climate changes spatial planning

Hot places - Cool spaces

Symposium 25 October 2007
Amsterdam

The symposium 'Hot places – Cool spaces' was organised by the Dutch research programme Climate changes Spatial Planning (CcSP) on the 25th and 26th of October 2007. The subject was climate change in urban areas, the effects of heat in cities and what measures could be implemented to mitigate these effects. The seminar consisted of two days, one open to a wider public and the following day restricted to a selected group of scientists and some practitioners. The objective of the seminar was to gain insight in what research and policies on the issue of heat in urban areas are undertaken in some other countries. The second objective was to appraise the focus of the CcSP research project Climate and heat in urban areas.
This report reflects the proceedings of the first day.

Welcome by Pier Vellinga, Wageningen University/CcSP (chair)
Prof. P. Vellinga welcomes the participants at this symposium organised by the Climate changes Spatial Planning programme. The programme is funded by the Dutch government to do research on spatial planning from a climate change perspective. In the programme we have projects both on adaptation and mitigation, but during this seminar we focus mainly on adaptation. The subject is adaptation in cities, as we are still at the start of organizing a knowledge base on this issue. We are honoured to have guests from the United Kingdom and Germany, who have done pioneering work in this area. It is the start of a new research agenda, that we are putting together with stakeholders and researchers.

Introduction by Florrie de Pater, VU University Amsterdam/CcSP
Adaptation to increasing temperatures in cities is not yet an issue in the Netherlands. Since the hot summer of 2003 the Red Cross has started to lobby the Dutch government to make a Heat wave Plan. Such a plan has recently been issued by the Dutch Ministry of Health. This plan, however, only deals with ways to react when there is a heat wave. There are no ideas yet on how to plan a neighbourhood and how to build houses that are heat proof. In the last century 38 heat waves occurred, of which 11 were after 1990 and six after 2000. The frequency of heat waves is expected to increase, according to IPCC figures. The KNMI climate scenarios describe not only higher temperatures, but also dryer summers and wetter winters, depending on the circulation patterns. In cities, the air temperature can be 8 to 10 degrees Celsius higher than in the surrounding countryside. We need to mitigate heat extremes in cities as to avoid people turning on air conditioning devices, which consume a lot of energy, make the heat problem in the city worse and aggravate the climate problem.

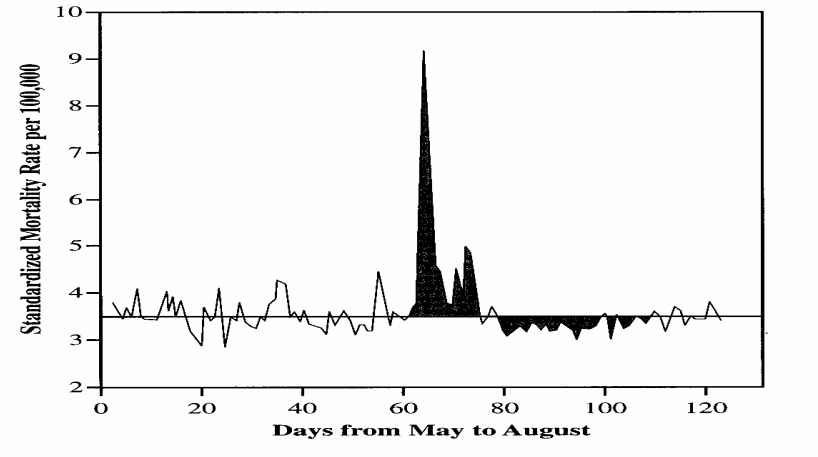
Of course, for some people higher temperatures are no problem, but for other groups it can have serious health implications. What kind of research do we need? We plan to do four projects on the short term:

1. A Dialogue project, with Vincent Kuypers and Bert Enserink, meant to explore the field and connect it to a broad array of public and private stakeholders;
2. A scientific project 'Heat in the city', with Peter van Oppen and Karel Mulder, about planning and building in anticipation of more heat waves;
3. A scientific project 'Water-robust building', with Frans van der Ven, about planning and building in anticipation of more (heavy) rainfall but also more droughts;
4. A scientific project 'Climate in the city', which is still in the preparatory phase, on actual measurement and scenario's for the microclimate at city level.

