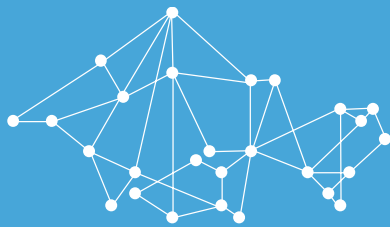


IMPACT OF CLIMATE CHANGE AND THE URBAN HEAT ISLAND ON IN- AND OUTDOOR HEAT STRESS AND PRODUCTIVITY LOSSES

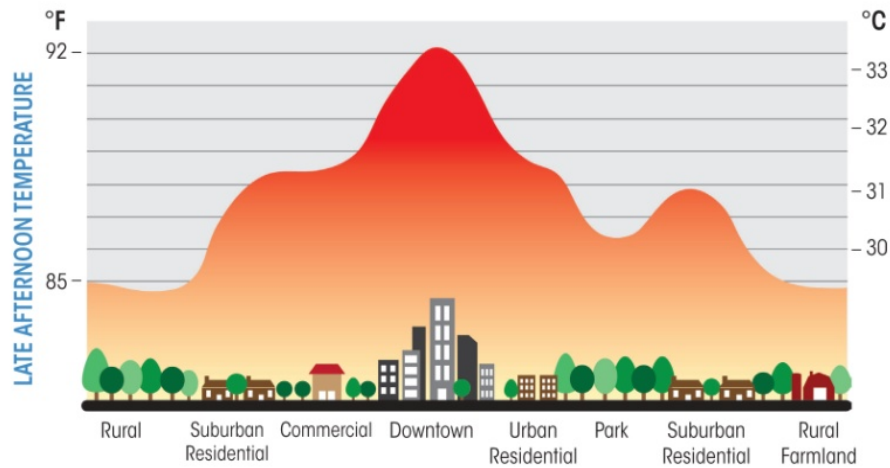
05/10/2016

Lauwaet Dirk

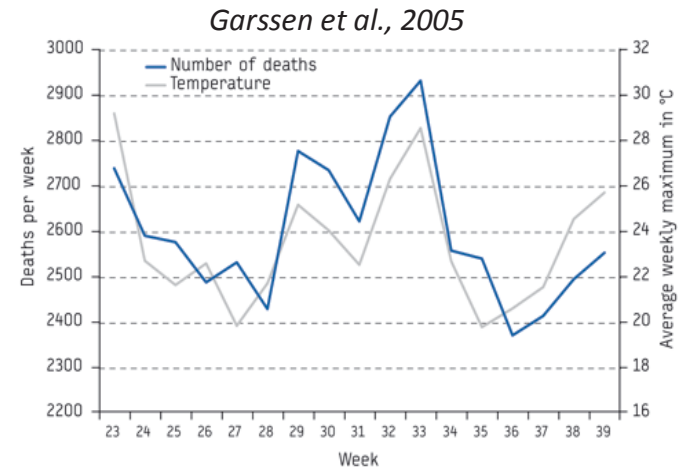
Hans Hooyberghs, Koen De Ridder, Filip Lefebvre



What is urban climate and why is it important?



<http://www.cleanairpartnership.org/files/urbanheatisland.jpg>



Some facts:

75% population living in urban area

In summer 2003, 70 000 excess deaths in Central Europe

Impact on:

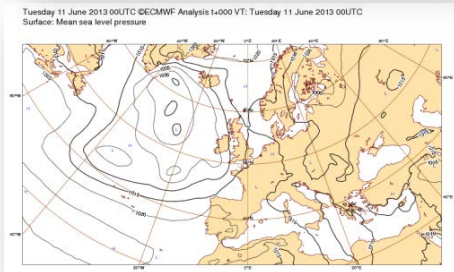
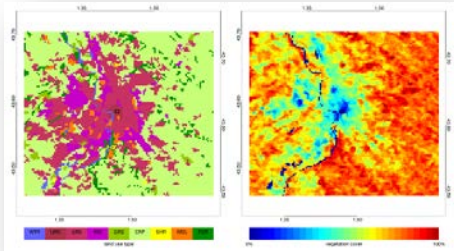
- Health and wellbeing citizens
=> Sleep deprivation, illness, mortality
- Economy
=> Energy consumption, infrastructure breakdown, image of a city, horeca



