

JOINT ACTIVITIES: METRO MICROENVIRONMENTS

Citizens usually spend a considerable amount of their time commuting in large urban agglomerations. The use of the subway, and in general public transport, contributes to reduce the road traffic. In this sense, subway transport is considered a clean transport system. Previous studies in numerous subway systems found that particulate matter (PM) concentrations can be relatively high in these environments. In this context, the ESR8 project "Personal exposure to PM during commutes: underground systems (metro)" within the HEXACOMM project aims at characterising passenger exposure to PM while commuting (including waiting time on the platform and travelling inside the trains) in underground environments in different European cities. Given the nature of this metro project, it resulted in a broad collaboration between different HEXACOMM partners. The subway systems included in the study were those from Barcelona, Prague, Athens, and Oporto.

The IDAEA-CSIC team led this project and established a sampling protocol developed for the Barcelona subway system and that was further applied to all the subway systems under study. This standardisation of the sampling protocol allows for a direct comparison of the results obtained in the different subway systems.



The difficulty in obtaining permission from the subway transport companies to perform the aerosol measurements was not negligible. In this regard, the subway systems chosen depended on their significance and interest, the existence of partners within the consortium in the subway city, and the possibility of permission from the subway transport company.

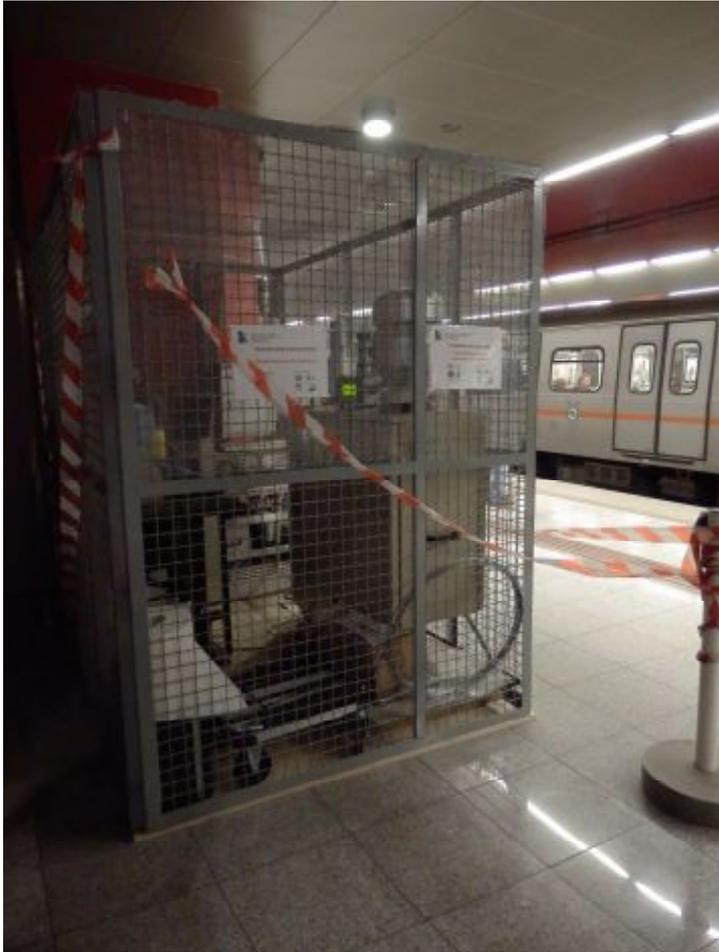
The Barcelona subway system comprises eight subway lines, at different depths, with different tunnel and station designs and train frequencies. An extensive measurement campaign of eight months was performed in this subway system. The measurements included real-time PM concentrations in more than 20 subway stations and inside the trains of six different subway lines, complete PM chemical composition, real-time particle size distribution ($>0.3 \mu\text{m}$), CO and CO₂ measurements, and some biological analyses, among others. Different tests were conducted to study variations in air quality depending on ventilation conditions both on

platforms and inside the trains. IDAEA-CSIC group was in charge of these campaigns, and there was some collaboration with research groups outside of the consortium. A collaboration with the Technical University of Crete through a secondment of the ESR8 allowed for the calculation of the particle dose in the Barcelona subway system. Scientific papers have been already published and more are under review and in preparation.



The Prague subway system campaign was short in time, but included several types of measurements, such as real-time PM concentrations on the platforms, PM chemical composition of different PM size fractions, and particle number size distribution (starting from 10nm). The campaign was a collaboration between the Institute of Chemical Process Fundamentals (ICPF) and IDAEA-CSIC. A scientific article is currently under review for its publication.

The Athens subway system campaign lasted for three weeks and included several aerosol measurements, such as real-time PM concentrations in several subway stations and inside the trains, complete PM chemical composition, real-time particle size distribution ($>0.3 \mu\text{m}$), CO and CO₂ measurements, analyses of bioaerosols, and particle number size distribution (starting from 10nm). The campaign was a collaboration between IDAEA-CSIC, N.C.S.R. Demokritos, Technical University of Crete, and University of Essex. Scientific publications are currently in preparation.



The Oporto subway system campaign lasted for two weeks and included real-time PM concentrations in subway stations and inside the trains, complete PM chemical composition, real-time particle size distribution ($>0.3 \mu\text{m}$), and CO and CO_2 measurements, among others. This campaign was a collaboration between IDAEA-CSIC and the University of Aveiro (outside of HEXACOMM consortium).

