

Urban heat and heat stress in Rotterdam

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TNO | Kennis voor zaken



CONNECTING WATER WITH OPPORTUNITIES
ROTTERDAM CLIMATE INITIATIVE
Climate Proof

Heat stress – effects of heat

- Heat stroke
- Excess mortality
- Sleep disturbance
- Loss of work productivity
- Decreased wellbeing



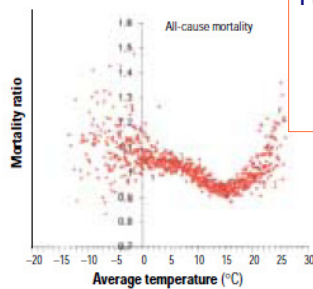
Risk factors for heat stroke and mortality:

- Being elderly
- Obesity
- Diabetes
- Cardiovascular disease
- Respiratory disease
- Psychiatric disease
- Medication use



Excess mortality in Rotterdam

- Heat waves: 40 deaths per day in the Netherlands (Huynen et al 2001)
- Excess mortality with average temp >20 °C (~25 °C max temp): 12.1%
- Heatwave 2003 NL: 500 extra deaths in 2 weeks (Garssen et al 2005)
- Heatwave 2006 R'dam: 20 extra deaths per week (van der Wilt, 2006)



Rotterdam:

- ~3.75 % of population in the Netherlands
- 1.5 extra deaths per day with average temp >20 °C
- 24 days with max temp > 25 °C (KNMI, de Bilt)
- → 36 heat-related deaths per year



Heat-related sleep problems in Rotterdam

- ERGO (Erasmus Rotterdam Health Study)
- Data from 1024 elderly participants (6906 subject nights)
- Average outdoor air temperature day before

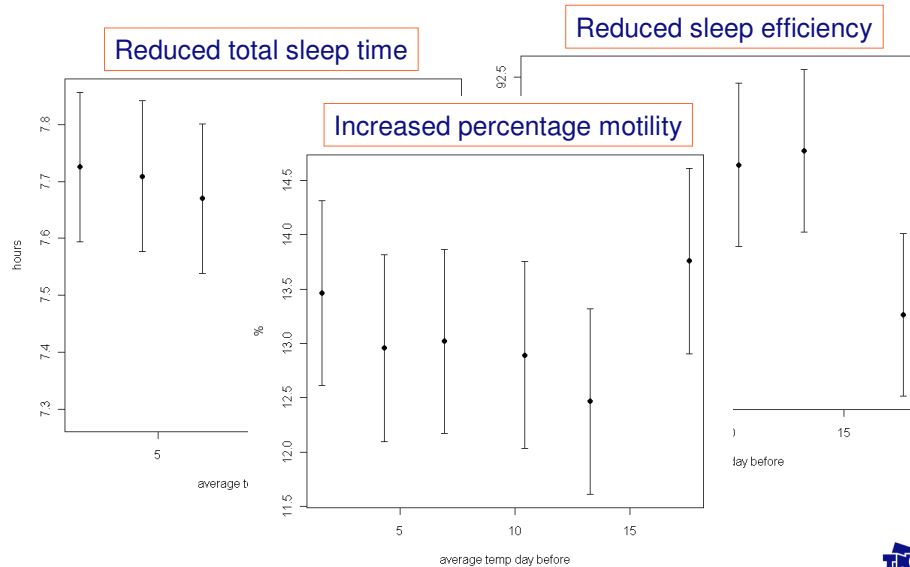


Sleep aspects derived from wrist actigraphy:

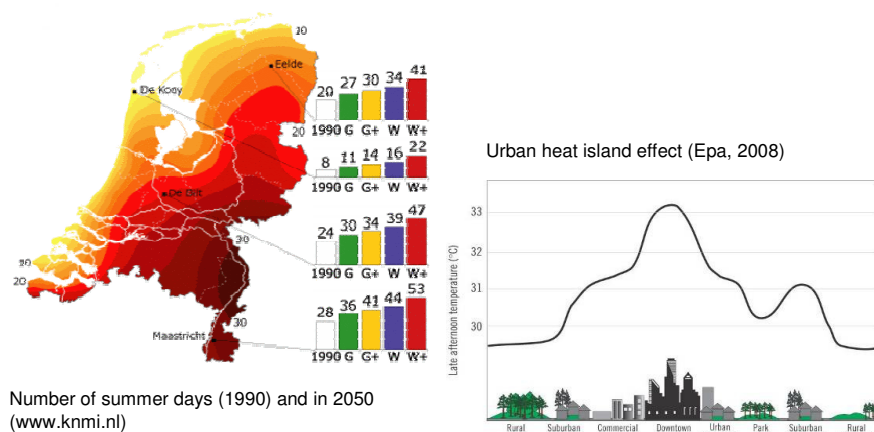
- Total sleep time (actual time asleep, hours)
- Sleep efficiency (ratio total sleep time / total time-in-bed)
- Sleep onset latency (time-in-bed prior to sleep onset)
- Motility (% wrist movements during sleep period)



