

Met-One E-BAM Air Quality Monitor

Real-time measurements of particulate matter for emergency response support & focused studies

What is the E-BAM monitor?

The Met-One Environmental Beta-Attenuation Mass Monitor (E-BAM) is a reliable portable air quality monitor that:

- measures particulate matter (PM₁₀ or PM_{2.5});
- is relatively easy to transport; and
- can be deployed quickly.



How are E-BAM data shared?

Real-time E-BAM data broadly indicate air quality and can be used to identify poor air quality conditions. Alberta Environment and Protected Areas shares real-time E-BAM data with emergency response personnel, governments, communities, and other stakeholders via a web-platform as one line of evidence to inform response decisions. Real-time data may include small negative PM_{2.5} values when ambient concentrations are at very low levels. These are corrected based on standard operating procedures before the data are used for further evaluation.

Alberta Environment and Protected Areas also shares a publicly available [interactive data summary](#) of corrected E-BAM data throughout wildfire season.

How can I interpret E-BAM PM_{2.5} data?

- One-hour averaged PM_{2.5} concentrations can be compared to the [Alberta Ambient Air Quality Guideline](#) (AAAQG) of 80 µg/m³.
- 24-hour averaged PM_{2.5} concentrations can be compared to the [Alberta Ambient Air Quality Objective](#) (AAAQO) of 29 µg/m³.

The PM_{2.5} AAAQG and AAAQO are based on health effects and other factors. E-BAM PM_{2.5} data is part of the multiple considerations that allow emergency response decision-makers to take appropriate action.

How are E-BAMs used in Alberta?

Emergency response support

Alberta Environment and Protected Areas collects and shares real-time air quality data to support emergency response activities. Monitoring may be deployed, for example, in response to unplanned industrial events or wildfires impacting communities. Monitoring during emergency situations supports decisions to protect the health of emergency response personnel and the public. Alberta Environment and Protected Areas deploys E-BAMs to areas affected by wildfire smoke, typically in consultation with Alberta Health Services or other stakeholders. Alberta Environment and Protected Areas also provides timely analysis and interpretation of the data to stakeholders.

Why monitor PM_{2.5}?

PM_{2.5}, or fine particulate matter, is an air pollutant that can be harmful to human health.

PM_{2.5} is generally the largest contributor to poor air quality during episodes of wildfire smoke. PM_{2.5} is made up of very small particles, with a size of 2.5 micrometers or smaller. PM_{2.5} can be inhaled into the lungs and may cause symptoms such as coughing or may worsen existing heart and lung conditions.

Focused studies

Focused studies are shorter-term monitoring projects (less than five years) designed to answer specific questions that cannot be addressed by existing monitoring. This includes investigations of specific or highly localized air quality issues. E-BAMs are deployed where particulate matter is anticipated to be a parameter of concern. For example, Alberta Environment and Protected Areas has deployed E-BAMs to measure air quality near industrial or commercial facilities, to explore the spatial variation of PM_{2.5} in urban centres, and where wind-blown dust may affect nearby residents.

What are the limitations of the E-BAM monitor?

- **The E-BAM monitor is generally not suitable for regulatory compliance monitoring in Alberta.**
For regulatory compliance monitoring, Alberta accepts Federal Equivalent Methods (FEM) for PM_{2.5}, as designated by the United States Environmental Protection Agency. The E-BAM monitor does not have FEM designation for PM_{2.5}. However, there is a configuration available for PM₁₀ that is FEM approved.
- **The E-BAM monitors particulate matter (PM₁₀ or PM_{2.5}) and meteorological parameters only.**
The E-BAM may not be ideal for all air quality monitoring applications.
- **The wind-speed and wind-direction data collected by the E-BAM are used as a general indicator only.**
The measurement height does meet the requirements of [Alberta's Air Monitoring Directive](#).

How are E-BAM monitors deployed and maintained?

The E-BAM is relatively easy to deploy, with setup taking approximately one hour for a trained technician. The E-BAM can be configured to report on PM₁₀ or PM_{2.5}. Once it is up and running, it continuously collects and transmits data on an hourly basis. It is a standalone instrument, requiring only a power connection, a secure area for deployment, and siting that allows for representative measurements.

In order to ensure data quality, the E-BAM undergoes an audit and maintenance process prior to, during, and after each deployment. During operation, data and diagnostics are checked remotely to ensure that it is functioning properly. Furthermore, if it is deployed for one month or more, the instrument is routinely audited to ensure continued proper operation.

The E-BAM is able to measure high PM_{2.5} concentrations, such as during heavy wildfire smoke. When PM_{2.5} concentrations are persistently high, the unit may require more frequent maintenance or a change in settings.

How does the E-BAM compare to other monitoring methods?

