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Application and performance of Kestrel sensors for assessing thermal comfort in outdoor built environments

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In face of climate change and urbanization, the need for thermally comfortable outdoor urban spaces is increasing. In the design of the thermally comfortable urban spaces and decision making about interventions that enhance thermal comfort, scientists and professionals that work for cities use meteorological measurements and models. These measurements can be done by professional and accurate meteorological sensors, but also by simpler mobile instruments such as the easy-to-use Kestrel weather meters. In using these simple type of sensors, it is important to know what the performance of these sensors is for outdoor thermal comfort assessments and how they can be used by scientists and professionals in decision making about urban designs that enhance thermal comfort.

To answer these questions, we carried out three experiments in the summer of 2020 in Amsterdam, in which we tested the 11 Kestrel 5400 heat stress sensors and assessed the performance of this equipment for thermal comfort studies. We concluded that Kestrel sensors can be used very well for assessing differences in air temperature and PET (Physiological Equivalent Temperature) between outdoor built environments. For both air temperature and PET, the RMSE between the 11 Kestrel sensors was 0.5 °C maximum when measuring the same conditions. However, Kestrel sensors that were placed in the sun without a wind vane mounted to the equipment showed large radiation errors. In this case, temperature differences up to 3.4 °C were observed compared to Kestrels that were shaded. The effect of a higher air temperature on the PET calculation is, however, surprisingly small. A sensitivity analysis showed that an increase of 3 °C in the air temperature results in a maximal PET reduction of 0.5 °C. We concluded that Kestrel sensors can very well be used for assessing differences between air temperatures and PET between two locations and assessing the thermal effects of urban designs, but care should be taken when air temperature measurements are carried out in the sun. We always recommend using the wind vanes to deviate from high radiant input orientations for the temperature sensor, and placing the stations next to each other at the beginning and at the end of the measurements to check whether the stations actually measure the same values. Any differences can be corrected afterwards.