Milestone M22 (M4.6)

Start of sampling in health indicator pilot cities

RI-URBANS

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

By

CSIC

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Milestone M22 (M4.6): Start of sampling in health indicator pilot cities

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1. About this document

This document summarises the actions that have been taken to start sampling in health indicator pilot cities (Milestone M22) in the WP4 of RI-URBANS (Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial AreaS, Horizon-2020 GD project #101036245).

This is a public document, available in the RI-URBANS website (https://riurbans.eu/work-package-4/#milestones-wp4), and will be distributed to all RI-URBANS partners for their use and submitted to the European Commission as an RI-URBANS milestone M22 (M4.6).

2. Objectives

WP4 tackles RI-URBANS' SOJB2 to test and demonstrate solutions for advanced urban AQ monitoring systems and the evaluation of exposure to air pollutants (SP1, WPs 1-3) at urban background representative areas and hot spots in Europe. Specifically, WP4 will implement 5 testing and demonstration pilot studies in 9 cities and create synergies with SP3 to devise the roadmap for upscaling STs. These pilot studies encompass diverse European urban environments and will demonstrate on a real scale the ability to integrate complementary AQ measurement systems in existing AQMNs, addressing modalities where the 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.

Pilot 4 (Task 4.4) will demonstrate the measurement of a series of novel health indicators in pilot studies. It aims to identify particulate matter that could be especially dangerous for human health. This information will allow us to complement existing air quality policy with measures directly targeting health-relevant emission sources. The activities in the pilot cities will explore the importance of novel health indicators on the health impact of both short-term and long-term exposure to different regulated and non-regulated pollutants and their sources.

This pilot study is to be implemented in 3 cities: Athens, Barcelona, and Zurich. Currently, we are exploring the possibility of including Paris (participating in T4.1 and T4.3) pilot 4. Actually, although the final agreement is not yet signed with Paris, sampling has been already initiated in Paris and the activities are coordinated with T4.4. The wide spatial coverage will help assess the impact of PM, oxidative potential (OP), and nanoparticles sources that are abundant only in some regions in Europe. The long-term assessments will be complemented with real-time assessment of temporally sparse sources and study of aging effects on the OP of previously fresh PM emissions. The final product is a summary of novel health indicators, their sustainability and benefits for the AQMNs and AQ policies (D4.10).

3. Methodological approach

The pilot studies carried out in Athens, Barcelona, Paris and Zurich would cover different environments in Europe with different geographic and pollution patterns. The four city monitoring sites will measure both regulated standards (such as NOx, SO2, PM10 and/or PM2.5) as well as other non-regulated metrics. During RI URBANS, the measurement of novel metrics (such as eBC, nanoparticles, PNSD, PM chemical composition…) will be performed at the pilot cities following the guidance provided by WP1-2, ensuring that this activity can easily be up-scaled. The methods that will be used for the corresponding

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measurements will be those developed in WP1 and WP2, and will be complemented by additional novel analyses such as offline Aerosol Mass Spectrometry (AMS) and, possibly, Extractive Electrospray Ionization (EESI). This task will focus on the demonstration of the measurement techniques, on their validation, and on the approaches to produce the health-relevant information that can then be used to assess the exposure and health effects of these indicators. Different temporal resolutions will be used for the measurement of the various health indicators varying from minutes to daily averages.

To this end we have devised a two-fold strategy: 1) using existing data to develop and test improved evaluation of health effects in epidemiologic time series studies; 2) collection of new filters, aimed to evaluate the drivers of PM's oxidative potential.

3.1 Improved evaluation of health effects in epidemiologic time series studies

In connection with WP2, available data will be used to evaluate premature mortality and morbidity by cause, gender and age, and compared with the health outcomes of conventionally measured AQ pollutants. To make the link between PM sources and health, long term data sets (≥3 yr) are needed. Given the delay between health data, typically becoming available roughly 2 years after the fact, this study will be focused on existing data, preferably before 2020 in order to avoid impact of COVID-19.

The novel metrics that will be evaluated are:

- PM chemistry: 24h-resolution filter-based– PM10 vs PM2.5: including OA (offline AMS), trace elements, other constituents, ROS/OP.
- UFP, PNSD, BC

Table 1 summarises the measurements of these metrics carried out at the selected sites before (and during) RI-URBANS.

3.2. Evaluation of the drivers of PM's oxidative potential

Time series of PM2.5 and PM10 speciation and source apportionment obtained during RI URBANS will also be used to assess the oxidative potential (OP) and the sources and components with the highest OP.

Continuous measurements of regulated pollutants and novel metrics, such as those reported in Table 1, will continue during RI URBANS. New time series of novel metrics will be obtained following WP1 and WP2 guidelines and requirements.

