



# Milestone M17 (M4.1)

## Source apportionment started



**RI-URBANS**

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

**By  
FMI & CNRS**



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### Milestone M17 (M4.1): Source apportionment started

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<b>Work package (WP)</b>	WP4 Pilot implementations for testing and demonstrating services
<b>Milestone</b>	M17 (M4.1)
<b>Lead beneficiary</b>	FMI
<b>Means of verification</b>	Measurements started, chain tested
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<b>Version</b>	Final
<b>Reviewed by</b>	WP4 leaders
<b>Accepted by</b>	RI-URBANS Project Coordination Team
<b>Comments</b>	Report from Task 4.1 on the implementation of pilots to demonstrate Innovative near-real-time source apportionment for carbonaceous particles by combining Aerosol Chemical Speciation monitors (ACSM) for organic fraction and aethalometers for black carbon (BC). It contains a description of the steps taken in preparation to start in 13 sites situated in 7 countries across Europe, and of the current status of measurements and data chain in different cities.

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## **1. About this document**

The aim for WP4 is to test and demonstrate solutions for advanced urban AQ monitoring systems and to evaluate the human exposures at representative areas and hot spots in Europe. The selected pilot sites encompass diverse European urban environments and will demonstrate at a real scale the ability to integrate complementary AQ measurement systems in existing Air Quality Monitoring Networks (AQMNs), addressing modalities where the research infrastructures (RIs) are engaged with the national/local authorities, proposing innovative solutions such as mobile instrumentation and building on citizens' observatory initiatives, applying tools developed, and improving their operational integration in AQMNs.

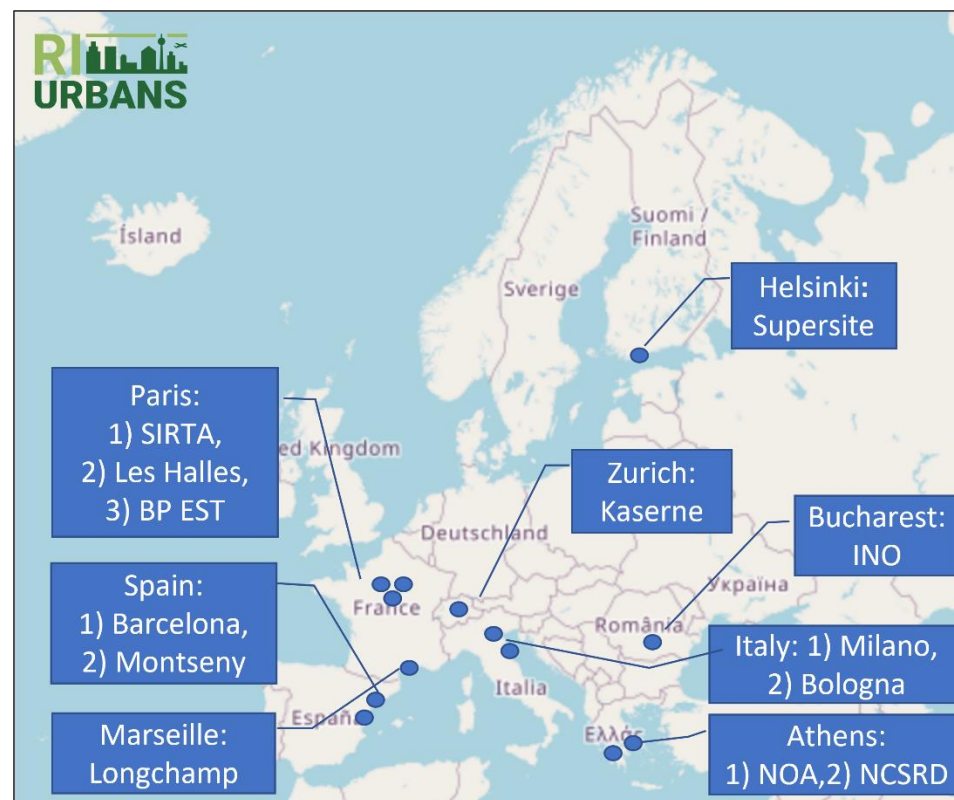
This milestone addresses Task 4.1 on the implementation of pilots to demonstrate Innovative near-real-time (NRT) aerosol source apportionment service tools (ST) for carbonaceous particles, by combining Aerosol Chemical Speciation monitors (ACSM) for organic fraction and aethalometers for black carbon (BC) source apportionment (SA). Service tools (softwares) for SA will be provided by WP1. This milestone M17 (M4.1) describes: (i) the steps taken in preparation to start the NRT-SA in 13 sites situated in 7 countries across Europe, and (ii) the current status of measurements and data chain in such different cities.

