Impact des changements climatiques dans les villes: Contraste entre stress thermique urbain et rural

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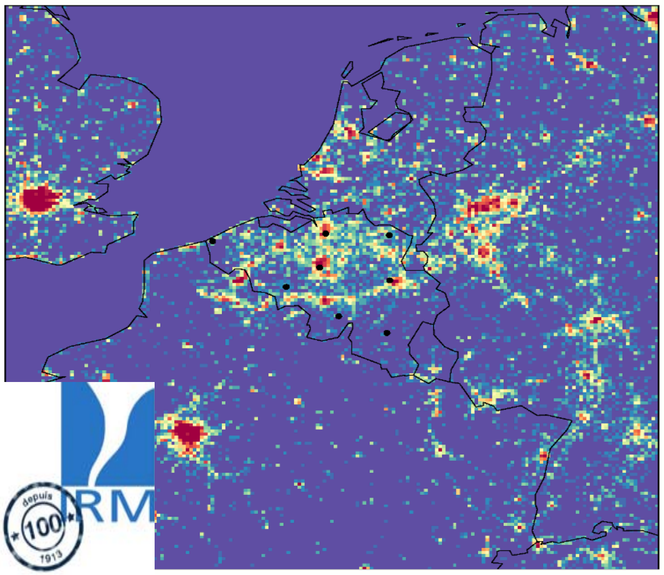
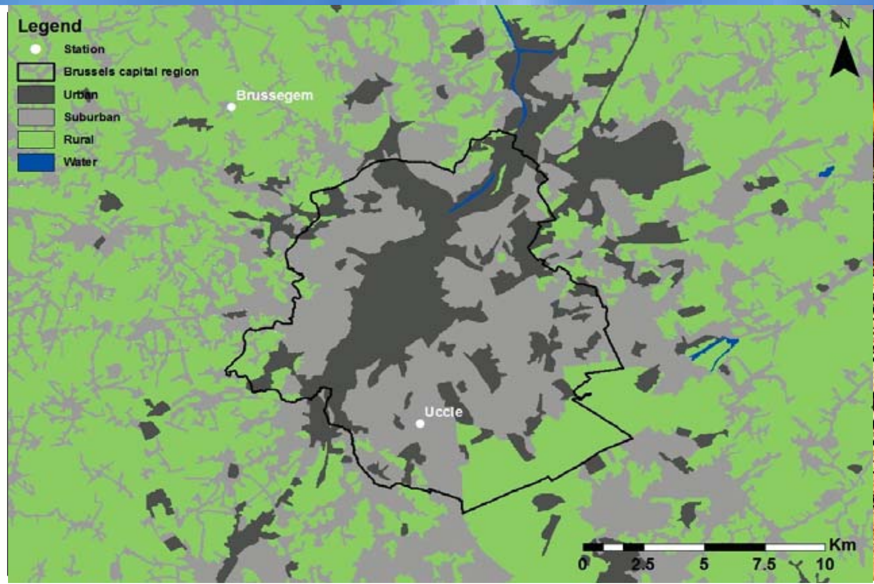
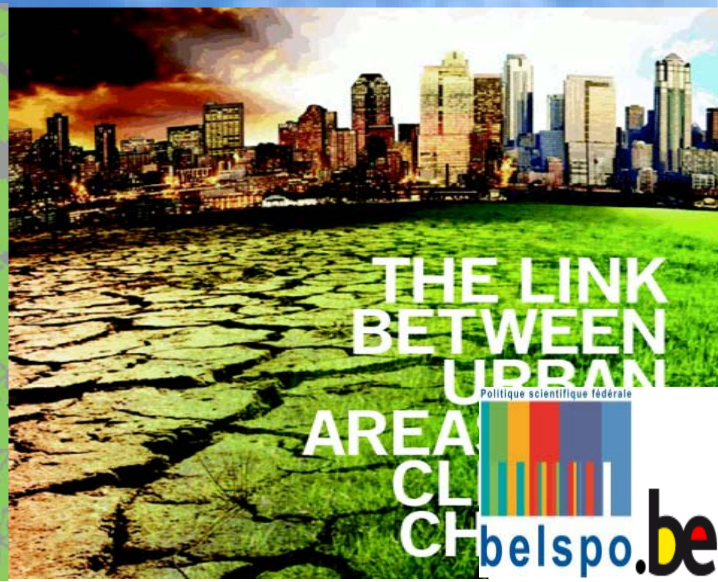
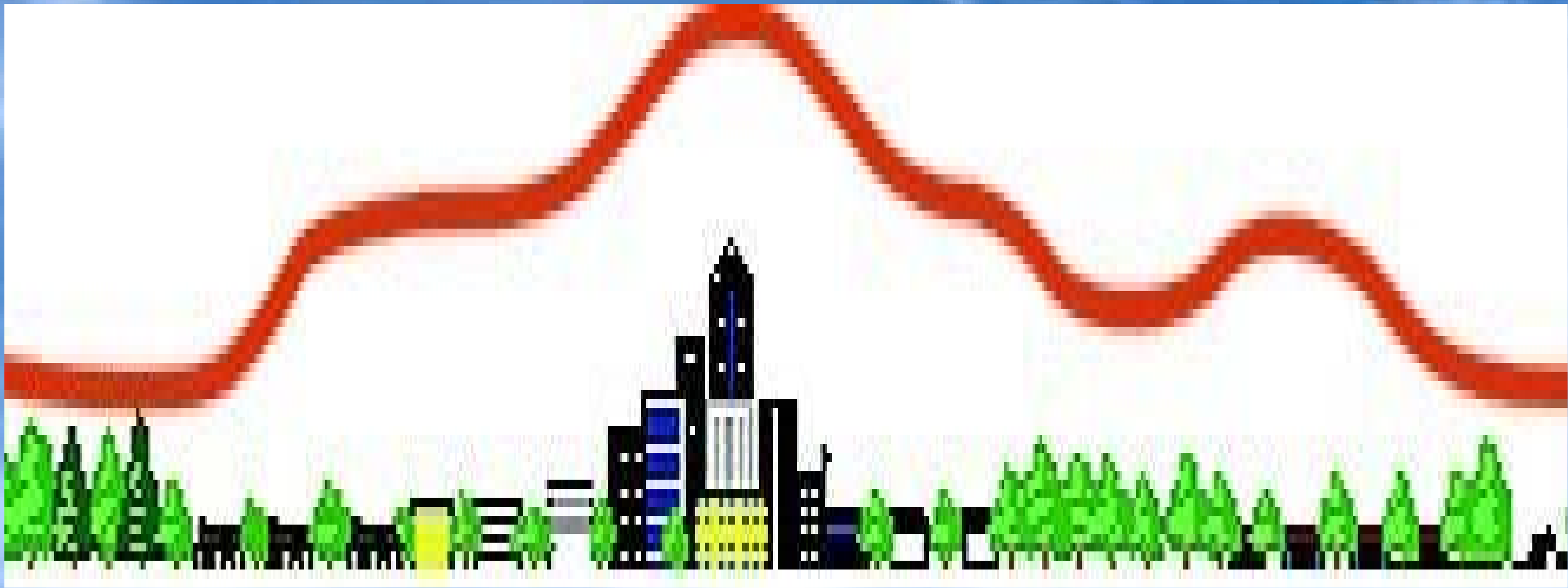




