Crowdsourcing urban air temperatures through smartphone battery temperatures in São Paulo, Brazil

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Crowdsourcing as a method to obtain and apply vast datasets is rapidly becoming prominent in meteorology, especially for urban areas where traditional measurements are scarce. Earlier studies showed that smartphone battery temperature readings allow for estimating the daily and city-wide air temperature via a straightforward heat transfer model. This study advances these model estimations by studying spatially and temporally smaller scales. The accuracy of temperature retrievals as a function of the number of battery readings is also studied. An extensive dataset of over 10 million battery temperature readings is available for São Paulo (Brazil), for estimating hourly and daily air temperatures. The air temperature estimates are validated with air temperature measurements from a WMO station, an Urban Fluxnet site, and crowdsourced data from 7 hobby meteorologists' private weather stations. On a daily basis temperature estimates are good, and we show they improve by optimizing model parameters for neighbourhood scales as categorized in Local Climate Zones. Temperature differences between Local Climate Zones can be distinguished from smartphone battery temperatures. When validating the model for hourly temperature estimates, initial results are poor, but are vastly improved by using a diurnally varying parameter function in the heat transfer model rather than one fixed value for the entire day. The obtained results show the potential of large crowdsourced datasets in meteorological studies, and the value of smartphones as a measuring platform when routine observations are lacking.