A specific PM sampling campaign has been devised in order to perform a comprehensive characterization of PM composition and the identification and attribution of PM sources. Samples obtained will be analysed following the protocols devised in WP1 / WP2. Moreover, this will be complemented by additional novel analyses such as offline measurement of filters using AMS and, possibly EESI.

New samples will be collected at Athens, Barcelona and Paris. For Zurich, samples already collected in 2018-2019 will be used. This strategy permits us to start the analytical tasks earlier, testing and refining the methodologies.

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Table 1. Available existing data at the stations before RI URBANS

	Athens	Barcelona	Paris	Zurich
PM	PM2.5	PM10/2.5/1	PM2.5	PM10/2.5
Period	2013-ongoing	2002-ongoing	2020-ongoing	2018-2019
Variables Analyed				
Ions	Y	Y	tbd	Y
OC/EC	Y	Y	Y	Y
Metals	Y	Y	tbd	Y
Organic tracers	campaigns	campaigns	tbd	Y
OP analysis				
Fraction	PM2.5	PM10/PM2.5	PM2.5	PM10/PM2.5
Start	July 2016	January 2018	early 2022	
End	still running	March 2019		2013, 2018-2019
Method/lab	DDT / NOA	U Grenoble	U Grenoble	U Grenoble
Online measurements				
ACSM				
Instrument	Quad-ACSM	Quad-ACSM	Quad-ACSM	Quad-ACSM
Start	January 2016	9-2-18	Early 2019	3 yr campaign
End	on	on	on	
XRF				
Instrument				XACT
Start				3 yr campaign
BC				
Instrument	AE33	AE33/MAAP	AE33	
Size fraction	PM2.5	PM10	PM2.5	
Start	1-5-15	1-1-16	Early 2019	1-1-18
End	on	on	on	on
PNSD				
Instrument	TSI 3034	TSI 3080 / 3082	PALAS	
Size fraction	10.4-487 nm	10.9-478 nm	10-800nm	
Start	19-6-15	1-1-13	Late 2019	1-1-10
End	on	on	on	2015

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4. Actions to start sampling in health indicator pilot cities

As previously stated, continuous measurements at the pilot sites of regulated pollutants and novel metrics (Table 1), will continue during RI URBANS. This new time series of novel metrics will be obtained following WP1 and WP2 guidelines and requirements. In addition to the referenced measurements, new measurements will be implemented at some pilot stations, such as continuous monitoring of VOCs at Barcelona site by a ToF-PTRMS, installed in September 2021. Continuous measurement of concentrations for metals in PM10 and PM2.5 are planned for specific campaigns at each site.

In order to get enough sampled material to perform all the analytical determinations planned, a similar strategy has been addressed at the pilot sites (Athens, Barcelona, and Paris), simultaneously sampling PM10 and PM2.5 by using high-volume samplers (30 m^3/h), as carried out in Zurich in 2018-2019.

In Barcelona, PM10 and PM2.5 will be continuously sampled, with a daily frequency (24h samples every day) started on 2022 January 1st.

In Paris, PM10 and PM2.5 will be continuously sampled, with daily frequency (24h samples every day) starting on 2022 April 1st. In parallel, PM2.5 samples will be collected everyday by using low-volume samplers (1-2.3 m^3/h).

In Athens, sampling of PM2.5 will involve using High-volume samplers, initiated 2022 January 21st, with a frequency of 1 24h filter every 3rd day. PM10 sampling, with the same frequency, started 2022 April 20th, by using a High-volume sampler loaned by CSIC. In parallel, PM2.5 samples are to be collected everyday by using low-volume samplers (1-2.3 m^3/h).

The sampling campaign will be extended for 1-1.5 yr period for representativeness. At a first step, samples collected every 3rd-4th day will be analysed, accounting for 274/365 filters per station; that means 822-1095 filters in total.

Samples obtained at all cities will be analysed by the same institutes. Analysis of duplicates by different labs will allow intercomparison and quality assurance. Table 2 summarizes the analytical tasks to be performed and the responsible laboratories. This is a first plan that can be modified during the project.

Table 2. Variables to be analysed in filters collected in 2022-2023 at Pilot 4 sites, and responsible laboratories.

Variable/Analysis	Responsible Laboratory	Comments
Soluble ions	NOA	Duplicates by U Grenoble / CSIC
Trace metals	CSIC	
OC/EC	CSIC	Duplicates by U Grenoble / NOA
WSOC	PSI/NOA	To be defined
Sugars and polyols	U Grenoble	Duplicates by CSIC / NOA
Other organic tracers	CSIC	Duplicates by U Grenoble / NOA
Offline AMS	PSI	
Oxidative potential	U Grenoble	Duplicates by NOA

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