The Urban Heat Island of Rotterdam derived from satellite imagery

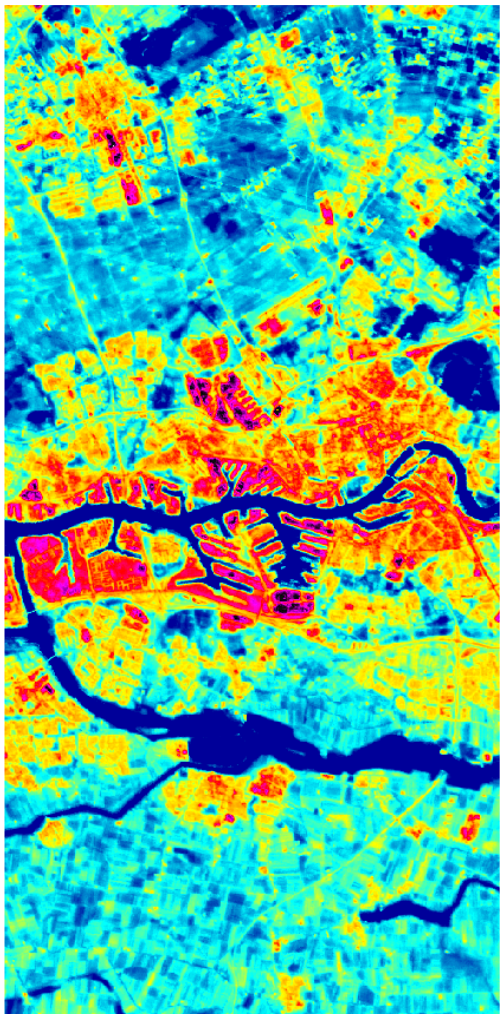
Location	Rotterdam
Contractor	Municipality of Rotterdam, Knowledge for Climate programme
Period	2009

Scope of the project

The urban heat island (UHI) refers to the warmer temperatures within urban settlements compared to the temperatures over the surrounding rural areas. Each settlement exhibits an UHI regardless of its size. Its strength depends on the urban structure, building density, canyon geometry, surface materials, heat added by human activities, vegetation coverage and water surfaces in the city. Urban areas are therefore particularly vulnerable to heat waves and the negative effects for humans, such as increased hospitalisation and mortality and reduced labour productivity and thermal comfort.

Study approach

Thermal infrared high resolution satellite images from the Landsat sensor were used to identify the Urban Heat Island. Surface temperature maps from 15 summer days since 1984 have been investigated to spatially quantify the surface heat island of Rotterdam. For each day, the average derived surface temperature of several districts and neighbourhoods within the city was compared to the rural temperature outside the city. Furthermore, NOAA-AVHHR satellite images were used to monitor the heat wave of July 2006 and retrieve the diurnal variation in the surface heat island of Rotterdam. These were compared with air temperatures measured hobby meteorologists inside the city.



Average surface temperature in Rotterdam and surroundings

Results

Landsat thermal infrared images of 15 summer days since showed that the daytime surface heat island of urban Rotterdam can be as large as 10 ºC compared to surrounding non-urban areas. The SHI differs between the several districts and neighbourhoods in Rotterdam. Especially urban vegetation and the use of urban materials (through the surface emissivity) explain these differences. The spatial pattern of the SHI also differs significantly between day and night. This was revealed by the analysis of the diurnal variation in the surface temperature retrieved from a series of NOAA-AVHHR derived surface temperature maps. This implies that districts with a maximum nighttime SHI differ from the districts with a maximum daytime SHI.

Conclusions

Spatial quantified information on the extent of the UHI effect is important for future city design with respect to the quality of living for its inhabitants, but also for policy makers and health organizations to provide appropriate measures addressed to the right neighbourhoods to mitigate the effects of the UHI. Thermal remote sensing can provide this information at relatively small costs with high detail over large areas.

This work was carried out together with TNO Built Environment and Geosciences based in Utrecht.

WaterWatch – Generaal Foulkesweg 28 – 6703 BS – Wageningen – the Netherlands
T +31 317 423 401 – F +31 344 693 827 – E info@waterwatch.nl – www.waterwatch.nl