



Urban Heat Islands Conference

Arnhem, The Netherlands

May 26th, 2010

Minutes

Future Cities is een Europees samenwerkingsverband met als Nederlandse partners:



Minutes of the Conference *Urban Heat Islands* in Arnhem, The Netherlands

This meeting was organized by the Dutch municipalities of Arnhem, Nijmegen and Tiel, partners in the EU Interreg IVB Future Cities project. The meeting offered the major Dutch Cities a broad overview of the current knowledge on the topic of urban heat islands from both a scientific and a practical perspective. Officials dealing with climate adaptation issues from municipalities, water boards and provinces attended the meeting.

May 26th 2010, Villa Sonsbeek, Arnhem, The Netherlands



Context

Climate change affects human wellbeing, especially in the urban environment. Because the climate is changing, weather extremes, heat waves, excessive rainfall and periods of drought will occur more frequently. Heat island effects in summer and wetter winters with increased flash flooding are only a few climate change phenomena that will greatly impact urban living conditions.

Climate change is on the top of the agenda of current scientific, political and public discussions. In Northwest Europe, these discussions have resulted in The Interreg IVB NWE Future Cities project. This project aims at making city regions in Northwest Europe able to cope with the predicted climate change impacts. The Future Cities strategy combines strategic urban key components (green structures, water systems and energy efficiency) for a proactive transformation of urban structures.

Within the Future Cities project, the City of Arnhem is investigating the Urban Heat Island effect (UHI-effect) to answer the following questions: are urban areas heating up, and if so, what are the consequences and what adaptive measures are the most (cost) effective for coping with the heat's negative effects. The study covers the 20 municipalities of the City Region Arnhem Nijmegen.

The City of Arnhem aims at developing a method to evaluate climate resistance at different urban levels: region, city and district. Keywords in the evaluation are green structures, water systems (surface water), heat balance and urban design, also called urban morphology. Furthermore, a toolbox of adaptive measures is being developed to reduce the negative effects of Urban Heat.

Conference programme

- Opening
Margreet van Gastel, Alderman of the City of Arnhem
- Adapting Public Space to Climate Change: Municipal Councils Set to Work on Climate Adaptation
Ineke Westerbroek, Environment Project Manager, CROW, The Netherlands
- Urban Climate and the Urban Heat Island Effect
Professor Dr. Lutz Katzschner, Faculty of Architecture and Planning, University of Kassel, Germany
- Urban Climate Analysis Map: An Information Tool for Sustainable Urban Spatial Planning
Ms Chao Ren, Chinese University of Hong Kong
- Urban Climate Analysis Map (heat map) of Arnhem
Professor Dr. Lutz Katzschner

Parallel sessions

- Climate Change and Public Space: An Interactive Workshop on Climate Adaptation in the Public Space
Harro Verhoeven, CROW, The Netherlands
- Climate in the City and Green in Rotterdam: State of Affairs on Study of the UHI Effect and Results of International Comparison to Toronto and London
Erika Koning and Heleen Mees, City of Rotterdam
- Urban Climate Analysis Map of Arnhem: Discussing the Consequences of the Heat Map for the City of Arnhem
Martijn Heerkens, Future Cities project, City of Arnhem

Wrap-up

Summary and informal talks

Opening Speech, Margreet van Gastel, Alderman of Environment of the City of Arnhem
Welcome and perspective

Margreet van Gastel welcomed the participants. She expressed how she looked forward to a fruitful meeting and emphasised the urgency of the topic at hand, and the appropriateness of Arnhem as host for this conference: Arnhem was awarded the prize for the 'Greenest City in Europe' (2009) and has also recently received an award for Sonsbeek Park as 'The Best Public Space in the Netherlands' (2010). Sonsbeek Park was also the venue for this conference.

She expressed a warm welcome to all active participants of the conference, as well as to the participants who had done valuable work for the Future Cities project, including the German partners from the Future Cities project, Mrs Anke Althoff of the Lippeverband, manager of this European project, and Mr Torsten Frehmann of the Emscher-genossenschaft.