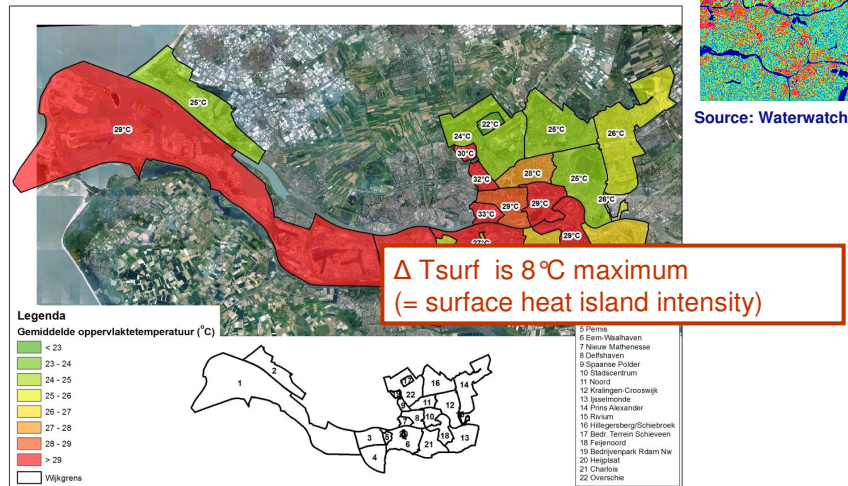
Effects of heat stress on sleep



Heat in Rotterdam: climate change + urban heat



Districts vulnerable to heat

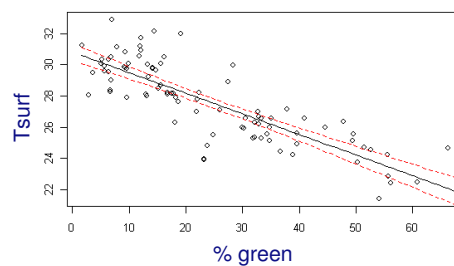


Average surface temperature of each district for summer situation at noon based on 15 Landsat images.



Causes of urban heat island

- Vegetation
- Water
- Building density
- Surface materials
- Anthropogenic heat



10% increase in percentage green
causes decrease in Tsurf of 1 °C



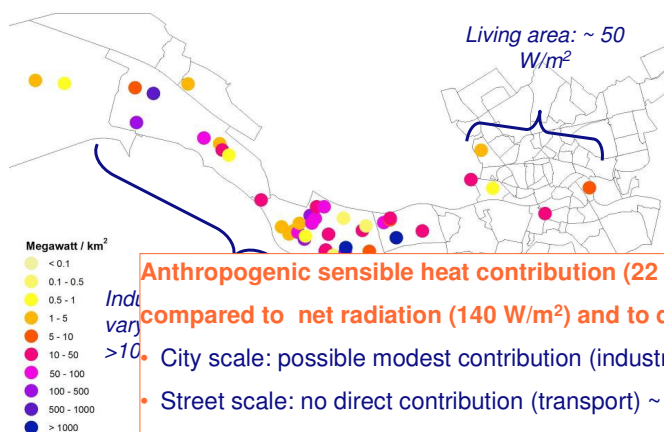
Anthropogenic heat

- Heat losses from energy consumption in summer time
- Main sources: buildings / households, industrial processes and road transport
- Inventory based upon statistical information of Statistics Netherlands, Emission register, Traffic register, Building register (Directorate General of Public Works and Water Management)

How important for urban heat?



Sensible anthropogenic heat - Industry

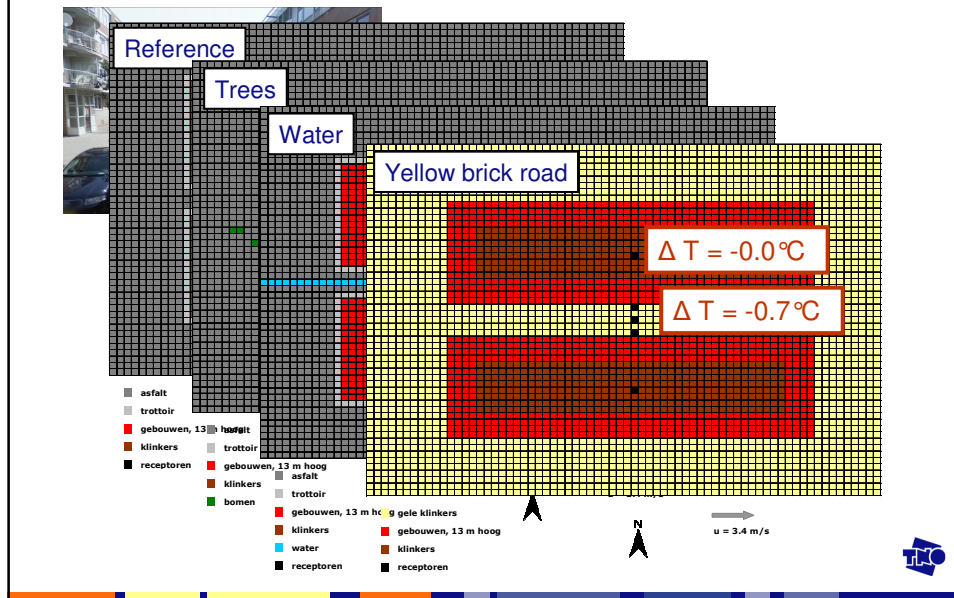


Anthropogenic sensible heat contribution (22 W/m²) is low compared to net radiation (140 W/m²) and to densely built cities.

- City scale: possible modest contribution (industry) ~ 20 W/m²
- Street scale: no direct contribution (transport) ~ 6 W/m²
- Indoors: important for heat stress (appliances) ~ 50 W/m²



Measures against heat tested in Envi-met



No-regret measures for Rotterdam

Large uncertainties → No regret

=

No cooling in winter, No negative side-effects, Flexible in time & place

No-regret options:

- Small scale green, blue roofs and fountains
- Sprinklers on roofs, outer walls and streets (disadvantage is water use)
- Indoor: Energy conservation, sunblinds and active cooling (airco disadvantage is <1%- energy use and CO₂ emission)
- Behavioral measures: lower work tempo, search shading and cooling, acclimatize to heat, adapt medication, increase liquids intake