Effects of urban heat on health by Maud Huynen, ICIS, University Maastricht

IPCC reports have already listed health effects of climate change, such as increased chance on disease and premature deaths. The Lancet also published an article about climate change, mentioning thermal stress, malaria, food security and poverty as areas of increased risk. These effects are not the same around the world. Africa will suffer from infectious diseases, malaria and food insecurity, whereas Europe expects more heat stress, allergies and Lyme disease. Africa has less adaptive capacity, but Europe and the US also appear to be unprepared for extreme events such as Katrina. In Mrs. Huynen's study the relation between temperature and mortality appears as a U-like shape, with an optimum at 16 degrees of the combined heat and cold effect on human beings. This optimum is related to the region: in the South of Europe the optimum is higher and in the North of Europe the optimum is lower. Younger people are less vulnerable. The question how these effects will change with a changing climate is interesting. An increase in average temperature is expected in winter as well as summer. Therefore, we would expect less cold related deaths and more heat related deaths. This is when we consider average temperatures, but the projected increase in heat waves is also interesting. Should we worry, since there is a net reduction of weather related deaths? Yes, because there is not only an effect on mortality (deaths) but also on morbidity (illnesses). There are less data on this, but the year 2003 showed some effects, such as overwhelmed health systems, effects on labour efficiency, and even increased crime rates. Therefore we consider it worthwhile to think about how to adapt.

In the Netherlands, we have an official definition of a heat wave: at least five days in a row with temperatures higher than 25 degrees, of which 3 days with temperatures above 30 degrees. What was the excess death rate per heat wave? The figures show that especially elderly people are vulnerable, as well as people with cardiovascular and respiratory diseases. In 2003, there were between 1400 and 2200 extra deaths during the whole summer. There also are figures on heat wave deaths in other countries. France leads the list with 55% excess deaths in two weeks. During the peak they had 2000 extra deaths per day. In the figures, sometimes a so-called 'harvesting effect' is found, meaning that after the heat wave, less people die compared to the average number. This suggests that a heat wave only has a small effect on the timing of death. There is a debate if heat waves lead to a real loss of life or not. The harvesting effect is not found in all heat waves.



Another debate is on the relation with air quality. Higher temperatures lead to more ozone and smog, so are people killed by the heat alone, by the increase in air pollution, or by a combination of both?

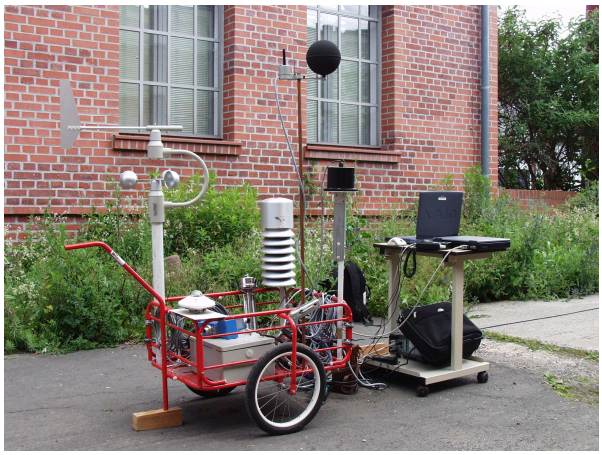
The next issue is the urban heat effect: the urban population is supposed to be more affected than people in the surroundings of a city, because city temperatures are generally higher. In 2003, most of the French heat wave deaths occurred in Paris, and in that period pollution figures were also higher. In the Netherlands, 40% of the extra deaths of 2003 were related to air pollution. The effects of the heat waves were milder because the densely populated areas of the Netherlands are in the west, where the sea breeze reduces the temperature. Concluding: why should we worry: because there will be more urbanization, increased numbers of aging people, higher air pollution levels and more heat waves because of climate change. Remaining questions: Are we prepared? What are the adaptation options? Do we need to change building guidelines? Can air conditioning help?