Margreet van Gastel also addressed her colleagues from the City of Rotterdam. Together with the City of Rotterdam, Arnhem measured the temperature inside and outside Rotterdam and Arnhem last summer after a series of warm days. In her remarks Mrs van Gastel stated how the results surprised her and her colleagues in the municipalities and even the scientists working on the project.

Finally, Ms van Gastel expressed a special welcome to Professor Dr. Lutz Katzschner of the University of Kassel (Germany) and to Ms Chao Ren, PhD at the Chinese University of Hong Kong. For the last two years, Professor Katzschner and Ms Ren have been co-operating with the Future Cities project and the City of Arnhem and helping them to tackle the phenomenon of urban heating.

In conclusion, Ton Hesselmanns of CROW presented his organisation's new publication, *Adaptation of Public Space to Climate Change*, to Mrs van Gastel. She thanked Ton Hesselmanns, stating that the tools published by CROW are used daily by municipalities to improve their public space. CROW's new publication provides municipalities, provinces and water boards with tools to face the negative effects of climate change.



Adapting Public Space to Climate Change

Municipal Councils Set to Work on Climate Adaptation

Ineke Westerbroek, Environment Project Manager at CROW, The Netherlands



CROW is a Dutch National technology platform for transport, infrastructure and public space. It is a non-profit organisation in which governmental organisations and businesses collaborate to pursue their common interests.

Ineke Westerbroek informed the audience about the effects of climate change and, more specifically, about climate adaptation in coping with the negative consequences of climate change.

Keywords in her talk were adapt, accept and communicate, i.e., adapt where possible, accept where measures are not sufficient and open communication with parties involved.

Mrs Westerbroek presented a six-step plan for municipalities working on climate adaptation:

1. Determine the physical task
2. Search for balance between adaptation and acceptance
3. Search for opportunities for linking
4. Start test projects
5. Enlist support
6. Evaluate and learn (and go to step 1)

This six-step plan has been worked out in CROW's new publication no. 277 "*Aanpassing openbare ruimte aan klimaatverandering. Gemeenten aan de slag met klimaatadaptatie*". The publication is available in Dutch.

Urban Climate and the Heat Island Effect

Professor Dr. Lutz Katzschner, Faculty of Architecture and Planning, University of Kassel, Germany

Professor Dr. Lutz Katzschner is the head of the Department of Environmental Meteorology of Kassel University. Professor Katzschner has worked in the field of meteorology and climate mapping for many years and is considered a specialist on urban climate and planning, physics of the atmosphere, clean air programs and bioclimatology. He travels around the world spreading the news of climate mapping in Latin America, Europe and Asia. He has written many publications on this topic.



In the first part of his presentation, Professor Katzschner informed the audience about the phenomenon of urban heating and urban heat islands, specifically what can be done about the phenomenon and when could it become a problem or risk. He gave a broad overview of the state of research in this field. He explained that climate change has increased both the mean air temperature and the number of heat days. He also informed the audience of how urban design influences the severity of urban climate change. Suburban high-rise buildings, for example, prevent cool air from entering and cause the heat island effect. But also the lack of green, anthropogenic heat from air conditioning, cars etc., the absence of surface water, and heat absorbing materials (buildings, roads) cause an unfavourable urban heat profile leading to human discomfort and possibly even health risks.

Urban Climatic Map

An Information Tool for Sustainable Urban Planning

Ms Chao Ren, Chinese University of Hong Kong

Ms Chao Ren is a PhD student in Architecture from the Chinese University of Hong Kong. Ms Ren has also been participating in the Future Cities project since 2009 when she started studying the climatic situation in the City Region Arnhem Nijmegen. In her thesis *Application of Urban Climatic Map to Urban Planning of High Density Cities*, she focused on Hong Kong. Ms Ren showed the audience ways to incorporate urban climate information into urban spatial planning using global UHI mapping.