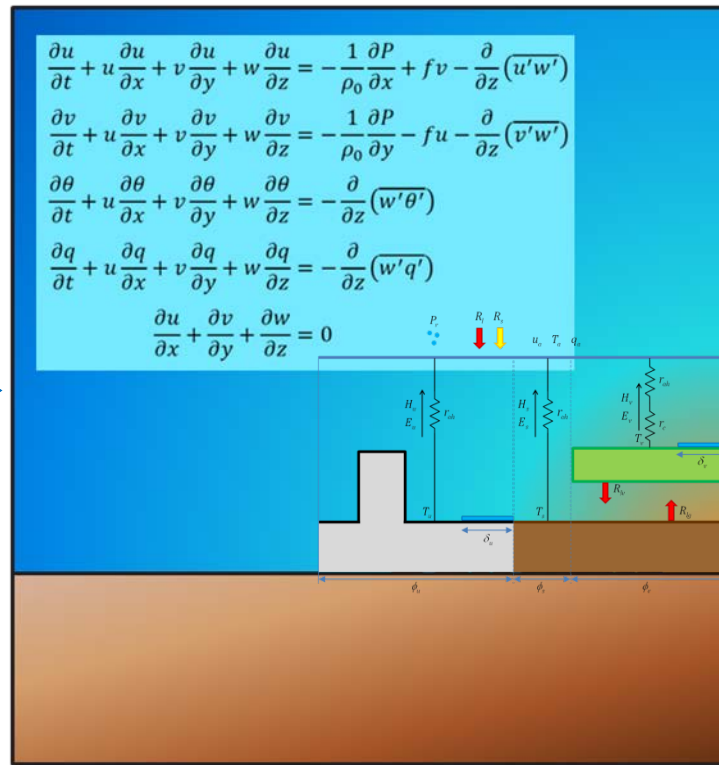
The *UrbClim*[®] model



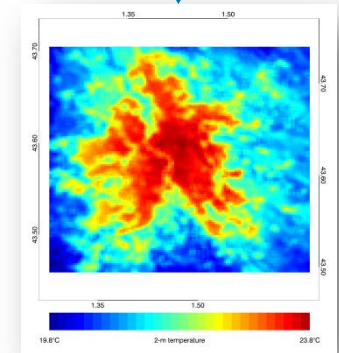
terrain



large-scale meteorology



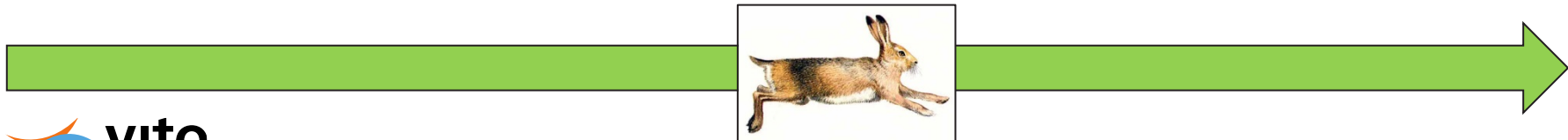
- hourly gridded (100-m)
- temperature
 - humidity
 - wind speed



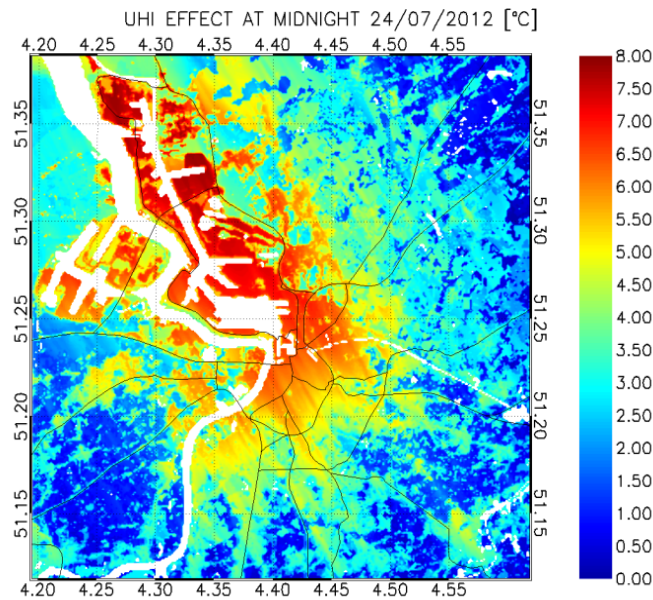
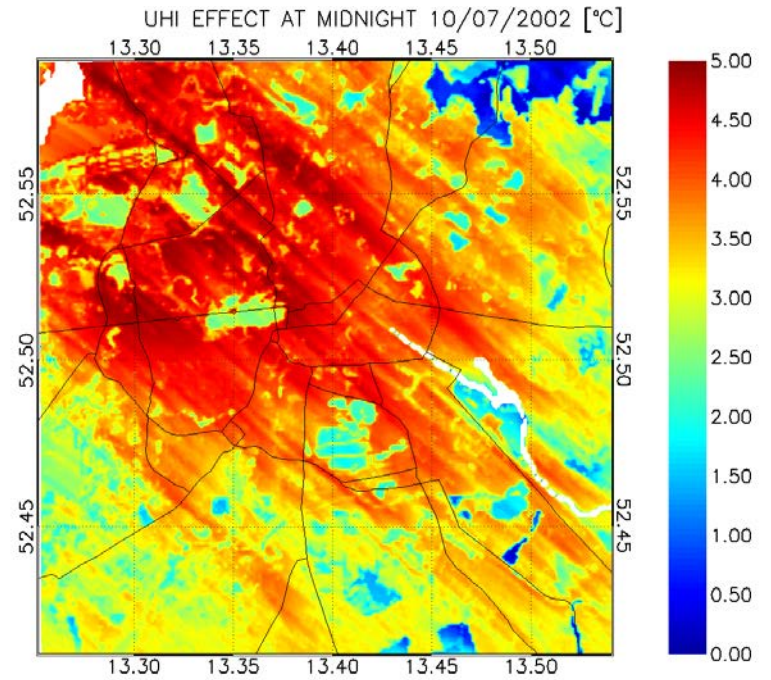
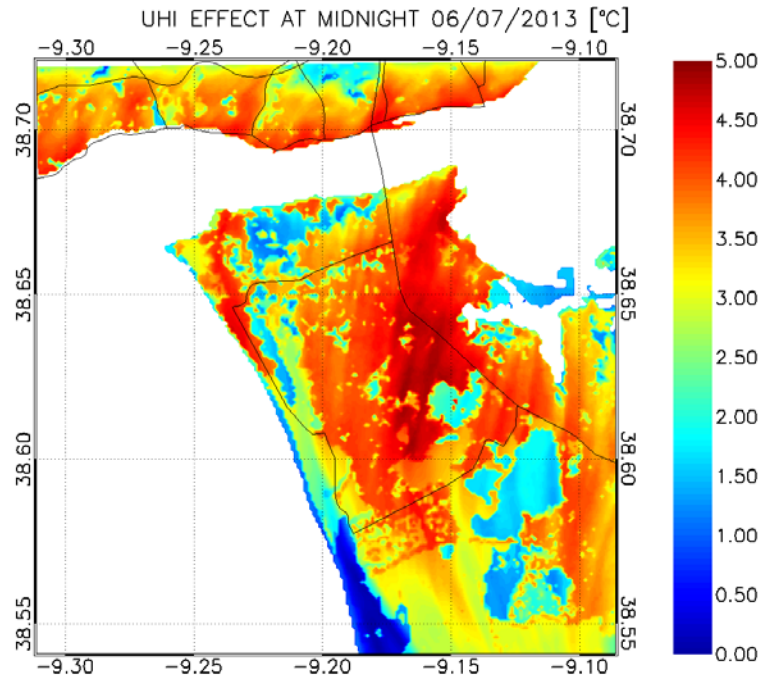
UHI maps
Output

