Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-158-AC2, 2019

Atmospheric Measurement Techniques Discussions
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Interactive comment on "Characterising low-cost sensors in highly portable platforms to quantify personal exposure in diverse environments" *by* Lia Chatzidiakou et al.

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Received and published: 12 June 2019

Overall response: Thank you for taking the time to provide useful comments. Referee #2 mentions that this manuscript is essential to underpin the validity of personal exposure measurements collected in two major health studies (APHH-Beijing, Theme3: AIRLESS https://doi.org/10.5194/acp-19-7519-2019 and COPE study https://doi:10.1136/bmjopen-2016-011330). The specific aim of the manuscript is therefore to evaluate a specific sensor package (the PAM) with a comprehensive, robust and reproducible methodology, rather than individual sensors or a generic sensor package.

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Discussion paper

The referee states that “there are many sensor studies worldwide in recent years”, feeling this work is not novel. However, there are concerns remaining in the scientific community regarding the validity of measurements collected with miniaturised portable sensors. For example, a recent literature review on portable sensors (Thompson, 2016 https://doi.org/10.1016/j.teac.2016.06.001) states that “current technology for inexpensive portable sensors is not sensitive or specific enough to meet demands” while a commentary article in Nature 2016 (https://www.nature.com/news/validate-personal-air-pollution-sensors-1.20195) disregards novel technologies due to “questionable air quality data”. Such opinions act as a barrier in adopting innovative methods that could revolutionise multiple disciplines including epidemiological research and the built environment and have significant societal benefits. Extending beyond the specific aim outlined above, we feel that this manuscript does also contribute significantly and positively to the wider literature of novel portable sensor technologies.

Detailed response: Temperature and relative humidity were not included explicitly in the linear model for the calibration of the electrochemical sensors. The effect of relative humidity on particulate matter estimations has been quantified in a previous publication (Di Antonio, A., et al., 2018. Sensors, https://doi.org/10.3390/s18092790). The cross-interference of other gases on the electrochemical sensors is covered in the manufacturers specifications and is beyond the scope of this work.

Calibration periods were selected based on campaign time periods not conflicting with deployments of the PAM to participants. The training set was about 1/3 of the total observations, an arbitrary choice. We used a combined training set from the winter and the summer co-locations. In that way, the selected training periods of each season become less important as the variation in pollutant levels between seasons is much greater providing the necessary wide range of calibration conditions.

The vehicle deployment aimed to evaluate the performance of the PAM in movement and did not aim to capture personal exposure of an individual within a vehicle. Forthcoming publications focus on the magnitude and duration of personal exposure in diverse microenvironments (including indoor locations and different commuting modes) during daily life activities.

The selected references on static outdoor co-locations are inevitably selective, and are not exhaustive of the large body of evidence on novel technologies. However, there is a lack of publications on the performance of portable platforms in diverse microenvironments, as presented in this manuscript.

Prices for individual sensors can be provided by the manufacturers. Low R^2 values especially for the NO and NO2 sensors were noticed at temperatures above 40 C (non-heating season in Beijing), which is above operational specifications and were not recorded during the participant deployment.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-158, 2019.