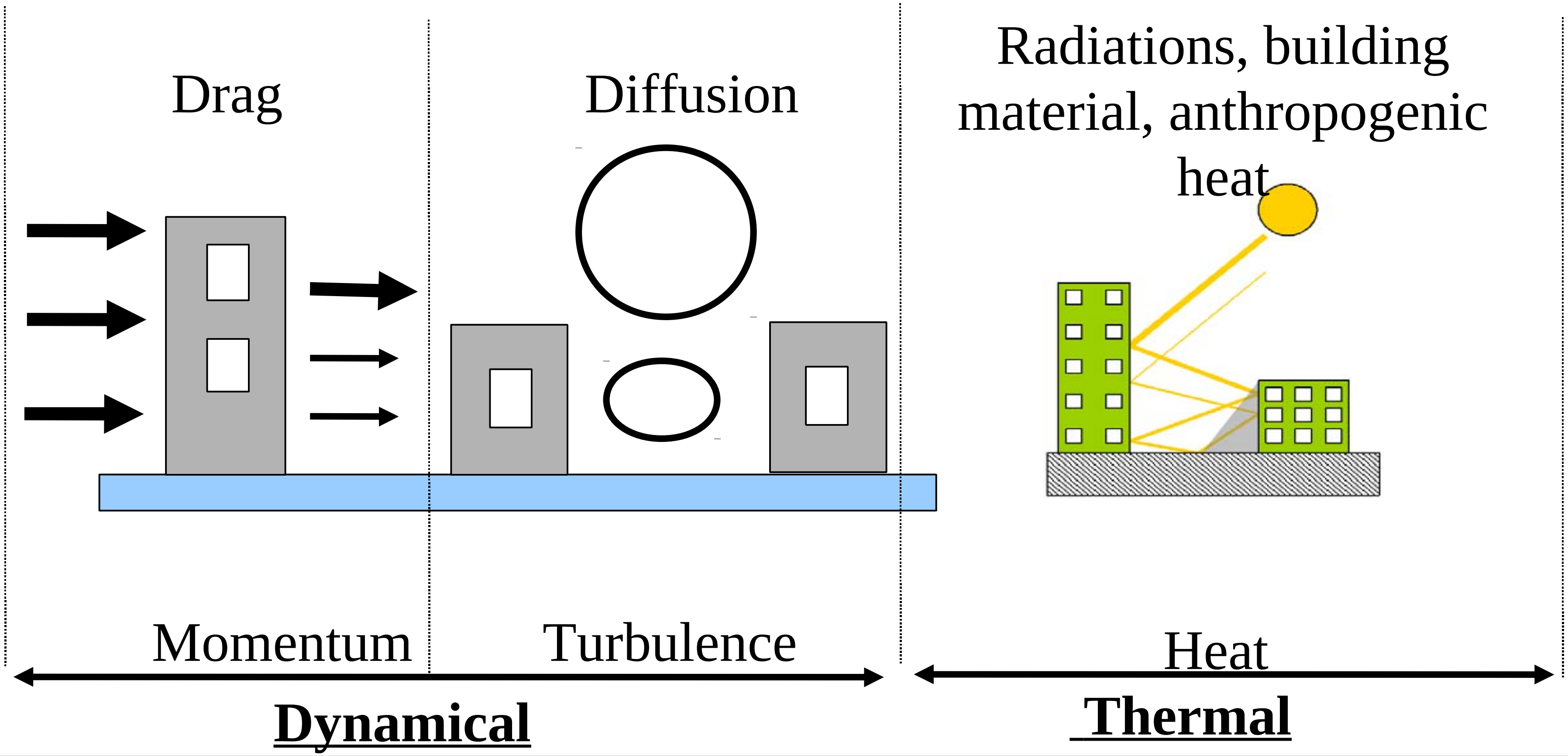


Il est bien connu que les températures sont généralement plus élevées durant la nuit en ville que dans les sites environnants plus ruraux.

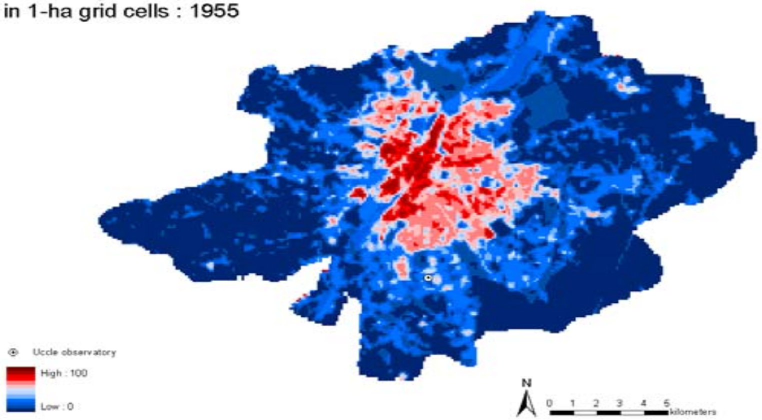
C’est ce qu’on appelle l’îlot de chaleur urbain (ou effet urbain).



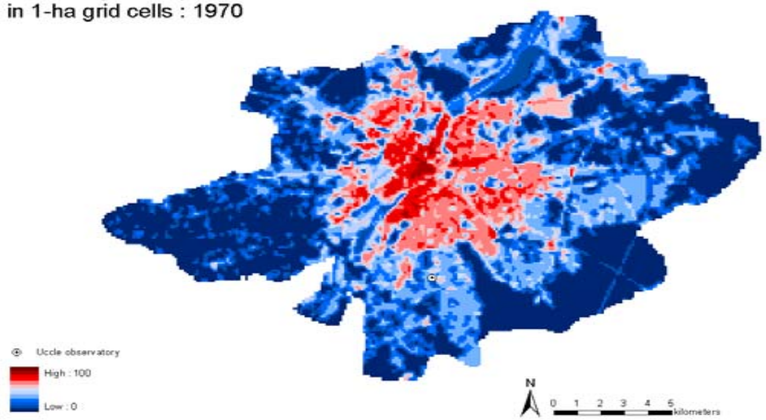
The most common approach is to use NWP models (with a horizontal scale larger than the city) at high resolution and parameterize the impact of the city on wind, turbulence, and heat fluxes.



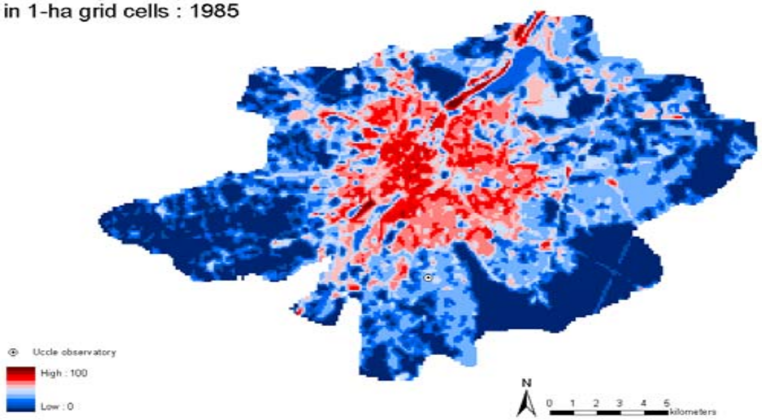
Percentage of impervious surfaces
in 1-ha grid cells : 1955



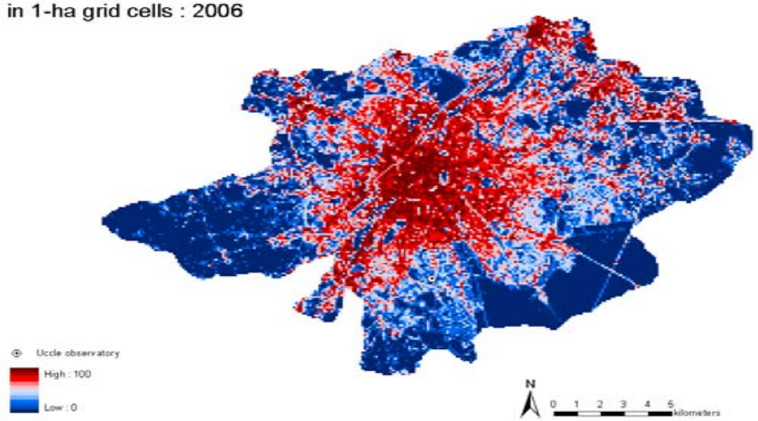
Percentage of impervious surfaces
in 1-ha grid cells : 1970

