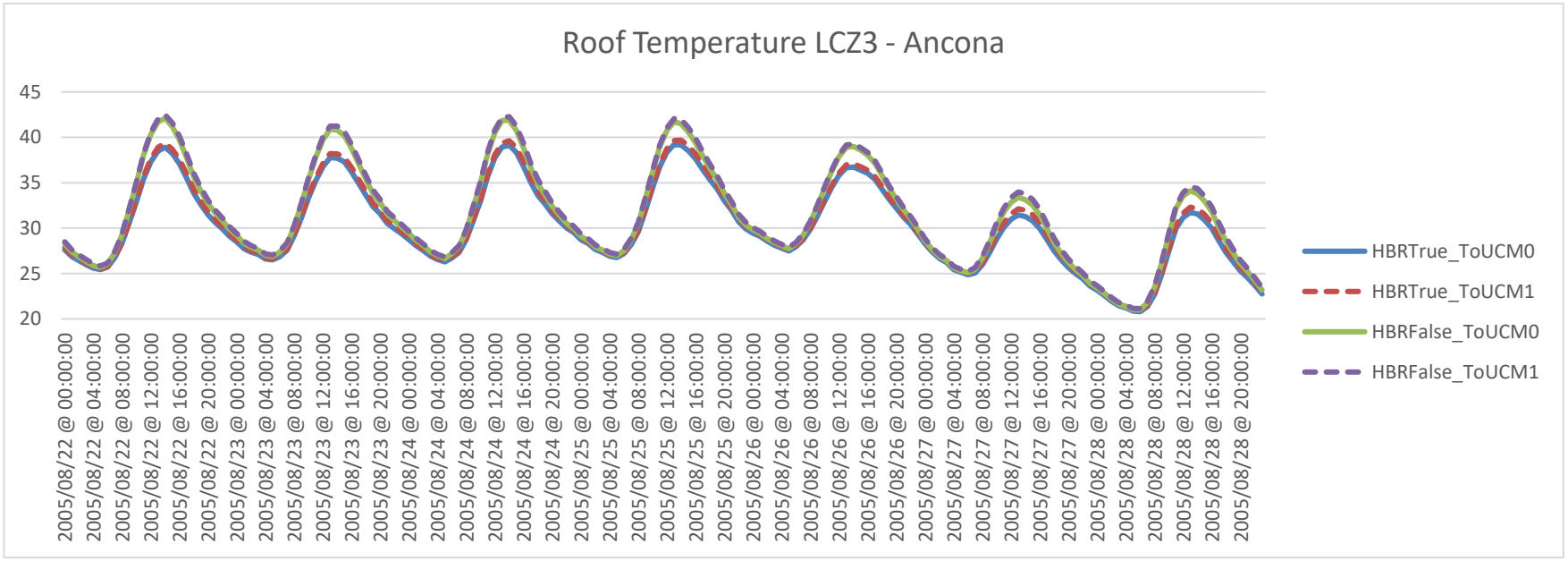
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/12 @ 23:00:00	21,8836	21,5166	22,3225	21,9302	29,8558	29,3655	30,0952	29,5818
2005/08/13 @ 00:00:00	20,4040	20,1054	20,8099	20,4880	28,6228	28,2659	28,8594	28,4768
2005/08/13 @ 01:00:00	19,2450	18,9960	19,6132	19,3433	27,6467	27,3812	27,8747	27,5843
2005/08/13 @ 02:00:00	18,3307	18,1209	18,6584	18,4304	26,8972	26,6811	27,1151	26,8765
2005/08/13 @ 03:00:00	17,5646	17,3890	17,8549	17,6626	26,4187	26,2290	26,6201	26,4108
2005/08/13 @ 04:00:00	16,9637	16,8120	17,2200	17,0533	25,6173	25,4518	25,8036	25,6210
2005/08/13 @ 05:00:00	16,7763	16,5880	16,9996	16,8013	25,3037	25,1429	25,4767	25,3018
2005/08/13 @ 06:00:00	18,0281	17,5468	18,2262	17,7547	25,0956	24,8605	25,2612	25,0202
2005/08/13 @ 07:00:00	20,5055	19,5465	20,6948	19,7744	25,4789	25,0554	25,6515	25,2379
2005/08/13 @ 08:00:00	24,0278	22,4344	24,2187	22,6900	26,7306	25,9998	26,9313	26,2343
2005/08/13 @ 09:00:00	28,0189	25,7963	28,2324	26,1005	28,4074	27,3226	28,6633	27,6333
2005/08/13 @ 10:00:00	32,0868	29,3215	32,3404	29,6854	30,2978	28,8536	30,6309	29,2569
2005/08/13 @ 11:00:00	36,0124	32,7297	36,2962	33,1359	31,8129	30,0965	32,2487	30,6070
2005/08/13 @ 12:00:00	38,8747	35,3633	39,2245	35,8351	32,8603	30,9828	33,3963	31,5895
2005/08/13 @ 13:00:00	40,8724	37,2598	41,2768	37,7798	33,3879	31,4507	33,9977	32,1246
2005/08/13 @ 14:00:00	41,4648	38,0209	41,9407	38,5938	33,1283	31,2640	33,7787	31,9670
2005/08/13 @ 15:00:00	41,0035	37,8518	41,5264	38,4500	32,5510	30,8162	33,1792	31,4849
2005/08/13 @ 16:00:00	39,4414	36,7220	39,9972	37,3269	31,4751	29,9645	32,0598	30,5754
2005/08/13 @ 17:00:00	37,2155	34,9610	37,7732	35,5439	29,9566	28,7451	30,4956	29,2931
2005/08/13 @ 18:00:00	34,4764	32,6694	35,0232	33,2197	28,4050	27,4840	28,8941	27,9668
2005/08/13 @ 19:00:00	31,9865	30,4947	32,5021	31,0101	27,2097	26,5210	27,6479	26,9427
2005/08/13 @ 20:00:00	29,8370	28,5769	30,3185	29,0617	26,2177	25,6727	26,6052	26,0409
2005/08/13 @ 21:00:00	27,9477	26,8780	28,3950	27,3336	25,4300	24,9941	25,7728	25,3166
2005/08/13 @ 22:00:00	26,4019	25,4975	26,8099	25,9065	24,7855	24,4216	25,0936	24,7102
2005/08/13 @ 23:00:00	24,8340	24,0769	25,2229	24,4529	23,9334	23,6294	24,2106	23,8876
2005/08/14 @ 00:00:00	23,5788	22,9296	23,9365	23,2731	23,4262	23,1620	23,6764	23,3946
2005/08/14 @ 01:00:00	22,5126	21,9559	22,8399	22,2688	22,8290	22,6002	23,0545	22,8095
2005/08/14 @ 02:00:00	21,5866	21,1077	21,8854	21,3921	22,1784	21,9806	22,3812	22,1685
2005/08/14 @ 03:00:00	20,8147	20,3998	21,0842	20,6556	21,6249	21,4605	21,8057	21,6274
2005/08/14 @ 04:00:00	20,1476	19,7871	20,3903	20,0168	21,3505	21,2132	21,5144	21,3643
2005/08/14 @ 05:00:00	19,8741	19,5028	20,0919	19,7112	21,0055	20,8734	21,1556	21,0129
2005/08/14 @ 06:00:00	21,0440	20,3925	21,2414	20,5967	21,0273	20,8095	21,1652	20,9442
2005/08/14 @ 07:00:00	23,4240	22,2848	23,6142	22,5057	21,8088	21,3793	21,9399	21,5205
2005/08/14 @ 08:00:00	26,7019	24,9744	26,9006	25,2300	23,4724	22,6844	23,6032	22,8449
2005/08/14 @ 09:00:00	30,6166	28,2383	30,8322	28,5346	26,1877	24,9102	26,3281	25,1034
2005/08/14 @ 10:00:00	34,7272	31,6871	34,9660	32,0330	29,2935	27,5012	29,4639	27,7475
2005/08/14 @ 11:00:00	38,5156	34,9231	38,7918	35,3209	32,1884	29,9781	32,4289	30,3088
2005/08/14 @ 12:00:00	41,2578	37,4475	41,5926	37,9038	33,5332	31,1790	33,9156	31,6473
2005/08/14 @ 13:00:00	43,3404	39,3795	43,7104	39,8680	34,1020	31,7474	34,6007	32,3198
2005/08/14 @ 14:00:00	44,0903	40,2313	44,5062	40,7534	33,8130	31,5490	34,3623	32,1590

Table 31 - Roof temperature result for LCZ3 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**
2005/08/14 @ 15:00:00	43,8842	40,2387	44,3227	40,7686	32,9755	30,8990	33,5288	31,4989
2005/08/14 @ 16:00:00	42,7810	39,4677	43,2366	39,9897	31,8081	29,9820	32,3363	30,5432
2005/08/14 @ 17:00:00	40,8855	38,0266	41,3403	38,5214	30,0917	28,5909	30,5918	29,1075
2005/08/14 @ 18:00:00	38,5365	36,1735	38,9750	36,6286	28,5285	27,3059	28,9869	27,7702
2005/08/14 @ 19:00:00	36,2977	34,3613	36,7098	34,7733	27,2621	26,2824	27,6803	26,6981
2005/08/14 @ 20:00:00	34,4281	32,8142	34,8087	33,1854	26,0902	25,2964	26,4714	25,6694
2005/08/14 @ 21:00:00	32,8217	31,4566	33,1707	31,7909	25,2053	24,5563	25,5539	24,8931
2005/08/14 @ 22:00:00	31,4101	30,2364	31,7313	30,5398	24,2041	23,6698	24,5246	23,9763
2005/08/14 @ 23:00:00	30,1517	29,1332	30,4455	29,4077	23,1983	22,7557	23,4910	23,0332



Graphic 19 - Roof Temperature result for LCZ3 – Lisbon.



Graphic 20 - Roof temperature result for LCZ3 – Ancona.

Table 32 - Roof temperature result for LCZ4.

Roof Temp	*LCZ4*							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/08 @ 00:00:00	19,6788	19,5389	19,7479	19,6025	28,3124	27,6585	28,4014	27,7383
2005/08/08 @ 01:00:00	18,8948	18,7897	18,9550	18,8453	27,4250	26,8804	27,5075	26,9534
2005/08/08 @ 02:00:00	18,2208	18,1400	18,2730	18,1884	26,8575	26,4187	26,9323	26,4837
2005/08/08 @ 03:00:00	17,6094	17,5469	17,6549	17,5892	26,3424	25,9868	26,4081	26,0432
2005/08/08 @ 04:00:00	17,0443	16,9960	17,0839	17,0330	25,8968	25,6074	25,9522	25,6541
2005/08/08 @ 05:00:00	16,8262	16,7522	16,8598	16,7845	25,6942	25,4313	25,7393	25,4691
2005/08/08 @ 06:00:00	17,5774	17,3435	17,6062	17,3748	26,0543	25,7087	26,0924	25,7432
2005/08/08 @ 07:00:00	19,7895	19,1469	19,8186	19,1868	27,3310	26,7770	27,3659	26,8151
2005/08/08 @ 08:00:00	22,7377	21,6310	22,7743	21,6862	29,2774	28,3518	29,3129	28,3975
2005/08/08 @ 09:00:00	25,7274	24,2528	25,7776	24,3251	32,0208	30,5860	32,0603	30,6450
2005/08/08 @ 10:00:00	28,4966	26,7224	28,5614	26,8116	34,9141	32,9182	34,9615	32,9933
2005/08/08 @ 11:00:00	30,6620	28,7656	30,7419	28,8678	37,9886	35,4501	38,0498	35,5457
2005/08/08 @ 12:00:00	31,9604	30,1053	32,0515	30,2140	40,3516	37,3934	40,4316	37,5245
2005/08/08 @ 13:00:00	33,7269	31,7611	33,8291	31,8808	41,7614	38,5784	41,8621	38,7438
2005/08/08 @ 14:00:00	34,5296	32,5832	34,6454	32,7140	42,1822	39,0098	42,3027	39,1867
2005/08/08 @ 15:00:00	34,1228	32,3703	34,2499	32,5069	41,3122	38,3446	41,4474	38,5228
2005/08/08 @ 16:00:00	32,9467	31,4506	33,0785	31,5868	39,8479	37,2147	39,9905	37,3878
2005/08/08 @ 17:00:00	30,9563	29,7917	31,0882	29,9221	37,9001	35,6578	38,0429	35,8204
2005/08/08 @ 18:00:00	28,6979	27,8612	28,8252	27,9819	35,8073	33,9483	35,9444	34,0967
2005/08/08 @ 19:00:00	26,6129	26,0173	26,7332	26,1287	34,2111	32,6768	34,3382	32,8097
2005/08/08 @ 20:00:00	24,5953	24,1843	24,7068	24,2866	32,8510	31,5663	32,9672	31,6849
2005/08/08 @ 21:00:00	22,9860	22,6875	23,0878	22,7810	31,7872	30,6971	31,8931	30,8033
2005/08/08 @ 22:00:00	21,6110	21,3910	21,7025	21,4751	30,9362	29,9937	31,0339	30,0901
2005/08/08 @ 23:00:00	20,4743	20,3086	20,5552	20,3833	29,9959	29,1746	30,0856	29,2620
2005/08/09 @ 00:00:00	19,5391	19,4124	19,6094	19,4774	29,2713	28,5520	29,3532	28,6309
2005/08/09 @ 01:00:00	18,7589	18,6593	18,8199	18,7158	28,4342	27,8027	28,5084	27,8738
2005/08/09 @ 02:00:00	18,0803	18,0010	18,1330	18,0499	27,9503	27,3956	28,0174	27,4594
2005/08/09 @ 03:00:00	17,4657	17,4023	17,5114	17,4448	27,6297	27,1426	27,6902	27,1999
2005/08/09 @ 04:00:00	16,8653	16,8150	16,9049	16,8521	27,0642	26,6358	27,1187	26,6873
2005/08/09 @ 05:00:00	16,6099	16,5366	16,6429	16,5682	26,9459	26,5416	26,9947	26,5880
2005/08/09 @ 06:00:00	17,7056	17,4043	17,7334	17,4358	27,3888	26,9069	27,4322	26,9505
2005/08/09 @ 07:00:00	19,9936	19,2604	20,0223	19,3029	28,3148	27,6277	28,3547	27,6725
2005/08/09 @ 08:00:00	23,2060	21,9890	23,2415	22,0463	30,2454	29,2113	30,2857	29,2632
2005/08/09 @ 09:00:00	26,4560	24,8568	26,5025	24,9288	32,6892	31,1846	32,7358	31,2507
2005/08/09 @ 10:00:00	30,2450	28,1936	30,3058	28,2852	35,4061	33,3876	35,4646	33,4725
2005/08/09 @ 11:00:00	34,0736	31,5907	34,1542	31,7067	37,7739	35,2693	37,8499	35,3769
2005/08/09 @ 12:00:00	36,4576	33,8866	36,5628	34,0226	39,7150	36,8418	39,8115	36,9723
2005/08/09 @ 13:00:00	37,5900	35,1116	37,7141	35,2596	40,9112	37,8503	41,0282	38,0002
2005/08/09 @ 14:00:00	37,6180	35,3876	37,7544	35,5396	40,8721	37,8233	41,0059	37,9860