The Urban Climate Analysis Map (UCA Map) that has been applied in many countries worldwide forms a bridge between climatologists and wind engineers, on the one hand, and spatial planners, designers and policy makers, on the other hand. The map integrates urban climatic factors and town planning considerations. It provides a strategic information platform and urban climatic planning framework for spatial planners in their planning processes. The UCA Map broadly consists of layers:

- Climatic elements
- Geographical terrain information (topography)
- Greenery information and planning parameters

The Urban Climate Analysis Map of Kaohsiung (Taiwan), for example, has the following layers: 1) Topography, 2) Population density, 3) Land use, 4) Urban Heat Islands, 5) Landscape, 6) Water bodies, and 7) Wind information.



This map is the basis for the Urban Climate Recommendation Map used for general planning recommendations for specific urban districts in order to mitigate the urban heat island effect. These recommendations can be ordered as follows:

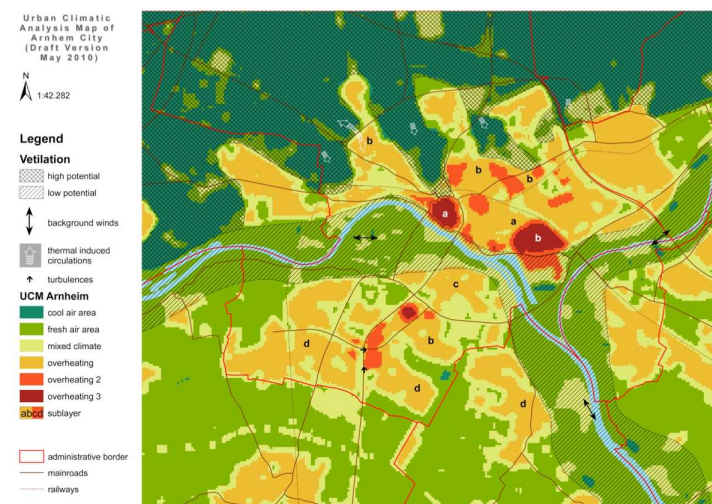
Goal	Strategy	Action	Scale
Thermal comfort	Albedo	Cool building material and pavement Cool roof and facade Water retention paving	Material and surface
	Vegetation	Planting and greeneries Parks and open spaces	
Wind potential	Shading	Building geometric design Shelter design Street orientation H/W ratio Trees	Buildings
	Ventilation	Air paths Building ground cover and building bulks H/W ratio Street orientation Open spaces Building disposition	Urban planning

In her study, Ms Ren observed the following characteristics in the Dutch approach:

- Dutch planners seldom consider the climatic data and information.
- Climatologists and spatial planners in the Netherlands never communicate or cooperate with each other.
- Climatic evaluation and relevant plan action are no clear and are not easily understood by spatial planners and policy makers.
- In the Netherlands, the climatic implementation should be focused on the central municipality first.
- The lack of research in urban climate issues has been acknowledged in the Netherlands.

Urban Climate Analysis Map of Arnhem Professor Dr. Lutz Katzschner

Professor Katzschner closed the first part of this meeting by showing the audience the first Urban Climate Analysis Map, or heat map, of the City of Arnhem. The map was designed using existing geo-data and meteorological data from the KNMI. In this process no actual temperature measurements were used. The map showed several hot areas (maximum urban heat island) and areas that could ventilate and cool these overheated spots.



The map has been validated using the temperature measurements done by Wageningen University on bike in Arnhem and Rotterdam in August 2009.

Professor Katzschner proposed the following adaptation measures for the city of Arnhem:

- Ventilation: keep and enhance the open green structures, i.e., mostly the parks inside the city that are linked to the Veluwe.
- Heat storage and radiation: use guidelines to reduce health risks.
- Shade: plant and preserve trees
- Modelling: use thermal calculations
- Micro-climate: analyze and redesign

The primary aim of these measures should be:

- to keep the green areas in and outside the city green and open.
- to reduce the heat increase of the 'maximum urban heat island' areas by greening these areas, enlarging their surface water and opening the areas to let the wind in.

Parallel session 1: Climate Change and Public Space

An Interactive Workshop on Heat in the City

Harro Verhoeven, CROW, The Netherlands

In this session, participants created mind maps and discussed adaptation measures that apply to public space. Throughout the session, participants explored solutions, the way to organise these solutions and ways to enhance the sharing of knowledge on climate change and the public space.

