



CitiObs

CitiObs - ENHANCING CITIZEN OBSERVATORIES
FOR HEALTHY, SUSTAINABLE, RESILIENT, AND
INCLUSIVE CITIES

DELIVERABLE 2.2

Deliverable Report – The ‘Using Low-Cost Sensors’ Toolkit

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Abstract:	This Deliverable Report contains the current version of the <i>Environmental Monitoring Toolkit</i> , which aims to remove important barriers in the usage of sensing devices and other monitoring systems, regarding technical skills, data quality, interoperability and data interpretation.		

VERSION LOG

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CitiObs - Enhancing Citizen Observatories for healthy, sustainable, resilient and inclusive cities

CitiObs (Enhancing Citizen Observatories for Healthy, Sustainable, Resilient and Inclusive Cities) is a four-year Horizon Europe project funded by the European Commission. The project aims to strengthen the role of Citizen Observatories (COs) in urban environmental governance by developing and applying tools, methodologies, and practice-based knowledge that support the co-creation of data, knowledge, and local action (www.citiobs.eu).

Citizen Observatories enable citizens and communities to actively participate in the observation, monitoring, and protection of their local environment. Through the use of sensing technologies, wearables, participatory methods, and collaborative data practices, they can complement traditional environmental monitoring systems, contribute valuable local knowledge, and support evidence-based decision-making. CitiObs seeks to enhance both existing and emerging Citizen Observatories by increasing the quality, interoperability, accessibility, and societal impact of citizen-generated environmental observations.

The project places particular emphasis on air quality and related environmental challenges in urban areas. Through the co-design and deployment of innovative tools, data services, and participatory methodologies, CitiObs supports citizens, researchers, public authorities, and other stakeholders in collaboratively addressing environmental issues while contributing to the objectives of the European Green Deal.

To ensure relevance, usability, and uptake, CitiObs adopts a large-scale co-design, demonstration, and mentoring approach. Project tools and methodologies are developed and validated in collaboration with 5 Frontrunner Cases, refined and tested with 30 Alliance Cases, and further disseminated and showcased through a network of over 50 Fellow Cases distributed across different regions of the world. This iterative process enables the project to respond to real-world needs while fostering mutual learning among diverse Citizen Observatory communities.

EXECUTIVE SUMMARY

This deliverable presents the CitiObs Environmental Monitoring Toolkit, an open-access resource developed to support Citizen Observatories, Citizen Science practitioners, communities, researchers, public authorities, and other stakeholders involved in environmental monitoring. The Toolkit addresses technical and non-technical barriers commonly encountered when designing, implementing, analysing, and communicating environmental monitoring campaigns, with a particular focus on air quality and related environmental challenges in urban environments.

The Toolkit was developed through an iterative co-design process involving CitiObs partners, Frontrunner Cases, Alliance Cases, Fellow Cases, and the wider Citizen Science community. Its development was informed by a review of existing resources, a series of workshops organised throughout the project, and continuous engagement with Citizen Observatory practitioners. The resulting content reflects real-world experiences, needs, challenges, and lessons learned from environmental monitoring initiatives.

The Toolkit adopts a socio-technical perspective, recognising that successful environmental monitoring depends not only on sensing technologies and data infrastructures but also on community engagement, stakeholder collaboration, communication, governance, and the ability to transform environmental observations into meaningful action. To support this approach, the Toolkit guides users through the environmental monitoring journey, from identifying environmental concerns and defining research questions to data collection, quality assurance, analysis, visualisation, interpretation, and decision-making.

The Toolkit is organised into five main thematic areas: Environmental Monitoring, Sensing Devices, Sensor Data Platforms, Data Management, and Community. Content is structured around practical user-driven questions and provides guidance through a consistent format including a rationale for why a topic is relevant, practical recommendations, useful resources, and links to related content. The Toolkit is closely aligned with the CitiObs Technical Architecture and introduces key concepts such as interoperability, SensorThings API (STA), STAplus, Analysis Ready Data (ARD), and Decision Ready Information (DRI), while serving as an accessible entry point to CitiObs services including ValAir, VirtualAir, and MapAir.

To support different user needs and learning styles, the Toolkit is complemented by a range of supporting resources. These include a simplified companion guide entitled *Your Environmental Monitoring Journey: A Short Guide for Communities*, practical reflection and planning templates developed and tested during workshops with the CitiObs Frontrunner Cases, publicly available workshop recordings, instructional videos, and a Citizen Observatory Stories section that captures experiences and lessons learned from Citizen Observatories and Citizen Science initiatives. Together, these resources provide multiple pathways for users to engage with the Toolkit and apply its guidance in practice.