Input

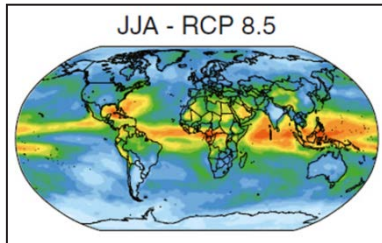
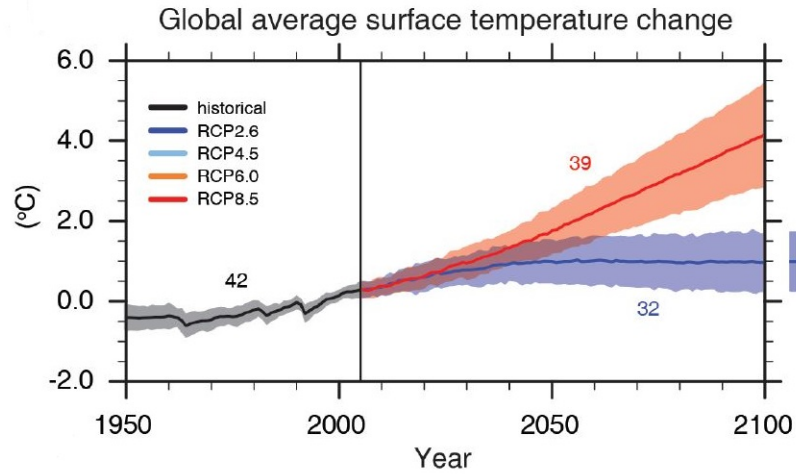
UrbClim



MODEL RESULTS

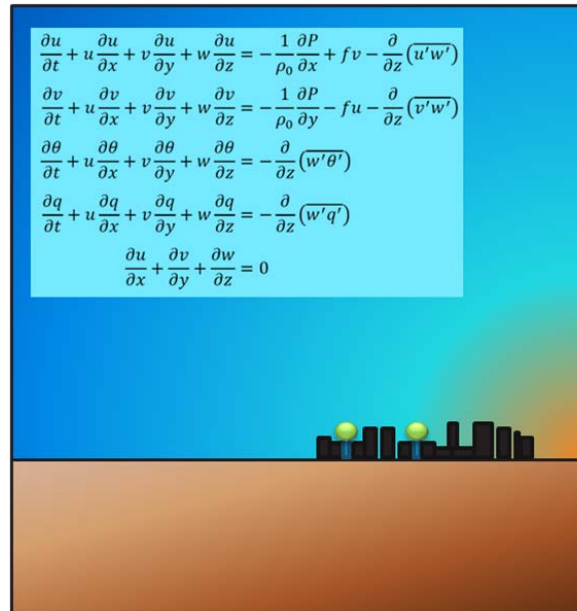


CLIMATE PROJECTIONS



-
-
-
-
-
-
-

11 Global Climate Models

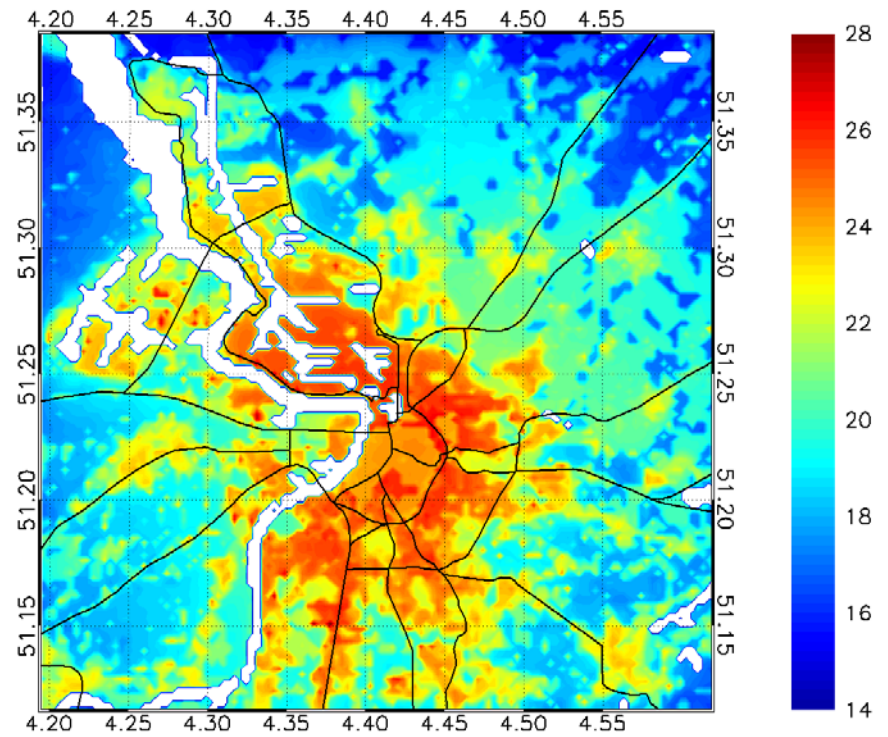
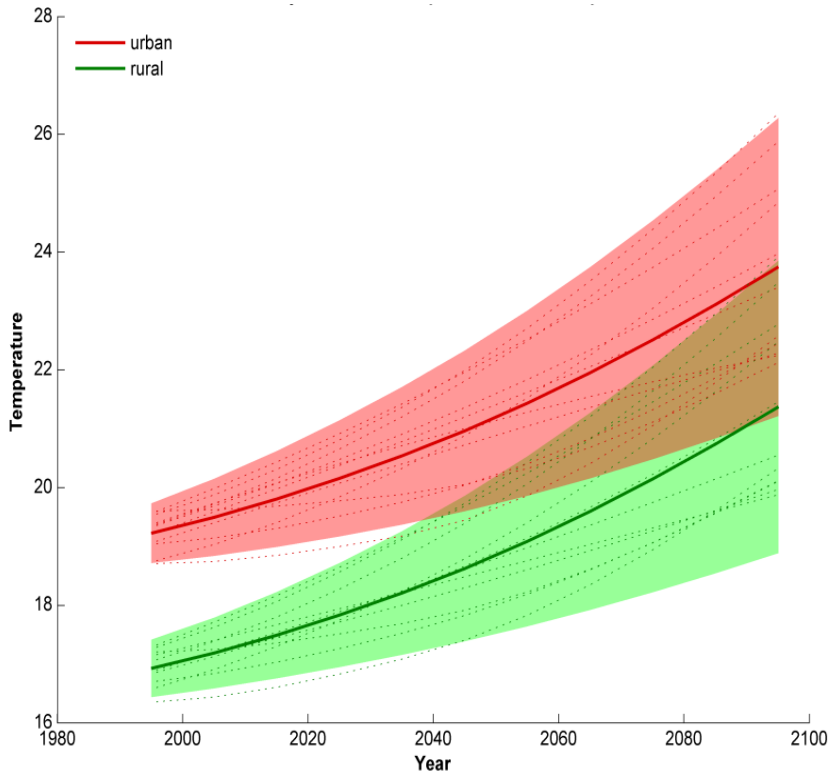


