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Quantifying local impacts of regional adaptation measures in the urban environment

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Background

According to present-day climate projections the atmospheric temperature (both maximum and minimum) will rise, and precipitation is expected to change as well compared to the current climate. These changes will have a major impact in the urban environment. The focus on this poster is the effect of a land use change on the thermal comfort in the urban environment.

Objective

The possible role of land use in the region surrounding the city on urban meteorology is investigated. As an example we take the city of Rotterdam to investigate this. To that end, a regional atmospheric model (RAMS) is run with different configurations of land use during the July 2006 heatwave. The analysis will focus on the sensitivity of temperature and its extremes to changes in the land use from grasslands (dominant land use at present) to forest.

Introduction

It is hypothesized that land use in the surroundings of major cities influences the urban environment and will therefore be an interesting adaptation measure. Results from earlier studies for Metropolitan Paris showed that the effect of a change in land use may be in the order of 2-3 degrees Celsius.

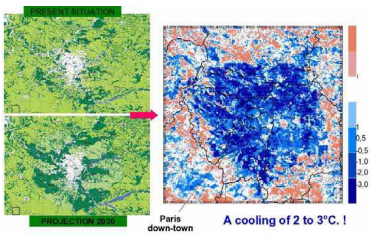

Figure 1. Differences in night-time temperatures between the two simulations based on the 2003 heatwave. The control simulation was drawn up with the actual land use characteristics in the Ile de France region and the other was undertaken with a scenario of expanded forests circling Paris

Model configuration

Table 1. RAMS configuration used in this study

Model options used:

grids	1	2	3
δx, δy	18 km (50x54)	6 km (60x62)	2 km (149x149)
δt	20 sec	20 sec	6.667 sec
δz		25 - 1000 m (35)	
radiation		Harrington (1996)	
land surface		LEAFv3	
diffusion		Mellor-Yamada	
forcing		ECMWF (atmosphere)	
forcing time scale		lateral 1800 s	
convection		Full microphysics package (Flatau, 1989)	
period		15 July 2006 – 25 July 2006	

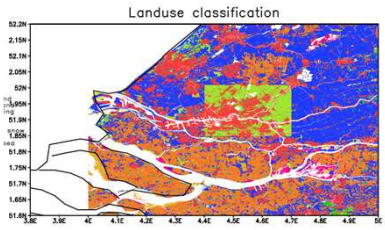

Figure 2. Alternative land use configuration: Urban, Forest, Grassland, Crop farming

Results

- Temperature in urban Rotterdam during daytime is on average 0.2-0.4 °C higher in the alternative land use.
- Temperature in urban Rotterdam during night time is on average 0.3-0.8 °C lower in the alternative land use.

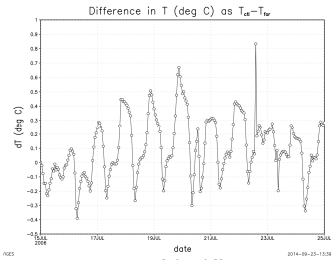

Figure 3. Time series of the difference in temperature averaged over urban Rotterdam between the control simulation and the 'forest' simulation

Results

The strongest signal of the presence of the forest is apparent at the built-up areas close to the forest (dT ~ 0.6 °C) at the edge of the city. However, the effect of the forest is also apparent in the city centre (dT ~0.2 °C).

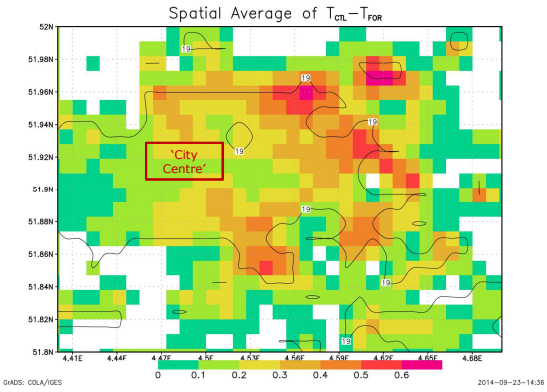

Figure 4. Difference in midnight temperature (°C), as T_{CTRL} - T_{FOR} for urban Rotterdam (black contour).

Conclusions

- The effect of the forest on average temperatures in the city is present (~0.5 °C) , and is even larger on extremes (max 2 °C, not shown)
- 'Greening' of the region around a city has potential as an adaptation measure to improve thermal comfort in the urban environment during night time.

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