Questions from the audience

- Prof. Helmut Mayer, Freiburg Met-office, asks whether the effect of heat stress is related to air temperature, perceived temperature or other factors? Mrs. Huynen answers that in the literature they look at mean air temperature, but apparent temperature and humidity are also relevant;
- Guus de Hollander, MNP asks whether the harvesting effect disappears in the noise, if it would happen over a longer period. Mrs. Huynen answers that in France there was no harvesting effect; they looked at a two month period. All studies use different methods, so they are difficult to compare;
- Bert Enserink remarks that the assumption is that temperatures are 10 degrees higher in cities, but we never measure temperatures there. All meteorological data are collected at airports or in places outside urban areas;
- Another question posed is whether an increase in heat effects is expected towards the south? The answer is yes. In a comparative study it was assumed that there would be a shift proportionate to the average temperature of an area. For the Netherlands we not only expect a shift in average temperature, but also a shift in variance. If summers become hotter and winters colder, than we may also have an increase in cold deaths;
- Pier Vellinga states that people in southern areas may have some biological adaptation but the building styles are also different;
- Leendert van Bree, MNP remarks that, if you get more data, you may not see any positive effect of winters;

- Pier Vellinga concludes that a lot more data are necessary and that we need to measure at different places.

Problems and policy solutions in Germany by Lutz Katzschner, University of Kassel
Prof. Lutz Katzschner is a meteorologist working in an institution of architects on urban climatology. Important factors for this discussion are air pollution, thermal comfort and climate change. In principle we are expecting an increase in air temperature and a reduction of wind. The question is how we can use the potential of an area to improve temperature characteristics. In coastal areas there is more wind; in inner country less, so there is no ventilation. This can lead to an uncomfortable situation even in a mild climate. In cities, often the ventilation is blocked; how to design to get fresh air into the cities? This depends on the height and breadth of buildings, and on the density or scatteredness of spatial developments. There has been an analysis of heat waves in Freiburg and effects are already visible. In Frankfurt the number of days with heat stress have increased.
In a project in Freiburg the PET index was used, including temperature, humidity, wind and long and short wave radiation. These factors were measured with a mobile installation. Simultaneously, people were interviewed about comfort. In Kassel, a temperature between 22 and 24 degrees was perceived as comfortable. In tropical areas, this may be around 28 degrees. In a moderate climate people go outside when the weather is nice, and then ventilation is important for their comfort. Some places, according to the measurement exercise, were never perceived as comfortable: where the landscape was ugly and always windy.
The picture is very variable. In Hong Kong, with a tropical climate, wind speed has a positive effect on thermal comfort, but in Kassel, at 18-20 degrees people do not want much wind. In Berlin, streets stay hot for a long time, while slopes cool down in the night. The PET value varies more than the temperature; long wave radiation comes from buildings and leads to a higher value of heat stress. Temperature and rain are distributed unevenly, and lead to heat stress areas as well as cooler areas.



The thermal comfort value can be used as a planning tool. Different uses ask for different planning. PET data can also be used to plan adaptation strategies to climate change. Maps can make clear where heat islands are, and where wind should not be blocked; or where there is too much wind, which actually should be blocked. Heat islands usually exist in situations with high buildings, small streets and less green areas. Sometimes there is not much to be done to mitigate the effects of heat islands, other than destroying buildings. The PET method was used to analyse local situations in Stuttgart and Hong Kong. In Stuttgart a planning map

showed how to make use of slopes, where not to build, and where to limit the number of floors.
The use of building materials also has an effect on the microclimate. Photovoltaic systems have a positive effect on radiation and air temperature. Trees in Algeria had a drastic effect on the microclimate. Shadow also influences city heat.
An interdisciplinary approach is used in Kassel: experts on global climate change, on thermal comfort, on interviewing citizens, on evaluation of data and planning tools are combined in a team.

