Milestone M10 (M2.5)

Guidance document for mobile monitoring in RI-URBANS pilots

RI-URBANS

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

By

VITO, UU, UoB and INOE

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RI-URBANS (www.RIURBANS.eu) is supported by the European Commission under the Horizon 2020 – Research and Innovation Framework Programme, H2020-GD-2020, Grant Agreement number: 101036245

Milestone M10 (M2.5): Guidance document for mobile monitoring in RI-URBANS pilots

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Work package (WP)	WP2 - Health effect assessment of PM, PM components, nanoparticles, and their source contributions
Milestone	M10 (M2.5)
Lead beneficiary	VITO
Means of verification	Documents available to the pilots
Estimated delivery deadline	M14 (30/11/2022)
Actual delivery deadline	30/11/2022
Version	Final
Reviewed by	WP2 leaders
Accepted by	RI-URBANS Project Coordination Team
Comments	This document reports on the status of guidance document(s) for mobile monitoring in RI-URBAN pilots elaborated in WP2 to be tested in the pilots cities of WP4, T4.3 (Rotterdam, Birmingham, Bucharest, Helsinki).

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Table of Contents

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1. About this document

This document reports on the status of guidance document(s) for mobile monitoring in RI-URBANS pilots.

The current version describes the guidance documents that were available for the pilots at the time of writing. In addition, in section 2, we summarise the different approaches to increase spatial resolution of air quality (AQ) data, as discussed in the RI-URBANS Deliverable D13 (D2.5). For more details on the review of complementary approaches to traditional AQMN (Air Quality Monitoring Networks) to assess AQ exposure for health and epidemiological studies, and to assess policy actions at urban scale, we refer to Deliverable D13 (D2.5).

This milestone M10 (M2.5) is reached as planned in WP2, T2.3 on mobile monitoring of nanoparticles and citizen observatories to improve evaluation of health effects of long-term exposure. Mobile platforms and smart sensors networks with involvement of citizens are proposed to obtain the required urban maps supporting LUR modelling approaches. The regional and urban background concentrations are obtained from modelling tasks in WP3. This proposed methodology (D13, D2.5), including involving citizens and mechanisms to enrol citizens that can be readily upscaled at European levels, will be tested in the pilots WP4, T4.3 (Rotterdam, Birmingham, Bucharest, Helsinki).

This is a public document, available in the RI-URBANS website (https://riurbans.eu/work-package-2/#milestones-wp2). The document will be distributed to all RI-URBANS Partners for their use and submitted also to European Commission as the RI-URBANS milestone M10 (M2.5).

2. Different approaches

To increase the spatial resolution of AQ data, mobile and stationary approaches can be used. In general, a distinction can be made between mobile/fixed measurement and experimental design with/without citizens (see Figure 1, taken from Deliverable D13 (D2.5). The selection of the approach is also defined by the research question and considerations if citizens' involvement has added value.

Mobile monitoring can be used to map pollutants at a high spatial resolution with a limited number of instruments (in contrast to stationary/ fixed monitoring) and can also use high-end or mid-end instruments exhibiting higher data quality than sensors. Mobile monitoring has some challenges because of the spatiotemporal nature of the collected dataset. A special care should be taken during data collection and/or data processing in order to obtain representative results. Also, special attention should be taken related to the sampling conditions during the mobile measurements. If sensors are used, they should be checked against more performant equipment and calibrated.

Fixed monitoring requires more instruments and provides data with a low temporal resolution/ interval (from weekly to monthly) when using diffusive samplers and varying performance when using low-cost sensors. A proper calibration and validation approach is needed, and co-location to evaluate intra- and inter-sensor uncertainty and continuous calibration/validation to compensate for seasonal effects from e.g. air temperature and relative humidity, is recommended.