The performance of the E-BAM was verified for use in Alberta by comparing against other PM_{2.5} monitoring methods. Figure 1 shows that hourly E-BAM PM_{2.5} compares well with an accepted monitoring method at higher concentrations, typical of wildfire smoke (greater than the AAAQG of 80 µg/m³), with the E-BAM measuring lower concentrations of PM_{2.5} than the accepted method. At lower concentrations (less than the AAAQG of 80 µg/m³), there are fluctuations in the E-BAM data. Averaging of E-BAM data may smooth out the fluctuations¹. Figure 2 shows that when averaged over 24 hours, the E-BAM PM_{2.5} data agrees well with an accepted monitoring method.

¹ Recommendation for smoothing based on additional testing of short-term monitoring E-BAM data collected (not shown here).

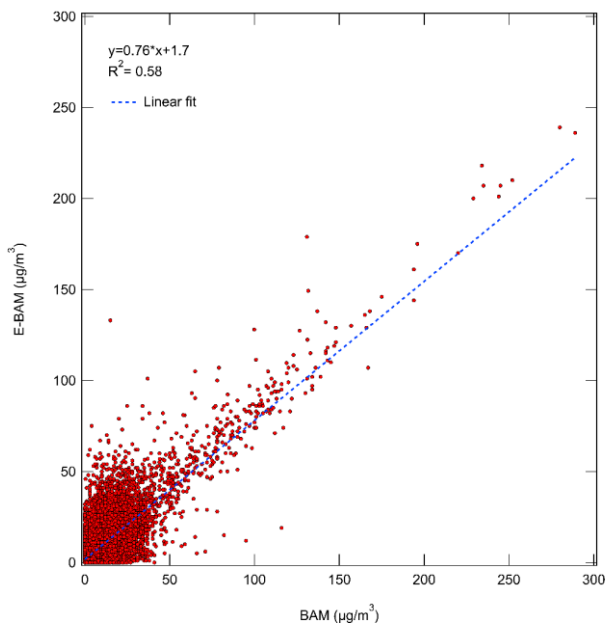


Figure 1: Agreement observed between hourly measurements from the E-BAM versus the Beta Attenuation Monitor (Met One BAM-1020)². The slope = 0.76 indicates that the E-BAM usually measures lower $PM_{2.5}$ concentrations than the BAM. The $R^2 = 0.58$ reflects relatively lower precision in the hourly E-BAM measurements. The BAM-1020 monitor is FEM designated.

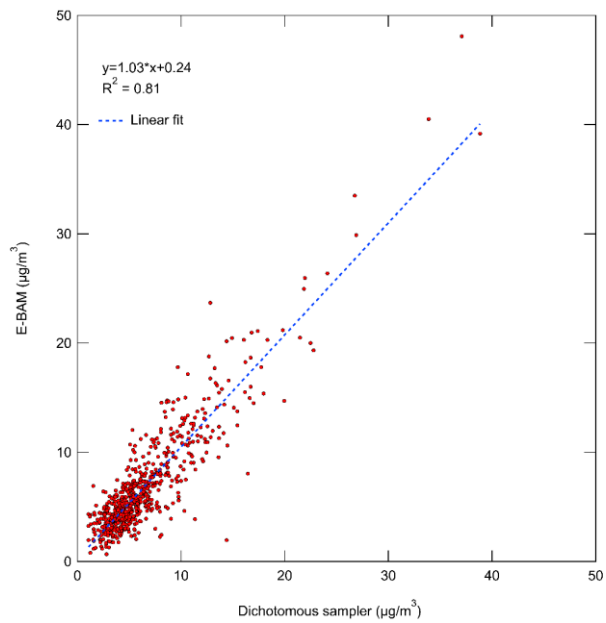


Figure 2: Good agreement observed between 24-hour average measurements from the E-BAM and the dichotomous integrated sampler³, with slope = 1.03 and $R^2 = 0.81$. The dichotomous integrated sampler is a Federal Reference Method (FRM) for $PM_{2.5}$, as designated by the United States Environmental Protection Agency.

Related Resources

- Wildfire smoke monitoring in Alberta: <https://aep-aws-air.shinyapps.io/wildfiresmokemonitoring/>
- E-BAM monitoring method and technical specifications: <https://metone.com/products/e-bam/>
- Evaluation of E-BAM versus FEM designated $PM_{2.5}$ in California: <https://www.sciencedirect.com/science/article/pii/S1309104215300581>

² Hourly average $PM_{2.5}$ measurements for the E-BAM versus the BAM monitor at McIntyre station in Edmonton for May 2011 to March 2019. Data collected between August 1, 2017 and June 30, 2018 were excluded from the comparisons because of E-BAM data quality issues.

³ 24-hour average $PM_{2.5}$ measurements for the E-BAM were compared against dichotomous integrated samples at McIntyre station in Edmonton for May 2011 to March 2019. Data collected between August 1, 2017 and June 30, 2018 were excluded from the comparisons because of E-BAM data quality issues. The dichotomous integrated samples were collected by the National Air Pollutant Surveillance Network.