UrbClim

Urban Climate Projections

- * 2026-2045
- * 2081-2100

CLIMATE PROJECTIONS

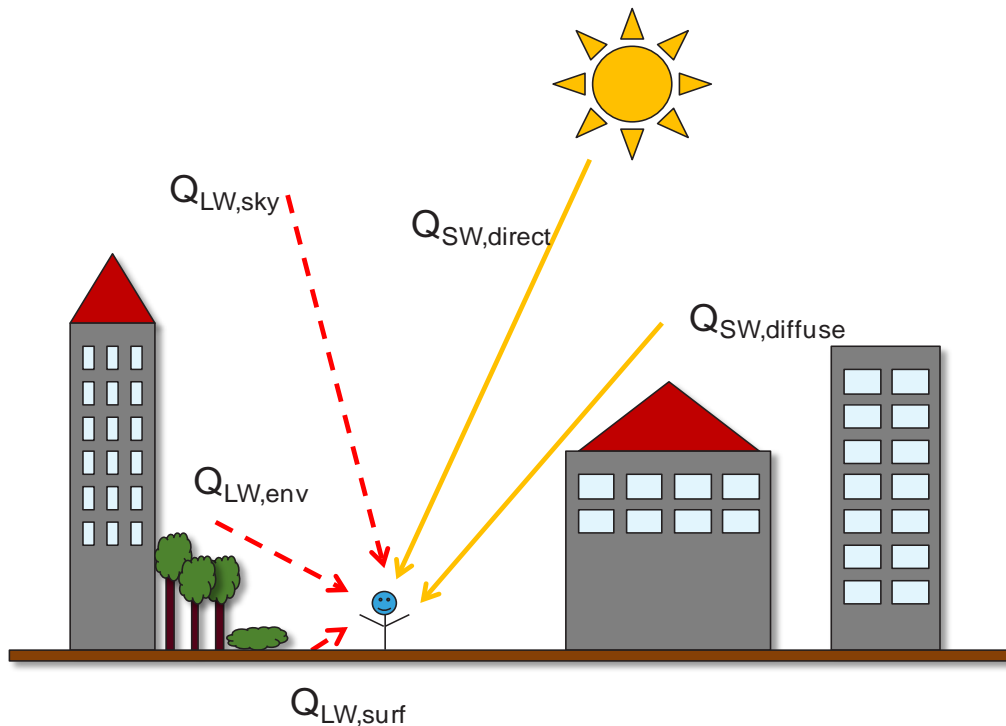


Heat Wave Days 2081-2100 (RCP8.5)

Lauwaet et al., 2015, Climate.

