Quality Control and Bias Correction of Citizen Science Wind Observations

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Wind observations collected at citizen science wind stations (CWS) could be an invaluable resource in climate and meteorology studies, yet these observations are underutilised because scientists do not have confidence in their quality. While a few studies have considered the quality of CWS wind speed observations, none have addressed the biases, likely caused by instrumentation biases and station placement errors. These systematic biases introduce spatial inconsistencies that prevent comparison of these stations spatially and limit the possible usage of the data. In this paper, we address these issues by improving and developing new methods for identifying suspect observations and calibrating systematic biases in the wind speed observations collected at CWS.

Our complete quality control system consists of four steps: (1) performing within-station quality controls to check the plausible range and the temporal consistency of observations; (2) correcting the bias, mainly caused by low sensor heights, using empirical quantile mapping; (3) implementing between-station quality control that compares observations from neighbouring stations to identify spatially inconsistent observations; (4) providing estimates of the true wind when CWS falsely report zero wind speeds, as a complement to bias correction.

We apply these methods to CWS from the Weather Observation Website (WOW) in the Netherlands, comparing the citizen science data with official data, and statistically assessing the improvements in data quality after each step. The results demonstrate that the citizen science wind data are comparable with official data after quality control checks and bias corrections. Our quality assessment methods therefore give confidence to CWS, converting their observations into a usable data product and an invaluable resource for applications in need of additional wind observations.