The mind mapping had three approaches:

1. What are possible solutions to deal with the heat in the city?
2. How can we organize these solutions in such a way that we can solve the problems together?
3. How can we optimize the sharing of knowledge?

Mind mapping is a model to visualise and exchange ideas, information and knowledge. It gives the participants the possibility to develop a good overview of the existing information on a topic. It stimulates the participants' creativity and encourages them to propose and exchange new ideas and to express these ideas in an easily understandable way. In this interactive process, participants also see the gaps and discrepancies in their information and ideas.

At the end of the session, the participants were asked:

- Who has experience with an idea or issue presented in the mind mapping?
- Who wants to work on an idea or issue presented in the mind mapping?



You can see the results of the mind mapping on enclosed images. CROW will now develop the ideas brought out in the session and may organise a follow-up meeting based on the results.

Parallel session 2: Heat Stress in the Cities of Rotterdam, London and Toronto

State of Affairs

Erica Koning and Heleen Mees, City of Rotterdam



In this session, Erica Koning showed several ways to identify the role and impact of green in the city on the Urban Heat Island effect. The city of Rotterdam has put several measures in practice. But Rotterdam is also measuring the temperature in the city, on the long term as well as on special occasions such as on the hot days in 2009. Erica Koning is researching the assumed cooling effect of water in the city and analysing satellite images to discover the link between the air temperature and the radiation of the surface.

Among other actions, Rotterdam will give more attention to public green (green roofs, green front, green wedges and paths), stimulated recreation nearby the city (suburban area, forests, green cycle paths). All measures are presented in a toolbox "climate and green", which gives designers and managers tools to use in their daily work on different levels of scale. The toolbox initiatives and the connection of green areas conserve and improve existing green wedges and prevent high-rise blocks from being built in the wedges.

Heleen Mees reported on her study: Climate Greening London, Rotterdam and Toronto. She has comparatively analysed the governance capacity of adaptation to climate change in urban areas. London, Rotterdam and Toronto lead in urban climate adaptation: they pursue a policy to protect and improve the green measures, in particular green roofs.

Main outcomes of the discussions

- What is the status of the plans to green as a remedy for the heat island effect? Answer: the toolbox for Rotterdam is ready for use by designers and managers. Policy makers still have to decide on a more formal execution of the proposed measures. The notion that public space has a high financial potential and that this potential fits perfectly with the notion of sustainable cities that is beginning to take hold.
- How about the vulnerability of green in the city? Answer: species must be varied to make the green resistant to diseases and plagues. Furthermore, water plays a crucial role: trees and green roofs use a large amount of water. This is a risk factor since periods of drought are a part of the climate change scenarios. In Rotterdam, the groundwater level is and will be high enough for trees. Rotterdam also gives a lot of attention to improving the quality of the soil of the planting plot for trees.
- What are the economic perspectives for adapting surface structures in the toolbox for Rotterdam? Answer: pavements and green are less expensive than buildings. Both contribute to and propagate the heat island effect. Economically favourable measures are therefore at hand for adapting pavements and applying green.
- What are the green measures for Rotterdam and how can they be "sold" to the public? Answer: multi-purpose is the keyword. Applying green wedges in urban planning, a green main structure, a network of green in the districts, urban agriculture, green roofs, vertical gardens, collective gardens, not only prevent heat islands, but also favour other policies like the "walkable city", "attractive city", "sustainable city", etc.

Parallel Session 3: Urban Climate Analysis Map for Arnhem

Martijn Heerkens, Future Cities project, City of Arnhem

In the third and final session Martijn Heerkens of the Future Cities project and a graduate of Saxion University of Professional Education in Deventer went deeper into the consequences of Professor Katzschner's heat map for the city of Arnhem.

In his session, Martijn Heerkens explored the consequences for three areas within the borders of the municipality of Arnhem.

He states the differences between:

1. The cool producing zones focussing on the beneficial effect of Sonsbeek Park. These green areas should be left open and untouched to gain as much positive effect of the so-called 'thermal induced winds' or slope winds entering the city.