Table 32 - Roof temperature result for LCZ4 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/09 @ 15:00:00	37,0910	35,0975	37,2325	35,2492	40,3015	37,4395	40,4453	37,6060
2005/08/09 @ 16:00:00	35,4500	33,8548	35,5946	34,0013	38,8996	36,3446	39,0462	36,5069
2005/08/09 @ 17:00:00	33,4649	32,2132	33,6080	32,3529	37,1811	35,0306	37,3268	35,1855
2005/08/09 @ 18:00:00	31,2835	30,3122	31,4141	30,4445	35,4654	33,7143	35,6063	33,8581
2005/08/09 @ 19:00:00	28,5765	27,9092	28,7053	28,0336	33,8779	32,4273	34,0070	32,5561
2005/08/09 @ 20:00:00	26,3735	25,8889	26,4967	26,0055	32,8707	31,6524	32,9875	31,7666
2005/08/09 @ 21:00:00	24,6629	24,2869	24,7786	24,3957	31,5959	30,5595	31,7014	30,6612
2005/08/09 @ 22:00:00	23,0819	22,7925	23,1890	22,8928	30,9035	30,0040	31,0005	30,0961
2005/08/09 @ 23:00:00	21,7647	21,5367	21,8627	21,6285	30,1986	29,4141	30,2875	29,4976
2005/08/10 @ 00:00:00	20,6835	20,4999	20,7722	20,5830	29,4847	28,7993	29,5661	28,8751
2005/08/10 @ 01:00:00	19,6968	19,5521	19,7751	19,6255	28,7316	28,1322	28,8057	28,2007
2005/08/10 @ 02:00:00	18,9020	18,7830	18,9718	18,8484	28,1220	27,5973	28,1892	27,6591
2005/08/10 @ 03:00:00	18,1885	18,0917	18,2503	18,1496	27,4110	26,9512	27,4717	27,0067
2005/08/10 @ 04:00:00	17,4955	17,4192	17,5495	17,4699	26,9714	26,5681	27,0261	26,6178
2005/08/10 @ 05:00:00	17,3254	17,1983	17,3726	17,2441	26,7058	26,3286	26,7548	26,3735
2005/08/10 @ 06:00:00	18,6186	18,1881	18,6623	18,2380	27,2114	26,7609	27,2548	26,8028
2005/08/10 @ 07:00:00	21,0348	20,1442	21,0812	20,2066	27,9994	27,3444	28,0389	27,3873
2005/08/10 @ 08:00:00	24,2195	22,8060	24,2755	22,8873	29,7666	28,7585	29,8061	28,8084
2005/08/10 @ 09:00:00	27,8703	25,9172	27,9423	26,0225	32,3773	30,8847	32,4229	30,9491
2005/08/10 @ 10:00:00	31,5852	29,1368	31,6778	29,2694	35,0192	33,0250	35,0751	33,1064
2005/08/10 @ 11:00:00	34,6196	31,8795	34,7379	32,0376	38,2097	35,7259	38,2784	35,8256
2005/08/10 @ 12:00:00	37,0223	34,0905	37,1648	34,2713	40,5555	37,7787	40,6469	37,9038
2005/08/10 @ 13:00:00	38,5917	35,5831	38,7559	35,7832	41,8715	38,9732	41,9841	39,1191
2005/08/10 @ 14:00:00	38,6971	35,8835	38,8808	36,0943	41,8753	39,1502	42,0197	39,3215
2005/08/10 @ 15:00:00	37,9036	35,3787	38,0981	35,5915	40,7679	38,3518	40,9357	38,5383
2005/08/10 @ 16:00:00	36,1943	34,0588	36,3922	34,2658	38,8210	36,7960	39,0009	36,9855
2005/08/10 @ 17:00:00	33,8555	32,1468	34,0502	32,3422	36,6453	35,0289	36,8231	35,2078
2005/08/10 @ 18:00:00	31,2449	29,9451	31,4311	30,1251	34,8858	33,5963	35,0489	33,7554
2005/08/10 @ 19:00:00	28,5396	27,6090	28,7137	27,7723	33,6392	32,6302	33,7853	32,7683
2005/08/10 @ 20:00:00	26,4659	25,7580	26,6269	25,9070	32,3790	31,5782	32,5081	31,6974
2005/08/10 @ 21:00:00	24,8359	24,2710	24,9843	24,4078	31,3881	30,7692	31,5009	30,8710
2005/08/10 @ 22:00:00	23,4655	22,9899	23,6012	23,1181	30,4630	29,9781	30,5633	30,0674
2005/08/10 @ 23:00:00	22,1820	21,7995	22,3074	21,9169	29,8505	29,4520	29,9414	29,5324
2005/08/11 @ 00:00:00	20,9818	20,6840	21,0936	20,7881	29,0286	28,6894	29,1116	28,7627
2005/08/11 @ 01:00:00	19,9887	19,7541	20,0874	19,8457	28,5584	28,2594	28,6334	28,3257
2005/08/11 @ 02:00:00	19,1964	19,0075	19,2836	19,0877	27,8835	27,6161	27,9508	27,6758
2005/08/11 @ 03:00:00	18,5033	18,3508	18,5799	18,4212	27,5508	27,3124	27,6112	27,3660
2005/08/11 @ 04:00:00	17,9241	17,7975	17,9918	17,8598	27,1184	26,9064	27,1725	26,9545
2005/08/11 @ 05:00:00	17,9566	17,7638	18,0157	17,8204	26,9468	26,7317	26,9950	26,7752
2005/08/11 @ 06:00:00	19,3149	18,8170	19,3687	18,8759	27,5054	27,1853	27,5480	27,2264

Table 32 - Roof temperature result for LCZ4 (continued).

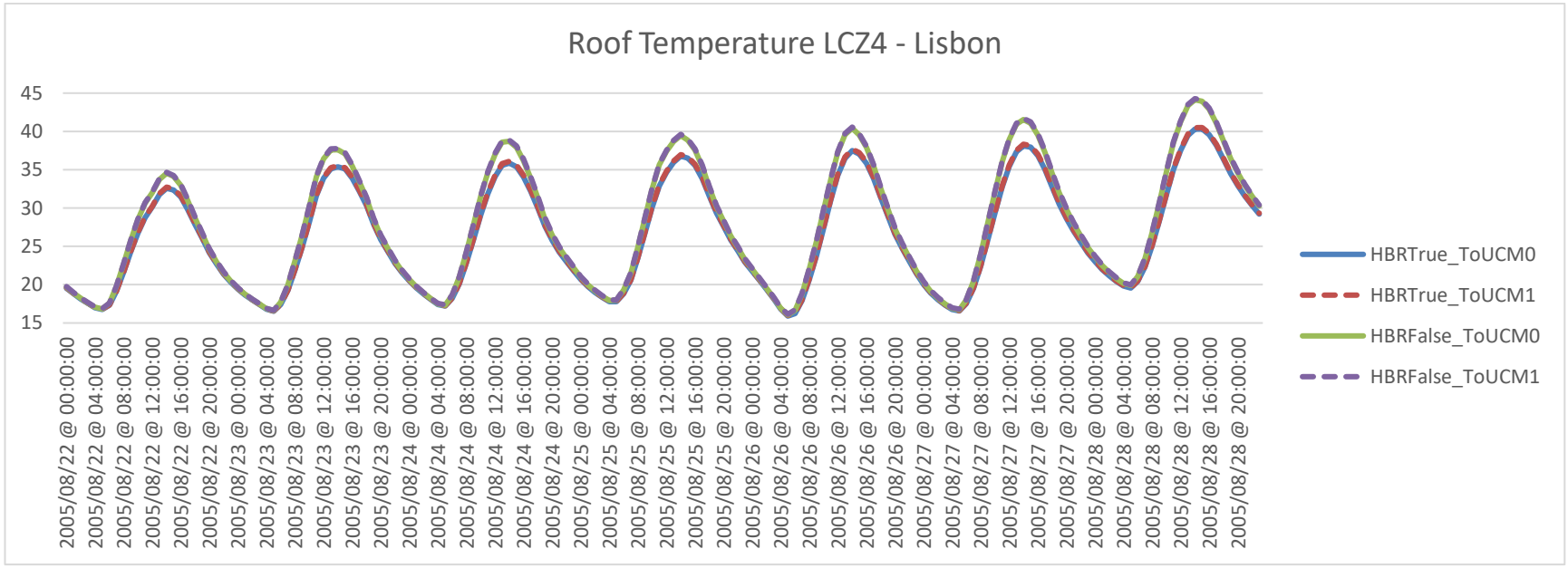
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/11 @ 07:00:00	21,5030	20,6005	21,5574	20,6694	28,7113	28,1669	28,7507	28,2098
2005/08/11 @ 08:00:00	24,8761	23,4427	24,9368	23,5278	30,4834	29,5908	30,5224	29,6399
2005/08/11 @ 09:00:00	28,7659	26,7794	28,8388	26,8859	33,2331	31,9166	33,2769	31,9798
2005/08/11 @ 10:00:00	32,4634	30,0398	32,5532	30,1686	36,1757	34,4249	36,2283	34,5051
2005/08/11 @ 11:00:00	35,6546	32,8786	35,7614	33,0273	38,9392	36,7767	39,0067	36,8775
2005/08/11 @ 12:00:00	37,4178	34,6568	37,5441	34,8190	40,7635	38,3723	40,8595	38,5032
2005/08/11 @ 13:00:00	38,6812	35,9661	38,8209	36,1368	41,6912	39,2166	41,8149	39,3729
2005/08/11 @ 14:00:00	39,4548	36,7988	39,6053	36,9772	41,4788	39,1690	41,6282	39,3436
2005/08/11 @ 15:00:00	38,8541	36,5217	39,0157	36,7011	40,5293	38,4934	40,6929	38,6736
2005/08/11 @ 16:00:00	37,5596	35,5609	37,7256	35,7366	39,3695	37,6114	39,5367	37,7884
2005/08/11 @ 17:00:00	35,4267	33,8465	35,5924	34,0131	37,8608	36,3732	38,0208	36,5382
2005/08/11 @ 18:00:00	32,7253	31,5789	32,8875	31,7345	36,5461	35,2766	36,6902	35,4229
2005/08/11 @ 19:00:00	30,1955	29,3585	30,3513	29,5041	35,3312	34,2819	35,4606	34,4108
2005/08/11 @ 20:00:00	28,2468	27,5923	28,3948	27,7292	33,8170	32,9681	33,9356	33,0837
2005/08/11 @ 21:00:00	26,3575	25,8528	26,4970	25,9813	32,5682	31,9228	32,6799	32,0284
2005/08/11 @ 22:00:00	24,8239	24,4136	24,9554	24,5348	31,1438	30,6446	31,2506	30,7417
2005/08/11 @ 23:00:00	23,2666	22,9473	23,3883	23,0596	30,2744	29,8673	30,3707	29,9543
2005/08/12 @ 00:00:00	22,0270	21,7641	22,1398	21,8685	29,7483	29,3903	29,8342	29,4677
2005/08/12 @ 01:00:00	20,7880	20,5734	20,8930	20,6707	29,3521	29,0307	29,4283	29,0996
2005/08/12 @ 02:00:00	19,5720	19,3955	19,6705	19,4873	28,7954	28,5069	28,8631	28,5682
2005/08/12 @ 03:00:00	18,3077	18,1648	18,4013	18,2525	28,3441	28,0848	28,4043	28,1395
2005/08/12 @ 04:00:00	16,9350	16,8225	17,0253	16,9077	28,0081	27,7752	28,0617	27,8240
2005/08/12 @ 05:00:00	16,0515	15,9031	16,1385	15,9870	27,7038	27,4667	27,7513	27,5105
2005/08/12 @ 06:00:00	16,6499	16,2460	16,7315	16,3310	28,2777	27,9412	28,3191	27,9817
2005/08/12 @ 07:00:00	18,7837	17,9387	18,8620	18,0301	29,2354	28,7062	29,2721	28,7466
2005/08/12 @ 08:00:00	22,0741	20,6719	22,1531	20,7750	30,6389	29,8424	30,6743	29,8873
2005/08/12 @ 09:00:00	25,6932	23,8178	25,7766	23,9328	32,4149	31,3161	32,4543	31,3718
2005/08/12 @ 10:00:00	29,6829	27,3317	29,7733	27,4612	34,3720	32,9406	34,4161	33,0061
2005/08/12 @ 11:00:00	33,7161	31,0303	33,8185	31,1730	36,2148	34,4684	36,2679	34,5466
2005/08/12 @ 12:00:00	37,2350	34,2468	37,3522	34,4069	37,8378	35,8055	37,9014	35,8965
2005/08/12 @ 13:00:00	39,5815	36,4945	39,7174	36,6713	38,8884	36,6920	38,9655	36,7963
2005/08/12 @ 14:00:00	40,4212	37,4949	40,5766	37,6828	39,0074	36,7754	39,0965	36,8894
2005/08/12 @ 15:00:00	39,5291	37,0481	39,7004	37,2377	38,5973	36,4414	38,6935	36,5589
2005/08/12 @ 16:00:00	37,9003	35,8334	38,0783	36,0196	38,0666	36,0730	38,1646	36,1880
2005/08/12 @ 17:00:00	35,5595	33,9113	35,7385	34,0905	37,1630	35,3981	37,2596	35,5068
2005/08/12 @ 18:00:00	32,5739	31,3563	32,7511	31,5265	35,8104	34,3141	35,9028	34,4139
2005/08/12 @ 19:00:00	29,8529	28,9427	30,0254	29,1047	34,4142	33,1830	34,5009	33,2730
2005/08/12 @ 20:00:00	27,2894	26,6072	27,4556	26,7617	33,2338	32,2071	33,3145	32,2887
2005/08/12 @ 21:00:00	25,2817	24,7328	25,4379	24,8780	32,0430	31,2136	32,1199	31,2884
2005/08/12 @ 22:00:00	23,4796	23,0325	23,6261	23,1689	31,0363	30,3835	31,1122	30,4545

