



Milestone M27 (M4.11)

Pilot 5 measurements initiated



RI-URBANS

**Research Infrastructures Services Reinforcing Air
Quality Monitoring Capacities in European Urban &
Industrial Areas (GA n. 101036245)**

By

KNMI, INOE & ISAC



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Milestone M27 (M4.11): Pilot measurements initiated

Authors: Arnoud Apituley and Diego Alves Gouveia (KNMI), Doina Nicolae (INOE), Angela Marinoni (ISAC)

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1. About this document

The WP4 tackles OJB4 to test and to demonstrate solutions for advanced urban air quality (AQ) monitoring systems and evaluation of exposures, which are proposed by WP1-3, at representative areas and hot spots in Europe. Specifically, it will implement 5 testing and demonstration pilots in 9 European cities (Athens, Barcelona, Birmingham, Bucharest, Helsinki, Milano, Paris, Rotterdam-Amsterdam and Zurich, with at least 3 cities in each pilot). In the scope of WP4, the task T4.5 focuses on mapping and characterizing hotspots for pollution emissions and concentrations in urban areas with intensive traffic and/or industrial activities, aiding in the evaluation of pollutant exposure and policy-making. To accomplish that, the pilot cities of Rotterdam-Amsterdam (The Netherlands), Bucharest (Romania) and Milano-Bologna (Italy) were selected as representative European areas for intensive measurement campaigns.

This milestone M27 (M4.11) reports on the initiation of the pilot measurement campaigns for hotspots in the selected cities, as previously described in milestone [M26 \(M4.10\)](#).

This is a public document, available in the RI-URBANS website (<https://riurbans.eu/work-package-4/#milestones-wp4>). The document will be distributed to all RI-URBANS partners for their use and submitted to European Commission as the RI-URBANS milestone M27 (M4.11).

2. Pilot measurements initiated

This chapter gives a short summary of the observational campaigns that were initiated in the selected pilot cities, as a follow up for the plans described previously in the milestone M4.10. It is worth mentioning that many of the measurement campaign efforts have strong connections (but not limited) to tasks that focuses on the urban mapping (T4.3 and T2.3).

2.1 Rotterdam-Amsterdam campaigns

During August-September 2022 an intensive period of observations was conducted for fine scale urban mapping and hotspots characterization in the harbour (including ship emissions), industrial and domestic areas of the Rotterdam-Amsterdam (The Netherlands), in a campaign carried out in collaboration with the local authorities, the H2020-PAUL project, and the Ruisdael Observatory. The campaign efforts included:

- The involvement of representatives from the national (RIVM) and municipal (DCMR) air quality monitoring authorities for the provision of data from the permanent national and municipal AQMNs (Air Quality Monitoring Networks) and operational support.
- Ground-based fine scale mapping of aerosols (number and mass concentrations, ultra-fine particles (UFP), CCN, BC, BrC, PM concentrations, and chemical composition) and gasses (CO₂, CO, NO₂, CH₄, COS, C₂H₆, NO₂, NO, NO_x, NH₃) using mobile and semi-mobile trailers, UUAQ car, and bicycles in specific routes.
- Temporary network of remote sensing instruments that included FTIR (Fourier Transform InfraRed) spectrometry for CO₂ and CH₄, wind lidar and 3 ceilometers for atmospheric dynamic and innovative air quality techniques (linked to T1.3), 2 MAX-DOAS (Multi-Axis Differential Optical Absorption Spectroscopy) observations for NO₂ and ship emissions.
- Two aircrafts: first aircraft (6 flights) for in-situ airborne measurements of gasses and aerosols in and outside of the boundary layer over the city and adjacent suburban and rural areas; and a second aircraft (4 flights) equipped with TNO's Spectrolite instrument for mapping and satellite validation (TROPOMI - TROPospheric Monitoring Instrument) (Figure 1).

In parallel, measurements with cloud and rain radars, and microwave radiometers were conducted in the urban area, as well as in-situ and Raman lidar measurements at the Cabauw station (nearby rural area).

During the intensive period of observations, specific daily meetings and general weekly meetings were conducted for planning and evaluation of data quality. On November 14th, 2022, a first campaign workshop was held in KNMI (The Netherlands) on the data collected. A second workshop is scheduled on February 22nd, 2023.