The Toolkit is published online through GitBook and its source content is available in a GitHub repository, enabling collaborative content development, community contributions, integrated feedback mechanisms. In addition, AI-assisted navigation was integrated. It is accessible through the CitiObs Knowledge Platform, which connects the Environmental Monitoring Toolkit with other CitiObs Toolkits and resources, promoting a holistic understanding of Citizen Observatories and environmental monitoring.

Following the completion of the CitiObs project, the Toolkit will continue to be maintained as part of the CitiObs Knowledge Platform. Through its open and collaborative development model, engagement with Communities of Practice such as the European Citizen Science Association (ECSA) Working Group on Air Quality and the Citizen Science Global Partnership (CSGP) Citizen Science and Air Quality Community of Practice, and connections to a global network of Citizen Observatory initiatives, the Environmental Monitoring Toolkit is positioned as a sustainable resource that can continue supporting environmental monitoring initiatives both within Europe and internationally.

The Environmental Monitoring Toolkit contributes to the broader CitiObs vision of empowering citizens and communities to participate meaningfully in environmental monitoring, generating trustworthy environmental information, and supporting evidence-based action towards healthier, more sustainable, resilient, and inclusive cities.

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ACRONYMS

Acronym	Full name
API	Application Programming Interface
ARI	Analysis Ready Information
CARE	Collective Benefit, Authority to Control, Responsibility, and Ethics
CO	Citizen Observatory
CoP	Communities of Practice
COAP	Constrained Application Protocol
CS	Citizen Science
CSV	Comma Separated Values
D	Deliverable
DB	Database
DoA	Description of Action
EC	European Commission
ECSA	European Citizen Science Association
EEA	European Environmental Agency
EPA	(United States) Environmental Protection Agency
ESBs	Enterprise Service Buses
FAIR	Findable, Accessible, Interoperable and Reusable
FOSS	Free and Open Source
GDPR	General Data Protection Regulation
GPS	Global Positioning System
GUI	Graphical User Interface
HTTP	Hyper Text Transfer Protocol

IoT	Internet of Things
IT	Information Technologies
ISO	International Organization for Standardization
JSON	JavaScript Object Notation
LED	Light-Emitting Diode
LoRa	Long Range
MQTT	Message Queuing Telemetry Transport
NGOs	Non-Governmental Organizations
OGC	Open Geospatial Consortium
PH	Potential of Hydrogen
PM	Particulate Matter
SD	Secure Digital
SensorML	Sensor Model Language
SOAP	Simple Object Access Protocol
SOS	Sensor Observation Service
SQL	Structured Query Language
STA	Sensor Things API
WCAG	Web Content Accessibility Guideline
WHO	The World Health Organization
WP	Work Package

GLOSSARY

Term	Definition
Sensing Device / Low-cost sensor device	A Sensing Device refers to a compact electronic device that uses one or more than one sensor and other electronic components to detect, monitor, and/or report on specific environmental parameters or phenomena at a relatively affordable price. These sensing devices are often built using economical components and simplified designs, making them accessible to a wide range of users, including citizen scientists, educators, and community groups. Despite their lower cost, they are engineered to provide reasonably accurate measurements, allowing for meaningful data collection and analysis. Sensing devices play a vital role in democratising scientific research, enabling individuals and communities to monitor and understand their local environment, address environmental concerns, and contribute to scientific knowledge and public policy decisions. In this document we mostly refer to Sensing Devices to monitor air pollution. During the creation of this document, we decided to adopt the terminology Sensing Device, to avoid detrimental connotations that can be associated with the term “low-cost”, as for example, of worse quality. However, the term low-cost sensor is still widely recognised and used by the Citizen Science and the academic community.
Open science	UNESCO defines Open Science as a set of principles and practices that aim to make scientific research from all fields accessible to everyone for the benefits of scientists and society. Open science is about making sure not only that scientific knowledge is accessible but also that the production of that knowledge itself is inclusive, equitable and sustainable. Open science advocates for transparency, accessibility and reproducibility, principles that have a larger potential of benefiting society. The use of open source and open science can contribute to increase acceptance of data in science and policy, as it moves away from black boxes and unknown proprietary algorithms.
Free and open source (FOSS)	FOSS refers to groups of technology that are licensed to freely use, copy, study, and modify in any way, without charge. Here the word ‘free’ is used in the sense of ‘free speech’, not ‘free beer’ (Richard Stallman, GNU 2011).
Open Source	Open source refers to making the underlying source code or designs of a technology publicly available so that people are encouraged to re-use, re-purpose, or improve the design. This is in contrast to proprietary