Table 32 - Roof temperature result for LCZ4 (continued).

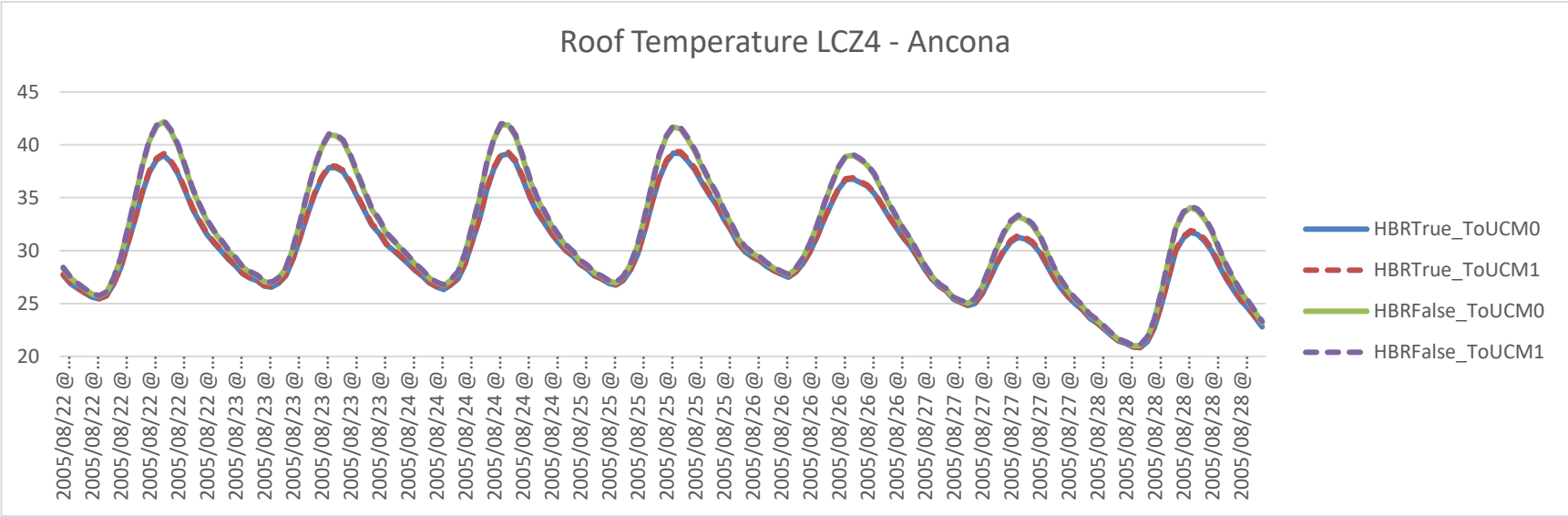
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/12 @ 23:00:00	21,7979	21,4360	21,9358	21,5647	29,8227	29,3428	29,8966	29,4099
2005/08/13 @ 00:00:00	20,3153	20,0229	20,4443	20,1434	28,5694	28,2240	28,6398	28,2872
2005/08/13 @ 01:00:00	19,1591	18,9171	19,2764	19,0269	27,5776	27,3239	27,6438	27,3834
2005/08/13 @ 02:00:00	18,2466	18,0442	18,3514	18,1422	26,8179	26,6131	26,8807	26,6700
2005/08/13 @ 03:00:00	17,4896	17,3228	17,5812	17,4083	26,3445	26,1666	26,4039	26,2206
2005/08/13 @ 04:00:00	16,9064	16,7640	16,9867	16,8389	25,5484	25,3948	25,6044	25,4460
2005/08/13 @ 05:00:00	16,7354	16,5567	16,8048	16,6227	25,2397	25,0905	25,2925	25,1395
2005/08/13 @ 06:00:00	17,9980	17,5284	18,0595	17,5935	25,0314	24,8078	25,0829	24,8583
2005/08/13 @ 07:00:00	20,4856	19,5412	20,5449	19,6145	25,4012	24,9906	25,4545	25,0479
2005/08/13 @ 08:00:00	24,0217	22,4457	24,0818	22,5297	26,6307	25,9148	26,6905	25,9852
2005/08/13 @ 09:00:00	28,0251	25,8228	28,0936	25,9250	28,2889	27,2166	28,3624	27,3063
2005/08/13 @ 10:00:00	32,1048	29,3634	32,1875	29,4870	30,1517	28,7183	30,2456	28,8321
2005/08/13 @ 11:00:00	36,0435	32,7866	36,1366	32,9253	31,6442	29,9377	31,7653	30,0792
2005/08/13 @ 12:00:00	38,9229	35,4371	39,0398	35,5998	32,6769	30,8080	32,8244	30,9747
2005/08/13 @ 13:00:00	40,9356	37,3478	41,0728	37,5288	33,1961	31,2672	33,3629	31,4513
2005/08/13 @ 14:00:00	41,5364	38,1152	41,7000	38,3164	32,9330	31,0783	33,1100	31,2691
2005/08/13 @ 15:00:00	41,0750	37,9431	41,2577	38,1547	32,3800	30,6559	32,5578	30,8444
2005/08/13 @ 16:00:00	39,5042	36,8010	39,6989	37,0137	31,3333	29,8334	31,5059	30,0123
2005/08/13 @ 17:00:00	37,2690	35,0289	37,4667	35,2348	29,8354	28,6336	29,9979	28,7965
2005/08/13 @ 18:00:00	34,5113	32,7218	34,6953	32,9074	28,2969	27,3842	28,4450	27,5277
2005/08/13 @ 19:00:00	32,0101	30,5490	32,1856	30,7210	27,1127	26,4315	27,2447	26,5570
2005/08/13 @ 20:00:00	29,8482	28,6449	30,0130	28,8147	26,1368	25,6011	26,2538	25,7105
2005/08/13 @ 21:00:00	27,9458	26,9799	28,0992	27,1336	25,3631	24,9369	25,4668	25,0328
2005/08/13 @ 22:00:00	26,4259	25,5903	26,5723	25,7285	24,7288	24,3745	24,8225	24,4609
2005/08/13 @ 23:00:00	24,8627	24,1589	24,9980	24,2860	23,8852	23,5900	23,9700	23,6678
2005/08/14 @ 00:00:00	23,6001	22,9864	23,7293	23,1088	23,3875	23,1319	23,4641	23,2019
2005/08/14 @ 01:00:00	22,5200	21,9964	22,6372	22,1069	22,7989	22,5789	22,8678	22,6418
2005/08/14 @ 02:00:00	21,5870	21,1391	21,6930	21,2388	22,1563	21,9678	22,2181	22,0241
2005/08/14 @ 03:00:00	20,8188	20,4318	20,9136	20,5209	21,6077	21,4527	21,6628	21,5027
2005/08/14 @ 04:00:00	20,1571	19,8229	20,2418	19,9023	21,3386	21,2109	21,3886	21,2563
2005/08/14 @ 05:00:00	19,8892	19,5435	19,9648	19,6151	20,9983	20,8760	21,0442	20,9183
2005/08/14 @ 06:00:00	21,0560	20,4328	21,1241	20,5028	21,0216	20,8144	21,0640	20,8558
2005/08/14 @ 07:00:00	23,4328	22,3280	23,4981	22,4036	21,8039	21,3864	21,8447	21,4310
2005/08/14 @ 08:00:00	26,7084	25,0145	26,7763	25,1028	23,4695	22,6958	23,5107	22,7480
2005/08/14 @ 09:00:00	30,6250	28,2804	30,6984	28,3833	26,1901	24,9294	26,2350	24,9938
2005/08/14 @ 10:00:00	34,7359	31,7496	34,8170	31,8686	29,2980	27,5261	29,3534	27,6094
2005/08/14 @ 11:00:00	38,5351	35,0118	38,6278	35,1478	32,1948	30,0061	32,2753	30,1200
2005/08/14 @ 12:00:00	41,2874	37,5358	41,4008	37,6933	33,5087	31,1766	33,6275	31,3264
2005/08/14 @ 13:00:00	43,3793	39,4694	43,5053	39,6390	34,0583	31,7243	34,2095	31,9019
2005/08/14 @ 14:00:00	44,1349	40,3191	44,2787	40,5022	33,7713	31,5266	33,9429	31,7200

Table 32 - Roof temperature result for LCZ4 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**
2005/08/14 @ 15:00:00	43,9278	40,3196	44,0811	40,5068	32,9410	30,8826	33,1206	31,0787
2005/08/14 @ 16:00:00	42,9069	39,5961	43,0648	39,7793	31,7784	29,9698	31,9527	30,1555
2005/08/14 @ 17:00:00	41,0602	38,1740	41,2171	38,3469	30,0658	28,5818	30,2325	28,7537
2005/08/14 @ 18:00:00	38,7291	36,3198	38,8801	36,4781	28,5076	27,3014	28,6606	27,4556
2005/08/14 @ 19:00:00	36,4869	34,4960	36,6287	34,6389	27,2483	26,2854	27,3877	26,4232
2005/08/14 @ 20:00:00	34,6017	32,9333	34,7326	33,0615	26,0831	25,3053	26,2115	25,4286
2005/08/14 @ 21:00:00	32,9768	31,5610	33,0967	31,6761	25,2053	24,5723	25,3221	24,6832
2005/08/14 @ 22:00:00	31,5585	30,3331	31,6695	30,4377	24,2079	23,6892	24,3153	23,7902
2005/08/14 @ 23:00:00	30,2870	29,2187	30,3889	29,3135	23,2058	22,7781	23,3038	22,8696



Graphic 21 - Roof temperature result for LCZ4 – Lisbon.



