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Dense network of wet bulb globe temperature observations to assess the effect of diverse micro-environments on heat stress

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There is an urgent need for governments to know which measures effectively decrease heat stress and how to adapt urban environments to keep our cities livable in a climate with more, and more extreme, heatwave days. To answer this question, an observational campaign took place in the urban fringe of Ghent (Belgium), a maritime mid-latitude city, during the summer of 2023, including a heatwave in June. This campaign employed diverse in-situ weather stations (2 Campbell stations, 2 Hobo devices and a station from the Flemish MOCCA and VLINDER networks) complemented by 16 AT-HTS01 devices, specifically designed to measure heat stress. Combined, the stations are equipped with black globe thermometers, anemometers, humidity sensors, short-wave radiation pyranometers and actively and passively ventilated air temperature sensors. Based on these variables the wet bulb globe temperature (WBGT) is computed and from this, the influence of different suburban micro-environments on heat stress is derived. In particular, the effects of the surface type, neighboring buildings, trees and forest patches on WBGT are investigated. Some air temperature sensors are installed in actively ventilated shields to detect air temperature differences in different forest patches excluding any radiation-induced measurement errors. Additionally, drone infrared measurements were conducted to estimate the surface temperature of the different surface types during the day and the night. A forest patch decreases the maximum air temperature during the heatwave to up to 1.5°C. At night, the unpaved surface decreases the globe temperature to up to 1.5°C compared to paved surfaces. During daytime shadow effects of buildings and trees have the largest impact on decreasing the globe temperature (by 10°C) and consequently strongly lowers the actual WBGT (up to 4°C). Future research will focus on validating meter-scale numerical models with these observations.