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Spatial variation of human thermal comfort and impact of mean radiant temperature during a heat-wave in the town of Wageningen, The Netherlands

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The Netherlands has a mild Cfb climate but occasional heat waves during anticylonic weather conditions may have a large impact on human thermal comfort. Climate projections show an increase in strength and duration of heat waves and urban space is expanding. Expansion may lead to stronger urban heat islands (UHI) and an increase in the population exposed to higher temperatures, especially the more fragile sectors such as the elderly, ill, etc. Thus there is a need to include human thermal comfort in urban planning and design rules. Outdoor space is a complex 3D environment composed of topography, built space, greenery, water and impervious surfaces. To understand outdoor human thermal comfort there is a need to quantify every environmental component of the human thermal energy balance. These components are air temperature, humidity, wind speed, and radiation components (both thermal and short wave in all 6 directions). A measurement campaign was initiated for Wageningen (size 5 km2, population 37,500 in 2010). Meteorological Instrumentation including all relevant radiation measurements to derive mean radiant temperature were mounted on 2 cargo bicycles to increase manoeuvrability in complex environments (Heusinkveld et al., 2009). The data were recorded at 1 Hz, with concurrent readings from a GPS device. Measurements were performed along previously determined routes to include grasslands, parks, forests and various urban districts. The observations were carried out during a heat wave and each measurement round lasted <1 h, with these rounds repeated every 2 h. The temperature and moisture field was monitored with a novel dense network of 30 weather stations throughout the city. All 30 stations were installed inside the urban canyon and equipped with a ventilated Stevenson screen. These measurements started in summer of 2013. The maximum nocturnal UHI seems similar to those of much larger cities. Measurements show that while the heat wave progresses and topsoil dries out, UHI becomes very small during Tmax. Spatial variation in human thermal comfort is strongly affected by radiation and therefore heat stress exposure is not directly linked to UHI.

Reference:
Heusinkveld, B.G., L.W.A. van Hove, C.M.J. Jacobs, G.J. Steeneveld, J.A. Elbers, E.J. Moors, and A.A.M. Holtslag (2010): Use of a mobile platform for assessing urban heat stress in Rotterdam, Proceedings of the 7th Conference on Biometeorology. - Berichte des Meteorologischen Instituts der Albert-Ludwigs-Universität Freiburg 20 (2010). - ISSN 1435-618XFreiburg : , 2010 - p. 433 - 438.