Graphic 22 - Roof temperature result for LCZ4 – Ancona.

Table 33 - Roof temperature result for LCZ5.

Roof Temp	*LCZ5*							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/08 @ 00:00:00	19,5941	19,4467	19,6774	19,5238	27,8231	27,2990	27,9186	27,3827
2005/08/08 @ 01:00:00	18,8077	18,6966	18,8800	18,7636	27,0060	26,5689	27,0942	26,6455
2005/08/08 @ 02:00:00	18,1307	18,0448	18,1933	18,1029	26,5069	26,1539	26,5861	26,2218
2005/08/08 @ 03:00:00	17,5165	17,4495	17,5709	17,5001	26,0461	25,7593	26,1151	25,8176
2005/08/08 @ 04:00:00	16,9492	16,8969	16,9963	16,9409	25,6437	25,4093	25,7009	25,4568
2005/08/08 @ 05:00:00	16,7314	16,6538	16,7711	16,6919	25,4771	25,2585	25,5227	25,2959
2005/08/08 @ 06:00:00	17,4960	17,2590	17,5296	17,2954	25,8671	25,5585	25,9047	25,5924
2005/08/08 @ 07:00:00	19,7368	19,0912	19,7699	19,1373	27,1744	26,6509	27,2082	26,6884
2005/08/08 @ 08:00:00	22,7299	21,6205	22,7711	21,6840	29,1230	28,2319	29,1575	28,2786
2005/08/08 @ 09:00:00	25,7630	24,2860	25,8200	24,3695	31,8078	30,4328	31,8491	30,4960
2005/08/08 @ 10:00:00	28,5605	26,7839	28,6348	26,8875	34,5779	32,6852	34,6320	32,7693
2005/08/08 @ 11:00:00	30,7508	28,8521	30,8434	28,9714	37,4509	35,0800	37,5259	35,1907
2005/08/08 @ 12:00:00	32,0647	30,2073	32,1709	30,3347	39,5514	36,8379	39,6537	36,9773
2005/08/08 @ 13:00:00	33,8495	31,8816	33,9692	32,0223	40,6927	37,8285	40,8231	37,9932
2005/08/08 @ 14:00:00	34,6658	32,7173	34,8020	32,8715	40,9024	38,0926	41,0567	38,2752
2005/08/08 @ 15:00:00	34,2517	32,4971	34,4022	32,6590	39,9104	37,3239	40,0807	37,5140
2005/08/08 @ 16:00:00	33,0541	31,5560	33,2112	31,7181	38,4227	36,1666	38,5991	36,3542
2005/08/08 @ 17:00:00	31,0358	29,8694	31,1938	30,0253	36,5296	34,6445	36,7031	34,8212
2005/08/08 @ 18:00:00	28,7470	27,9084	28,9000	28,0534	34,5463	33,0142	34,7097	33,1747
2005/08/08 @ 19:00:00	26,6092	25,9857	26,7498	26,1212	33,0755	31,8341	33,2243	31,9763
2005/08/08 @ 20:00:00	24,5708	24,1346	24,7025	24,2588	31,8364	30,8114	31,9701	30,9369
2005/08/08 @ 21:00:00	22,9320	22,6033	23,0535	22,7171	30,8845	30,0232	31,0046	30,1343
2005/08/08 @ 22:00:00	21,5302	21,2892	21,6400	21,3917	30,1375	29,3966	30,2470	29,4968
2005/08/08 @ 23:00:00	20,3811	20,2003	20,4785	20,2911	29,2894	28,6460	29,3889	28,7361
2005/08/09 @ 00:00:00	19,4428	19,3048	19,5274	19,3836	28,6460	28,0839	28,7360	28,1648
2005/08/09 @ 01:00:00	18,6633	18,5548	18,7364	18,6229	27,8803	27,3865	27,9613	27,4589
2005/08/09 @ 02:00:00	17,9828	17,8962	18,0459	17,9551	27,4593	27,0233	27,5319	27,0881
2005/08/09 @ 03:00:00	17,3659	17,2963	17,4205	17,3472	27,1930	26,8082	27,2580	26,8661
2005/08/09 @ 04:00:00	16,7633	16,7077	16,8105	16,7520	26,6734	26,3326	26,7316	26,3841
2005/08/09 @ 05:00:00	16,5092	16,4314	16,5484	16,4688	26,5966	26,2681	26,6481	26,3142
2005/08/09 @ 06:00:00	17,6219	17,3167	17,6542	17,3535	27,0834	26,6704	27,1283	26,7133
2005/08/09 @ 07:00:00	19,9262	19,1869	19,9585	19,2342	28,0431	27,4238	28,0836	27,4681
2005/08/09 @ 08:00:00	23,1905	21,9682	23,2298	22,0326	29,9703	29,0127	30,0117	29,0659
2005/08/09 @ 09:00:00	26,4894	24,8859	26,5414	24,9677	32,3398	30,9353	32,3908	31,0069
2005/08/09 @ 10:00:00	30,3181	28,2628	30,3869	28,3681	34,8969	33,0148	34,9663	33,1119
2005/08/09 @ 11:00:00	34,1879	31,7015	34,2800	31,8360	37,0396	34,7205	37,1346	34,8480
2005/08/09 @ 12:00:00	36,6062	34,0323	36,7281	34,1909	38,7284	36,0961	38,8517	36,2531
2005/08/09 @ 13:00:00	37,7569	35,2758	37,9020	35,4494	39,6853	36,9184	39,8351	37,0995
2005/08/09 @ 14:00:00	37,7865	35,5536	37,9472	35,7328	39,4728	36,7579	39,6424	36,9532

Table 33 - Roof temperature result for LCZ5 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/09 @ 15:00:00	37,2478	35,2517	37,4153	35,4313	38,8271	36,3182	39,0063	36,5161
2005/08/09 @ 16:00:00	35,5799	33,9823	35,7521	34,1567	37,4449	35,2411	37,6242	35,4315
2005/08/09 @ 17:00:00	33,5650	32,3111	33,7363	32,4781	35,9976	34,1398	36,1694	34,3156
2005/08/09 @ 18:00:00	31,3050	30,3272	31,4734	30,4875	34,5239	33,0019	34,6841	33,1613
2005/08/09 @ 19:00:00	28,5756	27,8889	28,7382	28,0397	33,0000	31,7680	33,1455	31,9084
2005/08/09 @ 20:00:00	26,3544	25,8565	26,5080	25,9977	32,0654	31,0477	32,1958	31,1711
2005/08/09 @ 21:00:00	24,5858	24,1998	24,7304	24,3327	30,8639	30,0089	30,9807	30,1177
2005/08/09 @ 22:00:00	22,9667	22,6694	23,1005	22,7925	30,2493	29,5129	30,3559	29,6109
2005/08/09 @ 23:00:00	21,6355	21,4010	21,7575	21,5135	29,6126	28,9757	29,7098	29,0640
2005/08/10 @ 00:00:00	20,5506	20,3613	20,6605	20,4628	28,9606	28,4077	29,0490	28,4873
2005/08/10 @ 01:00:00	19,5621	19,4124	19,6588	19,5019	28,2641	27,7815	28,3442	27,8532
2005/08/10 @ 02:00:00	18,7716	18,6482	18,8574	18,7276	27,7048	27,2817	27,7770	27,3460
2005/08/10 @ 03:00:00	18,0601	17,9593	18,1357	18,0293	27,0370	26,6644	27,1019	26,7220
2005/08/10 @ 04:00:00	17,3691	17,2891	17,4349	17,3502	26,6343	26,3049	26,6924	26,3564
2005/08/10 @ 05:00:00	17,2024	17,0718	17,2596	17,1267	26,4018	26,0887	26,4534	26,1348
2005/08/10 @ 06:00:00	18,5107	18,0749	18,5628	18,1336	26,9449	26,5527	26,9897	26,5952
2005/08/10 @ 07:00:00	20,9627	20,0668	21,0168	20,1397	27,7628	27,1656	27,8027	27,2093
2005/08/10 @ 08:00:00	24,1997	22,7816	24,2644	22,8762	29,5248	28,5830	29,5654	28,6354
2005/08/10 @ 09:00:00	27,9002	25,9391	27,9829	26,0604	32,0588	30,6559	32,1088	30,7268
2005/08/10 @ 10:00:00	31,6366	29,1776	31,7395	29,3243	34,6327	32,7343	34,6978	32,8279
2005/08/10 @ 11:00:00	34,7147	31,9636	34,8495	32,1429	37,6970	35,3344	37,7812	35,4527
2005/08/10 @ 12:00:00	37,1455	34,2026	37,3080	34,4073	40,1867	37,4872	40,2884	37,6280
2005/08/10 @ 13:00:00	38,7277	35,7086	38,9107	35,9300	41,6076	38,7665	41,7253	38,9220
2005/08/10 @ 14:00:00	38,8539	36,0319	39,0636	36,2707	41,6949	39,0115	41,8403	39,1873
2005/08/10 @ 15:00:00	38,0572	35,5253	38,2829	35,7706	40,6362	38,2511	40,8039	38,4401
2005/08/10 @ 16:00:00	36,3255	34,1843	36,5580	34,4258	38,7111	36,7096	38,8920	36,9021
2005/08/10 @ 17:00:00	33,9576	32,2440	34,1880	32,4738	36,5459	34,9493	36,7284	35,1342
2005/08/10 @ 18:00:00	31,3149	30,0108	31,5364	30,2238	34,7877	33,5141	34,9566	33,6798
2005/08/10 @ 19:00:00	28,5752	27,6408	28,7834	27,8351	33,5392	32,5443	33,6916	32,6887
2005/08/10 @ 20:00:00	26,4731	25,7470	26,6663	25,9399	32,2772	31,4895	32,4130	31,6147
2005/08/10 @ 21:00:00	24,7747	24,1953	24,9517	24,3673	31,2877	30,6790	31,4081	30,7871
2005/08/10 @ 22:00:00	23,3589	22,8851	23,5202	23,0400	30,3717	29,8950	30,4799	29,9907
2005/08/10 @ 23:00:00	22,0471	21,6669	22,1948	21,8074	29,7638	29,3723	29,8628	29,4592
2005/08/11 @ 00:00:00	20,8412	20,5438	20,9737	20,6687	28,9422	28,6090	29,0329	28,6885
2005/08/11 @ 01:00:00	19,8510	19,6156	19,9682	19,7255	28,4720	28,1781	28,5543	28,2502
2005/08/11 @ 02:00:00	19,0643	18,8735	19,1678	18,9701	27,7912	27,5299	27,8648	27,5945
2005/08/11 @ 03:00:00	18,3738	18,2191	18,4647	18,3036	27,4562	27,2236	27,5218	27,2813
2005/08/11 @ 04:00:00	17,7934	17,6644	17,8737	17,7389	27,0230	26,8161	27,0815	26,8675
2005/08/11 @ 05:00:00	17,8344	17,6391	17,9042	17,7064	26,8527	26,6424	26,9044	26,6884
2005/08/11 @ 06:00:00	19,2135	18,7130	19,2765	18,7825	27,4171	27,1040	27,4624	27,1473

Table 33 - Roof temperature result for LCZ5 (continued).