Questions from the audience

- Frederik Hoedeman, Environmental assessment, Denmark is interested in thresholds: when is a park in a city too small to have an effect on cooling? Mr. Katzschner answers that on the micro scale even very small spots of green have effects. For increased ventilation you need a large size;
- Rob de Waard, Nieuwland Advies asks what the effect of green facades would be and whether this was modelled. Mr. Katzschner answers that he did not do any modelling, but only measured changes in land use and buildings, and their effects on the microclimate. Models are easier to use, but also more uncertain. There should be done more quantitative work;
- Peter Mensinga, ARUP states that next to the PET index, there are ten other indexes of comfort, and they all lead to different results and different advice. How sure can one be about the PET index? The answer is that they should not lead to differences in advice. The calibration is through the interviews. The people in Amsterdam and Hong Kong are not the same. In Latin America, there are 20 indexes around. But the important thing is to find out what it means in interviews;
- Pier Vellinga asks what other parameters these indexes use. Peter Mensinga answers that most of them use relative humidity, there is not much difference in parameters. Mr. Katzschner adds that they are quite comparable; measurement of humidity is sometimes different. Mr. Mayer adds that the same meteorological data are always used: temperature, humidity, radiation and wind. Many indices are empirical and they should not be used.
- Mr. Katzschner agrees and says that they analyze with facts and then sit together with planners and discuss what the problem is and how it can be solved.

In what way can London adapt to climate change by Alex Nickson, Greater London Authority

London is the first in the world to publish a municipal adaptation plan to climate change. The contents of the plan are: an outline of impacts, a baseline goal, a risk based, precautionary approach, research questions, and opportunities. In London, warmer, wetter winters are expected, and hotter, drier summers. In a Swiss analysis by the insurance sector, London came out as the ninth most dangerous place to be. This means we have to adapt seriously to stay an attractive marketplace. Questions are: when to adapt, and how much do we need to adapt? Four strategies are discerned:

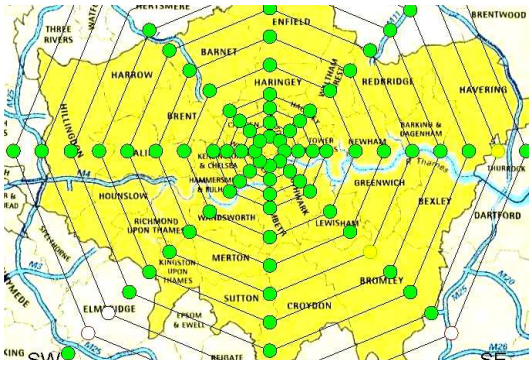
- prevent: infrastructural changes
- prepare: assess risks, insurance arrangements
- response: emergency plans
- recovery: support the people that suffered

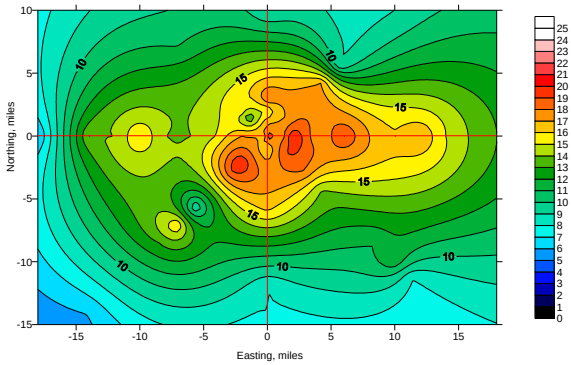
Urban heat is expected to increase due to:

- climate change
- increased density of building activities
- anthropogenic heat: traffic, air conditioning

- reduced evaporative cooling because of droughts

The average temperature in London (measured at the airport) shows an increase, and the number of hot days increases even more. In 2000 an experiment was done to identify heat islands in London. Air temperature measures were taken at 6 meters height and a graph showed areas where temperature remained above 19 degrees. Parks appear clearly in this picture as cool spots. Another experiment with remote sensing showed that the centre of London is about 5 degrees hotter than its fringes.