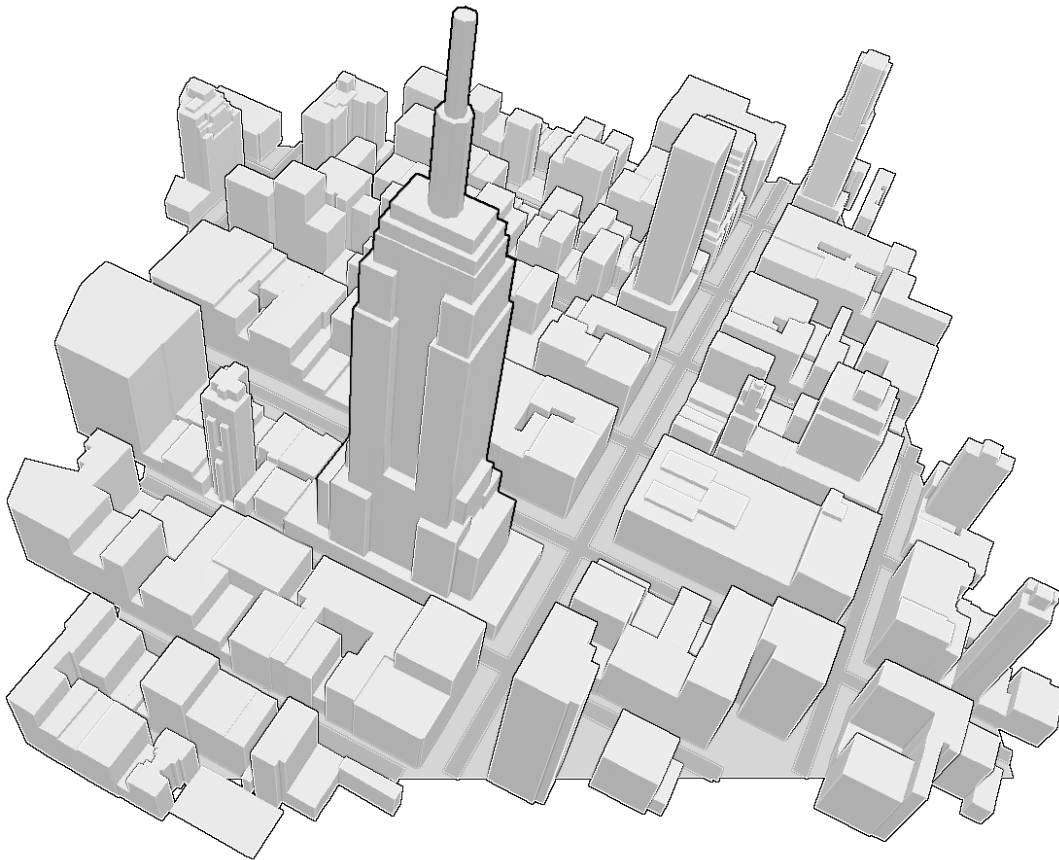
HEAT STRESS INDICATOR

- Air temperatures don't tell whole story
- To assess (daytime) heat stress of people in public space => humidity, wind speed and radiation load needs to be taken into account
- Indicator: Wet Bulb Globe Temperature (WBGT)
- Incorporated in legislation in several countries (incl Belgium)
- Possible to compute productivity losses due to heat



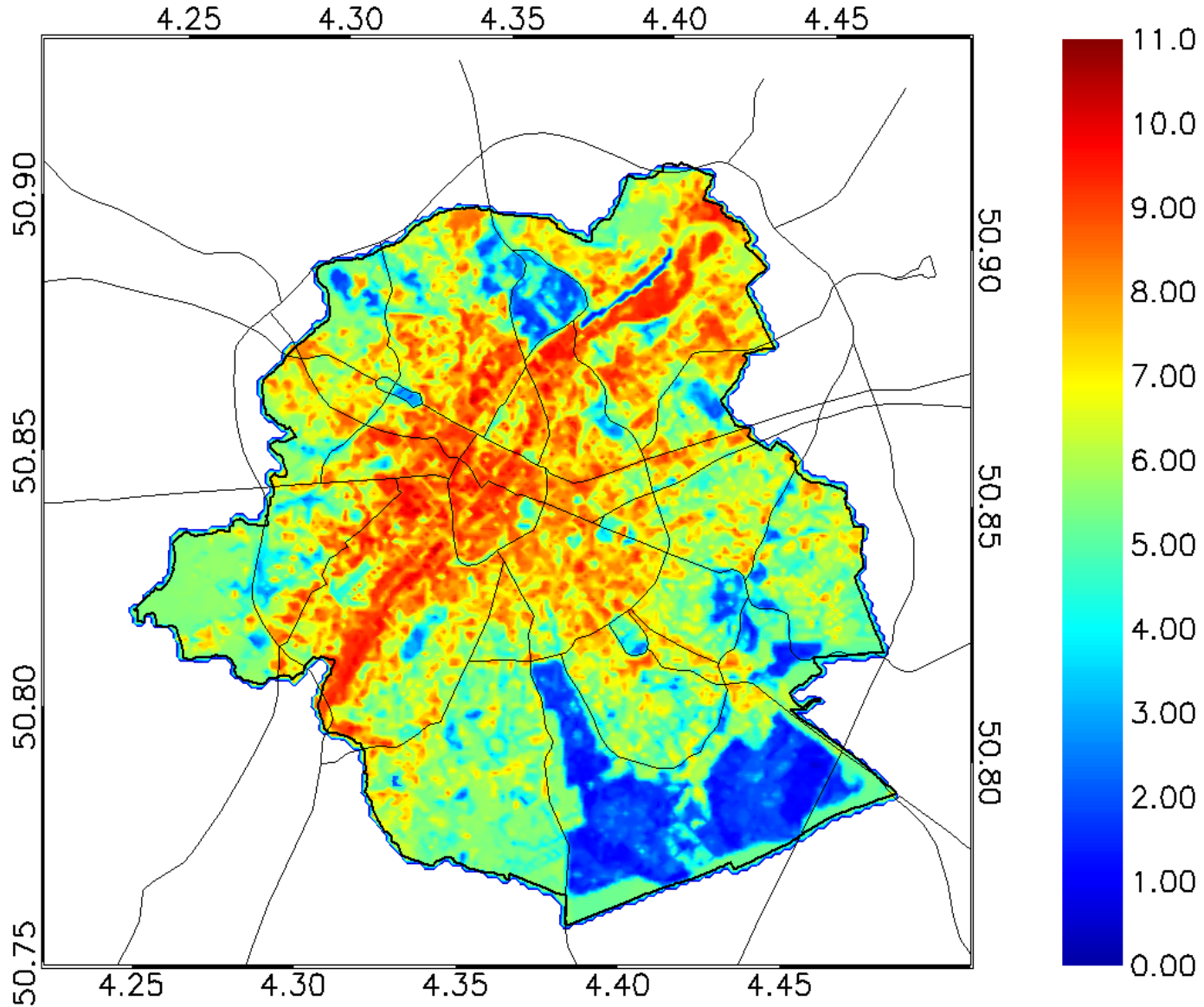
HEAT STRESS INDICATOR

- Suited for local governments because of high variability in city center => small-scale measures can have big local impact
- Input for radiation calculations: detailed 3D building data and location of trees