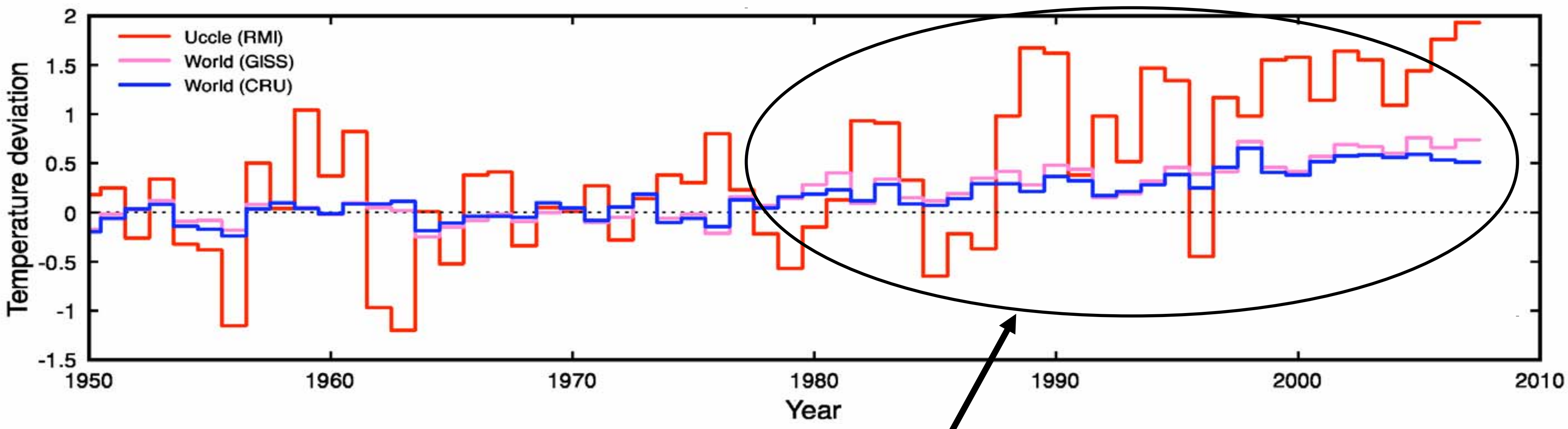


Percentage of impervious surfaces
in 1-ha grid cells : 1985



Percentage of impervious surfaces
in 1-ha grid cells : 2006



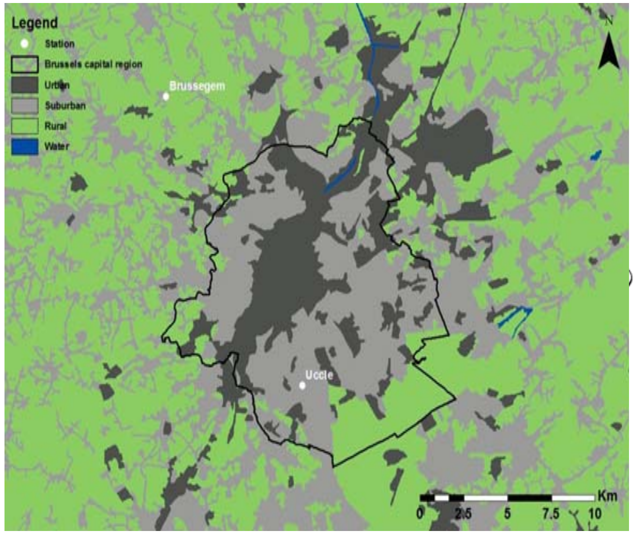


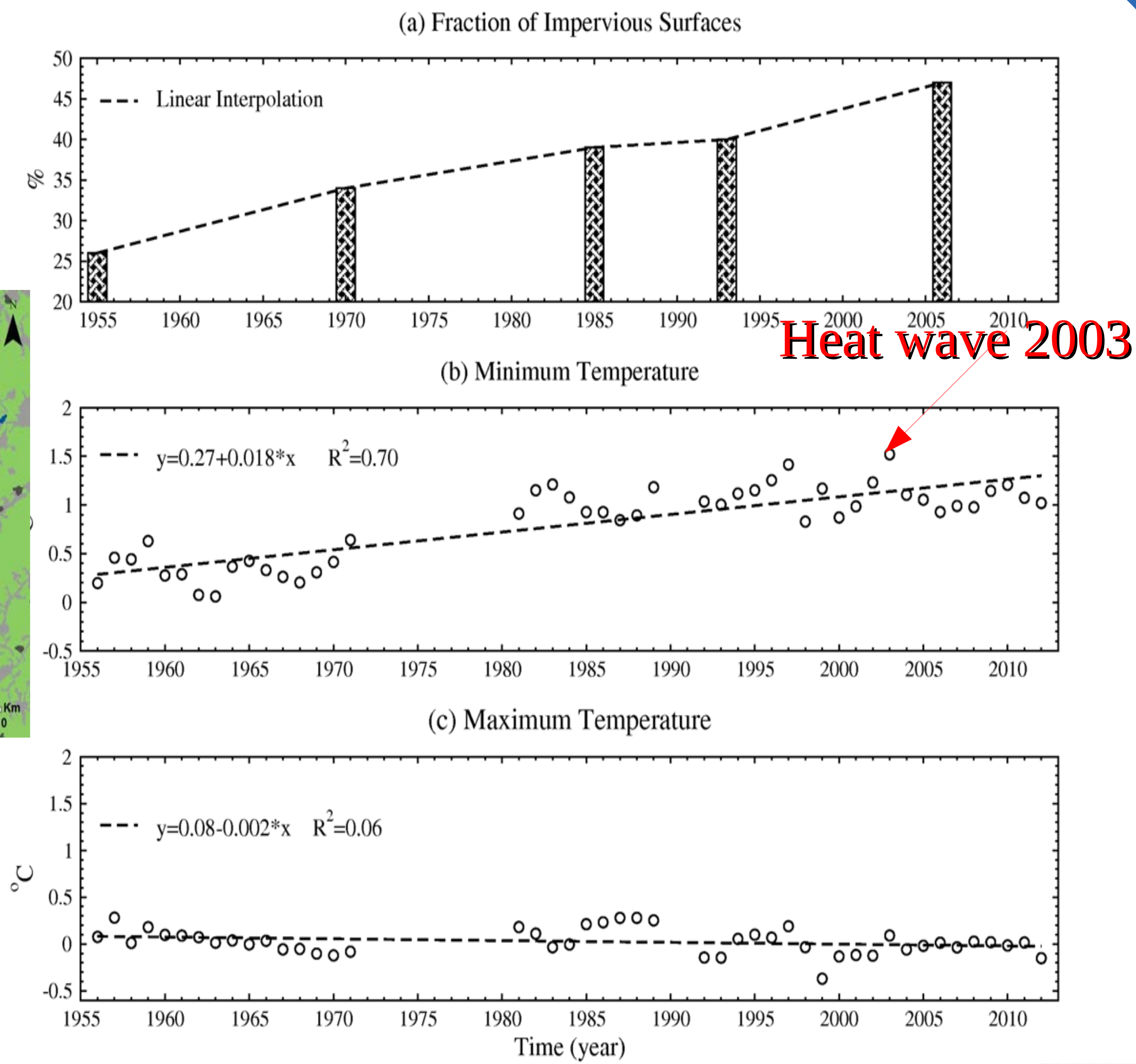
Deviation from 1951-1980 period

The aim is to quantify which part of this warm bias with respect to the global trend can be explained by urbanization of the city of Brussels.

HISTORICAL URBANIZATION

Brussels's uhi effect on Tmin and Tmax





We now estimate that the 57-years urban warming trend on mean temperature $T_{MEAN}=(T_{MIN}+T_{MAX})/2$ at Uccle is 0.62 °C which correspond to 38% of the warming trend of 1.63 °C in the Uccle series between 1956 and 2012.

Today, scientists, urban planners and policy makers are beginning to work together to understand and monitor the interaction between urban areas and climate change and to consider adaptation and mitigation strategies.

To maintain or improve the quality of living in cities, urban planners need detailed information on future urban climate on residential scale.

However, because impervious surfaces cover only less than one percent of the world's land area, most of the global circulation models that are utilized for climate change research do not account for urban surfaces IPCC AR4/AR5.