Vulnerable people may not be able to get out of the heat, and they may lack the knowledge to reduce it. Air pollution figures are also important: in dry years the effect of heat is stronger. There are two camps right now, with one saying that air pollution kills, and the other that mere heat kills.

The researchers of the London City Authority concluded that the average rise in temperature does not kill; heat waves do. Rural areas are 9 degrees cooler in summer and 4 degrees warmer in winter, compared to the inner city. We still have to plan for hotter events. London is still growing on a massive scale, and we do not want 50% of people to buy air conditioning, especially not the inefficient portable units. In our policy proposal we try to

1. reduce the heat effect of new developments:
    a. define where heat islands are
    b. re-greening London with an aggressive policy: not leftovers but priority
    c. seasonal shading
    d. cool materials for pavements etc
    e. cooperate with supermarkets (green roofs?)
    f. find climate resistant tree species
2. design buildings differently
    a. energy saving, but also prevention of overheating
    b. guidelines how to construct
3. use low carbon methods; cooling hierarchy:
    a. minimize heat generation
    b. stop heat from getting in (albedo)
    c. ventilation
    d. manage heat inside (thermal mass, higher ceilings)
    e. cooling: district cooling? Decentralized energy combined with cooling?
4. work with energy suppliers on adaptation; periods of high temperature will be less interspersed with cooler periods, and this is what causes people to buy air conditioners.
5. develop a heat wave emergency plan: it was tested in 2006. Measures for example: discourage traffic, promote clean cars, provide information about public buildings with air conditioning.

Questions from the audience

- Andy van den Dobbelsteen, TUDelft suggests that a solution for the air conditioners problem may be to put a tax on heat produced. Mr. Nickson finds this an interesting idea;
- Huibert Haccou, Habiforum asks whether the casualties in the summer are not compensated for in the winters. He also asks whether Mr. Nickson consulted with cities like Athens, Rome and Madrid for measures. Mr. Nickson states that excess deaths in the winter are not measured in the same way as in the summer, so it is hard to compare. They work with an international network of cities. Should we rebuild London like a Mediterranean city: no, planting trees is more effective.

Solutions through town planning and urban ecology by Prof.dr. Wilfried Endlicher

Prof.dr. Wilfried Endlicher started to show the derived insights from IPCC regarding climate change. He showed that the relationship between the number of habitants in cities and the Urban Heat Island effect (UHI) is different for Europe and the USA, the same holds true for mortality rates in correlation with thermal loads for different metropoles in the World. Heat stress is better expressed by the concept of 'Thermal Comfort' in contrary to Air temperature, which was exemplified by a simple model for the horizontal distribution of air temperature and thermal concept of a street surrounded by two walls, partly shadowed. Prof. Endlicher identified short-term and long-term adaptation measures to cope with the UHI effect. Short-term measures include measures such as early-warning systems and city heat wave plans.

Long-term measures are embedded in urban planning and building design. Some practical examples were presented regarding building design such as green roofs and the albedo enhancement of buildings (white painted walls) in combination with vegetation inside the building. The necessary energy for evaporation has a cooling effect for the temperature inside the building. Within the field of urban planning it is important to enhance the number of micro-climates within a city and the use of 'mobile shadowing' by use of trees and buildings.