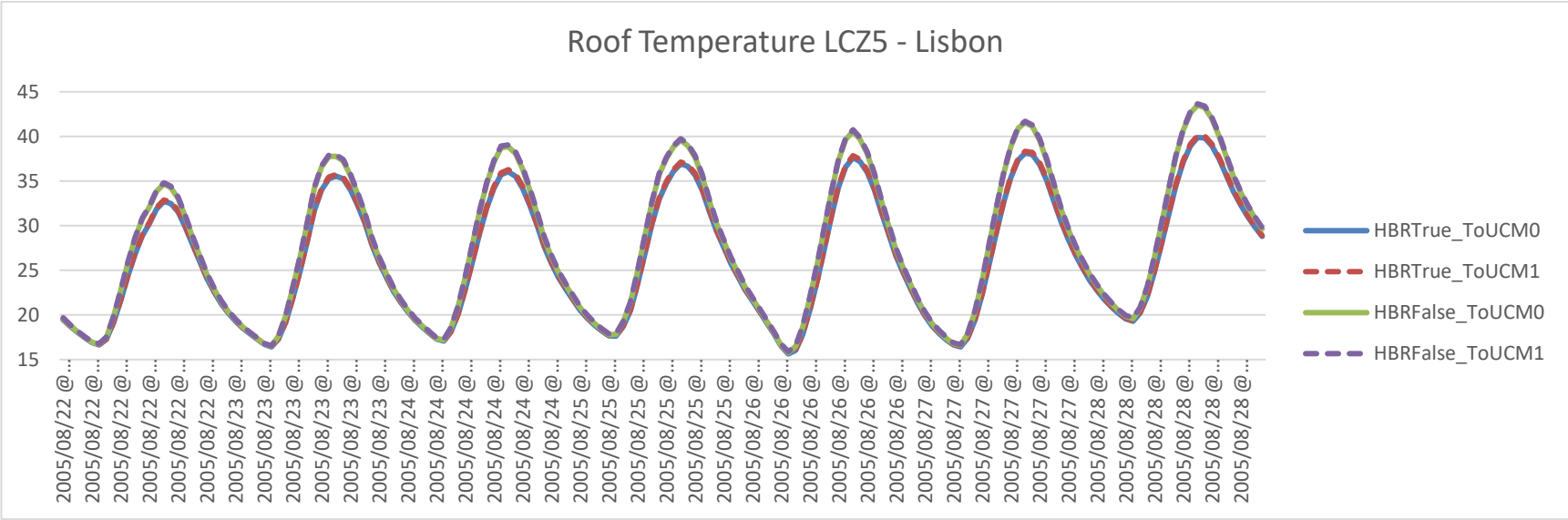
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/11 @ 07:00:00	21,4236	20,5163	21,4854	20,5942	28,6199	28,0881	28,6615	28,1337
2005/08/11 @ 08:00:00	24,8543	23,4164	24,9225	23,5130	30,3819	29,5077	30,4231	29,5608
2005/08/11 @ 09:00:00	28,7956	26,8009	28,8773	26,9205	33,1662	31,8633	33,2105	31,9281
2005/08/11 @ 10:00:00	32,5217	30,0873	32,6207	30,2290	36,1295	34,3887	36,1816	34,4692
2005/08/11 @ 11:00:00	35,7179	32,9334	35,8294	33,0890	38,9133	36,7581	38,9793	36,8578
2005/08/11 @ 12:00:00	37,5207	34,7523	37,6586	34,9285	40,7570	38,3707	40,8506	38,4992
2005/08/11 @ 13:00:00	38,8084	36,0860	38,9636	36,2743	41,6982	39,2267	41,8187	39,3798
2005/08/11 @ 14:00:00	39,5875	36,9245	39,7514	37,1175	41,5111	39,2029	41,6662	39,3831
2005/08/11 @ 15:00:00	38,9919	36,6537	39,1733	36,8533	40,5737	38,5392	40,7518	38,7336
2005/08/11 @ 16:00:00	37,6856	35,6822	37,8757	35,8814	39,3996	37,6430	39,5803	37,8333
2005/08/11 @ 17:00:00	35,5302	33,9459	35,7227	34,1375	37,8721	36,3856	38,0439	36,5619
2005/08/11 @ 18:00:00	32,7970	31,6377	32,9876	31,8190	36,4043	35,1727	36,5611	35,3298
2005/08/11 @ 19:00:00	30,2354	29,3890	30,4199	29,5599	35,1067	34,1137	35,2488	34,2525
2005/08/11 @ 20:00:00	28,2319	27,5460	28,4056	27,7066	33,6256	32,8187	33,7555	32,9432
2005/08/11 @ 21:00:00	26,3003	25,7491	26,4656	25,9052	32,4068	31,7909	32,5307	31,9062
2005/08/11 @ 22:00:00	24,7129	24,2678	24,8682	24,4118	31,0088	30,5308	31,1257	30,6379
2005/08/11 @ 23:00:00	23,1241	22,7795	23,2691	22,9137	30,1534	29,7626	30,2597	29,8590
2005/08/12 @ 00:00:00	21,8512	21,5688	21,9854	21,6933	29,6338	29,2897	29,7287	29,3754
2005/08/12 @ 01:00:00	20,5640	20,3340	20,6897	20,4510	29,2417	28,9332	29,3256	29,0091
2005/08/12 @ 02:00:00	19,3032	19,1140	19,4213	19,2244	28,6896	28,4115	28,7640	28,4785
2005/08/12 @ 03:00:00	17,9985	17,8454	18,1114	17,9514	28,2409	27,9901	28,3059	28,0478
2005/08/12 @ 04:00:00	16,6281	16,5064	16,7370	16,6093	27,9072	27,6814	27,9633	27,7302
2005/08/12 @ 05:00:00	15,7943	15,6344	15,8975	15,7345	27,6059	27,3736	27,6524	27,4145
2005/08/12 @ 06:00:00	16,4406	16,0278	16,5366	16,1281	28,1916	27,8612	28,2314	27,8991
2005/08/12 @ 07:00:00	18,6223	17,7673	18,7130	17,8732	29,1602	28,6421	29,1952	28,6807
2005/08/12 @ 08:00:00	21,9550	20,5439	22,0429	20,6577	30,5670	29,7826	30,6011	29,8269
2005/08/12 @ 09:00:00	25,6392	23,7525	25,7316	23,8794	32,3627	31,2727	32,4007	31,3275
2005/08/12 @ 10:00:00	29,6573	27,2943	29,7537	27,4313	34,3144	32,8885	34,3584	32,9549
2005/08/12 @ 11:00:00	33,7577	31,0621	33,8696	31,2179	36,1135	34,3794	36,1699	34,4621
2005/08/12 @ 12:00:00	37,3087	34,3095	37,4339	34,4797	37,5290	35,5688	37,6033	35,6707
2005/08/12 @ 13:00:00	39,6868	36,5886	39,8304	36,7742	38,3652	36,2947	38,4602	36,4157
2005/08/12 @ 14:00:00	40,5648	37,6289	40,7358	37,8334	38,3160	36,2517	38,4278	36,3859
2005/08/12 @ 15:00:00	39,6789	37,1907	39,8735	37,4034	37,8196	35,8575	37,9396	35,9957
2005/08/12 @ 16:00:00	38,0319	35,9593	38,2378	36,1722	37,2737	35,4852	37,3943	35,6192
2005/08/12 @ 17:00:00	35,6641	34,0111	35,8735	34,2185	36,3913	34,8330	36,5086	34,9583
2005/08/12 @ 18:00:00	32,6443	31,4226	32,8536	31,6217	35,0777	33,7792	35,1885	33,8932
2005/08/12 @ 19:00:00	29,8875	28,9749	30,0911	29,1653	33,7333	32,6857	33,8361	32,7874
2005/08/12 @ 20:00:00	27,2922	26,6079	27,4897	26,7906	32,6122	31,7559	32,7065	31,8465
2005/08/12 @ 21:00:00	25,2557	24,7046	25,4393	24,8747	31,5289	30,8355	31,6168	30,9176
2005/08/12 @ 22:00:00	23,4317	22,9663	23,6026	23,1252	30,6252	30,0784	30,7105	30,1557

Table 33 - Roof temperature result for LCZ5 (continued).

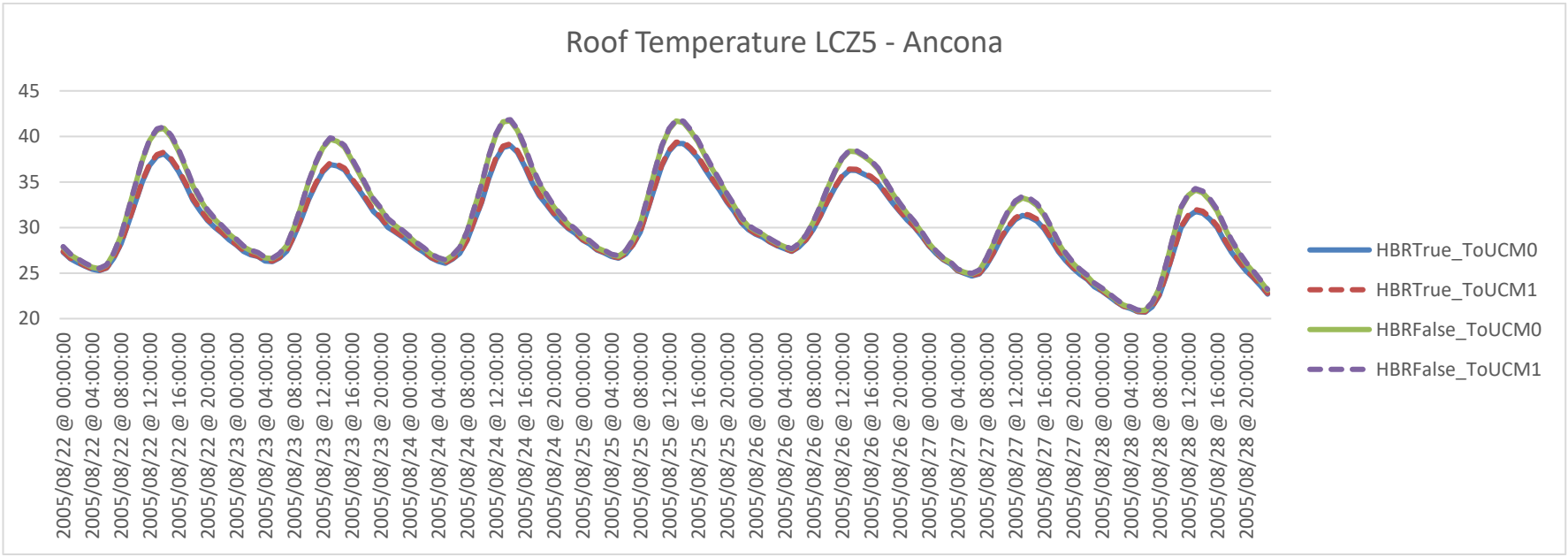
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/12 @ 23:00:00	21,7299	21,3416	21,8901	21,4986	29,5077	29,1048	29,5899	29,1778
2005/08/13 @ 00:00:00	20,2262	19,9048	20,3762	20,0530	28,3251	28,0342	28,4033	28,1035
2005/08/13 @ 01:00:00	19,0599	18,7954	19,1963	18,9289	27,3792	27,1646	27,4530	27,2303
2005/08/13 @ 02:00:00	18,1444	17,9238	18,2664	18,0423	26,6413	26,4674	26,7118	26,5306
2005/08/13 @ 03:00:00	17,3795	17,1971	17,4872	17,3011	26,1775	26,0255	26,2441	26,0857
2005/08/13 @ 04:00:00	16,7878	16,6320	16,8822	16,7229	25,3882	25,2563	25,4511	25,3136
2005/08/13 @ 05:00:00	16,6115	16,4214	16,6932	16,5011	25,0861	24,9549	25,1455	25,0098
2005/08/13 @ 06:00:00	17,8808	17,4011	17,9526	17,4784	24,8900	24,6804	24,9479	24,7370
2005/08/13 @ 07:00:00	20,3875	19,4342	20,4550	19,5178	25,2809	24,8808	25,3411	24,9458
2005/08/13 @ 08:00:00	23,9055	22,3292	23,9729	22,4237	26,5442	25,8359	26,6122	25,9167
2005/08/13 @ 09:00:00	27,9499	25,7429	28,0228	25,8529	28,2485	27,1810	28,3328	27,2848
2005/08/13 @ 10:00:00	32,0613	29,3155	32,1457	29,4430	30,1448	28,7142	30,2538	28,8472
2005/08/13 @ 11:00:00	35,9074	32,6786	36,0060	32,8241	31,6678	29,9628	31,8098	30,1295
2005/08/13 @ 12:00:00	38,8516	35,3846	38,9688	35,5482	32,7223	30,8540	32,8965	31,0514
2005/08/13 @ 13:00:00	40,9128	37,3377	41,0457	37,5144	33,2550	31,3261	33,4529	31,5448
2005/08/13 @ 14:00:00	41,5557	38,1421	41,7122	38,3353	32,9958	31,1407	33,2064	31,3678
2005/08/13 @ 15:00:00	41,1129	37,9859	41,2874	38,1887	32,4282	30,7033	32,6374	30,9252
2005/08/13 @ 16:00:00	39,5451	36,8460	39,7351	37,0537	31,3536	29,8529	31,5522	30,0592
2005/08/13 @ 17:00:00	37,2989	35,0614	37,4932	35,2637	29,8323	28,6304	30,0186	28,8178
2005/08/13 @ 18:00:00	34,4806	32,6903	34,6692	32,8844	28,2763	27,3634	28,4474	27,5297
2005/08/13 @ 19:00:00	31,8629	30,4534	32,0444	30,6345	27,0726	26,3907	27,2266	26,5360
2005/08/13 @ 20:00:00	29,5857	28,4652	29,7592	28,6339	26,0789	25,5412	26,2151	25,6680
2005/08/13 @ 21:00:00	27,5959	26,6905	27,7600	26,8475	25,2897	24,8614	25,4103	24,9724
2005/08/13 @ 22:00:00	26,0077	25,2513	26,1589	25,3944	24,6519	24,2954	24,7607	24,3952
2005/08/13 @ 23:00:00	24,4724	23,8473	24,6143	23,9804	23,8033	23,5058	23,9017	23,5956
2005/08/14 @ 00:00:00	23,2382	22,7076	23,3681	22,8291	23,2929	23,0374	23,3809	23,1175
2005/08/14 @ 01:00:00	22,1851	21,7336	22,3033	21,8436	22,6962	22,4773	22,7748	22,5488
2005/08/14 @ 02:00:00	21,2745	20,8890	21,3815	20,9884	22,0490	21,8616	22,1191	21,9252
2005/08/14 @ 03:00:00	20,5051	20,1741	20,6016	20,2635	21,4973	21,3425	21,5601	21,3992
2005/08/14 @ 04:00:00	19,8504	19,5659	19,9368	19,6457	21,2262	21,0979	21,2834	21,1496
2005/08/14 @ 05:00:00	19,5940	19,2924	19,6708	19,3644	20,8846	20,7612	20,9372	20,8094
2005/08/14 @ 06:00:00	20,7743	20,1933	20,8434	20,2649	20,9112	20,7024	20,9597	20,7494
2005/08/14 @ 07:00:00	23,1384	22,0785	23,2053	22,1585	21,7008	21,2813	21,7469	21,3313
2005/08/14 @ 08:00:00	26,4276	24,7752	26,4980	24,8698	23,3803	22,6042	23,4259	22,6612
2005/08/14 @ 09:00:00	30,2669	27,9919	30,3462	28,1054	26,1174	24,8486	26,1658	24,9179
2005/08/14 @ 10:00:00	34,1894	31,3565	34,2819	31,4900	29,2413	27,4630	29,2990	27,5497
2005/08/14 @ 11:00:00	37,7726	34,4961	37,8823	34,6501	32,1592	29,9656	32,2405	30,0810
2005/08/14 @ 12:00:00	40,6835	37,1174	40,8114	37,2895	33,5244	31,1878	33,6544	31,3513
2005/08/14 @ 13:00:00	42,6454	38,9657	42,7915	39,1528	34,1081	31,7696	34,2800	31,9713
2005/08/14 @ 14:00:00	43,4894	39,8759	43,6524	40,0736	33,8211	31,5721	34,0129	31,7881

