



Indoor Air Quality and Sensors CAAAC Meeting

September 27, 2018

Laura Kolb
Environmental Protection Agency
Office of Air and Radiation
Office of Radiation and Indoor Air
Indoor Environments Division
Kolb.laura@epa.gov

EPA's Role in Improving Indoor Air Quality

- OAR's Indoor Environments Division implements non-regulatory programs to reduce public health risks from poor indoor air quality.

- Goal - reduction/prevention of human exposure to harmful indoor contaminants such as radon, particulate matter (PM), indoor asthma triggers, mold, environmental tobacco smoke (ETS), and volatile organic compounds (VOCs).

- Program activities include technical guidance and assistance; public information and education; partnerships with industry, NGOs, Feds, States, Tribes, and communities; promotion and synthesis of research.

Indoor Use of Lower-Cost, Sensor Technology/ Indoor Air Monitors

- Lower cost indoor air monitors (<$300) are widely available.
- Some people are using these monitors to measure IAQ parameters and pollutants to make decisions in their homes.
- Accuracy of devices is variable, may currently be less accurate than the often more expensive devices used for research and for outdoor air monitoring.
- No standard rating system for sensors and monitors.

Indoor Conditions are not the Same as Outdoor Conditions

Indoors:

- Temperature range may be smaller.
- Indoor pollutants include pollutants generated outdoors that migrate indoors and pollutants that are generated indoors.
- # of pollutants will be greater, indoor pollutants may include:
  - All of the National Ambient Air Quality Standards (NAAQS) Criteria Air Pollutants: carbon monoxide (CO), lead, nitrogen dioxide (NO_2), particulate matter ($PM_{2.5}$ and PM_{10}), and sulfur dioxide (SO_2).
  - Multiple volatile organic compounds (VOCs) including chemicals from consumer products.
  - Combustion by-products from gas stoves, fireplaces, candles, etc.
  - Biological contaminants from mold, bacteria, dust mites, pets, etc.
  - Radon and other soil gases.
- Concentrations of pollutants may be greater indoors than outdoors.
  - Pollutant concentrations can often be 2X-5X higher indoors.
- Indoor chemical reactions can generate particles and additional chemicals.

Use of Lower Cost Sensors/Monitors in Indoor Environments is Evolving Quickly

- **Sensor costs are decreasing** - Recent paper on low-cost sensors, air quality monitoring, and exposure assessment (Morawska et al. 2018): "…a range of sensor technologies became available on the market, enabling a revolutionary shift in air pollution monitoring and assessment. With their cost of up to three orders of magnitude lower than standard/reference instruments…"
- **Development & testing of consumer and research monitors is advancing but there's still more to do:** Recent paper comparing consumer vs. research grade monitors (Singer and Delp. 2018): "All 7 of the consumer and both research monitors substantially under-reported or missed events for which the emitted mass was comprised of particles smaller than 0.3 μm diameter.

Morawska et al. 2018. Environ Int. Jul;116:286-299. doi: 10.1016/j.envint.2018.04.018. Epub 2018 Apr 26. *Applications of low-cost sensing technologies for air quality monitoring and exposure assessment: How far have they gone?*

Singer and Delp. 2018. Indoor Air. Jul;28(4):624-639. doi: 10.1111/ina.12463. Epub 2018 May 14. *Response of consumer and research grade indoor air quality monitors to residential sources of fine particles.*

Discussion Question: Portable Sensors Used Indoors

4) For sensors that have been tested or evaluated for outdoor use, please comment on what additional research should be done to assess those sensors for indoor use. Are there additional considerations for long term use?

Discussion Question: Portable Sensors Used Indoors

5) Provide feedback on how sensors for detection of multiple indoor pollutants and/ or complex mixtures found in indoor environments should be evaluated.

Discussion Question: Portable Sensors Used Indoors

6) Please comment on the state of sensors for biological contaminants indoors, particularly for use in residential environments, and what further research may be required to further develop or evaluate them.