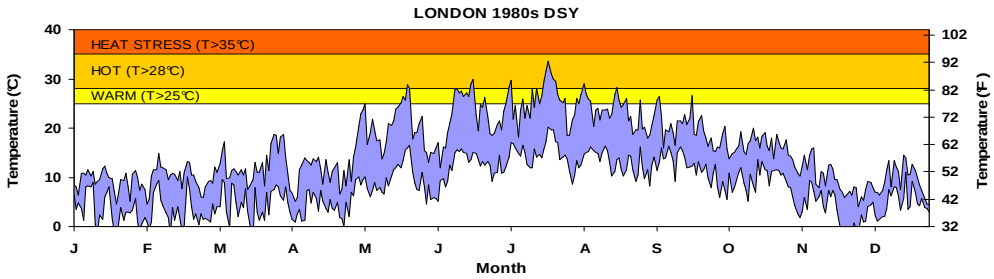
Rachel Capon, ARUP/UKCIP

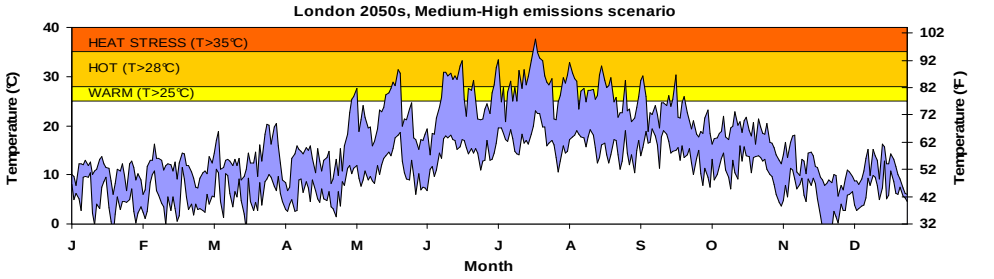
Miss Capon first presented the climate scenarios of UKCIP as well as the estimated flood and insurance costs due to climate change within the last decades (source Swiss Re). The latest climate scenarios from UKCIP are from 2002. An update of the scenarios will be published in 2008. The latter will be based upon the latest insights from IPCC 4AR, 2007. ARUP uses the UKCIP scenario's in order to estimate the UHI effect on city level.

After this introduction Mrs. Capon focussed on:

- Retrofitting of existing buildings in order to cope with the UHI.
- Indoor Climate Research

And showed some pictures of how a building can be adapted in order to mitigate heat effects indoor.





Martin Dubbeling, SAB/BNSP/NVTL working group
Martin Dubbeling called for an integrated approach of the Urban Heat Island Effect. Coping strategies should be integrated within sustainable urban design methods. The Urban Heat Island effect is not a single issue that stands on its own, it should be integrated in water- and energy policies. In addition coping strategies should be flexible: what should we do in 2010 in order to be climate proof in 2030?

Panel discussion
Martin Dubbeling kicked off the panel discussion with the statement that *we do not need to worry about hot weather in European Cities. There are no additional policy measures necessary.*

Prof. Lutz Katzschner states that you cannot make such a conclusion for all European cities, the (potential) urban heat island effect is much bigger in London than in for example Kassel. Health concerns are at stake. The mortality rates in Paris (2000) and in London (600) in the hot summer of 2003 prove that the Urban Heat Island effect is an issue.

Martin Dubbeling put his statement into perspective: what he wanted to say is that at this moment the UHI-effect is not a big issue, it might change due to climate change. Furthermore see the UHI issue in relation to other issues within the cities. Huib Haccou (Habiforum) agrees and proposes that UHI (temperature) risks should be combined with flood risks. Frans van der Ven (Deltares) disagrees. Conflicting interests for water during hot days will make an integrated approach difficult. He adds that UHI is in fact energy/heat! Can this energy from the sun be used by smart ways of building design and city planning? Salcedo Rahola (TU Delft) states that current Dutch houses are like “ovens”, cooling (air conditioning) will be necessary and that will request energy. It is important to show to designers and policy makers how many tonnes CO2 are emitted by the use of air conditioning.

A statement is made that the (health) effects of the UHI take place mostly indoors. So the solution should not be sought in urban planning but in building design and retrofitting of existing houses.

