Geoscientific Instrumentation Methods and Data Systems Discussions

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Reply on RC2

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Author comment on "Measurements of natural airflow within a Stevenson screen and its influence on air temperature and humidity records" by Stephen Burt, Geosci. Instrum. Method. Data Syst. Discuss., https://doi.org/10.5194/gi-2021-31-AC2, 2022

The manuscript was interesting and relevant to better understand the sampling characteristics as function of external wind flow in a Stevenson screen shelter. Many Met Services and other agencies still use the Stevenson Screen as their primary framework for taking measurements of temperature and humidity. Results from studies like this could help understand measurement uncertainites and also provide wind dependent correction factors for measurements using Stevenson screen.

Overall, I think the paper was well written and provided new results that will be interesting for readers. However, I feel the paper was limited in scope and could be expanded to better understand flow characteristics in the Stevenson screen at different locations within the screen. The could further be expanded to collect actual measurements of temperature and pressure to compare the variability of measurements with observed environmental wind speed and direction observations at the height of the Stevenson screen. I would like to see the author to expand on these ideas for future studies.

- I thank the reviewer for the suggestions. With respect however, this paper was never intended as a definitive statement of the variation of airflow *within* the screen, and its title reflects that. Indeed, understanding 'flow characteristics in the Stevenson screen at different locations within the screen' in any detail would suggest a combination of (small) multi-sensor and CFD approach rather than a programme of exploratory measurements with a single sensor as was the purpose of this experiment. Some work regarding a CFD approach has been attempted, and is referenced in my paper (Dobre, et al). The work documented was, and is, deliberately limited in scope to quantify the range of typical ventilation speeds occurring within a Stevenson screen, measurements hitherto lacking although often assumed in various important areas such as psychrometric coefficient and response times, as my paper points out. Observed ventilation rates are then compared with conventional measurements of wind speed at standard heights, in order to provide guidelines for the wider meteorological community of how standard wind measurements can be used to infer in-screen ventilation rates, and onwards to suggest occasions when responsive and accurate measurements of air temperature within thermometer screens of the Stevenson type may be less reliable.

  A separate but related project is ongoing to document observed differences between aspirated and Stevenson screen measurements of air temperature, for which these

results will be directly relevant. Some results have already been published (Harrison, R. G. and S. D. Burt, 2021: Quantifying uncertainties in climate data: measurement limitations of naturally ventilated thermometer screens. Environmental Research Communications, 3, 061005).

Below is some specific comments for consideration:

Lines 55-62: The wind sensor was mounted in the center of the screen. Was this representative of the location of where temperature and humidity measurements are typically made? If not, why not mount the wind sensor at that location(s)? Was there any thought of makin flow measurements at other locations (higher/lower, closer to the screen walls, etc.) to see to characterize the variability in the screen. Significant variability could impact the observations of the temperature/humidity measurements. Did you explore any impacts of the measurements while using the laboratory stand to mount the sensor?

- The siting of the sensor was intended as far to match the typical location of temperature and humidity sensors within this type of enclosure. Agreed that it would be interesting to understand the variability of the flow at other points in the screen, but this would present experimental difficulties with the current apparatus mainly owing to the size of the sensor – there was simply not enough room to fit two such units within the screen (more than one unit would in any case complicate airflow within the screen). To determine variations within the screen structure, an experimental design could be envisaged using multiple small hot-wire anemometers (and probably within a wind tunnel), and the results used to develop a CFD model, but as stated above variation *within* the screen was not the primary motivation of the experiment as described.

Lines 63-64: Were the wind measurements logged at 1 min, 5 min, and hourly or was the observations logged at 1-min and averaged to 5 min and hourly or were subsampled at 5 min and hourly? This is a bit confusing.

- The sensor was sampled at 1 Hz and logged at 1 min, 5 min *and* Logged samples included average, minimum and maximum speeds, and vector mean directions. For most of the analysis, hourly means were sufficient, although 1 min and 5 min records were available and were examined where additional detail was beneficial. There was little point in providing additional analyses based upon the 1 min and 5 min records when conclusions using these data differed little from that derived using hourly values.

In Fig. 1, it would be interesting to know what is the direction of North for reference. This could help understand if there were any impacts of flow if the environmental wind was directly along one of the corners for example.

- Added note on orientation to Fig 1. In the northern hemisphere midlatitudes, screen doors open to the north and I had assumed this was common knowledge. The possible impact of the corners of the screen structure was examined in section 4.2.

Lines 128-130: The external wind speeds are measured at 2 m and 10 m. What is the height of the wind sensor above ground inside the screen? If the sensor in the wind screen is not at 2 m, what is the potential impact in the results of the study?

- The sensor within the screen was located at 1.25 m above ground level, the standard height within the UK of temperature and humidity sensors when exposed within a Stevenson screen. While wind speeds at this level are available from the observatory records, it is not a standard height for wind records and thus would make the results less relevant to other sites with wind records at standard heights (2m and/or 10 m).

I found the results shown in the discussion sections 4.3.3-4.3.6 interesting and a nice

exercise to explore the potential impacts. What would make this paper (or future paper) even more interesting if these results could be verified with actual observations from a Stevenson screen comparison study.

- Again with respect, I fear the referee may have misunderstood the purpose of this particular research, which is not to undertake comparisons between different Stevenson screens – although we are in fact accumulating data towards something similar, and the results will be published in due course. It would lengthen and dilute the current paper unduly to include these comparisons.

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