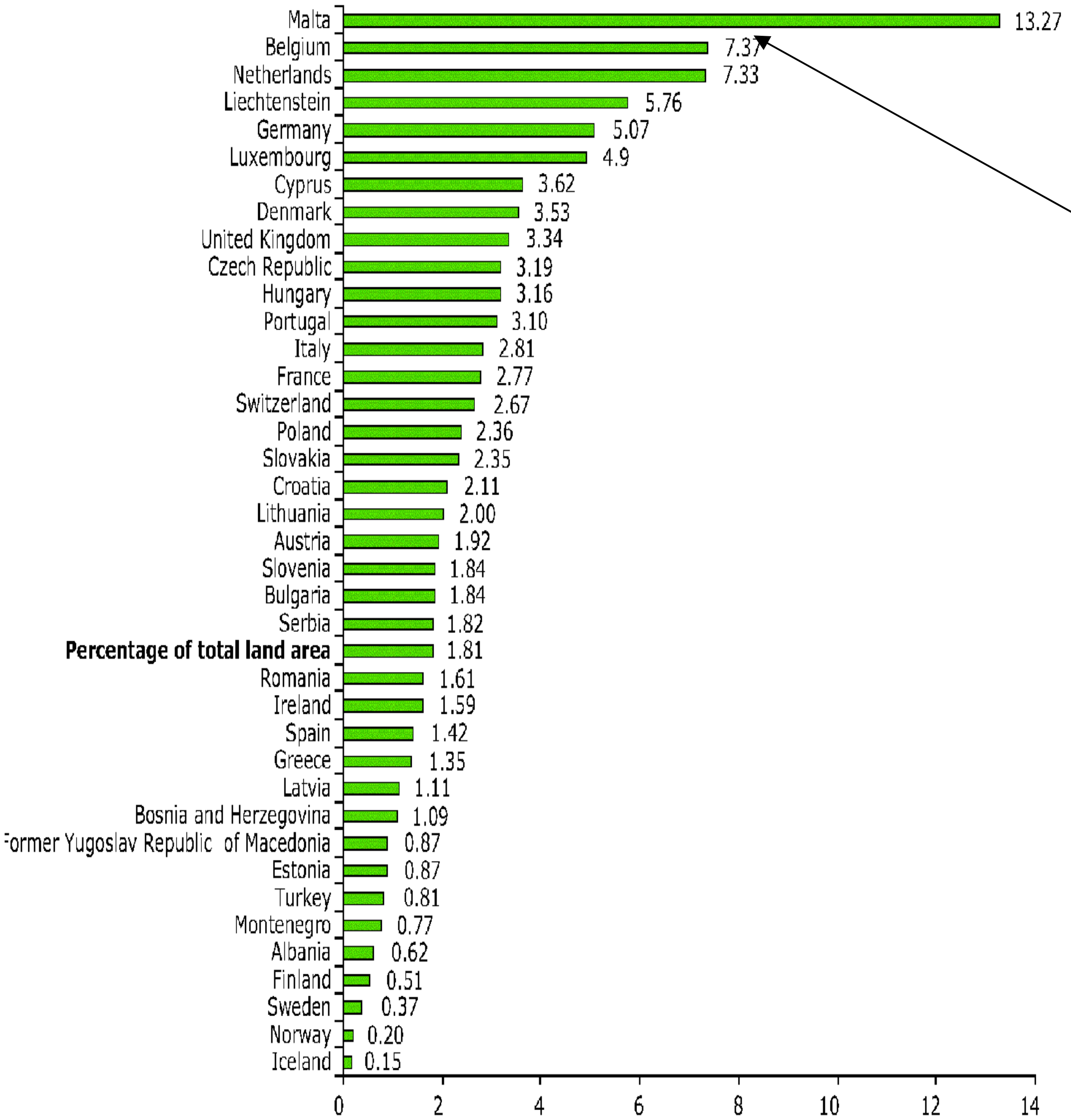
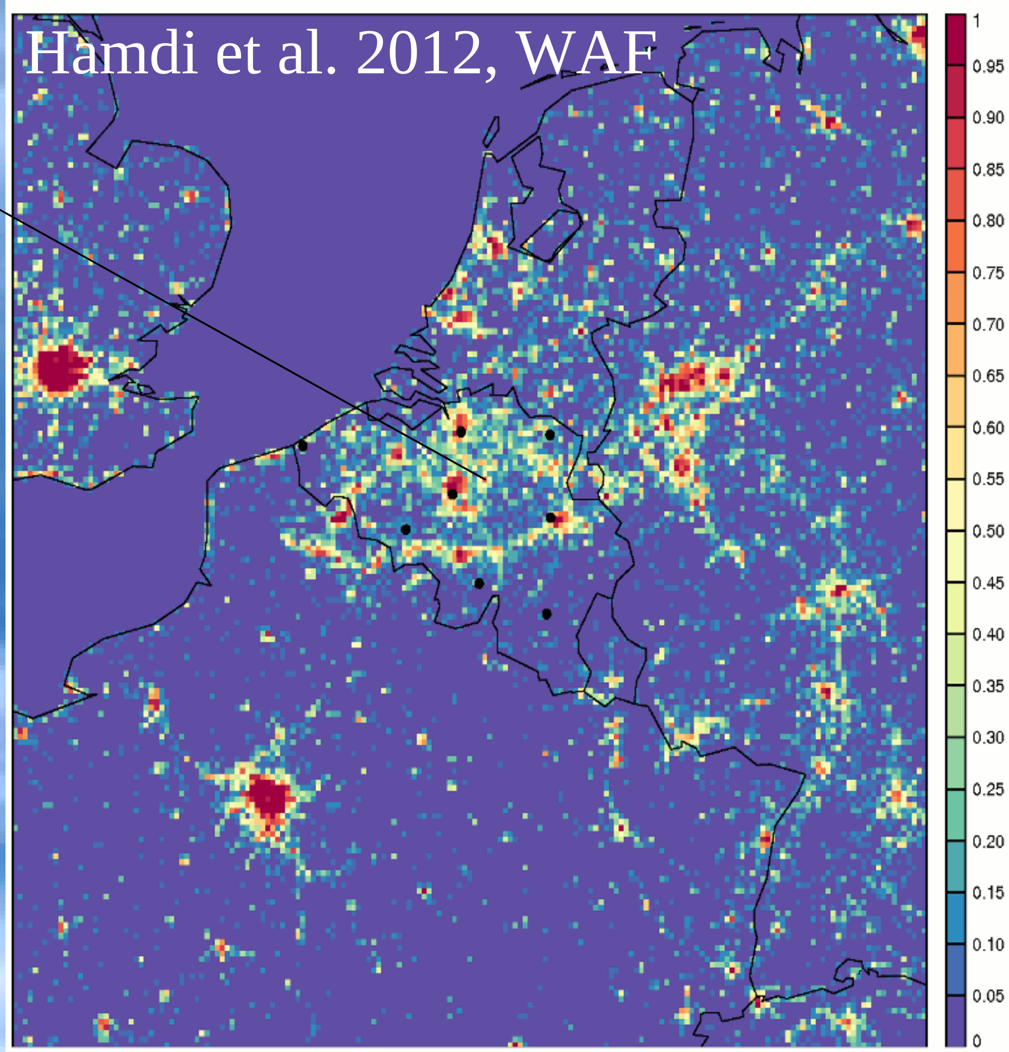
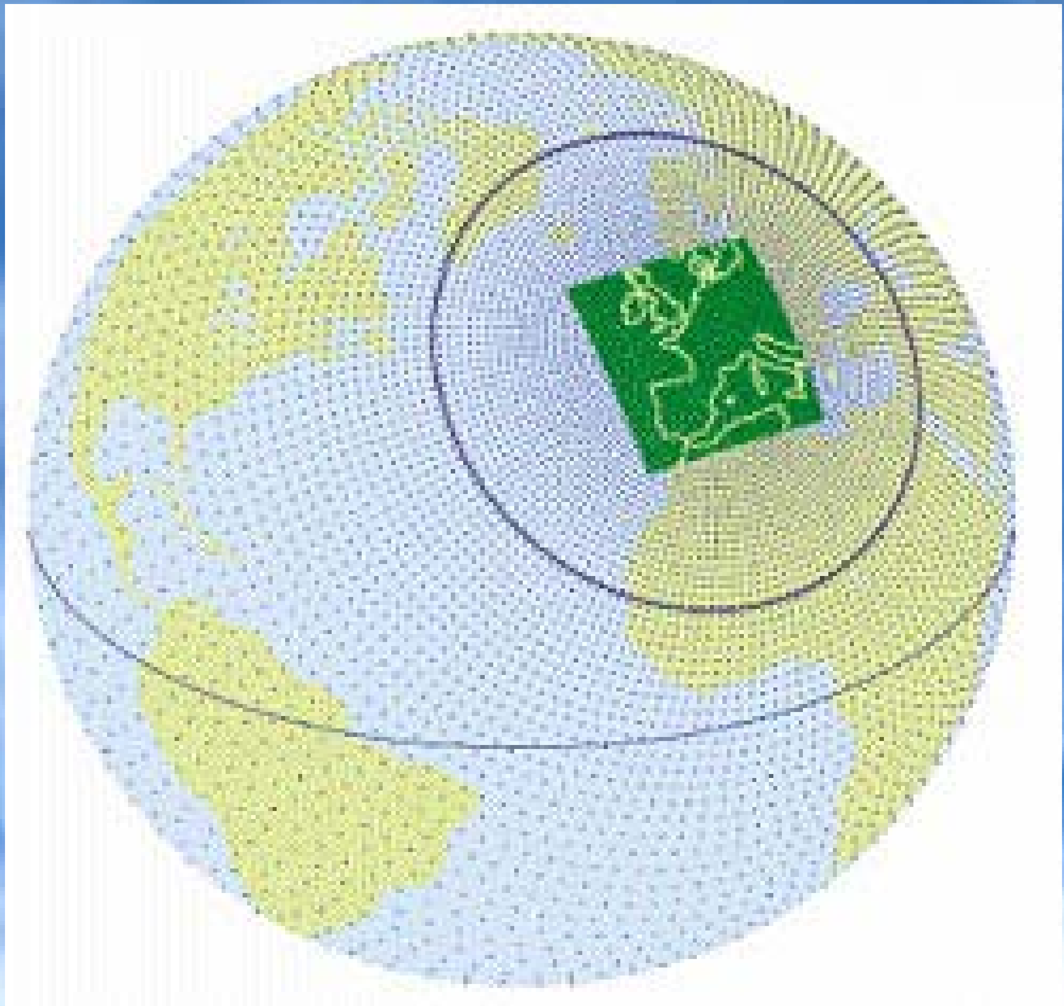


Figure 3. Degree of soil sealing as a percentage of total land area, in European countries (European Environment Agency 2006[3])