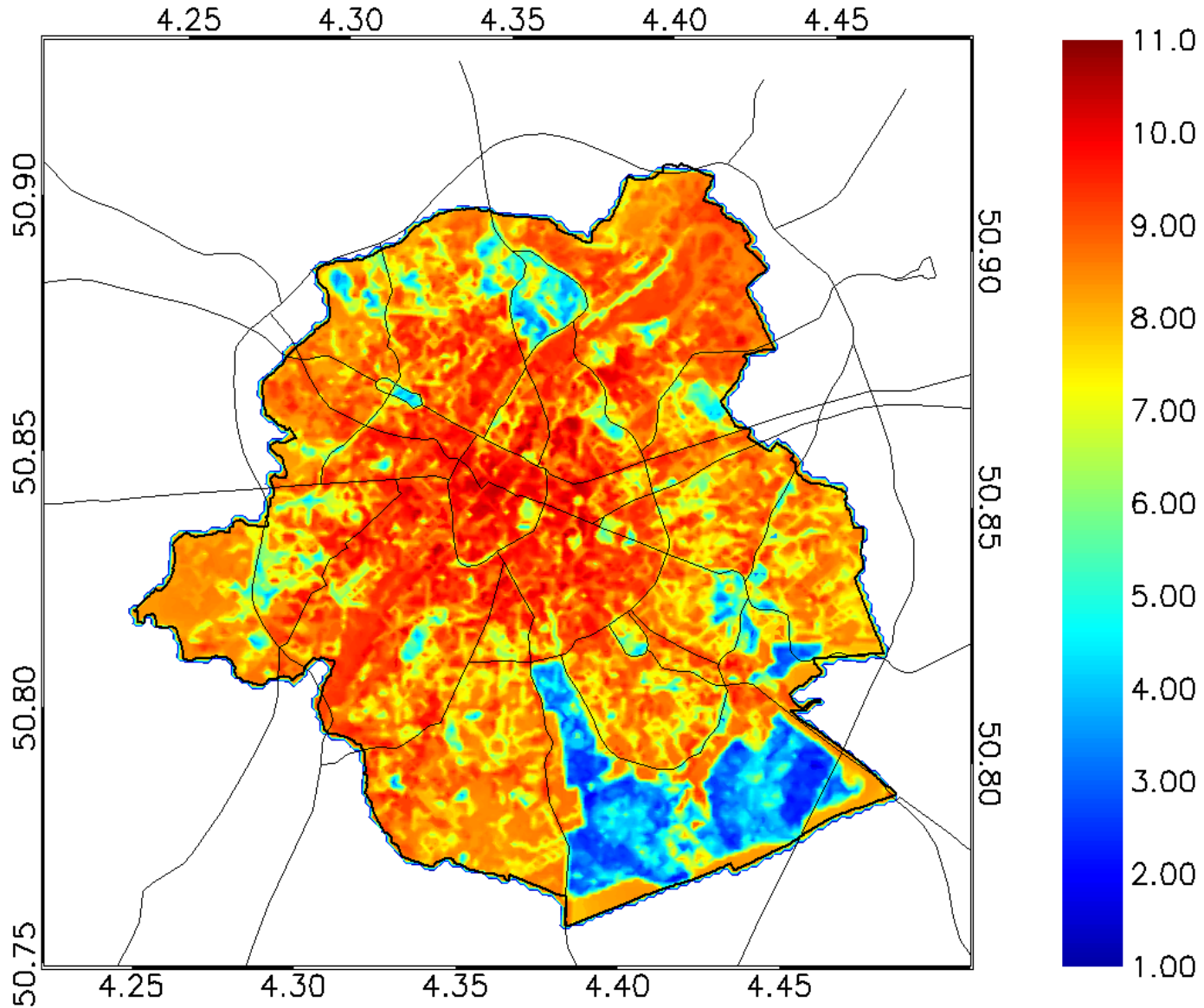
OUTDOOR IMPACT ASSESSMENT

STRONG HEAT STRESS JJA 2003 [% OF TIME]

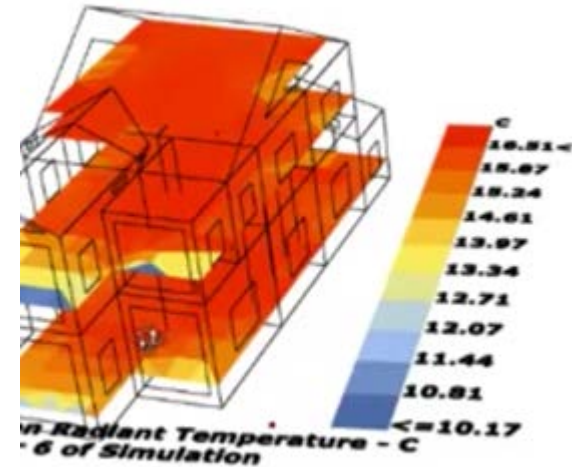
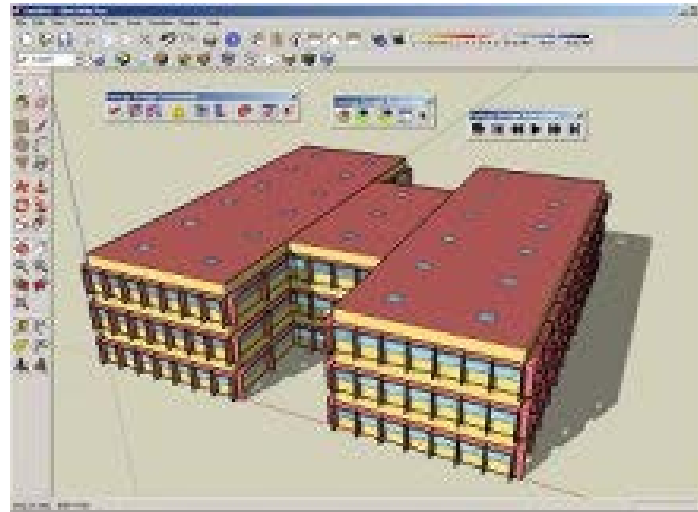