Table 33 - Roof temperature result for LCZ5 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**
2005/08/14 @ 15:00:00	43,2149	39,8336	43,3916	40,0363	32,9732	30,9110	33,1684	31,1243
2005/08/14 @ 16:00:00	41,9754	38,9636	42,1593	39,1635	31,7907	29,9784	31,9784	30,1787
2005/08/14 @ 17:00:00	40,0398	37,4821	40,2225	37,6709	30,0578	28,5701	30,2370	28,7552
2005/08/14 @ 18:00:00	37,7123	35,6293	37,8871	35,8016	28,4726	27,2686	28,6375	27,4348
2005/08/14 @ 19:00:00	35,5257	33,8412	35,6885	33,9957	27,1976	26,2349	27,3485	26,3838
2005/08/14 @ 20:00:00	33,7187	32,3293	33,8675	32,4671	26,0183	25,2406	26,1562	25,3742
2005/08/14 @ 21:00:00	32,1785	31,0122	32,3135	31,1350	25,1296	24,4957	25,2559	24,6165
2005/08/14 @ 22:00:00	30,8504	29,8459	30,9747	29,9572	24,1273	23,6070	24,2441	23,7176
2005/08/14 @ 23:00:00	29,6618	28,7870	29,7753	28,8875	23,1192	22,6896	23,2266	22,7902



Graphic 23 - Roof temperature result for LCZ5 – Lisbon.



Graphic 24 - Roof temperature result for LCZ5 – Ancona.

Table 34 - Roof temperature for LCZ6.

Roof Temp	*LCZ6*							
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/08 @ 00:00:00	19,5767	19,4327	19,6599	19,5092	27,8370	27,3032	27,9351	27,3892
2005/08/08 @ 01:00:00	18,7932	18,6845	18,8654	18,7510	27,0153	26,5700	27,1060	26,6485
2005/08/08 @ 02:00:00	18,1183	18,0342	18,1809	18,0920	26,5121	26,1524	26,5934	26,2221
2005/08/08 @ 03:00:00	17,5059	17,4403	17,5602	17,4906	26,0484	25,7563	26,1192	25,8161
2005/08/08 @ 04:00:00	16,9400	16,8888	16,9871	16,9326	25,6440	25,4054	25,7028	25,4541
2005/08/08 @ 05:00:00	16,7238	16,6470	16,7635	16,6850	25,4766	25,2544	25,5234	25,2929
2005/08/08 @ 06:00:00	17,4910	17,2545	17,5244	17,2907	25,8677	25,5560	25,9063	25,5909
2005/08/08 @ 07:00:00	19,7355	19,0904	19,7685	19,1363	27,1766	26,6506	27,2112	26,6887
2005/08/08 @ 08:00:00	22,7297	21,6206	22,7708	21,6840	29,1255	28,2330	29,1607	28,2801
2005/08/08 @ 09:00:00	25,7584	24,2816	25,8155	24,3652	31,8094	30,4344	31,8511	30,4978
2005/08/08 @ 10:00:00	28,5517	26,7752	28,6262	26,8790	34,5793	32,6867	34,6338	32,7710
2005/08/08 @ 11:00:00	30,7342	28,8356	30,8272	28,9554	37,4547	35,0822	37,5336	35,1933
2005/08/08 @ 12:00:00	32,0408	30,1835	32,1475	30,3114	39,5627	36,8439	39,6867	36,9839
2005/08/08 @ 13:00:00	33,8243	31,8564	33,9444	31,9975	40,7159	37,8416	40,8842	38,0073
2005/08/08 @ 14:00:00	34,6361	32,6875	34,7727	32,8422	40,9391	38,1145	41,1232	38,2985
2005/08/08 @ 15:00:00	34,2178	32,4631	34,3688	32,6256	39,9589	37,3541	40,1511	37,5462
2005/08/08 @ 16:00:00	33,0201	31,5219	33,1777	31,6845	38,4783	36,2023	38,6714	36,3921
2005/08/08 @ 17:00:00	31,0029	29,8365	31,1612	29,9928	36,5863	34,6817	36,7731	34,8608
2005/08/08 @ 18:00:00	28,7169	27,8785	28,8703	28,0237	34,6004	33,0501	34,7749	33,2129
2005/08/08 @ 19:00:00	26,5618	25,9526	26,7082	26,0885	33,1223	31,8643	33,2806	32,0089
2005/08/08 @ 20:00:00	24,5285	24,1082	24,6640	24,2326	31,8755	30,8357	32,0175	30,9635
2005/08/08 @ 21:00:00	22,8870	22,5812	23,0112	22,6950	30,9175	30,0430	31,0448	30,1562
2005/08/08 @ 22:00:00	21,4967	21,2708	21,6083	21,3733	30,1676	29,4145	30,2837	29,5167
2005/08/08 @ 23:00:00	20,3554	20,1847	20,4538	20,2755	29,3168	28,6619	29,4223	28,7540
2005/08/09 @ 00:00:00	19,4225	19,2916	19,5078	19,3703	28,6706	28,0975	28,7660	28,1804
2005/08/09 @ 01:00:00	18,6465	18,5432	18,7202	18,6113	27,9018	27,3976	27,9878	27,4719
2005/08/09 @ 02:00:00	17,9687	17,8860	18,0322	17,9448	27,4777	27,0316	27,5548	27,0983
2005/08/09 @ 03:00:00	17,3538	17,2871	17,4086	17,3380	27,2083	26,8139	27,2775	26,8737
2005/08/09 @ 04:00:00	16,7529	16,6996	16,8004	16,7438	26,6855	26,3362	26,7476	26,3892
2005/08/09 @ 05:00:00	16,5008	16,4247	16,5401	16,4621	26,6064	26,2704	26,6615	26,3178
2005/08/09 @ 06:00:00	17,6166	17,3127	17,6490	17,3494	27,0924	26,6731	27,1404	26,7171
2005/08/09 @ 07:00:00	19,9249	19,1865	19,9571	19,2336	28,0517	27,4273	28,0947	27,4726
2005/08/09 @ 08:00:00	23,1908	21,9693	23,2300	22,0334	29,9776	29,0167	30,0211	29,0706
2005/08/09 @ 09:00:00	26,4859	24,8830	26,5379	24,9647	32,3450	30,9388	32,3978	31,0109
2005/08/09 @ 10:00:00	30,3132	28,2584	30,3821	28,3637	34,9017	33,0179	34,9724	33,1155
2005/08/09 @ 11:00:00	34,1795	31,6935	34,2719	31,8282	37,0473	34,7251	37,1434	34,8531
2005/08/09 @ 12:00:00	36,5836	34,0099	36,7060	34,1691	38,7432	36,1048	38,8675	36,2625
2005/08/09 @ 13:00:00	37,7232	35,2423	37,8691	35,4167	39,7105	36,9338	39,8615	37,1159
2005/08/09 @ 14:00:00	37,7462	35,5134	37,9076	35,6934	39,5092	36,7805	39,6802	36,9773

Table 34 - Roof temperature for LCZ6 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/09 @ 15:00:00	37,2062	35,2103	37,3745	35,3905	38,8718	36,3463	39,0528	36,5459
2005/08/09 @ 16:00:00	35,5386	33,9412	35,7115	34,1162	37,4942	35,2722	37,6755	35,4647
2005/08/09 @ 17:00:00	33,5262	32,2724	33,6979	32,4399	36,0474	34,1694	36,2214	34,3477
2005/08/09 @ 18:00:00	31,2399	30,2899	31,4095	30,4505	34,5585	33,0198	34,7212	33,1818
2005/08/09 @ 19:00:00	28,5104	27,8560	28,6739	28,0071	33,0328	31,7851	33,1806	31,9279
2005/08/09 @ 20:00:00	26,3048	25,8203	26,4588	25,9618	32,0938	31,0620	32,2265	31,1876
2005/08/09 @ 21:00:00	24,5456	24,1683	24,6903	24,3014	30,8880	30,0202	31,0070	30,1312
2005/08/09 @ 22:00:00	22,9338	22,6430	23,0676	22,7661	30,2723	29,5239	30,3811	29,6239
2005/08/09 @ 23:00:00	21,6079	21,3783	21,7298	21,4908	29,6340	28,9858	29,7334	29,0761
2005/08/10 @ 00:00:00	20,5269	20,3414	20,6366	20,4429	28,9801	28,4165	29,0705	28,4980
2005/08/10 @ 01:00:00	19,5419	19,3952	19,6385	19,4847	28,2813	27,7888	28,3634	27,8622
2005/08/10 @ 02:00:00	18,7538	18,6328	18,8394	18,7122	27,7196	27,2872	27,7937	27,3532
2005/08/10 @ 03:00:00	18,0444	17,9456	18,1198	18,0155	27,0493	26,6678	27,1160	26,7271
2005/08/10 @ 04:00:00	17,3555	17,2771	17,4212	17,3381	26,6440	26,3062	26,7038	26,3594
2005/08/10 @ 05:00:00	17,1914	17,0621	17,2485	17,1169	26,4094	26,0888	26,4626	26,1365
2005/08/10 @ 06:00:00	18,5039	18,0691	18,5558	18,1276	26,9520	26,5535	26,9982	26,5973
2005/08/10 @ 07:00:00	20,9607	20,0654	21,0145	20,1380	27,7698	27,1677	27,8110	27,2124
2005/08/10 @ 08:00:00	24,2004	22,7828	24,2648	22,8770	29,5310	28,5860	29,5725	28,6391
2005/08/10 @ 09:00:00	27,9011	25,9400	27,9837	26,0612	32,0629	30,6585	32,1136	30,7300
2005/08/10 @ 10:00:00	31,6345	29,1752	31,7376	29,3222	34,6364	32,7365	34,7021	32,8306
2005/08/10 @ 11:00:00	34,7044	31,9546	34,8394	32,1350	37,7024	35,3371	37,7872	35,4560
2005/08/10 @ 12:00:00	37,1281	34,1861	37,2920	34,3930	40,1880	37,4910	40,2895	37,6312
2005/08/10 @ 13:00:00	38,7034	35,6849	38,8891	35,9096	41,6023	38,7633	41,7208	38,9189
2005/08/10 @ 14:00:00	38,8187	35,9972	39,0305	36,2388	41,6818	38,9998	41,8291	39,1771
2005/08/10 @ 15:00:00	38,0147	35,4834	38,2423	35,7308	40,6169	38,2329	40,7875	38,4243
2005/08/10 @ 16:00:00	36,2807	34,1400	36,5146	34,3832	38,6882	36,6876	38,8725	36,8832
2005/08/10 @ 17:00:00	33,9138	32,2007	34,1454	32,4318	36,5220	34,9259	36,7080	35,1141
2005/08/10 @ 18:00:00	31,2727	29,9539	31,4953	30,1684	34,7642	33,4911	34,9365	33,6598
2005/08/10 @ 19:00:00	28,5365	27,5842	28,7455	27,7796	33,5161	32,5216	33,6717	32,6689
2005/08/10 @ 20:00:00	26,4385	25,6753	26,6323	25,8594	32,2555	31,4678	32,3941	31,5956
2005/08/10 @ 21:00:00	24,7421	24,1359	24,9199	24,3032	31,2671	30,6584	31,3897	30,7685
2005/08/10 @ 22:00:00	23,3298	22,8362	23,4920	22,9878	30,3527	29,8760	30,4626	29,9733
2005/08/10 @ 23:00:00	22,0212	21,6259	22,1699	21,7641	29,7461	29,3547	29,8464	29,4428
2005/08/11 @ 00:00:00	20,8183	20,5099	20,9515	20,6330	28,9257	28,5925	29,0178	28,6731
2005/08/11 @ 01:00:00	19,8307	19,5871	19,9485	19,6955	28,4566	28,1628	28,5402	28,2360
2005/08/11 @ 02:00:00	19,0461	18,8489	19,1500	18,9443	27,7780	27,5164	27,8529	27,5820
2005/08/11 @ 03:00:00	18,3574	18,1977	18,4485	18,2813	27,4443	27,2111	27,5112	27,2698
2005/08/11 @ 04:00:00	17,7787	17,6457	17,8593	17,7195	27,0120	26,8041	27,0717	26,8566
2005/08/11 @ 05:00:00	17,8223	17,6239	17,8923	17,6905	26,8426	26,6313	26,8954	26,6783
2005/08/11 @ 06:00:00	19,2055	18,7026	19,2686	18,7716	27,4092	27,0953	27,4554	27,1394