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 an RI-URBANS milestone M17 (M4.1).

## **2. Steps taken in the preparation of NRT-SA**

Following preparatory steps were taken to ensure that the NRT-SA can be started as scheduled in January 2023. The original plan was to pilot NRT-SA in 11 sites, however later Marseille and Bucharest joined the Task 4.1 voluntarily.

- i. A list of sites and contact persons for the Task 4.1 measurements were collected to enable efficient communication and a map of measurement sites was compiled (Figure 1).
- ii. Information about the status of measurements and previous information about source apportionment in different cities were collected and will be updated in real-time to the online document as situation progresses during the project (Tables 1 and 2 for ACSM and BC, respectively).
- iii. WP3 meetings to establish the data flows were organised quarterly to follow the progress and help in installations. In addition, task leaders participated actively in WP1 meetings to follow the development of the status of STs.
- iv. Training and remote support for software installations was provided during spring and summer 2022 for both AE33 and ACSM data transfer.



**Figure 1.** Map of 13 measurement sites across Europe for NRT-SA of the OA of PM

**Table 1.** Information about the current on-line PM speciation instruments available at the different sites for NRT-SA of the OA of PM and available publications.

Name of Pilot	Athens		Barcelona		Helsinki	Po Valley		Paris			Zürich	Marseille	Bucharest
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 1	Site 2	Site 1	Site 2	Site 3	Site 1	Site 1	Site 1
Name of Site	NOA	Demokritos	Barcelona	Montseny	Supersite	Milano	Bologna	SIRTA	Les Halles	BP Est	Kaserne	Longchamp	INO
Background	<b>urban</b>	suburban	<b>urban</b>	background	<b>street canyon</b>	<b>urban</b>	periurban	periurban	<b>urban</b>	<b>traffic</b>	<b>urban</b>	<b>urban</b>	periurban
ACSM (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Quad/ToF	Quad	ToF	Quad	ToF	Quad	ToF	Quad	Quad	Quad	Quad	Quad	ToF	Quad
Igor version	6.37	7	6.37	7	8.04			6.37			6.37	7	6.37
Is it running now? (Y/N)	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Starting date	2016	2017	2018	2020	2015	2022	2020	2011	2018		2022	2017	2014
Prior SA knowledge? (Y/N)	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y
Publication for SA	Stavroulas et al., 2019	Zografou et al., 2022	Via et al., 2021 ACP	Ripoll et al., 2015 ACP	Saarikoski et al., 2021						Chen et al., 2022	Chazeau et al., 2022, Chen et al., 2022	Chen et al., 2022

**Table 2.** Information about the current instruments available at different sites for NRT-SA of BC

Name of Pilot	Athens		Barcelona		Helsinki	Po Valley		Paris			Zürich	Marseille	Bucharest
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 1	Site 2	Site 1	Site 2	Site 3	Site 1	Site 1	Site 1
Name of Site	NOA	Demokritos	Barcelona	Montseny	Supersite	Milano	Bologna	SIRTA	Les Halles	BP Est	Kaserne	Longchamp	INO
Background	urban	suburban	urban	background	street canyon	urban	periurban	periurban	urban	traffic	urban	urban	periurban
Filter photometer (Y/N)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Type	AE33	AE33	AE33	AE33	AE33	AE33	MetOne	AE33	AE33	AE33	AE33	AE33	AE33
Is it running now ? (Y/N)	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Starting date	2015	2016	2013	2016	2015	12/2022	05/2018	2011			04/2014	2014	2013
Previous SA knowledge? (Y/N)	Y	Y	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y
Size Cut-off	PM2.5	PM10	PM2.5*, PM10	PM10	PM1	PM10	PM10	PM10 & PM1	PM2.5	PM2.5	PM2.5	PM2.5	PM10
Co-located nephelometer measurements?	Y	Y	Y	Y	N	N	since 2022	Y	N	N	N	N	Partly
Previous co-located OC/EC measurements ?	Y	Y (Field Sunset)	Y	Y	N	Y	Y	Y			Y	Y	N

### 3. Instrumentation and software for NRT-SA

ACSM and aethalometers will be used for chemical characterization (organic components and BC) of particles. A short description of instruments and needed software for the offline PMF (Positive Matrix Factorization) and NRT-SA are shown below.

