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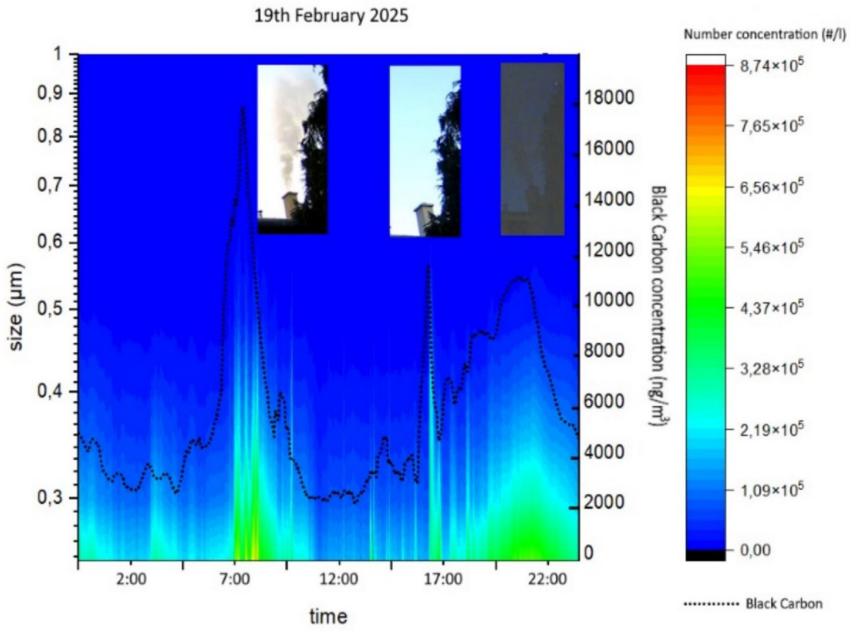
DETECTING WASTE BURNING IN RURAL AIR POLLUTION HOTSPOTS



APPLICATION NOTE

MOTIVATION

How the AE42 Aethalometer and DRI 2015 Series 2 reveal hidden combustion sources. Residential solid-fuel combustion is already a major source of fine particulate matter in winter time. When wood burning is mixed with illegal or poor-quality waste burning, local pollution episodes can intensify and become much harder to identify with routine PM measurements alone. This application note summarizes how a combined measurement strategy using a portable Aethalometer, particle sizing instrument, and thermal-optical Organic /Elemental Carbon (OC/EC) analyzer can separate traffic, biomass burning, and suspected waste-burning events in a rural environment.

METHODOLOGY

BACKGROUND

The location in Solymár, Hungary combines several common real-world influences: residential wood combustion, traffic, and suspected household waste burning during the winter season. A six-week campaign from January 10 to February 20, 2025 showed that local concentrations were substantially higher than those at a nearby background station.
This made the site a strong test case for determining whether carbonaceous aerosol measurements can demonstrate atypical combustion events that standard PM data may not explain clearly.

MEASUREMENT SETUP

1. Optical Particle Counter (Grimm 1.109) provides 1-minute particle number and size distribution from 0.25 to 32 µm.
2. Portable Aethalometer AE42 with 7 wavelengths is a real-time black carbon monitor for sample analysis at seven wavelengths, enabling Black Carbon (BC) time trend measurements and real-time biomass burning vs fossil fuel source apportionment.
3. DRI 2015 Series 2 OC/EC Analyzer is a laboratory OC/EC analyzer for quartz filter sample analysis using different thermal-optical protocols (EUSAAR2, IMPROVE, NIOSH) to quantify OC/EC fractions.

RESULTS & INSIGHTS

- Fine particles dominated the aerosol burden at the site, indicating strong influence from combustion-related sources rather than coarse dust alone.
- The AE42 captured BC peaks and enabled separation of biomass-burning and fossil-fuel-related BC components using the Aethalometer model.
- Filter analysis with the DRI 2015 Series 2 showed that OC_4 fraction was frequently dominant, indicating persistent traffic influence, while OC_1 and EC_2 became especially important during atypical events, indicating possible waste burning episodes.
- Correlations between BC source fractions and OC/EC fractions strengthened when “typical days” were isolated, helping identify days affected by additional combustion sources.
- Elevated EC_2 during biomass-related atypical days was consistent with mixed-fuel or plastic-burning contributions, supporting the interpretation of suspected waste-burning episodes.

References:

1. Kheirandish S. et al. (2026). Characterization of carbonaceous aerosol particles emitted by solid fuel combustion in rural areas. Environ Monit Assess (2026) 198:679, https://doi.org/10.1007/s10661-026-15514-8.
2. Aerosol Magee Scientific product information for the DRI 2015 Series 2 and AE42 Portable Aethalometer.
3. Figure in page 1 adapted from Kheirandish et al. (2026), Environmental Monitoring and Assessment (2026), 198:679, licensed under CC BY 4.0.

WHY THIS INSTRUMENT COMBINATION?

AE42 Aethalometer delivers real-time BC trends with seven-wavelength optical analysis. It supports source apportionment between biomass burning and fossil fuel combustion through wavelength dependence of absorption. Reveals short-lived pollution events that would be diluted or lost in 24-hour average measurements. It also provides field information for identifying when and where abnormal or atypical combustion is happening.
The DRI 2015 Series 2 quantifies OC and EC according to the applied thermal protocol and provides additional semi-quantitative compositional information through temperature-resolved carbon fractions derived from quartz filters.
It supports standard thermal-optical protocols such as EUSAAR2 and extends interpretation with multi-wavelength optical analysis. It helps distinguish routine combustion patterns from atypical events through fractions such as OC_1, OC_4, EC_2, and EC_3. Finally, it turns results from filter samples into source-apportionment evidence that can support data from Aethalometer and provides emissions inventories, mitigation planning, and targeted field investigations.

APPLICATION EXAMPLES

1. Combination of time-resolved optical BC data with offline OC/EC fractionation for stronger interpretation of mixed-source aerosol environments.

2. Practical approach for linking field campaigns, source apportionment, and filter-based laboratory analysis.

3. Generation of defensible evidence for hotspot identification, community exposure assesment, and mitigation.

4. Demonstration of a real-time event detection with the AE42 plus provides deeper compositional confirmation from the DRI 2015 Series 2.

CONCLUSIONS

This case study shows that high-pollution rural episodes cannot be understood from PM mass alone. The AE42 Aethalometer delivers the time resolution and source sensitivity needed to detect events as they happen, while the DRI 2015 Series 2 provides the OC/EC fraction detail needed to interpret why they happened. Together, they create a strong workflow for identifying abnormal combustion, strengthening source apportionment, and supporting targeted air-quality action.

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