Kennis voor Klimaat

Knowledge for Climate

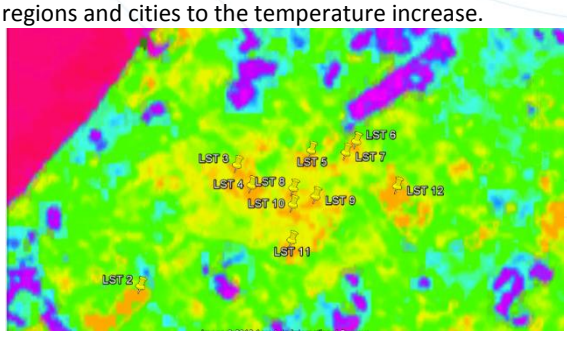
Project **Theme 4 | Design: City to region**

Description of research

It seems our cities are better prepared to provide shelter against low temperatures in the winter, than against high temperatures in the summer. Extreme summer temperatures are as dangerous as the extreme winter temperatures. More than 70 000 excess deaths were registered across Europe between June and September 2003 (Robine et al, 2008). Besides, **extreme summers**, far from being isolated phenomena, **will become more frequent, more intense and they will last longer**. See G.A. Meehl and C. Tebaldi, Science 305, 994 (2004) and T. R. Karl, K. E. Trenberth, Science 302, 1719 (2003).

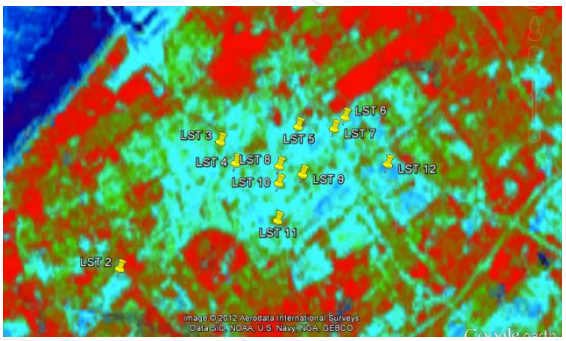
Heat waves wreak havoc especially in cities, where the Urban Heat Island effect increases the daily average temperature and prevents them from cooling off during the nights. Urban Heat Islands are caused by the changes human constructions introduce in the radiative and thermal properties of the environment. The annual mean air temperature difference between the city temperature and its rural environment ranges from 1 to 12 ºC.

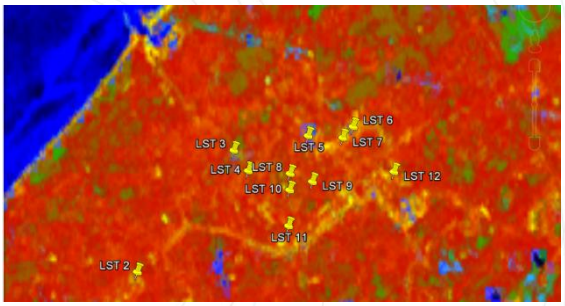
Although there are many scientific articles studying the UHI, there seems to be a gap between the sophisticated available technologies (remote sensing) and the UHI design adaptation proposals.
The objective of this research is to create a methodology based on remote sensing and developed from the urban planners perspective, to analyze the thermal behavior of cities in order to be able to provide design guidelines to adapt our regions and cities to the temperature increase.



Research question

- Why do certain urban areas within a city or a region heat up more than others?





The most important conclusions

- Identification of areas that have higher LST (Land Surface Temperature).
- Characterization and analysis of the areas with high LST (albedo, vegetation index, density, sky view factor, imperviousness, distance to the see or to water areas…).
- Assessment of the social vulnerability (age and income) of the areas most affected by heat in a certain city or region.
- Design of urban planning adaptation measures that will improve the thermal behavior of specific areas within cities and regions based in previous analysis. (This is particularly useful for the assessment of intervention in existing built environments.)
- Classification of neighborhood and city typologies based on their thermal behavior. This is particularly useful for the assessment of the construction of new neighborhoods.

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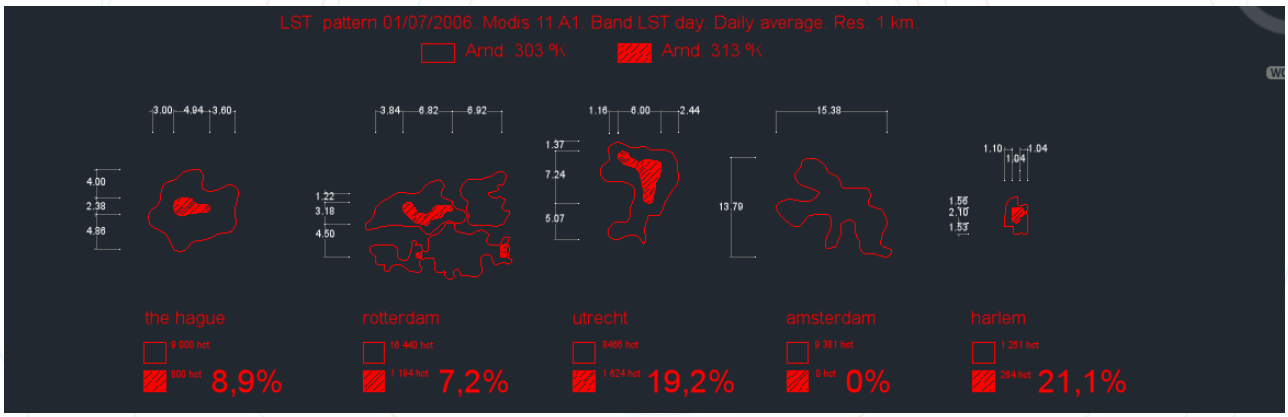
Possible applications from the project

- This research provides customized thermal adaptation solutions for each city or region. It provides assessment to municipalities on **where they need to act** (hotspots) and **how** (design solutions to be implemented).
- The approach is “analyze” before “design”, which maximizes the thermal impact of the design solutions, and therefore warranties the **efficiency of the investments** made by the municipalities.
- Remote sensing provides not only temperature maps, but also albedo, vegetation, imperviousness and shade maps. Therefore it provides a new way of analyzing the cities and allows to analyze the **historical** (since the 80´s) **evolution** of those parameters. The analysis of this new available information is the basis for the development of efficient urban designs.
- The recession has increased the awareness of the **cost** involved in the execution of any urban project. Therefore it is now more important than ever to understand the implications and efficiency of the designs implemented. The proposed methodology issues precisely accurate thermal documentation that justifies the suggested interventions.
- Topical issue: There is scientific evidence proving **extreme summers**, far from being isolated phenomena, will become more frequent, more intense and they will last longer. In NL, KNMI´06 climate scenarios for 2050, we can see that the knmi 30-year average temperature predictions in De Bilt will continue rising in any of the 4 scenarios and that the amount of summer days (maximum temperature >= 25°C) per year will also continue rising across the country. These data reveal that this research is clearly a **topical issue**.



Bottlenecks of the project

- Although heat waves are becoming more frequent, it is sometimes complicated to make the municipalities aware of the relevance of the issue, and of the importance of progressively starting to analyze the thermal impact of any construction or design.
- Urban planning has to take into consideration many different components (social interaction, design, connectivity, environmental impact, topography…), and thermal impact is one of them. Therefore design solutions suggested should be flexible enough to address all other aspects as well.

More information

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