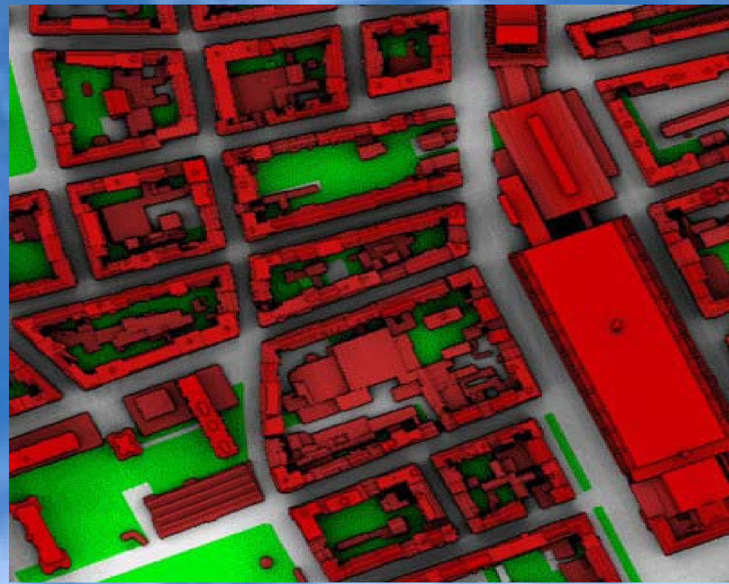


~ 200 km

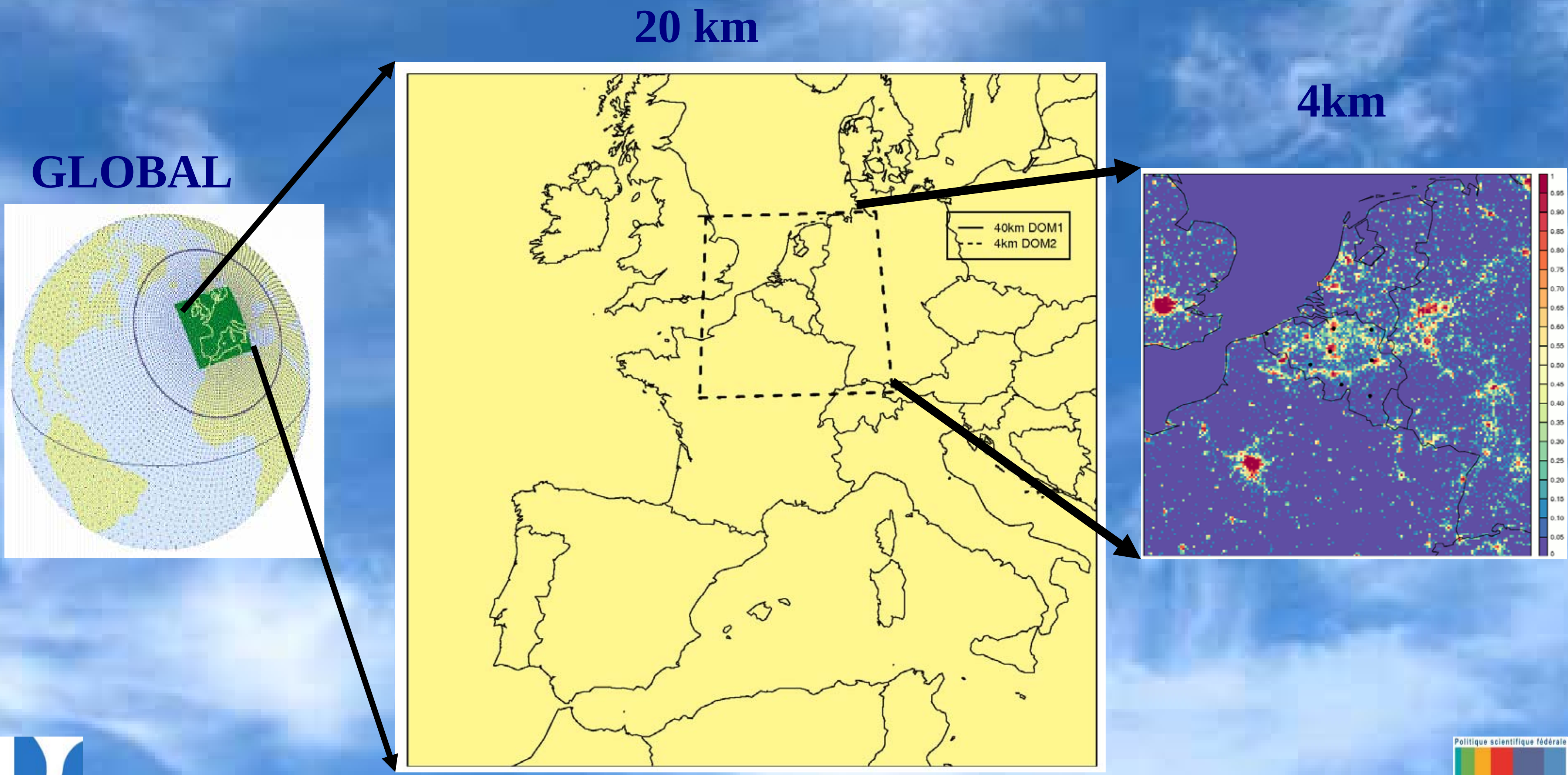


?