OUTDOOR IMPACT ASSESSMENT

POTENTIALLY LOST WORKING HOURS – HEAVY WORK JJA 2003 [%]



INDOOR ASSESSMENT

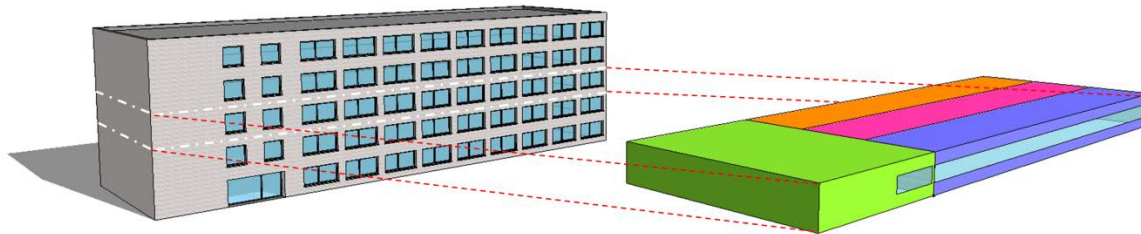


- indoor air temperature, Wet Bulb Globe Temperature
- energy demands ventilation and airco
- lost working hours
- economic costs

Case study: Antwerp office building



- VITO office Berchem
- Recent, modern office building
- Ventilation rate: 22 m³/hour/person
- 1 person/10m²
- Summer period (JJA)
- 9-17h work regime

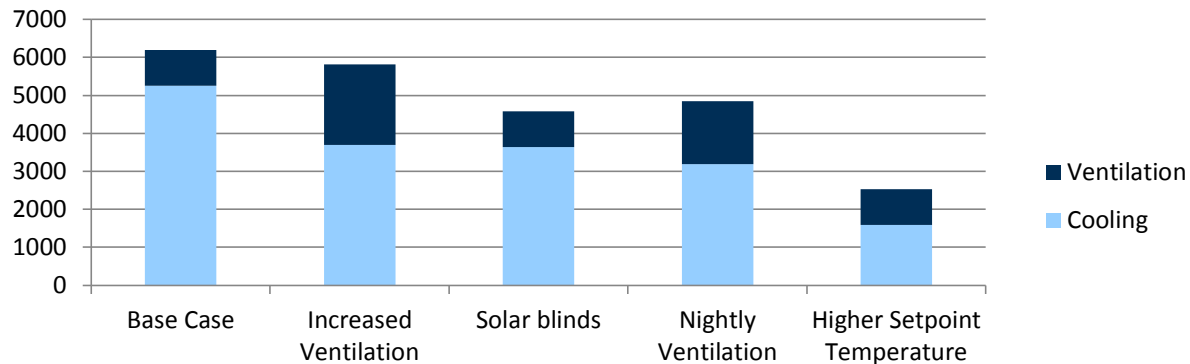


Hooyberghs et al., 2016, in preparation.

INDOOR ASSESSMENT RESULTS

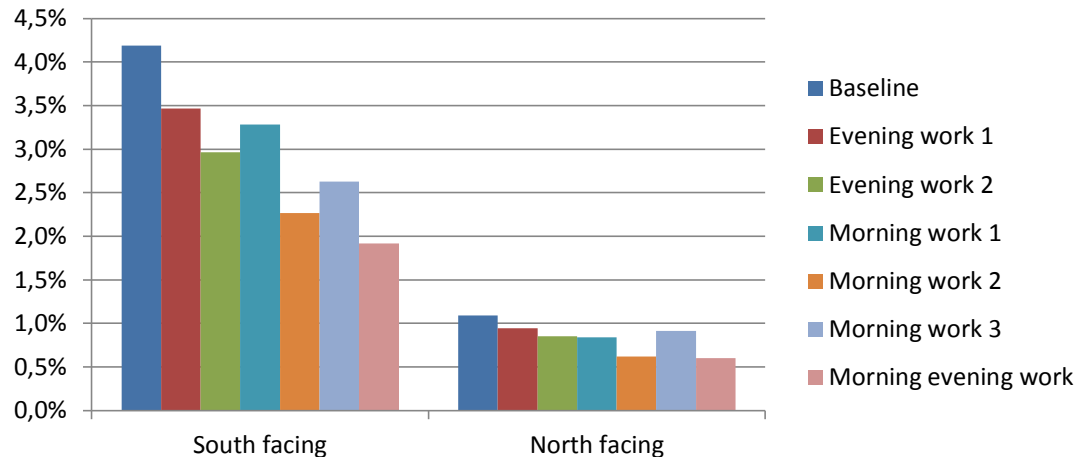
Cooling and ventilation demand during the reference period (1986 – 2005), base line working hours.

Energy demand for Antwerp: reference period



Fraction of lost working hours during the reference period (1986 – 2005) for different worker regimes.

