Quantification of the urban heat island effect and human comfort in the Netherlands using data from hobby meteorologists: role of vegetation in the city.

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Research questions

Urban meteorology and in particular the urban heat island effect (UHI) and human comfort have been overlooked in the Netherlands. However, recently the general public and urban planners have become more aware of the relevance of urban heat (Fig 1). Dutch cities are somewhat special due to water and green vegetation availability.

Methodology

Since long term observational records in cities are scarce, we explore the possibility to use long observations records from hobby meteorologists (Fig 2).

Results

Figure 3: distribution of daily maximum UHI and WBGT, and UHI as function of wind speed and incoming daily radiation for Apeldoorn city (site 11). UHI is approximately linear in received radiation, and decreases strongly with wind speed. Maximum WBGT values are close to the 22.7 °C threshold for general warning.

Figure 6: Validation of urban green cover estimation from GoogleMaps. Results shows performance for permutations of known green and water cover. Overall correspondence and correlation is satisfactory.

Figure 7: UHI as function of green vegetation cover (left) and population density (right).

Generalized Extreme Value (GEV) distribution

Daily maximum UHI and WBGT values follow the GEV distribution rather well. GEV can be used to estimate return period of extreme hot events.

Conclusion

• Mean daily maximum UHI ~2 K, 95 percentile 5.1 K.
• Human comfort and UHI follows GEV distribution
• Significant UHI reduction by urban green, in particular for higher percentiles.
• No link between UHI and water bodies detected.