< 1 km

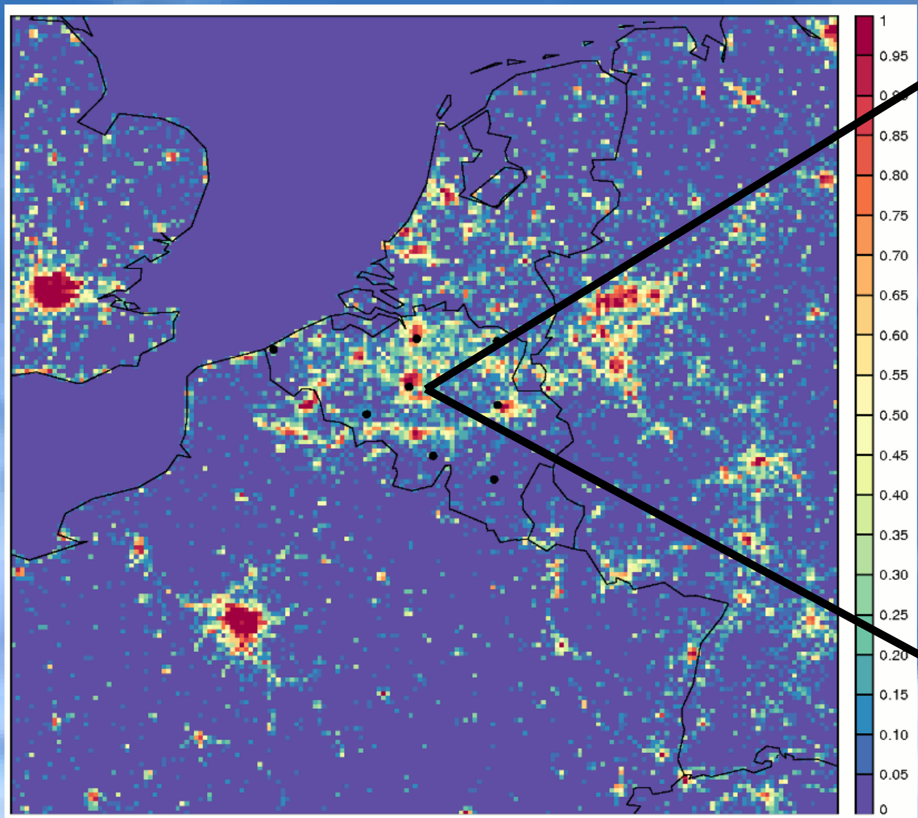


Regional climate simulations using ALARO+SURFEX+TEB

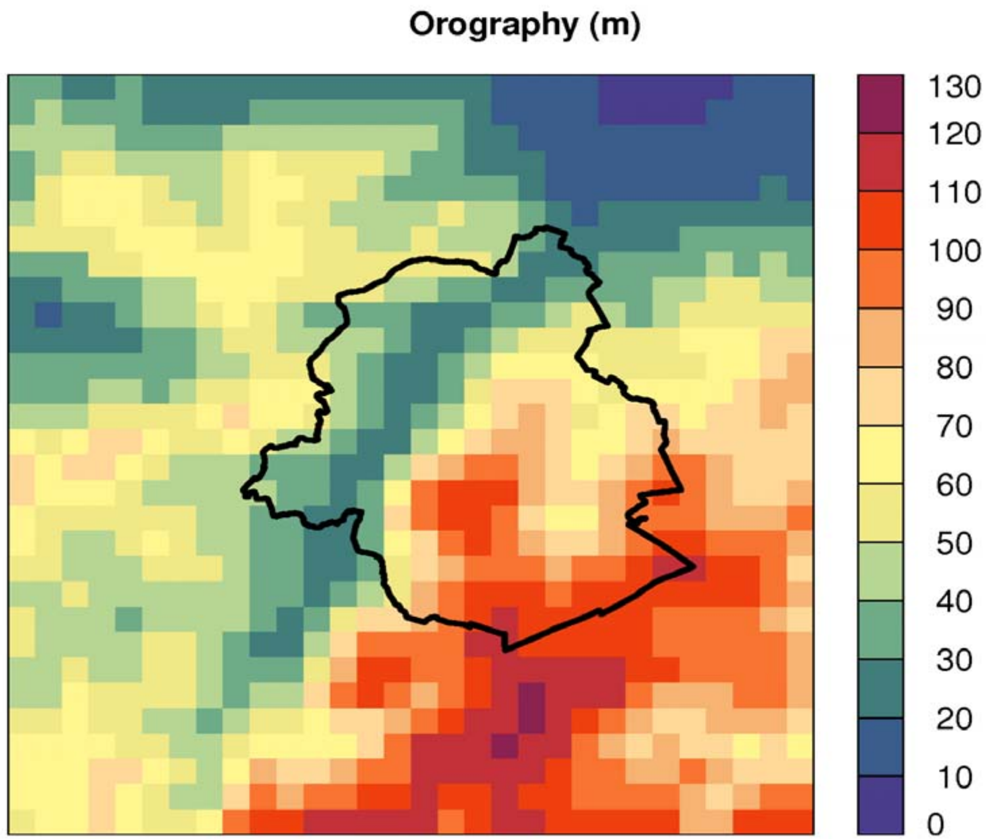


Urban climate simulations using SURFEX+TEB+SBL

ALARO+SURFEX INLINE 4km

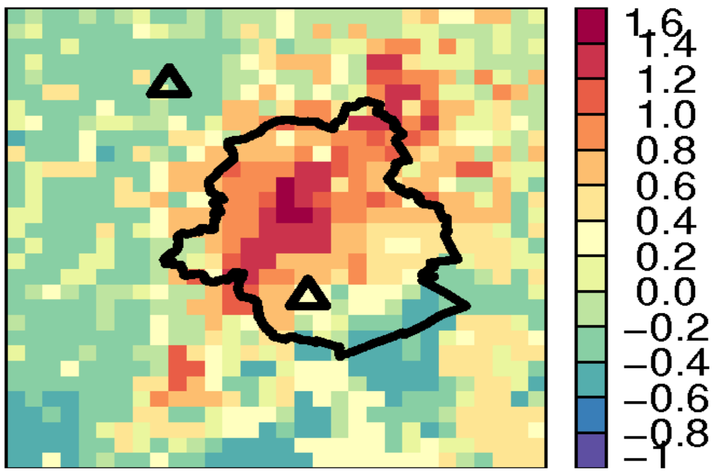


SURFEX OFFLINE 1 km, Brussels, 30x30

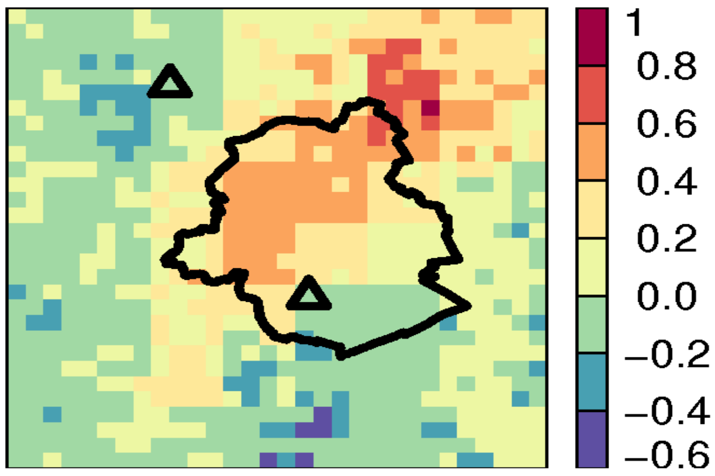


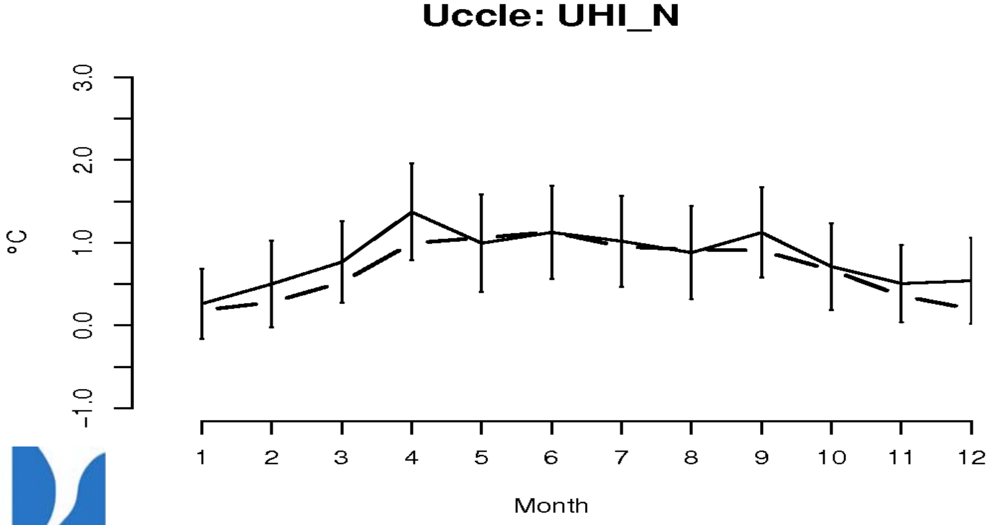
2001-2010

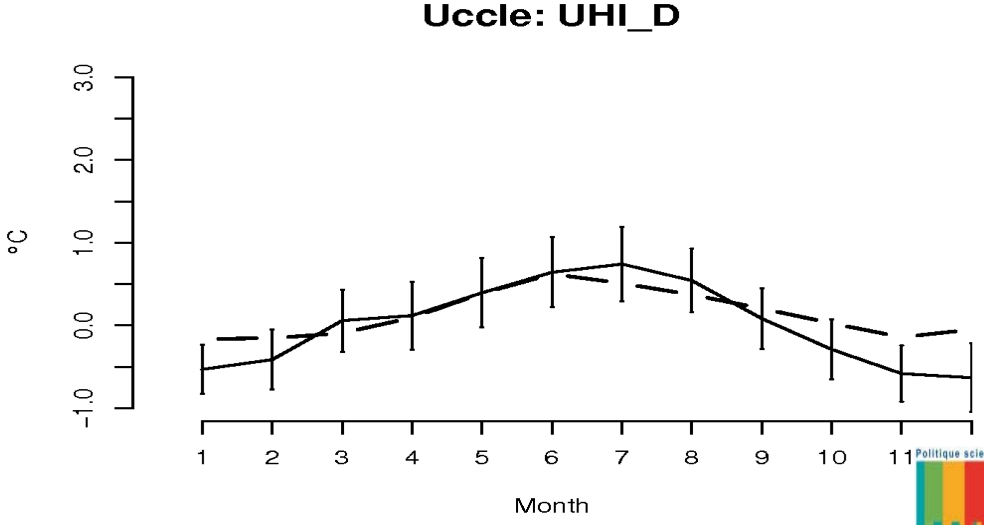
UHI_N, Center = 1.37 °C



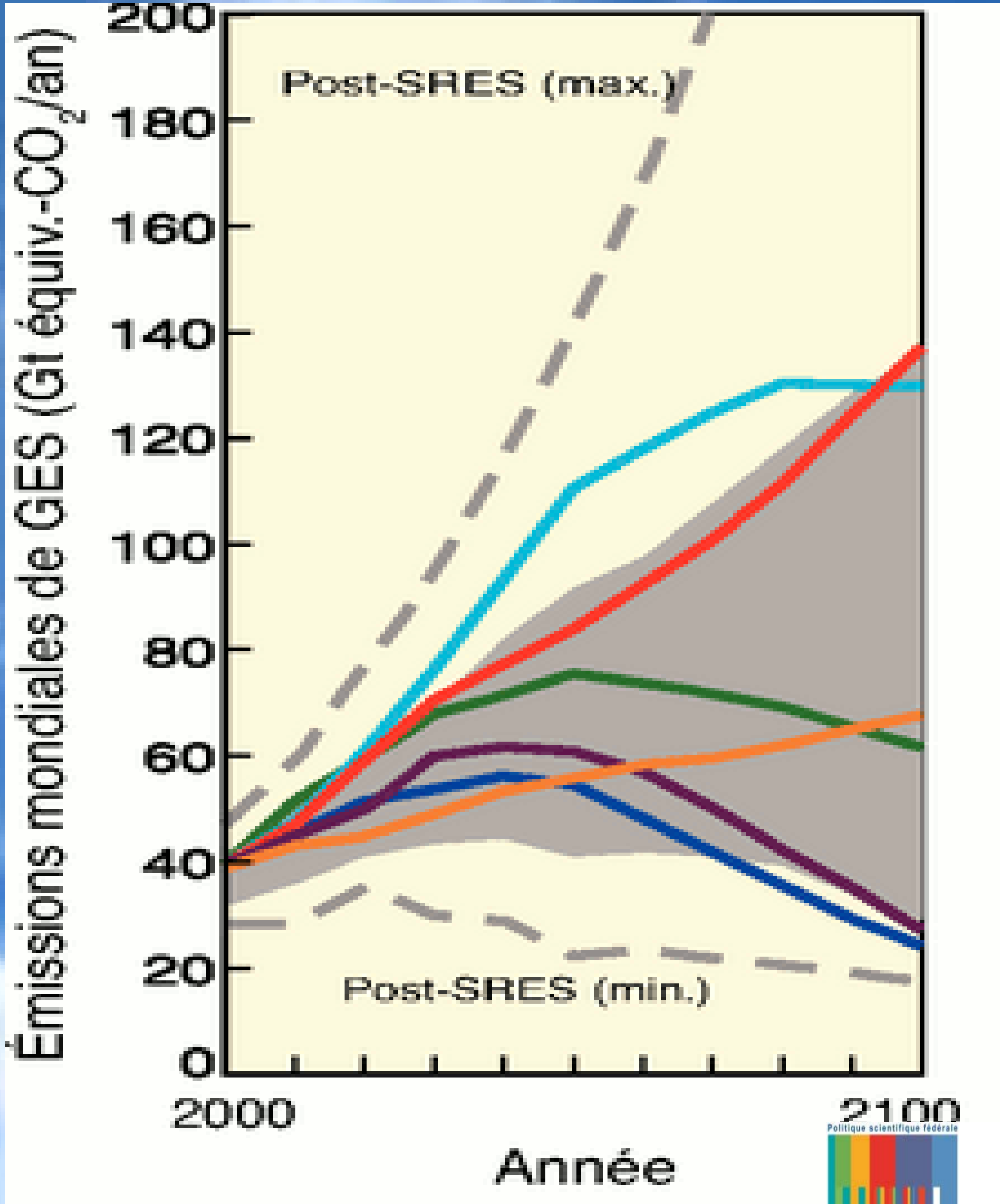
UHI_D, Center = 0.47 °C







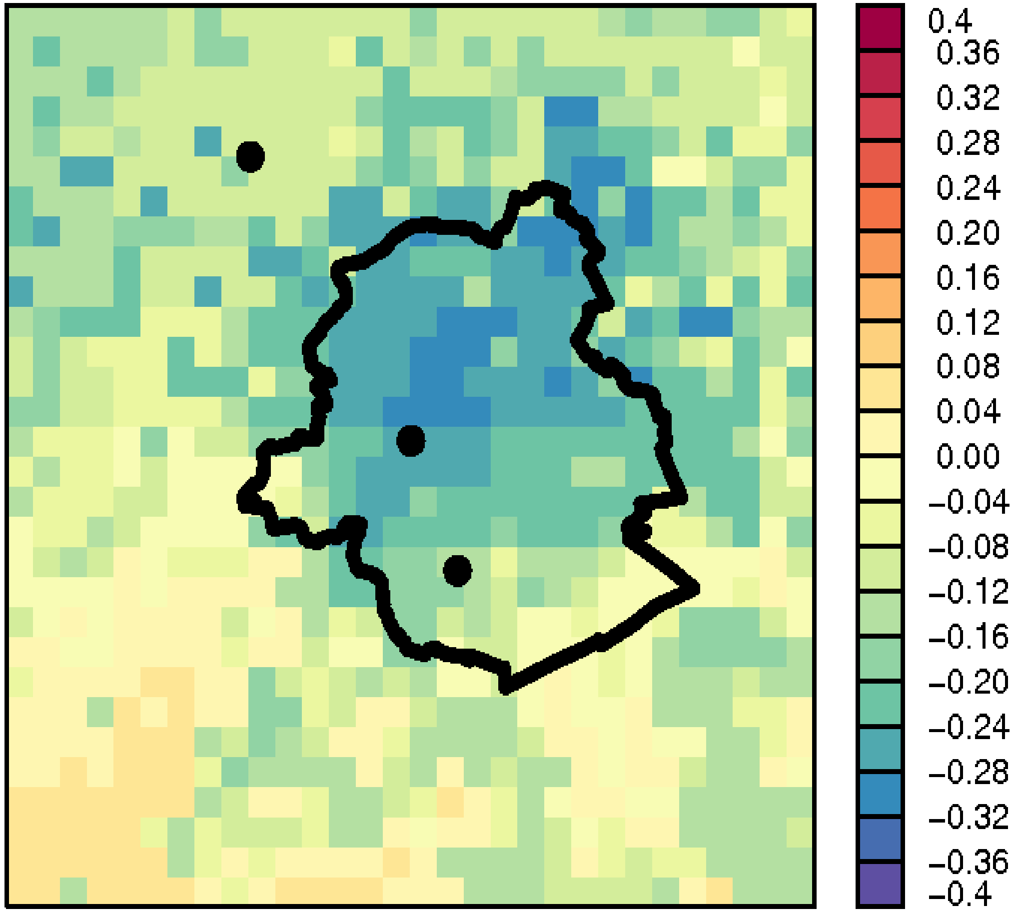
Par exemple, la famille de scénario A1 fait l’hypothèse d’un monde caractérisé par une croissance économique très rapide, un pic de la population mondiale au milieu du siècle et l’adoption rapide de nouvelles technologies plus efficaces. Cette famille de scénarios se répartit en trois groupes qui correspondent à différentes orientations de l’évolution technologique du point de vue des sources d’énergie : à forte composante fossile (A1FI), non fossile (A1T) et équilibrant les sources (A1B).



