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Retrieval of air temperatures from crowd-sourced battery temperatures of cell phones

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Accurate air temperature observations are important for urban meteorology, for example to study the urban heat island and adverse effects of high temperatures on human health. The number of available temperature observations is often relatively limited. A new development is presented to derive temperature information for the urban canopy from an alternative source: cell phones.

Battery temperature data were collected by users of an Android application for cell phones (opensignal.com). The application automatically sends battery temperature data to a server for storage. In this study, battery temperatures are averaged in space and time to obtain daily averaged battery temperatures for each city separately. A regression model, which can be related to a physical model, is employed to retrieve daily air temperatures from battery temperatures. The model is calibrated with observed air temperatures from a meteorological station of an airport located in or near the city. Time series of air temperatures are obtained for each city for a period of several months, where 50% of the data is for independent verification. Results are presented for Buenos Aires, London, Los Angeles, Paris, Mexico City, Moscow, Rome, and Sao Paulo. The evolution of the retrieved air temperatures often correspond well with the observed ones. The mean absolute error of daily air temperatures is less than 2 degrees Celsius, and the bias is within 1 degree Celsius. This shows that monitoring air temperatures employing an Android application holds great promise.

Since 75% of the world's population has a cell phone, 20% of the land surface of the earth has cellular telephone coverage, and 500 million devices use the Android operating system, there is a huge potential for measuring air temperatures employing cell phones. This could eventually lead to real-time world-wide temperature maps.