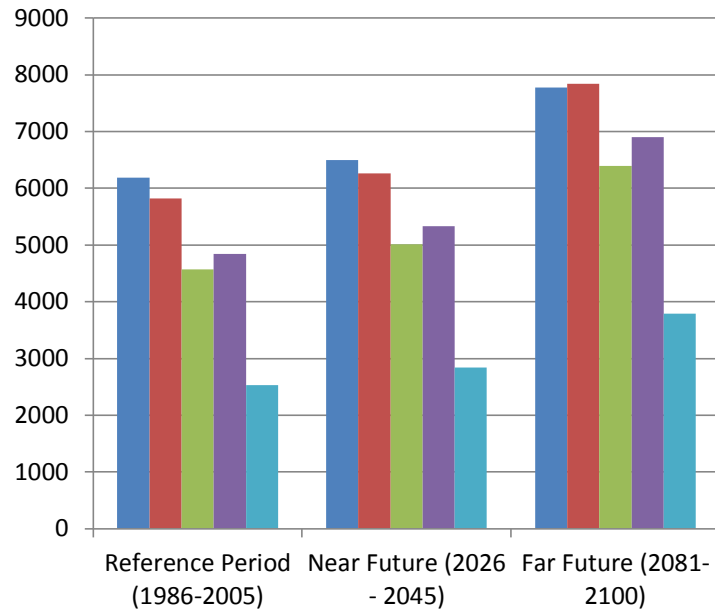
Lost working hours for Antwerp



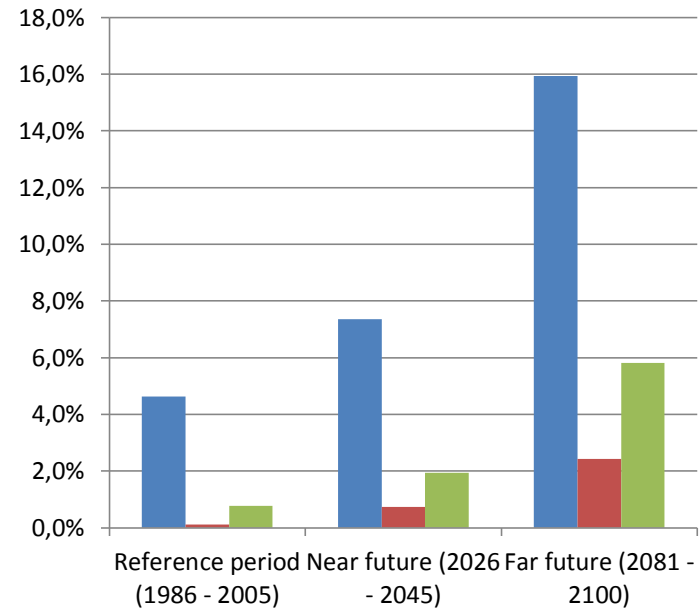
INDOOR ASSESSMENT RESULTS

Time evolution (RCP8.5 scenario) for base line working hours, south facing room.

Energy demand



Lost working hours

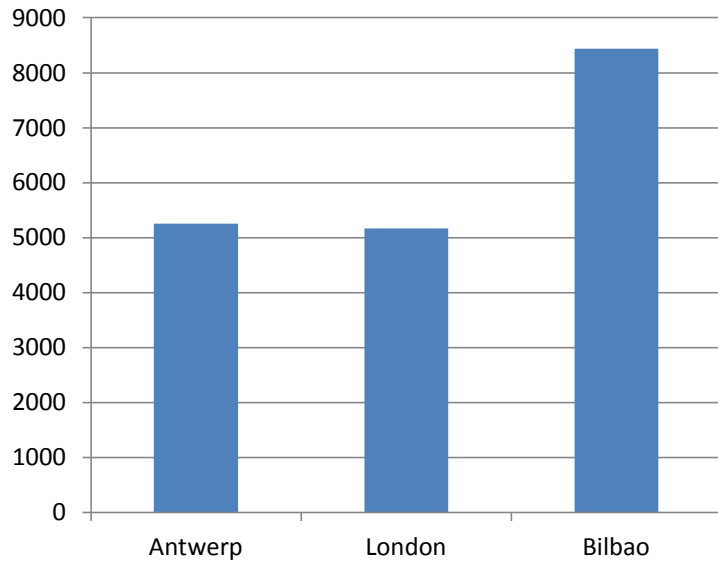


- Base Case
- Increased Ventilation
- Solar blinds
- Nightly Ventilation
- Higher Setpoint Temperature

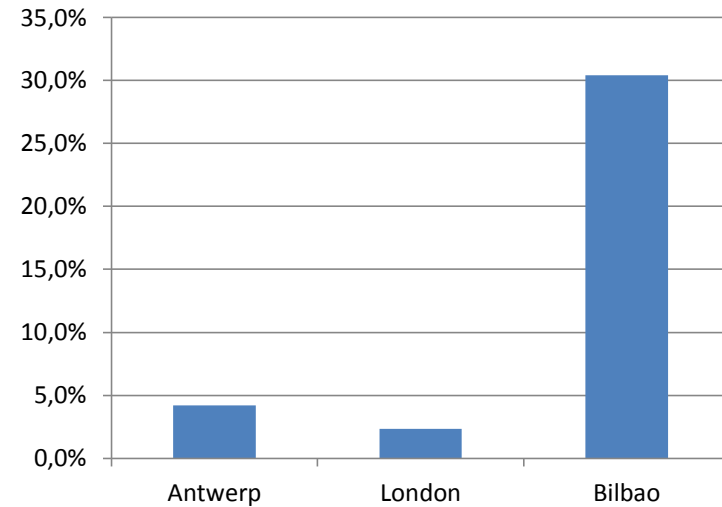
INDOOR ASSESSMENT RESULTS

Cooling demand (in kWh per year) and fraction of lost working hours for the south-facing room and the baseline working hours for the reference period.

Cooling demand in three EU-cities



Lost working hours in three EU-cities



CONCLUSION



Thank you for your attention!



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