#### 3.1. Instrumentation

- i. **Aerosol Chemical Speciation Monitor** (Q-ACSM, Ng et al. (2011) or ToF-ACSM, Frölich et al., 2013, Aerodyne Research Inc., Billerica, USA) will be used for the chemical characterization of non-refractory PM1 (total organics, sulfate, nitrate, ammonium, and chloride). Source apportionment of total organics will be conducted manually using the ME-2 software and automatically NRT-SA program.
- ii. **A dual-spot aethalometer** (AE33, Magee Scientific, Slovenia) will be used to measure aerosol light absorption and corresponding black carbon mass concentration at seven different wavelengths between 370 and 950 nm (Hansen et al., 1984; Drinovec et al., 2015). The concentrations of fossil fuel (BCff) and wood burning (BCwb) related BC will be calculated using Sandradewi et al. (2008) model in real-time. The software for this will be delivered by WP1.
- iii. In order to best characterise optical properties measured from AE33 and associated artefacts, **thermodenuded** (at 300°C) **absorption measurements** will be performed at 2 volunteer pilot sites (Paris and Zurich) during the duration of the pilot phase.

#### 3.2. Software

- i. **IGOR Pro software** (version 7-9) is needed for ACSM data collection, data validation and preparation of PMF matrices.
- ii. **SOFI-PRO** (Datalystica) is needed for conducting manual PMF and comparison with NRT-PMF.
- iii. **SOFI-RT** (WP1) is needed to conduct NRT-SA.
- iv. **ECAC tools** are needed for the data acquisition of ACSM and AE33 data, as well as for data submission.
- v. **NextCloud** software is needed for the transfer of input matrices of the ACSM source apportionment.

To ensure the comparability of the ACSM results, all partners are encouraged to follow ACTRIS guidelines and standard operation procedures. ACSM instruments used at the pilot sites were also invited to participate to an ACTRIS inter-comparison exercise forecasted in Fall 2022. Also, automatic QA/QC will be performed on all ACSM, following predefined procedures. Similarly, the quality of AE33 data will be ensured by the automatic QA/QC procedure developed by ACTRIS.

### 4. Status of dataflow in each city

A dedicated training session was organized in mid-July between pilot sites and the European Centre for Aerosol Calibration and Characterization (ECAC) in order to start the installation of AE33 acquisition tool. A subsequent trouble-shooting session was held in early August.

Table 3 includes the current status of data transfer in each measurement site. Three sites, (SIRTA at Paris, Barcelona and Athens NOA site) have all software installed and data chain tested. These sites are ready to start the NRT-SA as soon as RI-URBANS WP1 delivers the NRT-SA software. For the other cities, parts of data chain are not yet operative. We estimate these data chains will be ready by late autumn. However, the acquisition tool for ToF-ACSM needs further development to be NRT-SA compatible, especially for the generation of organic matrices. Installation of the tool is planned during the ToF-ACSM inter-comparison, in September/October 2022.



**Table 3.** Status of measurements, starting dates, data-flows for ACSM and AE33 and availability of software needed for the NRT-SA and offline PMF.

Name of Pilot	Athens		Barcelona		Helsinki	Po Valley		Paris			Zürich	Marseille	Bucharest
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 1	Site 2	Site 1	Site 2	Site 3	Site 1	Site 1	Site 1
Name of Site	NOA	Demikritos	Barcelona	Montseny	Supersite	Milano	Bologna	SIRTA	Les Halles	BP Est	Kaserne	Longchamp	INO
Background	urban	suburban	urban	background	street canyon	urban	periurban	periurban	urban	traffic	urban	urban	periurban
<b>ACSM DataFlow</b>													
Measurements started	Y	Sep. 2022	2021	N	2015	N	N	Y	Y	Y	May 2022	2017	2014
ECAC tool installed	Y	soon	Y	very soon	Y	soon	soon	Y	N	N	Y	soon	Y
NextCloud installed	Y	soon	Y	very soon	Y	N	N	Y	N	N	soon	soon	Y
<b>Aethalometer DataFlow</b>													
Measurements started	Y	Y	Y	Y	2015	N	N	Y	Y	Y	Y	2014	2013
ECAC tool installed	Y	soon	Y	Y	N	soon	N	Y	N	N	soon	soon	Y
<b>Ressources for offline PMF</b>													
Igor 9	N	N	N	N	N	Y	Y	N	N	N	Y	N	Y
ME-2	Y	Y	Y	Y	Y	N	N	Y	N	N	Y	Y	Y
SoFi Pro	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y

## 5. Conclusions

The measurements with the ACSM and AE33 have started in almost all cities where NRT-SA will be piloted. In many cities the measurements have been conducted for several years already and prior source apportionment information exists. This is an excellent starting point for the pilot actions.

During the first year of RI-URBANS we have established data-flows successfully in three of the cities and we estimate that the remaining issues in sites, which have not yet the dataflow, can be easily solved prior the NRT-SA period start (January 2023). Most of the issues experienced have been related to users unable to install software, too old laptops and other practical issues that are fairly easily solved.

We expect to start the NRT-SA in January 2023 as scheduled.

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