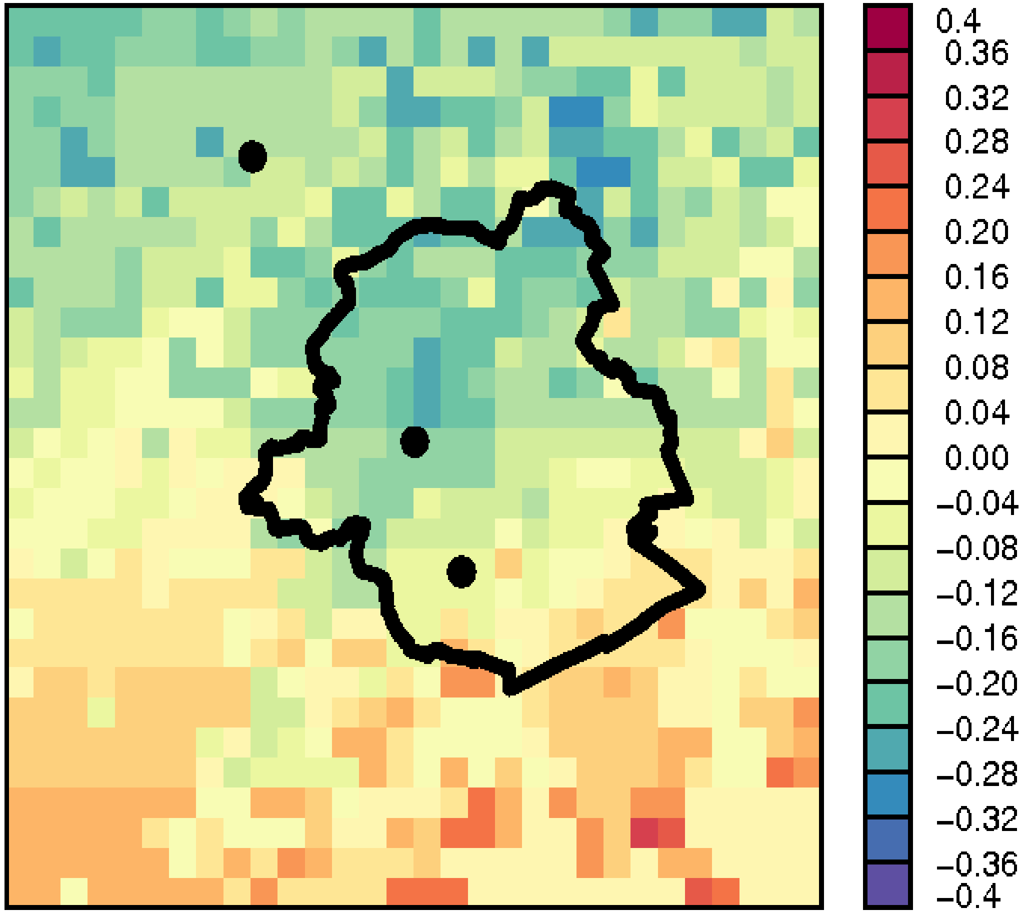
		T_MIN			T_MAX		
		1961-1990	2071-2100	Δ	1961-1990	2071-2100	Δ
Reference	City center	14.08	16.26	2.18	23.62	26.41	2.79
	Suburban (Uccle)	13.76	15.98	2.22	23.32	26.21	2.89
	Rural (Brussegem)	13.01	15.19	2.18	23.83	26.60	2.77
Offline	City center	14.36	16.21	1.85	23.62	26.30	2.68
	Suburban (Uccle)	13.94	15.90	1.96	23.40	26.19	2.79
	Rural (Brussegem)	13.01	15.19	2.18	23.83	26.60	2.77
Inline	City center	15.21	17.21	2.00	24.63	27.27	2.64
	Suburban (Uccle)	14.65	16.71	2.06	24.59	27.32	2.73
	Rural (Brussegem)	13.32	15.48	2.16	24.18	26.89	2.71

2071-2100 minus 1961-1990

Night time

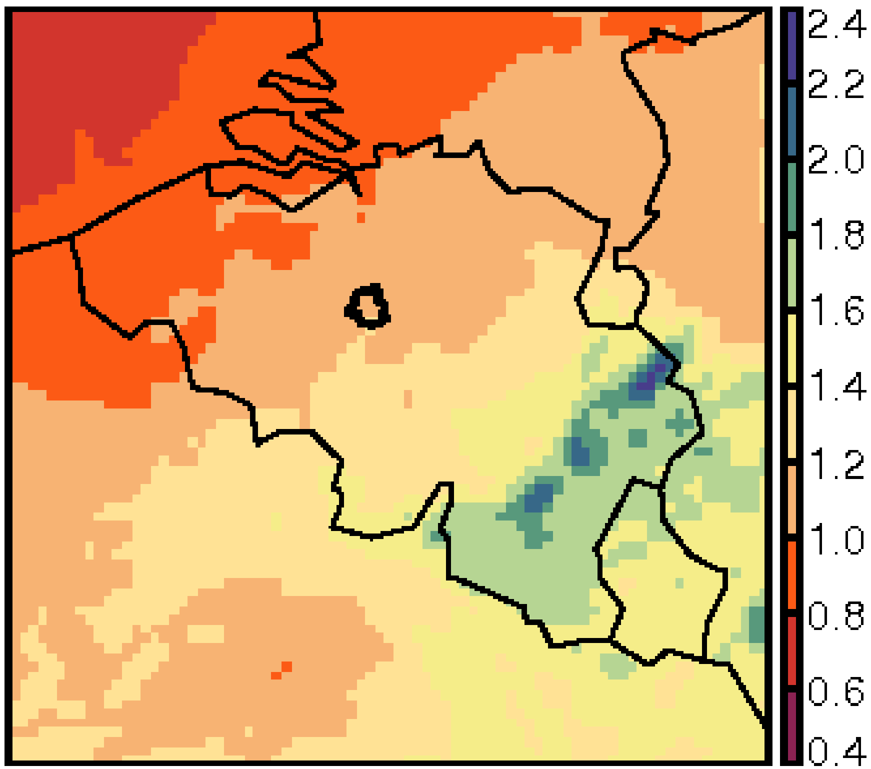


Day time



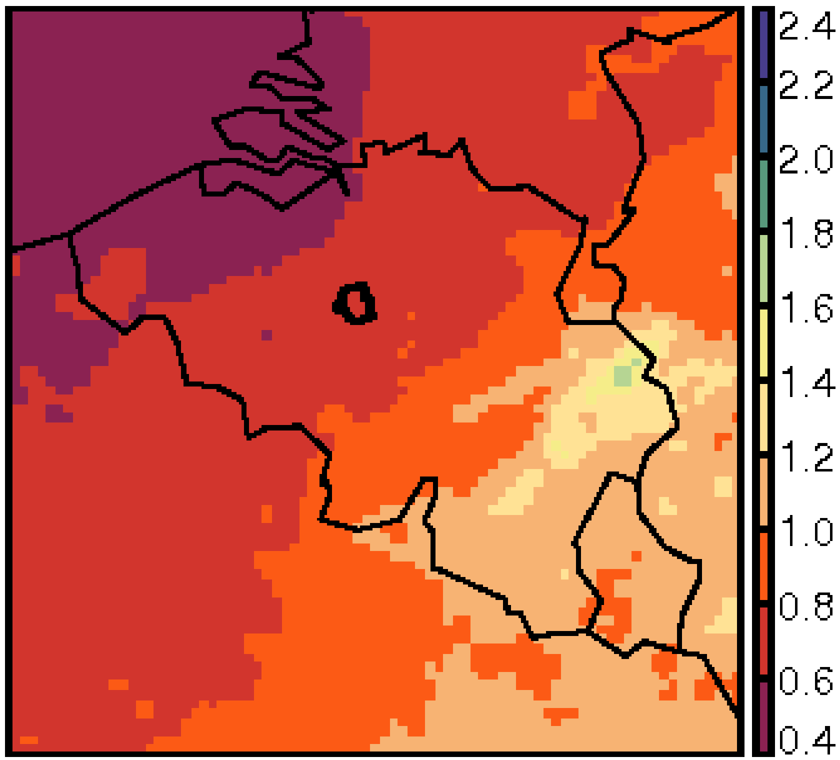
PC without TEB [mm/day]

