Fact sheet: Particle sensors

EPA VICTORIA | Environment Protection Authority Victoria

VICTORIA State Government

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Fact sheet

Overview

Particle sensors are small air monitors that measure airborne particles such as smoke and dust. Relatively cheap and easy to operate, particle sensors are becoming a popular way to monitor air quality. Although they are simpler and less accurate than most other types of particle monitors, particle sensors can provide useful information about air quality, particularly when used as part of a network of sensors.

What are particle sensors?

Particle sensors are small air monitors that measure airborne particles smaller than 10 micrometres (PM_{10}) or 2.5 micrometres ($PM_{2.5}$). These low-cost sensors are also known as optical particle counters; optical sensors; particulate matter sensors; air quality or air pollution sensors.

How do sensors work?

Sensors use a 'light-scattering' technique to measure the concentration of particles in the air. A beam of light inside the sensor is passed through a sample of air, and particles in the sample scatter the light beam. The scattered light is measured and used to calculate the concentration of particles in the air sample.

All particle sensors use similar technology but can calculate particle concentrations in different ways. They vary in size and can look very different. For example, a sensor could be a smart phone attachment or a much larger device with its own enclosure and solar panel.

What are sensors used for?

Due to their simplicity and low cost, there are many useful applications for particle sensors, including:

- to supplement existing air monitoring networks by increasing the geographical coverage of a network or to help identify localised air pollution problems
- to increase people's understanding of air quality and air pollution
- personal exposure monitoring, especially for people who are more sensitive to air pollution.

Across the world, researchers, industry, government agencies and community groups have set up networks of particle sensors to monitor their local air quality.

Environment Protection Authority Victoria (EPA) uses particle sensors to measure smoke and dust as a supplement to its main air monitoring network. Information from sensors is also not generally used for regulation or compliance purposes or to provide health advice.

How do I interpret information from particle sensors?

Particle sensors are not as accurate as traditional or more sophisticated types of air monitors. Different types of sensors, and even individual sensors of the same type can perform differently.

As a result, the readings from a particle sensor should only be taken as a guide, rather than a precise measurement of air pollution.

Further information

Contact EPA on **1300 372 842** (1300 EPA VIC) or **epa.vic.gov.au**

- Incident information and updates: **emergency.vic.gov.au**
- Up-to-date air quality information: **epa.vic.gov.au/airwatch**

How EPA monitors Victoria's air: epa.vic.gov.au/our-work/monitoring-the-environment/monitoring-victorias-air/how-epa-monitors-victorias-air

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The information you get from a particle sensor provides a general indication of air quality. For example, a high reading from a sensor could indicate that the air is smoky. You could use this information to decide whether you should go for a run or do some other type of strenuous activity outdoors

Due to their relatively low accuracy, information from sensors can't be compared with air quality standards.

Air quality information from an individual sensor is more useful when it is part of a network of sensors, as it provides a more complete picture of air quality across an area.

What affects the accuracy of a sensor?

Due to their simplicity, sensors may have the following issues:

- **Inconsistent measurement of particles from different sources.**

Particles scatter light beams differently, depending on the type and mixture of particles. For example, a sensor will detect particles from vehicles differently than particles from smoke.

- **Increased likelihood of false high readings when relative humidity is high.**

Sensors are sensitive to high relative humidity. This can affect sensors whether you place them outdoors or indoors. To overcome this issue, some particle sensors have relative humidity and temperature sensors, which allows a correction to be applied to the original measurement **before** the reading is shown. However, there is generally no way of knowing the specific correction factors used in different types of sensors.

- **Air ventilation of enclosures and wind speed may affect the air flow inside the sensor.**

If you put your sensor in a box or near a wall, it may show a lower concentration of particles than if you put it in an open space. This also means if a sensor is moving, for example, if you take it on your bicycle, it will respond differently to when it's stationary.

- **Ageing of sensors affecting air flow inside the sensor.**

As a sensor ages, its fan gets dirty and slows down over time. This slows down air flow, which changes the response of the sensor and reduces the accuracy of its measurements.

- **The calculations pre-programmed in sensors can include some of the effects above, or none.**

There is no way of knowing which (if any) issues apply to an individual sensor, even if you are comparing two sensors of the same type. As such, each sensor typically needs to be calibrated or tested individually. This variability makes it difficult to judge the accuracy of air quality information from a sensor.

- **Sensor technology is changing rapidly**

New types of sensors are becoming available all the time and sensor technology is evolving quickly. This makes it difficult to keep on top of all of the different models and be aware of their potential limitations. Not knowing things such as whether a sensor reading has been corrected, or which calculations have been used, affects the level of confidence we can have in the quality of information collected.

How to improve accuracy of sensors

There are a few practical steps that can help improve the accuracy of a sensor. These include:

- Regular, ongoing calibration helps improve sensor accuracy and reliability. This ideally needs to be done at the location.
- Ensuring there is sufficient ventilation by placing it in an open space away from walls and buildings.
- Selecting an averaging time period of at least one hour to obtain more accurate information from the sensor.

EPA's work with sensors

In 2018, EPA began testing two types of particle sensors: a sub-network of smoke sensors in the Latrobe Valley and dust sensors in Brooklyn. The aim of these sensor networks is to better understand sources of air pollution and how this affects local air quality.

Both types of sensors tested by EPA measure different size fractions of particles ($PM_{2.5}$ and PM_{10}) simultaneously. The sensors are in enclosures that include solar panels, batteries and electronics.

We are evaluating the accuracy and potential applications of particle sensors. We are comparing information from the sensors to the data collected by our Australian Standards air monitors. Better understanding the quality of information we get from each particle sensor will help us use this new air monitoring technology in the most effective and appropriate way.