Figure 1. Aerial view of the city of Rotterdam (The Netherlands) during one of the Spectrolite flights on 31 August 2022. At the same time, ground based observations on fixed locations and mobile observations were made. (Photo: Arnoud Apituley)

2.2 Bucharest campaign

In a city of Bucharest (Romania), a temporary observational site has been set up in May 2022 for in-situ and remote sensing observations in a highly polluted area near the CET Vest power plant (selected hotspot), one of the greatest industrial polluters for PMs, NO_x and CO and CO₂ in the city (highest chimney tower at 180 m). This site was equipped with ceilometer, wind lidar, PM counter, gas monitors and meteorological station. Simultaneously, mobile measurements of UFPs mass (PM_{0.3}), PM₁₀, PM_{2.5}, PM₁ and NO₂ in a dense residential area close to the hotspot were conducted as part of the urban mapping task (T4.3). Additionally, the permanent reference site (INOE ACTRIS NF), located about 10 km southwest of the study area, performed measurements of aerosol and clouds, gas remote sensing and solar radiation (Figure 2).

From June to November 2022 an extended summer campaign was carried out, with continuous measurements of the planetary boundary layer (PBL) height and cloud cover using ceilometer, radial wind speed, particle (PM1, PM2.5 and PM10) and gases (NO_x, O₃, and SO₂) concentrations, with a period of coincident mobile measurements (26 May to 13 July). Also, in January-February 2023 the winter campaign has started and it is focused on near-surface measurements, with plans for a subsequent near-surface summer campaign (in 2023). The near-surface measurements shall then be used to fine mapping the region and putting the results in the larger context of aerosol atmospheric transport from the power plant to the urban areas, when the chimneys are well below the typical boundary layer height.

During the measurements period, daily checks has been performed and periodically meetings were conducted for planning and evaluation of data quality.

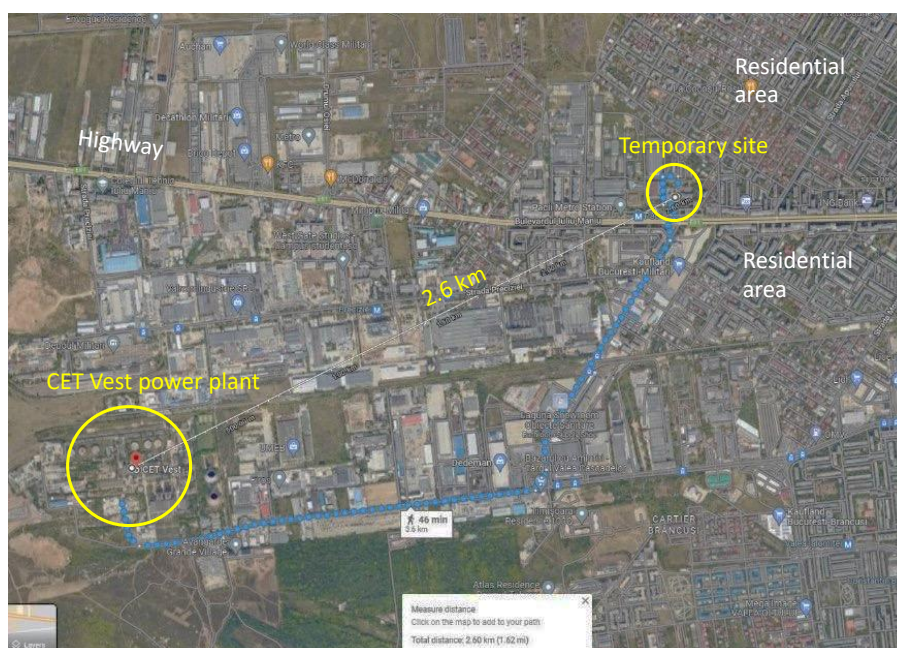


Figure 2. Study area in Bucharest (Romania).

2.3 Milano-Bologna campaigns

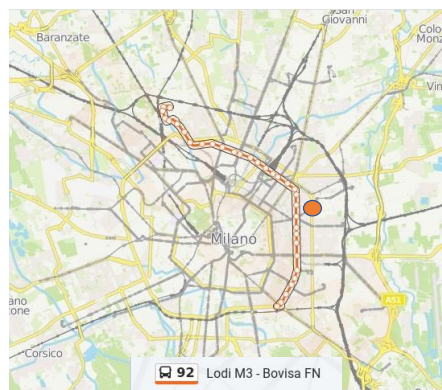
In Milano, pilot activities have started with monitoring air quality from Milano to the airport. The installation of the equipment was completed in January 2023. Interaction is going on with the transport agency to instrument a bus with BC and PNSD measurements. The bus goes from the Milano city center to the airport (Figure 3).

Negotiations are underway for an agreement with with the bike delivery company «Urban by messenger» in Milan. Microaethalometers MA200 will be installed on 10 bikes for BC mapping during their delivery trip in the Eastern part of the city. The campaign will be carried out in winter 2022/23, during about 3 months.

