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Deriving an urban climatology using crowd-sourced meteorological data: A case-study on Dublin, Ireland

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Urban areas have profound effects on the overlying atmosphere but historically, our knowledge of the effect on climate and weather has largely been derived from one-off field experiments that make observations over a defined period. Even where urban meteorological networks have been established the level of investment of time and finances have proved difficult to sustain. At the same time, detailed spatial and temporal urban meteorological data are a valuable resource that can be used for a great number of applications including air quality, heat stress, building energy management, and so on. Typically, this information is obtained from a standard meteorological station (often located at an airport outside the city), even though the observations may deviate significantly from the weather experienced in the city. Alternatively, some urban effects can be modelled using relatively simple models using observations on the background climate and information on the character of the urbanised landscape. To be valuable, however, these models should be evaluated against observations, which in cities are in short supply. The availability of meteorological data from personal weather stations (crowd-sourced data) has the potential to partially fill this gap, once their quality has been assessed.

This research examines the potential of crowd-sourced meteorological data to derive an annual climatology across a city (Dublin) and uses these data to evaluate the Surface Urban Energy and Water Balance Scheme (SUEWS). Data from NETATMO and the Weather Underground networks provide the substantive basis for this climatology; the quality of these data are evaluated by compiling metadata and statistical analyses. These data are combined with other official sources of meteorological data, to construct a detailed climatology for the period Apr. 2016 to Sept. 2017. Separately, the SUEWS model is applied to Dublin's urban landscape and is used to simulate near-surface air temperature and humidity. The derived climatology is used to evaluate these simulations and to examine the impact of topography and surface cover on the urban climate effect. The research will contribute to our understanding of the roles of urban surface cover on the local climate and the potential for urban planning and design to mitigate undesirable urban climate.