Table 34 - Roof temperature for LCZ6 (continued).

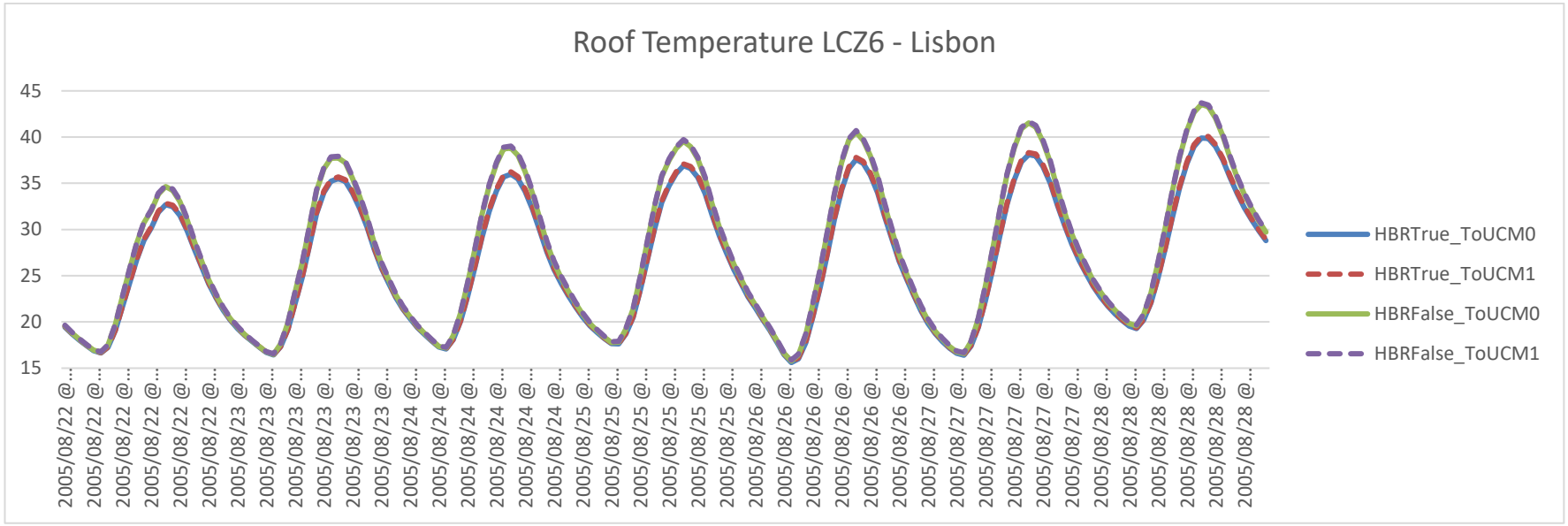
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/11 @ 07:00:00	21,4195	20,5101	21,4813	20,5874	28,6141	28,0819	28,6564	28,1281
2005/08/11 @ 08:00:00	24,8545	23,4151	24,9226	23,5111	30,3775	29,5037	30,4192	29,5573
2005/08/11 @ 09:00:00	28,7968	26,8005	28,8783	26,9196	33,1649	31,8621	33,2095	31,9271
2005/08/11 @ 10:00:00	32,5194	30,0834	32,6187	30,2253	36,1290	34,3880	36,1813	34,4687
2005/08/11 @ 11:00:00	35,7102	32,9242	35,8226	33,0808	38,9114	36,7559	38,9778	36,8560
2005/08/11 @ 12:00:00	37,5017	34,7328	37,6405	34,9101	40,7509	38,3643	40,8454	38,4937
2005/08/11 @ 13:00:00	38,7845	36,0616	38,9418	36,2522	41,6867	39,2150	41,8088	39,3698
2005/08/11 @ 14:00:00	39,5605	36,8971	39,7274	37,0933	41,4932	39,1850	41,6508	39,3677
2005/08/11 @ 15:00:00	38,9568	36,6185	39,1407	36,8206	40,5508	38,5162	40,7318	38,7132
2005/08/11 @ 16:00:00	37,6478	35,6442	37,8398	35,8454	39,3746	37,6180	39,5585	37,8112
2005/08/11 @ 17:00:00	35,4914	33,9069	35,6853	34,1001	37,8472	36,3606	38,0221	36,5399
2005/08/11 @ 18:00:00	32,7499	31,5598	32,9303	31,7434	36,3917	35,1572	36,5513	35,3169
2005/08/11 @ 19:00:00	30,1944	29,2817	30,3720	29,4553	35,1010	34,1037	35,2455	34,2448
2005/08/11 @ 20:00:00	28,1728	27,4413	28,3418	27,6045	33,6167	32,8066	33,7489	32,9333
2005/08/11 @ 21:00:00	26,2290	25,6432	26,3916	25,7980	32,3953	31,7772	32,5210	31,8942
2005/08/11 @ 22:00:00	24,6558	24,1832	24,8090	24,3282	30,9964	30,5168	31,1148	30,6252
2005/08/11 @ 23:00:00	23,0792	22,7148	23,2225	22,8494	30,1407	29,7487	30,2483	29,8462
2005/08/12 @ 00:00:00	21,8143	21,5167	21,9473	21,6415	29,6213	29,2763	29,7175	29,3631
2005/08/12 @ 01:00:00	20,5334	20,2916	20,6582	20,4088	29,2308	28,9209	29,3160	28,9978
2005/08/12 @ 02:00:00	19,2774	19,0789	19,3948	19,1896	28,6791	28,3994	28,7547	28,4673
2005/08/12 @ 03:00:00	17,9768	17,8164	18,0892	17,9227	28,2301	27,9775	28,2965	28,0364
2005/08/12 @ 04:00:00	16,6048	16,4706	16,7134	16,5740	27,8957	27,6684	27,9532	27,7184
2005/08/12 @ 05:00:00	15,7758	15,6074	15,8791	15,7077	27,5960	27,3623	27,6434	27,4039
2005/08/12 @ 06:00:00	16,4280	16,0090	16,5239	16,1092	28,1851	27,8537	28,2255	27,8919
2005/08/12 @ 07:00:00	18,6150	17,7551	18,7054	17,8608	29,1562	28,6375	29,1917	28,6763
2005/08/12 @ 08:00:00	21,9513	20,5361	22,0388	20,6496	30,5642	29,7797	30,5987	29,8241
2005/08/12 @ 09:00:00	25,6364	23,7463	25,7285	23,8729	32,3615	31,2712	32,3998	31,3261
2005/08/12 @ 10:00:00	29,6532	27,2872	29,7496	27,4244	34,3137	32,8873	34,3579	32,9538
2005/08/12 @ 11:00:00	33,7489	31,0513	33,8609	31,2073	36,1142	34,3786	36,1708	34,4616
2005/08/12 @ 12:00:00	37,2949	34,2937	37,4210	34,4651	37,5331	35,5698	37,6078	35,6721
2005/08/12 @ 13:00:00	39,6662	36,5664	39,8120	36,7545	38,3754	36,2994	38,4709	36,4210
2005/08/12 @ 14:00:00	40,5343	37,5977	40,7070	37,8045	38,3327	36,2604	38,4450	36,3955
2005/08/12 @ 15:00:00	39,6375	37,1489	39,8336	37,3634	37,8411	35,8692	37,9620	36,0083
2005/08/12 @ 16:00:00	37,9879	35,9149	38,1950	36,1293	37,2981	35,4983	37,4197	35,6335
2005/08/12 @ 17:00:00	35,6211	33,9678	35,8315	34,1764	36,4200	34,8506	36,5391	34,9773
2005/08/12 @ 18:00:00	32,6037	31,3718	32,8137	31,5721	35,1027	33,7936	35,2154	33,9090
2005/08/12 @ 19:00:00	29,8510	28,9310	30,0560	29,1226	33,7544	32,6966	33,8591	32,7998
2005/08/12 @ 20:00:00	27,2597	26,5701	27,4582	26,7537	32,6305	31,7647	32,7266	31,8567
2005/08/12 @ 21:00:00	25,2271	24,6721	25,4118	24,8431	31,5404	30,8396	31,6300	30,9231
2005/08/12 @ 22:00:00	23,3847	22,9115	23,5572	23,0718	30,6308	30,0783	30,7176	30,1569

Table 34 - Roof temperature for LCZ6 (continued).