Frederik Hoeddemann from Denmark states that the UHI effect is from a scientific perspective indeed relevant. However, it is not yet seen as an important issue within the policy domain. What is the right type of information towards policy makers to address the issue? Frederik states that it is important to assess the costs and benefits of the UHI effect; that will draw the attention of policy makers. He exemplifies the situation in Denmark, where there is no political support for an adaptation strategy. He asks Alex Nickson how did they get political support in London?
Mr. Nickson answers that, in the case of London, it was important that mayor Livingstone is pressing hard in the national climate change discussion, open for dialogue with us and willing to convince other politicians. Furthermore the London Adaptation strategy is based upon a risk based approach. Also they plotted a decision making road map, a pathway into the future, instead of provoking a sudden decision.

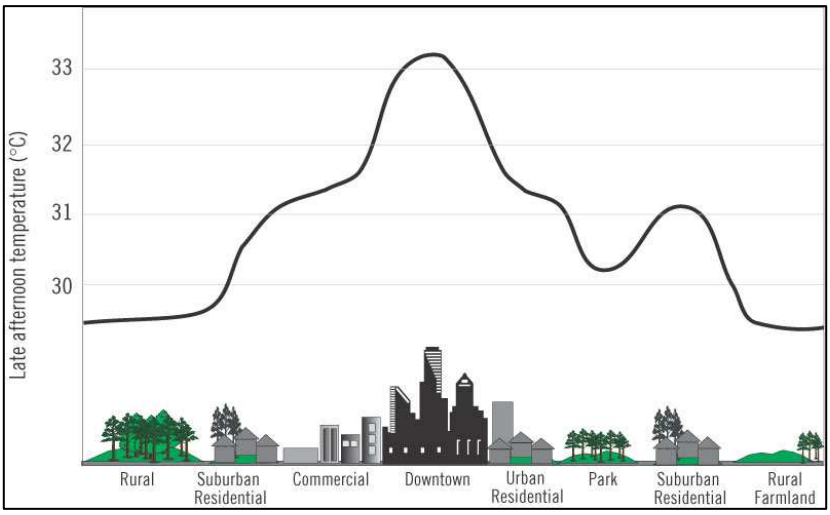
Wilfried Endlicher states that the fact that society is aging, increases the vulnerability of the urban society to the urban heat Island effect in the future. In reaction Alex Nickson states that climate proofing urban areas is, in fact, a well thought through sustainable development.

Wim de Jager (Provincie Zuid-Holland) was impressed by the large numbers and facts about the urban heat effect. Scientific insights do not seem the issue but the political will to take measures is lacking.

Miss Tine van de Weyer (Municipality of Tilburg) told that her political party in Tilburg has won a price from the national Government for the proposal to make many green roofs in buildings. Pier Vellinga asked if the ‘Cooling effect’ of the roofs was the primary argument for this activity. It was not the only reason, also energy saving and esthetical arguments were very important. However, currently many cities are approaching Tilburg to learn from their ‘Green Roof’ experience. Mr. Katzschner states that research proved that green roofs are not very effective in mitigating heat effects.

Leen de Jong, WNF, says that old knowledge from the sixties about ventilation corridors in Dutch cities is almost forgotten. It was developed in the context of air pollution issues, however also applicable for mitigating the UHI effect.

Florrie de Pater asks the panel if more vegetation in the city will also have a cooling effect on the indoor climate of houses. The panel confirms this is a possible strategy, this cooling effect exists. Someone states that in city design the benefits of climate change should be used. Climate change leads to more solar energy that can be used in energy supply (solar panels). As final statement it was concluded that adaptation in building design is 99% of the solution for UHI on indoors temperatures and Urban planning 1%.


Late afternoon temperature (°C)
33
32
31
30
Rural
Suburban Residential
Commercial
Downtown
Urban Residential
Park
Suburban Residential
Rural Farmland