2. A neighbourhood in the southern part of Arnhem as an example of the 'moderate urban heat island' effect. When the balance between buildings, roads and green is maintained, these areas will remain comfortable places to live in.
3. The city centre as the most prominent area for overheating. In this area, green roofs have apparently less influence on the temperature in the human comfort zone (street level) than green walls and trees. More research will be needed to determine what adaptive measures are the most suitable and cost effective.



The goal has been formulated as follows: adapt existing urban areas in such a way that they don't suffer the consequences of climate change. Focus will be placed on the 'red areas' as shown on the heat map. One of the first steps will be to determine the health risks. The keywords in this presentation were adaptation, application of green, water, favourable morphology and sustainable energy.

	Name	Description
	Cool air producing zones	<i>Thermal Induced Winds / Slope winds</i> The slopes formed by the edges of the Veluwe massive have a considerable cooling potential for the city of Arnhem. The presence of nature (forest) on the slopes allows this area to cool quickly and this creates a downhill movement of cool air in the prolonged direction of the arrow.
	Fresh air producing zones	<i>Background winds</i> The mainly green areas of the floodplains, agricultural grounds and transition zone absorb only a small amount of heat during the day. For the Netherlands, the predominant south-westerly winds cool these areas and this effect cools the rest of the city in the prolonged direction of the arrows.
	Mixed Climate	<i>Larger green areas in and around the city</i> Because of the high concentration of greenery in and around the city, these areas have a certain robustness for heat accumulation. To some extent these areas have a cooling potential for the surrounding areas.
	Moderate Urban Heat Island	<i>Slightly sensitive area for heat accumulation</i> This category includes the less densely built-up residential and business park areas. Because of the openness and vicinity of green structures and open water, these areas don't accumulate much heat.
	Remarkable Urban Heat Island	<i>Sensitive area for heat accumulation</i> This category includes the residential areas and business parks with higher densities and larger building volumes. In these areas there is not enough green to cool the area and the area's roughness makes the cooling effect of air paths marginal. These areas are having trouble losing their accumulated heat.
	Maximum Urban Heat Island	<i>Highly sensitive area for heat-accumulation</i> In this group we find the city centre and its surrounding dense and stony neighbourhoods. In these areas there is no green, almost no open water and a very rough surface, which means that the wind cannot penetrate this area to cool it. These areas have a great deal of difficulty losing their accumulated heat during the night.

Wrap-up

Hans van Ammers, chair of the meeting and the Arnhem project manager for the Future Cities project wrapped up the meeting. Before closing, he asked some participants to give their opinion of the meeting. Below is a selection of their opinions:

- We need arguments to enhance the sense of urgency. I've received them here. Thank you.
- I've seen a lot and learned a lot today.
- Please keep on stressing the relation of the activities of Future Cities with other related projects.
- There is a great need to gather all information and to make it accessible to all stakeholders. The first steps have been taken.

The aim of the meeting was to inform cities, provinces and water boards that the Dutch cities also face the Urban Heat Island effect, with positive effects in wintertime but maybe negative effects in summertime when the temperature rises. Mr Van Ammers dared to state that all cities, big or small, will develop a heat island... big or small.

Several countries around the world have gained knowledge and experience in mapping the UHI effect and using this information in spatial planning. This knowledge and experience are there to be used. That is exactly the aim of the Future Cities project: gathering national and international knowledge and experience, and translating that into practical and cost-effective measures for regions, municipalities, and cities.

For that reason Mr Van Ammers stated that this would not be the last meeting that they, the Dutch Future Cities partners, would organise. More will follow this year and next year. Larger and smaller meetings will be held to report the status of the project but also to join the Dutch partners in setting up effective strategies to adapt in our regions and cities.

The meeting was closed with the promise that participants would receive directions to download all presentations and information about the progress of Future Cities.

Finally, don't forget to apply for the conference 'Deltas in times of climate change', September 29th in Rotterdam and organised by *Kennis voor Klimaat*.

And please visit www.futurecities.nl, where all information of this conference will be available.