

Roadside point sampling applied for emission screening and ambient air quality - Insights into particle related air pollution in various European cities

Markus Knoll¹, Martin Penz¹, Erika von Schneidemesser², Alexander Bergmann¹

¹**Institute of Electrical Measurement and Sensor Systems, Graz University of Technology, Graz, Austria**

²Research Institute for Sustainability at GFZ, Potsdam, Germany

Black carbon (BC) and ultrafine particles (UFPs) are two key metrics of particulate matter (PM) for climate and health. Until 2024, neither of these metrics were addressed in the EU's ambient air quality directives, which only focused on PM₁₀ and PM_{2.5} metrics, dominated by micron-sized particles. However, with the EU Directive (EU) 2024/2881 both metrics will be measured for the first time, at least at supersites. Both are also key metrics for emissions: BC is the indicator of choice for identifying combustion related PM, and particle number (PN) of UFPs is regulated in the EU emission standards. Roadside point sampling (PS) is a measurement technique that has been used for decades, primarily for scientific studies of real-world particle emissions (Hansen and Rosen, 1990; Knoll et al., 2024). Due to the continuous roadside measurement of metrics such as BC and UFP/PN it also provides very useful information about ambient air quality at a high resolution next to roads, where large numbers of people live and travel (Farren et al., 2025).

This work presents the results of emission and ambient air quality measurements taken in various European cities using roadside PS. The campaigns were performed in different seasons (spring, autumn and winter), providing interesting information in different settings. The emission results show that exceedances of defined thresholds for PS measured emission factors correspond well with the failure rates of the newly introduced PN periodic technical inspections (PTI) for checking diesel particulate filters (DPFs) in vehicles. Trends in vehicle emissions under different Euro standards provide valuable insights into real-world emission patterns. These insights can be used to monitor the implementation of emission standards, as well as for the potential introduction of low-emission zones. Ambient air quality measurements show that significant concentrations of BC and UFPs are observed near the road, especially during periods of high traffic and in winter. Ambient concentrations of more than 25 µg/m³ of BC were observed in winter, which is likely caused due to various emission sources (transport, industry, residential heating) and climate conditions. An outlook is shown for extending the measuring approach to additionally measure non-exhaust emissions (tire, brake, resuspension) and their influence on ambient air quality.

Keywords: Black Carbon, Ultrafine Particles, Real-World Emissions, Point Sampling, Roadside Ambient Air Quality, High pollution events, Non-exhaust emission

This work has been supported by the EU projects CARES (grant no. 814966), LENS (101056777) and Net4Cities (101138405).

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