Supplementary Information for "The next generation of low-cost personal air quality sensors for quantitative exposure monitoring"

1.1. Fresh versus aged MOx results

Results from the 2nd co-location period in January showed better agreement with the reference monitors for CO and O_3, likely due to the replacement of the aged MOx sensors with fresh ones. Median standard errors among the M-Pods during the 2nd co-location were 0.28 ppm for CO (range 0.27-0.31 ppm), and 4.0 ppb for O_3 (range 3.3-4.2 ppb). These values compare favorably to the December co-location's median standard errors of 0.44 ppm (range 0.38-0.54 ppm) and 6.4 ppb (range 4.4-15.4 ppb) for CO and O_3. The fit with NO_2 was very similar to the first co-location, with median standard error of 8.8 ppb (range 5.4-9.0 ppb). Similarly, correlations among all M-Pods were higher than in the first co-location, with median CO, NO_2, and O_3 correlations of 0.94, 0.89, and 0.98, respectively. Fig S1 shows an example time series for CO using Equation 3. During this co-location 6 M-Pods were used, although one did not provide data due to a faulty power connection.

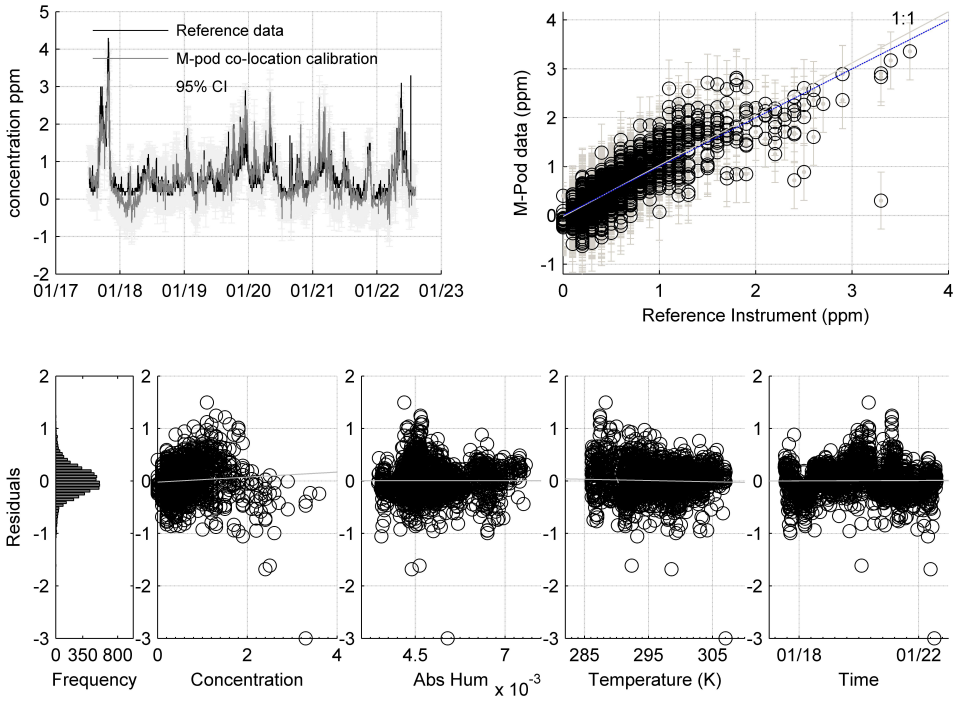

Figure S1 Comparison of CO measurements from the reference monitor and M-Pod 19 during the co-location in January 2013.

1.2. Drift

Linear drift correction (Haugen et al., 2000) was found to modestly improve the performance of all sensors during the co-location calibrations (Table 1), and during the

user study portion (Table 2). The CO and NO_2 sensors exhibited drift corresponding with increasing sensor resistance over time. Reversible and irreversible binding of gas molecules to sensor surfaces have been discussed in past works, and could increase sensor resistance due to removal of free electrons from the lattice. This would effectively remove a surface site from having the ability to interact with the target gas. However, adding a model term that allowed for flexibility in span over time did not improve the fit, and there appeared to be no significant changes in sensitivity of the sensors over the course of the experiment.

Temporal sensor drift was found to affect the results more during the user study than the co-location calibrations, likely due to exposing the sensors to diverse pollutants and environments, accelerating aging and increasing irreversible binding frequency. This drift was compensated for using a linear correction, but as others have found (Romain et al., 2010), the drift has a stochastic component and is difficult to predict. Performing an additional co-location, we found substantial drift in the direction opposite from which it had previously been drifting, possibly due to a “recovery” period, since the M-Pods were in a clean lab environment between those two calibrations.