



AIRPORT BLACK CARBON EMISSIONS AND THEIR IMPACT ON THE NEARBY LOCAL COMMUNITIES



MOTIVATION

APPLICATION NOTE

Black Carbon (BC) is a major component of particulate matter (PM) emitted from incomplete combustion processes. Airports, with their high traffic of jet engines and ground support equipment, are significant sources of black carbon emissions. Monitoring of BC levels at airports is crucial for assessing environmental and health impacts. This application note outlines the use of the Aethalometer for BC measuring at airports, providing insights from concrete case studies.

METHODOLOGY

IMPORTANCE OF MONITORING BLACK CARBON AT AIRPORTS

Airports are complex environments where numerous sources contribute to BC emissions, including aircraft engines, ground vehicles, and auxiliary power units. The proximity of these sources to airport workers and nearby residential areas makes BC monitoring essential for:

Environmental Impact

- **Climate Change:** BC contributes to climate change by absorbing sunlight and heating the atmosphere. It also affects the albedo when deposited on snow and ice, accelerating melting and impacting global climate patterns.
- **Air Quality:** Elevated BC levels deteriorate air quality, contributing to smog formation and reducing visibility. This is particularly concerning at airports, where visibility is crucial for safe operations.

Human Health Impact

- **Respiratory system:** Inhalation of black carbon particles can cause respiratory conditions such as asthma, bronchitis, and other chronic respiratory diseases. Airport workers and passengers are at higher risk due to close and frequent exposure.
- **Cardiovascular diseases:** BC has been linked to cardiovascular diseases, including heart attacks and strokes. Particles can enter the bloodstream, causing systemic inflammation and oxidative stress.
- **Cancer:** BC is associated with carcinogenic compounds. Thus, long-term exposure to black carbon is a potential risk factor for developing different types of cancer (e.g., lung cancer).

Regulatory and Compliance

- **Regulatory Requirements:** Increasingly stringent air quality regulations require accurate monitoring and reporting of emissions. Airports must comply with these regulations to avoid penalties and maintain operational permits.
- **Community Relations:** Monitoring of emissions by the airport authorities helps address community concerns about air quality and health impacts, fostering better relationships with local residents and stakeholders.

Related articles

1. Westerdahl D. et al. (2008). The Los Angeles International Airport as a source of ultrafine particles and other pollutants to nearby communities. *Atmospheric Environment* 42 (2008) 3143–3155.
2. Deshmukh P. et al., Identifying air pollution source impacts in urban communities using mobile monitoring, *Sci. of the Tot. Envir.* Volume 715, 1 May 2020, 136979

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Operational Benefits

- **Decisions based on data trends:** Continuous monitoring provides valuable data for making informed decisions regarding airport operations, including optimizing flight schedules, ground operations, and maintenance activities to minimize emissions.
- **Mitigation strategies:** Identifying high-emission sources and periods enables the implementation of targeted mitigation strategies, such as transitioning to electric ground support vehicles, optimizing airplane taxiing procedures, and improving fuel efficiency.

APPLICATION EXAMPLES

1. Case study: Optimizing operations at a major international airport

At a large international airport, researchers deployed Aethalometers at multiple locations, including near runways, taxiways, and terminal areas. The study found:

- **Emission pattern identification:** Elevated BC levels were observed during peak flight times, correlating with increased aircraft and ground vehicle activity.
- **Proposed mitigation strategy:** Introducing electric ground support equipment would significantly reduce BC emissions in specific areas.

2. Case study: Health impact on communities near airports

In a study at a mid-sized airport, Aethalometers were placed both on-site and in nearby residential areas. Key findings included:

- **Community exposure:** Elevated BC levels were detected in nearby neighborhoods, especially downwind from the airport.
- **Temporal trends:** BC concentrations varied with wind direction and airport activity, highlighting the need for targeted mitigation strategies.

CONCLUSIONS

BC monitoring at airports is essential for understanding and mitigating its environmental and health impacts on local communities. The Aethalometer's effectiveness at providing continuous BC measurements in real-time enables quantifying the effectiveness of planned mitigation strategies over time. The insights gained from such monitoring efforts can guide the implementation of policies and technologies to reduce emissions and protect public health at airport.