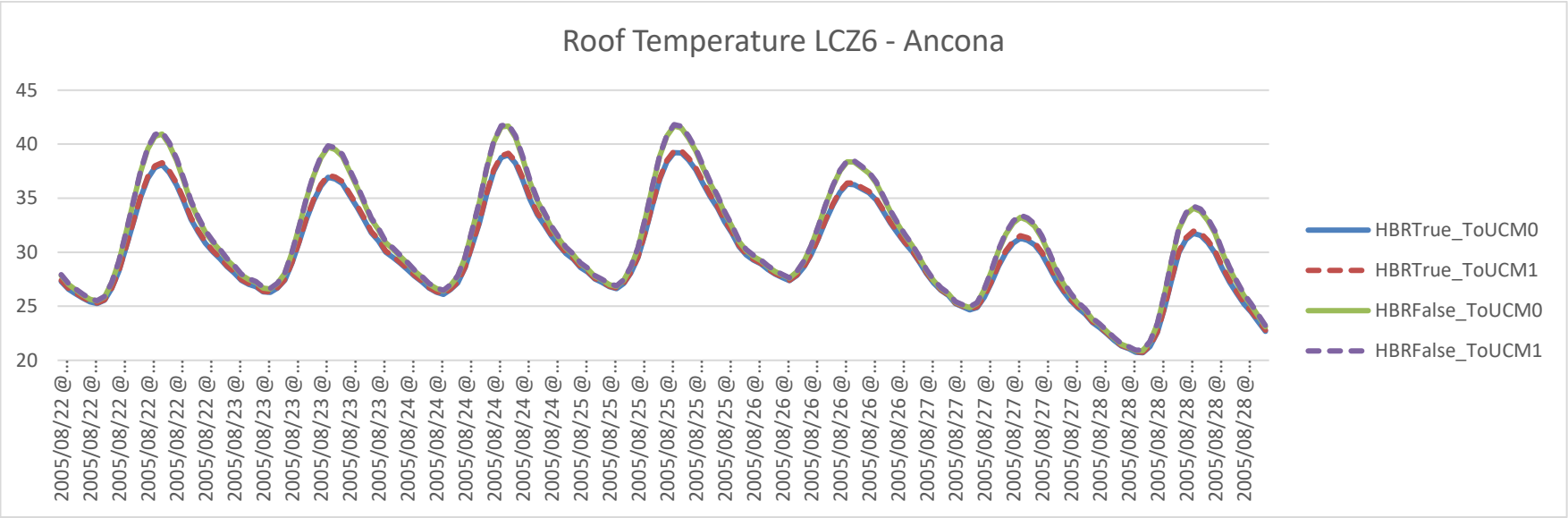
	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True	HBR False	HBR True
2005/08/12 @ 23:00:00	21,6723	21,2730	21,8383	21,4239	29,5088	29,1018	29,5922	29,1758
2005/08/13 @ 00:00:00	20,1710	19,8429	20,3232	19,9840	28,3235	28,0297	28,4027	28,0998
2005/08/13 @ 01:00:00	19,0157	18,7461	19,1538	18,8744	27,3762	27,1596	27,4508	27,2259
2005/08/13 @ 02:00:00	18,1081	17,8835	18,2315	17,9980	26,6377	26,4622	26,7089	26,5259
2005/08/13 @ 03:00:00	17,3494	17,1638	17,4582	17,2647	26,1738	26,0204	26,2411	26,0812
2005/08/13 @ 04:00:00	16,7619	16,6036	16,8573	16,6919	25,3845	25,2513	25,4481	25,3092
2005/08/13 @ 05:00:00	16,5903	16,3980	16,6727	16,4756	25,0826	24,9504	25,1426	25,0057
2005/08/13 @ 06:00:00	17,8654	17,3839	17,9376	17,4593	24,8876	24,6771	24,9460	24,7341
2005/08/13 @ 07:00:00	20,3777	19,4227	20,4453	19,5046	25,2804	24,8796	25,3409	24,9449
2005/08/13 @ 08:00:00	23,8973	22,3206	23,9648	22,4136	26,5460	25,8371	26,6142	25,9180
2005/08/13 @ 09:00:00	27,9440	25,7363	28,0169	25,8451	28,2491	27,1812	28,3336	27,2852
2005/08/13 @ 10:00:00	32,0549	29,3082	32,1395	29,4351	30,1410	28,7102	30,2504	28,8435
2005/08/13 @ 11:00:00	35,9084	32,6742	36,0073	32,8195	31,6561	29,9509	31,7986	30,1181
2005/08/13 @ 12:00:00	38,8443	35,3732	38,9626	35,5377	32,7026	30,8341	32,8774	31,0321
2005/08/13 @ 13:00:00	40,8979	37,3196	41,0328	37,4983	33,2293	31,3003	33,4278	31,5196
2005/08/13 @ 14:00:00	41,5326	38,1168	41,6925	38,3133	32,9658	31,1105	33,1770	31,3383
2005/08/13 @ 15:00:00	41,0835	37,9549	41,2626	38,1622	32,3980	30,6729	32,6087	30,8964
2005/08/13 @ 16:00:00	39,5120	36,8118	39,7074	37,0247	31,3238	29,8230	31,5246	30,0314
2005/08/13 @ 17:00:00	37,2649	35,0265	37,4648	35,2343	29,8041	28,6020	29,9927	28,7917
2005/08/13 @ 18:00:00	34,4032	32,6542	34,6041	32,8537	28,2496	27,3362	28,4229	27,5043
2005/08/13 @ 19:00:00	31,7905	30,4183	31,9830	30,6042	27,0473	26,3649	27,2028	26,5116
2005/08/13 @ 20:00:00	29,5253	28,4325	29,7077	28,6055	26,0562	25,5181	26,1939	25,6461
2005/08/13 @ 21:00:00	27,5450	26,6606	27,7163	26,8213	25,2695	24,8409	25,3914	24,9531
2005/08/13 @ 22:00:00	25,9723	25,2309	26,1293	25,3771	24,6336	24,2768	24,7436	24,3777
2005/08/13 @ 23:00:00	24,4406	23,8275	24,5874	23,9634	23,7868	23,4890	23,8863	23,5798
2005/08/14 @ 00:00:00	23,2141	22,6910	23,3484	22,8154	23,2795	23,0235	23,3685	23,1045
2005/08/14 @ 01:00:00	22,1668	21,7209	22,2886	21,8334	22,6850	22,4656	22,7645	22,5378
2005/08/14 @ 02:00:00	21,2600	20,8789	21,3701	20,9804	22,0394	21,8515	22,1103	21,9157
2005/08/14 @ 03:00:00	20,4925	20,1651	20,5917	20,2563	21,4884	21,3331	21,5519	21,3904
2005/08/14 @ 04:00:00	19,8390	19,5573	19,9277	19,6387	21,2179	21,0893	21,2758	21,1415
2005/08/14 @ 05:00:00	19,5838	19,2847	19,6627	19,3580	20,8772	20,7536	20,9305	20,8022
2005/08/14 @ 06:00:00	20,7662	20,1875	20,8369	20,2602	20,9055	20,6965	20,9545	20,7439
2005/08/14 @ 07:00:00	23,1317	22,0744	23,1999	22,1552	21,6972	21,2775	21,7437	21,3277
2005/08/14 @ 08:00:00	26,4218	24,7722	26,4931	24,8673	23,3793	22,6029	23,4252	22,6600
2005/08/14 @ 09:00:00	30,2623	27,9898	30,3423	28,1037	26,1169	24,8483	26,1654	24,9176
2005/08/14 @ 10:00:00	34,1883	31,3554	34,2814	31,4894	29,2416	27,4633	29,2995	27,5500
2005/08/14 @ 11:00:00	37,7785	34,4973	37,8888	34,6520	32,1573	29,9635	32,2390	30,0792
2005/08/14 @ 12:00:00	40,7007	37,1230	40,8293	37,2963	33,5141	31,1779	33,6446	31,3415
2005/08/14 @ 13:00:00	42,6777	38,9783	42,8249	39,1671	34,0888	31,7515	34,2614	31,9528
2005/08/14 @ 14:00:00	43,5394	39,8980	43,7041	40,0980	33,7970	31,5489	33,9907	31,7659

Table 34 - Roof temperature for LCZ6 (continued).

	Lisbon				Ancona			
	To_UCM0		To_UCM1		To_UCM0		To_UCM1	
2005	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**	**HBR False**	**HBR True**
2005/08/14 @ 15:00:00	43,2827	39,8666	43,4617	40,0722	32,9464	30,8848	33,1441	31,1001
2005/08/14 @ 16:00:00	42,0535	39,0039	42,2404	39,2073	31,7633	29,9515	31,9538	30,1541
2005/08/14 @ 17:00:00	40,1210	37,5259	40,3073	37,7183	30,0311	28,5437	30,2132	28,7313
2005/08/14 @ 18:00:00	37,7901	35,6716	37,9689	35,8477	28,4527	27,2450	28,6205	27,4138
2005/08/14 @ 19:00:00	35,5966	33,8799	35,7635	34,0381	27,1776	26,2122	27,3312	26,3633
2005/08/14 @ 20:00:00	33,7811	32,3629	33,9339	32,5042	25,9993	25,2194	26,1395	25,3551
2005/08/14 @ 21:00:00	32,2331	31,0409	32,3718	31,1670	25,1118	24,4763	25,2402	24,5989
2005/08/14 @ 22:00:00	30,9030	29,8745	31,0313	29,9891	24,1108	23,5892	24,2295	23,7014
2005/08/14 @ 23:00:00	29,7116	28,8142	29,8291	28,9180	23,1039	22,6733	23,2130	22,7754



Graphic 25 - Roof temperature result for LCZ6 – Lisbon.



Graphic 26 - Roof temperature result for LCZ6 – Ancona.

The results expected from the simulation were that if the roof ventilation is higher, the surface temperature is lower, and that is expressed in the graphics as it can be seen that in the simulations that we used the HBR roof the temperature is lower than the simulations that we used the conventional roof, and it happens as expected for the different LCZ.

Analyzing the graphics and the tables in detail, the simulations were made for a period of seven days and on each day there is an increase in temperature that reaches the peak, i.e. the maximum temperature for the roof, around 13pm and 14pm (the red values highlighted on the tables correspond to the maximum peak of each day in the city of Lisbon and the yellow values correspond to the maximum peak in the city of Ancona). After this peak, a decrease in temperature occurs, reaching the lowest values for roof temperature between 4am and 6am (the green values correspond to the minimum peak of each day for the city of Lisbon and the purple values correspond to the minimum peak for the city of Ancona). The results for the canopy layer are also highlighted, but the peak for maximum temperature is between 12pm and 18pm and the peak for the minimum temperature is between 2am and 7am.

The tables show the results obtained after each simulation, with the first column corresponding to the time at which they were simulated; the next four columns correspond to the simulation results for the city of Lisbon, being the first for To_UCM 0 and HBR False, the second for To_UCM 0 and HBR True, the third for To_UCM 1 and HBR False and finally the fourth for To_UCM 1 and HBR True; the last four columns are the results for the city of Ancona, being the distribution of the results by the columns arranged in the same way as the city of Lisbon. The simulations were also made for different LCZ's, where tables 25 and 30 correspond to the results for LCZ 2, tables 26 and 31 for LCZ 3, tables 27 and 32 for LCZ 4, tables 28 and 33 for LCZ 5 and finally, tables 29 and 34 for LCZ6.

The results obtained through these simulations come into agreement with the problem at hand, UHI, since one of the ways of mitigation would be to reduce the temperature of roofs, as explained in point 2.2.3. And since this phenomenon is more significant in the summer period, it was confirmed during this period that the use of this type of roof present lower temperature values. When compared with the standard roofs, we have an extremely positive result, becoming a starting point for the study, which is still ongoing, of this new type of roof, HBR.

5. Conclusion

5.1 Work Developed

This report is a result of an internship developed within the LIFE SUPERHERO research project, in Università Politecnica delle Marche, that aims for the use of Ventilated and Permeable Roof and HEROTILE based Roof as solutions to combat the main problem of climate change, the Urban Heat Island (UHI). The project is still on going, as it is expected to finish by 2025, and this report only represents a small part of the work that is going on.

The internship was organized into steps: in the first one there was research and literature review on urban climate models for the investigation of mitigation strategies, roofing technologies as urban climate mitigation techniques, UWG software and building physics for ventilated roofs; the second step was the use of the SENSAPIRO software in terms of simulations, with definition of roof features, climate files and comparisons of HBR and Not Ventilated Roof with the same thermal transmittance and optical properties in terms of entering heat flux; for the third step was the use of the UWG software, first on understanding how it works in terms of code for running the simulations with the different features, as the use of HBR roof and the release of the heating into the layers; the final step was assembly all the work and research done and put it into this present report.

5.2 Main Conclusions

The previous project LIFE HEROTILE achieved a significant improvement of brick tyles, but the potential of the VPR and HBR for climate adaptation and mitigation, as said before, is still limited. This project LIFE SUPERHERO intends to overcome this barrier, demonstrating that a ventilated roof built with innovative brick tiles, the HEROTILES, is an alternative and effective roofing technology, both for limiting the energy demand for cooling and to reduce the Urban Heat Island phenomenon. The science-based tools developed during the project, explained on chapter 3, will allow to choose alternative ways of reducing the external surface of a building, based on ventilation and permeability of the building envelope. The innovation of the project is to consider the roof itself as a unique system and not to delegate performance only to optical and thermal properties of the roof covering. This will ensure sufficient market penetration and effective environmental impact of the increasingly widespread installation of roofing systems, thanks to the installation of passive cooling technologies in buildings (Bonvicini et al., n.d.).

The results obtained throughout this internship were quite positive and expected, in terms of simulation results. In chapter 4, more specifically in the graphs obtained through the simulations, it can be seen that the estimated values for the roof temperature are in fact lower with the use of HBR and higher with the standard roof. These graphics demonstrate the variation of the temperature over the days and we can verify that both roofs reach the maximum peak within the same period and the same happens with the minimum peak, with the HBR presenting a lower value, although sometimes the difference is not very accentuated. This represents a starting point for the ongoing work that is being developed, since there is a very wide range of simulations that can still be done.

As the internship occurred during covid period, the fieldwork and testing was delayed, and it was not possible to participate in this step. Most of it took place online which was a barrier on the work developed. Nevertheless, it was an extremely positive experience and it's always positive to learn and enjoy professional growth with other mentalities and different nationalities.

5.3 Future Works

This project introduced different software's, such as SENSAPIRO, DesignBuilder and Urban Weather Generator, and provided a lot of knowledge in terms of simulations of Ventilated and Permeable Roofs and HEROTILE roofs and their impact on Urban Heat Island.

For future work and literature, there is different configuration in terms of roofs that can be simulated in UWG such as green roofs, cool roofs or flat roofs with other characteristics that can be compared with HBR to get more data. It is also possible to expand the study of this type of roof in other European cities, thus providing more information for analysis and comparison. And as for the LCZ, these simulations only show from LCZ2 to LCZ6, there are many more LCZ's that can be used for simulations.

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