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Crowdsourcing the urban wind climate using private weather stations

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Urban meteorological research is characterized by a stringent scarcity of observations in the urban fabric. The highly heterogeneous composition of cities causes a microclimate that varies from street to street, requiring a dense network of observations to capture the full scale of the urban system. However, urban observations are scarce: standard WMO stations only measure in undisturbed (natural) areas, and maintaining dense urban networks is expensive, prone to vandalism and often obstructed by regulations. Over the past years, crowdsourcing has been a successful tool to obtain citizen science data regarding the urban heat island, as well as pressure and even urban rainfall. This is partly due to the increase in ownership of Private Weather Stations (PWS) by weather enthusiasts. These stations are affordable and of sufficient quality to measure the climate in one's own street, and can thereby provide a wealth of information to the urban meteorologist. The Netatmo station is a prominent PWS, which automatically uploads the meteorological measurements to the company's own website, which combines the data of all of its stations into a weather map. Though NetAtmo stations have been validated against established reference observation of temperature, whether they can reliably measure urban wind remains unknown. The urban wind climate is highly variable, more so than heat, due to the influence of street orientation, building height and obstructions (e.g. trees) which can drastically alter the wind between two streets. This study uses 2 years of data collected by several dozen PWS obtained from Netatmo and the Weather Underground platform, situated in and around Amsterdam, the Netherlands. The PWS data is compared to data obtained from 30 weather stations maintained by the Meteorology & Air Quality section of Wageningen University as part of the Amsterdam Atmospheric Monitoring Supersite. These stations serve as a benchmark against which the PWS will be compared, in terms of Weibull distributions of wind, as well as the effect of canyon morphology and Local Climate Zone on the wind behaviour as measured by the stations.