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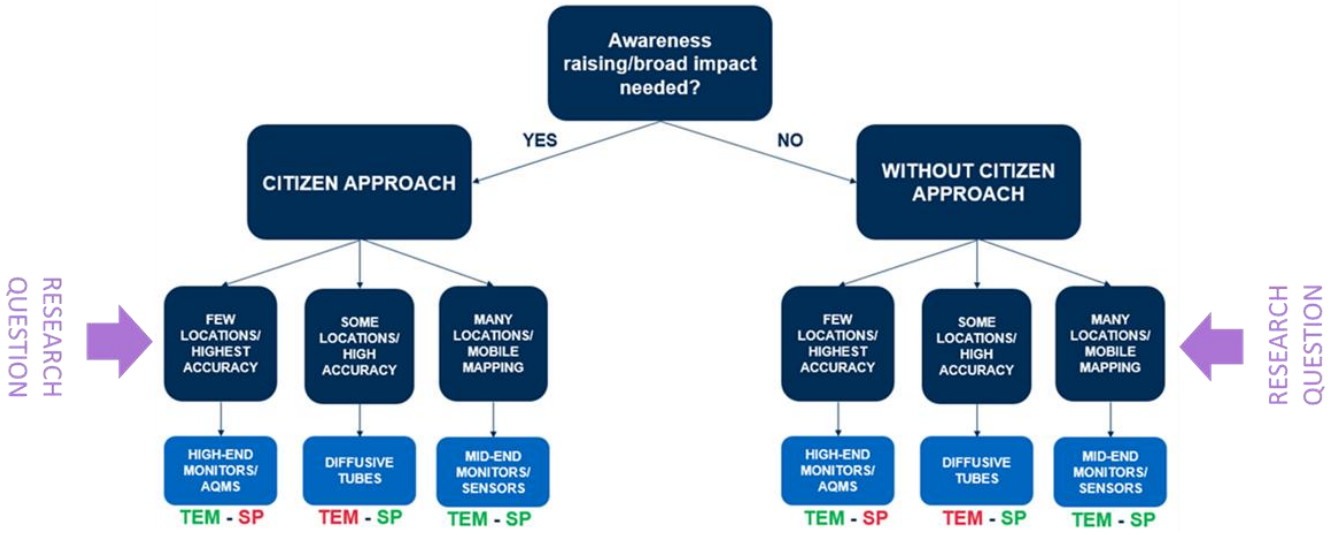

Figure 1: Flow chart with key decision to be taken when implementing mobile and fixed measurements for detailed characterisation of urban variability of atmospheric pollutants, with or without citizen approaches and function of the research question addressed; The colours indicate that the temporal (TEM) or spatial (SP) resolution is good (green) or bad (red).

3. Guidance documents provided to the pilot cities

3.1. Introduction

This paragraph gives an overview of the RI-URBANS pilots for which guidance documents have been delivered. The guidance documents were tailored to the needs of the pilots. A summary of the guidance documents is given in Table 1.

Each paragraph below gives a short summary of the pilot.

3.2. Pilot Rotterdam

More details on the pilots are given in the RI-URBANS Deliverable of WP4.

3.2.1. With citizens

The campaign with citizens was coordinated by *Dienst centraal milieubeheer Rijnmond* (Rijnmond Environmental Services, DCMR). In short, employees of DCMR, Gemeentelijke Gezondheidsdienst (Municipal Health Service, GGD) and city of Rotterdam (The Netherlands) were asked to volunteer to take part in the monitoring campaign (see "Invitation letter").

The coordinator of the campaign is an employee at DCMR. This person was responsible for communication with participants, organisation of the campaign, downloading of data, keeping instruments operational and sending data to VITO. This person is also the first contact point in case of technical issues and is the contact point of VITO/UU.

Two documents were made available as guidance document: one including more detailed instructions on how to operate airQmap and one with very simple instructions for the participants in data collection.

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3.2.2. Without citizens

Measurements were carried out with Google car.

3.3. Pilot Birmingham

The campaign (in Birmingham, UK) with citizens was designed to complement the measurements from multiple stationary points within the same area, near the University of Birmingham (UoB). The volunteers will be students at the (UoB), while the stationary measuring points will be deployed at citizen or council buildings within the same area.

