Field and laboratory performance evaluations of 28 gas-phase air quality sensors by the AQ-SPEC program

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Highlights

- Low-cost sensors can provide useful information on ambient CO, O_3, and NO_2.
- For gas-phase sensors, it's important to consider potential cross-sensitivities.
- Application and performance are both important considerations in sensor selection.

Abstract

As interest in using low-cost sensors continues to grow among members of the public, robust evaluations of commercially available sensors are necessary. Information gained from independent evaluations can help ensure that the sensors selected by individuals or communities meet both user needs and their abilities. Appropriate sensor selection has the potential to ensure the collection of useful and informative data. The AQ-SPEC (Air Quality Sensor Performance Evaluation Center) program at the South Coast Air Quality Management District in California, USA aims at providing thorough characterizations of sensor performance through both field and laboratory evaluations. To date, 28 commercially available gas-phase sensors have been tested and the resulting evaluations have been made available to the public on the program's dedicated website. Here, we present our test methodologies for both lab and field evaluations as well as the evaluation results for the 28 sensors tested (14 devices in total, some containing multiple sensors per device). We also explore the effects of exposure to extreme environmental conditions on sensor performance and their responsiveness to potential interferents in the AQ-SPEC environmental chamber. Overall, the results suggest that there are commercially available sensors, for carbon monoxide (CO) and ozone (O_3) are capable of providing useful quantitative and qualitative information when the devices are used “off-the-shelf”, as a member of the public would. Correlations (R^2) with reference instruments as high as 0.86 and 0.96 and mean absolute errors as low as 144 ppb and 5.76 ppb were observed for CO and O_3 sensor respectively. The results for nitrogen dioxide (NO_2) sensors were more varied, one sensor performed well with a correlation and mean absolute error of 0.77 and 5.41 ppb, respectively. Overall, the results indicate a wide range of performances, as well as how these performances vary under different environmental conditions or when exposed to interferent gases, reaffirming the necessity for thorough evaluations and application-dependent sensor selection.

Citation

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