1961-1990



A1B without TEB [mm/day]

2071-2100



A heat wave is defined as a continuous period of at least 5 days during which:

(1) T_MAX is higher than T_1 in at least 3 days,

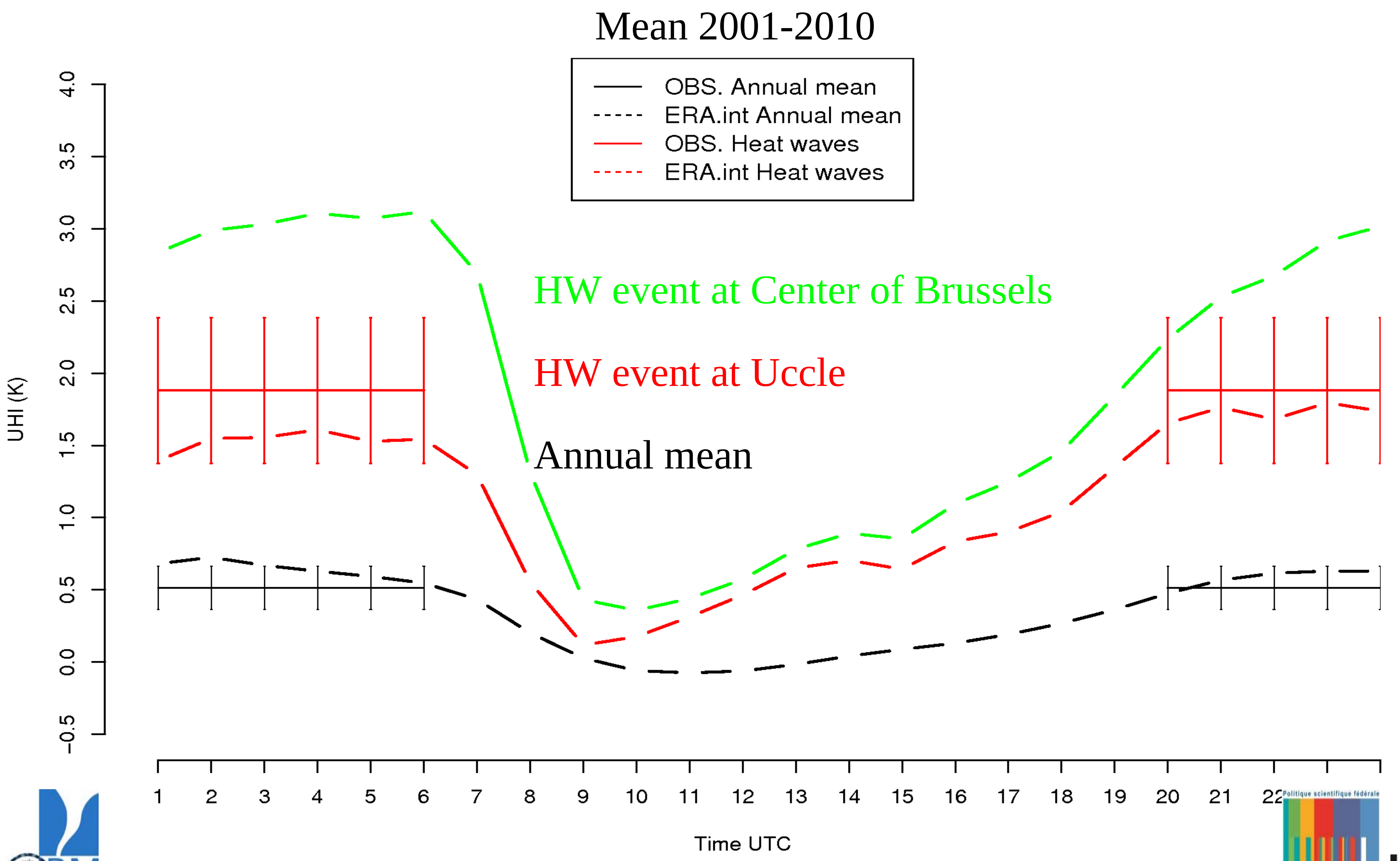
(2) mean T_MAX over the whole period is higher than T_1, and

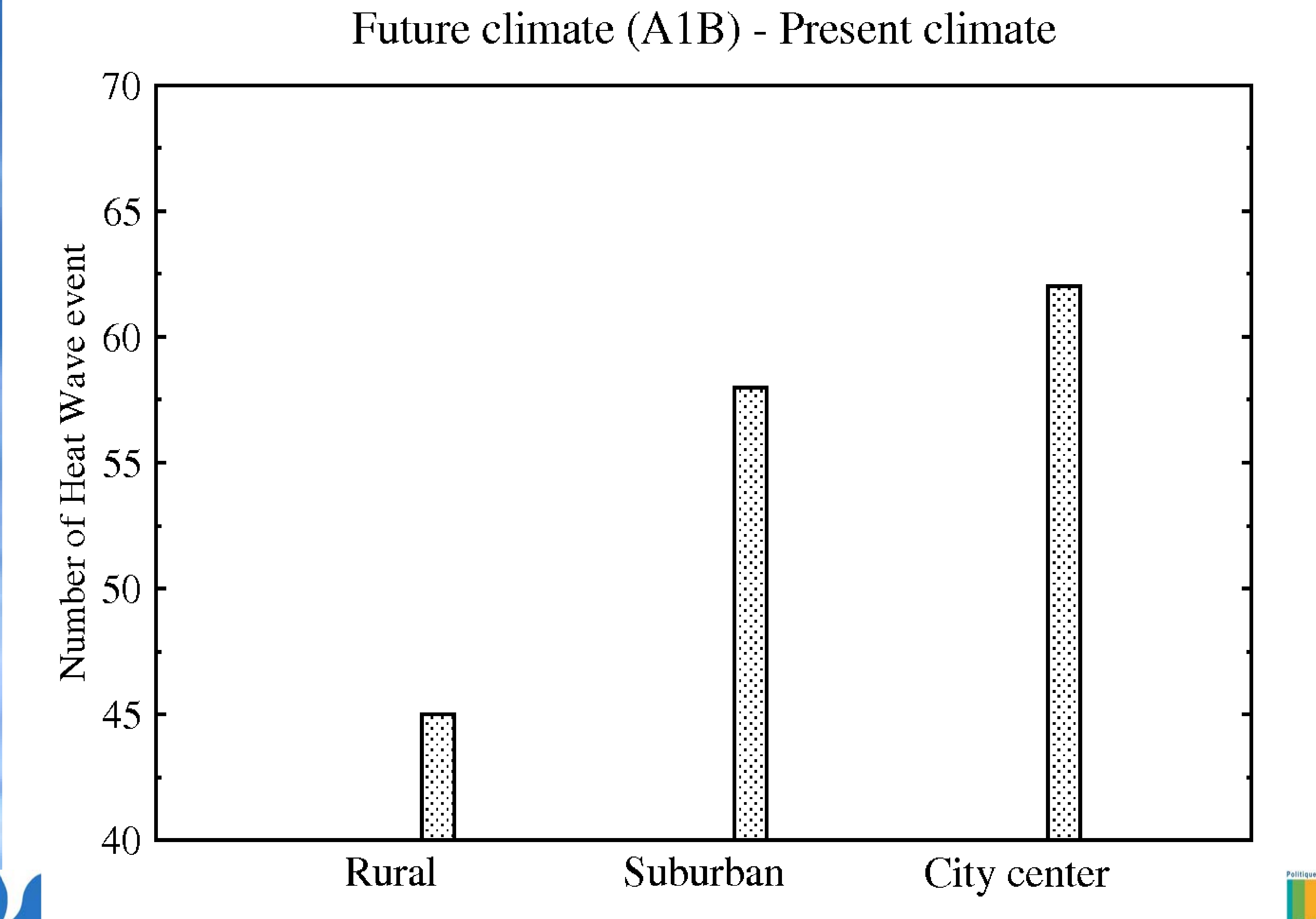
(3) T_MAX does not drop below T_2.

The threshold values were set to T_1=30 °C and T_2=25 °C,

In this study a third threshold T_3 was defined, with the corresponding conditions that T_MIN must be higher than T_3 in at least 3 nights.
The threshold value was set to T_3=20 °C which refers to as tropical night.

Heat wave episode




Future climate (A1B) - Present climate
Number of Heat Wave event
70
65
60
55
50
45
40
Rural
Suburban
City center

1. The responses of urban and rural areas to climate change are NOT THE SAME.

2. The feedback between urban environment and climate change is very important for urban impact studies.

3. Compared to the warming due to climate change (an increase of few degrees), changes in the magnitude of the UHI remain very low (a decrease of of a few tens of degrees in the city center)

4. The decrease of the UHI of Brussels is due to a drying of the soil in the future where the projected summer precipitation for Brussels will decrease by 35%

5. Climate change will, on average, have a limited impact on the UHI intensity, however, large impacts can be expected from the combination of urban development and potentially more frequent occurrence of extreme climatic events such as heat waves.

1. Study the heat stress in Brussels during future heat wave period.

2. Study the effect of some mitigation options: vegetation, white roofs, green roofs, compact city or sprawl city.

3. Use scenario for the future urbanization of Brussels together with climate change.

4. Use of the latest scenarios from IPCC: RCPs

5. Different time periods: 2030s, 2050s, 2071-2100.


Dank u voor uw aandacht
Merci pour votre attention