Furthremore, interactions are in progress with the municipality and local transport agency in order to install an Aethalometer AE-31 on a trolleybus for eBC mapping. The ideal route of the trolleybus 92 (Figure 4) for measurements is complementing the eBC bike mapping (Eastern part of the city).



Figure 3. The route from Milano Linate Airport to the city centre.



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Figure 4. Route of the trolleybus 92 for implementing mobile measurements of eBC in Milano.

In Bologna, a field campaign will be carried out with a transect of measurements of particle number concentration and size distribution observation points at different distances from the airport. Interactions are in progress with the municipality in order to install instrumentation on the people mover Marconi Express (Figure 5). The mobile mapping is done onboard of the AeroLab van, equipped with SMPS and

CPC for PNSD-UFP, aethalometer AE33 for eBC, nephelometer and radiation sensors. With aerosol properties also provided at the CNR-ISAC reference site.

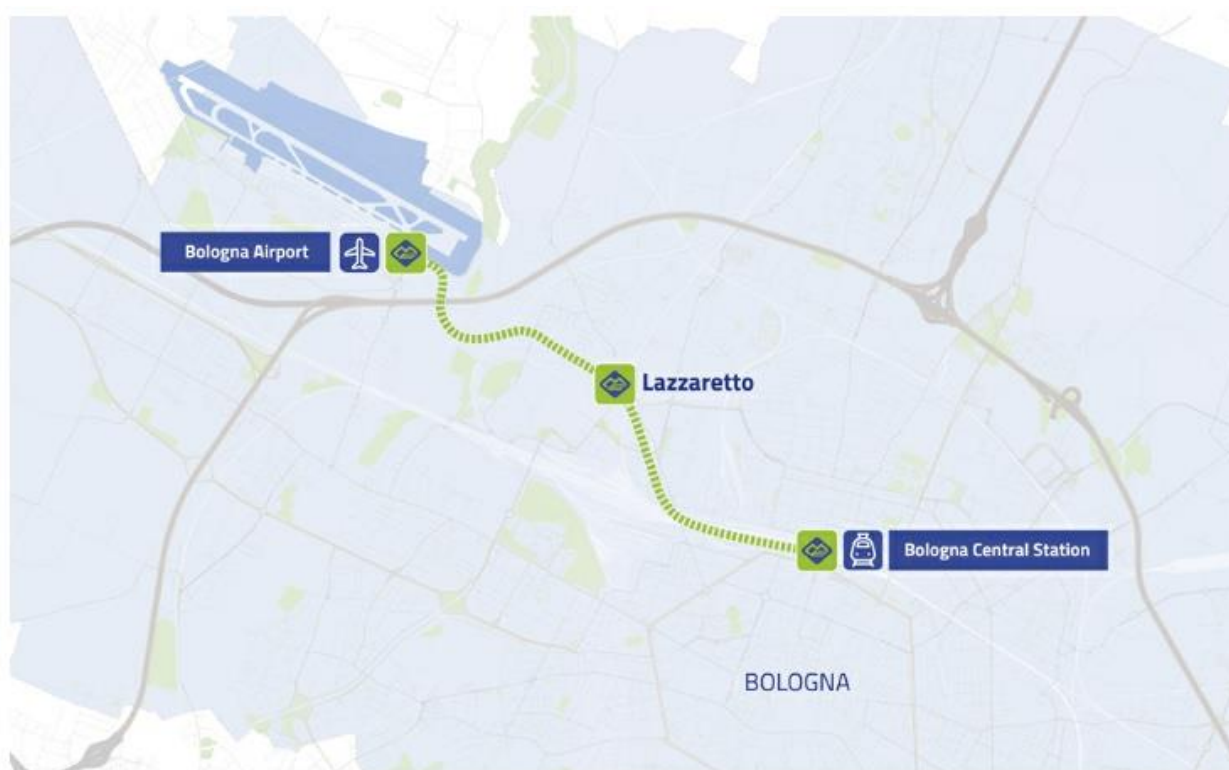


Figure 5. The Marconi Express route from Bologna Airport to the city centre, which Will be used to measure UFP and PNSD.

3. Summary

The pilot studies for observations of hotspots in Rotterdam-Amsterdam (The Netherlands), Bucharest (Romania) and Bologna-Milano (Italy) have been defined in detail, and all activities have started. Campaigns have been conducted in the different cities independently, in 2022-2023. More activities will follow in 2023 in Bucharest, Milano and Bologna and also in Rotterdam-Amsterdam.

Data collected will be brought to the modellers in the RI-URBANS WP3.

Possibly, from lessons learned during the pilots in T4.5, additional experiments will be planned in the future.