The coordinators of the campaign are staff at the UoB. The coordinators along with a PhD student are responsible for organising the campaign as well as communicating with the participants and the other project CoIs. Equipment design and maintenance, and data collection and analysis will be done by the coordinators and the University staff, using both University assets and funds from the project.

Two documents were made available as guidance documents: the first is for advertising the campaign and attracting citizen scientists and the second is for providing further information to participants about their involvement, data to be collected and other information relative to the measurement campaign.

3.4. Pilot Bucharest

Mobile measurements in Bucharest (Romania) were carried out without involvement of citizens. A car was used to sample in the Bucharest metropolitan area with low-cost sensor, that measurements were checked against high performance instruments following ACTRIS requirements

3.5. Pilot Helsinki

Stationary mapping for black carbon was explored in the Science Campus of University Helsinki, Finland during summer 2022. We deployed a total of 8 different BC sensors (Figure 2) to map out the small-scale variability of BC in a sub-urban area of Helsinki. Prior distribution the sensors we performed a side-by-side evaluation of the sensor data against a reference instrument (MAAP at SMEAR III supersite, Järvi et al. (2009)). Similar quality control step was done after the 1,5 month deployment. More details are presented in Elomaa (2022).

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Figure 2. Black carbon mapping pilot in Helsinki according to Elomaa (2022). The map was obtained through Google Maps.

Currently we are preparing a mobile pilot in Helsinki area. This is a joint activity with University of Helsinki, Finnish Meteorological Institute and Helsinki Air Quality Authority. We aim to explore black carbon, aerosol number concentration and PM2.5 gradients next to the highway leading to the city centre. We will utilize a combination of fixed sensor network equipped with Vaisala AQT 530 sensors (Petäjä et al. 2022) and passive NO_2 sensors with variable distance from the highway operated for extended period of time in the spring 2023. In particular, we are interested in evaluating the role of noise barrier constructed next the highway in the dispersion of air pollution.

The fixed network of sensors is complemented with mobile measurements onboard a drone. We will include aerosol number concentrations with CPCs and black carbon measurements with cost-effective BC sensors onboard the drone campaign. The campaign period is timed to coincide with the high PM2.5 season in March-April, associated with a combination of road dust and studded tires.

3.6. Other pilots

At the time of writing, we were not aware of other pilots where mobile measurement methods were used. However, we will interact with the pilot cities and other collaborators to initiate new pilot actions and to support the pilot development.

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4. References

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Petäjä, T., Ovaska, A., Fung, P.L., Poutanen, P., Yli-Ojanperä, J., Suikkola, J., Laakso, M., Mäkelä, T., Niemi, J.V., Keskinen, J., Järvinen, A., Kuula, J., Kurppa, M., Hussein, T., Tarkoma, S., Kulmala, M., Karppinen, A., Manninen, H.E. and Timonen, H. (2021) Added value of supporting air quality observations with the use of Vaisala AQT530 sensor as a part of a sensor network, Frontiers in Env. Sci., https://doi.org/10.3389/fenvs.2021.719567.

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Table 1: Overview of guidance documents and other documents used for the different pilots

Pilot city	Pilot case	Document name	Description
ROT	With citizens (DCMR)	Invitation letter	Invitation letter to recruit employees
		Manual airQmap	Description of the method and manual how to collect data, download data and send data to VITO (coordinator at DCMR)
		Short instruction manual airQmap	Short description of how to operate the instruments (participants)
ROT	Without citizens	Campaign procedure	Short description of how to operate the instruments (participants-research staff)
BIR	With citizens	Recruitment advertisement	Invitation for student participation
		Information sheet	Project overview and information for the participants
BUC	Without citizens	Campaign procedure	Short description of how to operate the instruments (participants-research staff)
HEL	Without citizens	Campaign procedure	Short description of how to operate the instruments (participants-research staff)

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