	software , or hardware designs where the technology is under restrictive copyright or licensing and the source code or designs are hidden from the users.
Metadata	Metadata refers to descriptive information that provides context, structure, and meaning to data. It serves as a set of data about data, encompassing details such as the origin, format, content, and usage of a dataset or individual data elements. Metadata helps users understand and interpret data by providing essential attributes and properties, such as creation date, authorship, location, and data quality indicators. It facilitates data discovery, organisation, retrieval, and management, enabling efficient data integration, sharing, and analysis across different systems, platforms, and domains. Metadata plays a crucial role in data governance, data management, and data-driven decision-making processes, ensuring the reliability, accuracy, and usability of data assets throughout their lifecycle.
Provenance	Data provenance refers to the documentation of the origin, history, and transformations applied to a piece of data throughout its lifecycle. It provides a detailed record of the processes involved in data creation, manipulation, and sharing, enabling users to trace back to the original sources and understand how the data has been modified or used over time.
Citizen Observatories	Citizen Observatories (COs) are community-based environmental monitoring and information systems, typically at the community level or in a specific location, even if linked to a national or global environmental concern.
Citizen Science	Citizen Science refers to initiatives actively involving the public in scientific research that generates new knowledge or understanding, and thus has the potential to bring together science, policy makers and society as whole in an impactful way.
WiFi /Wi-Fi	A technology that allows devices to wirelessly connect to a local area network (LAN) using radio waves.
Bluetooth	A wireless technology standard for exchanging data over short distances using short-wavelength radio waves. The original version of the Bluetooth standard was designed primarily for data streaming and file transfer between devices like smartphones, tablets, and computers.
ZigBee	A low-power, low-data-rate wireless communication protocol used for short-range communication between devices in Internet of Things (IoT) and home automation applications.
LoRa / LoRaWAN	LoRa (Long Range) is a wireless communication technology used for long-range, low-power communication between IoT devices. Developed by Semtech Corporation. LoRaWAN is short for Long Range Wide Area Network, LoRaWAN is a protocol specification built on top of the LoRa

	technology, defining the communication protocol and system architecture for LoRa-based IoT networks.
GSM (Global System for Mobile Communications)	A standard developed by the European Telecommunications Standards Institute (ETSI) for digital cellular networks used for voice and data communication. It uses a SIM card, a small card containing a microchip that securely stores subscriber identity and authentication information, allowing users to access GSM networks and services.
LTE (Long-Term Evolution)	A standard for wireless broadband communication designed to increase the capacity and speed of mobile telephone networks. LTE is often marketed as 4G LTE and is a successor to 3G technologies. The 4G (Fourth Generation) is a standard for wireless broadband communication designed to increase the capacity and speed of mobile telephone networks.
Eduroam (Education Roaming)	A secure, worldwide roaming service that enables students, researchers, and staff from participating institutions to access wireless network connectivity using their home institution's credentials.
Accuracy	"Accuracy" generally refers to the degree of conformity of a measured or calculated quantity to its actual value. In data analysis or data processing, accuracy refers to the correctness or precision of the data. It indicates how well the data reflects the real-world phenomenon it represents. Factors such as data collection methods, instrumentation, and human error can affect data accuracy.
Reliability	"Reliability" generally refers to the consistency, stability, and dependability of a system, process, measurement, or result over time and under varying conditions. Measurement reliability refers to the consistency and stability of measurements or data obtained from a measurement instrument or procedure. It assesses the extent to which repeated measurements yield consistent results.
Accessibility	"Accessibility" generally refers to the degree to which products, services, environments, or digital content are usable by people with disabilities, including those with visual, auditory, motor, cognitive, or other impairments. Digital accessibility focuses on ensuring that websites, software applications, electronic documents, and digital content are usable by people with disabilities. This includes considerations such as screen reader compatibility, keyboard navigation, alternative text for images, and captions for audio and video content.
Usability	"Usability" refers to the extent to which a product, system, or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.
Analysis Ready Data (ARD)	"Analysis ready data" (ARD) refers to geospatial or remote sensing data that has been pre-processed and optimized for analysis and interpretation by end-users. In CitiObs, we use the term ARD to sensor

	data that has been Quality Controlled and Corrected. Open algorithms for quality control and correction are being tested and developed within the project and made openly available.
Decision Ready Information (DRI)	"Decision-ready information" refers to data, reports, or analyses that have been processed, organized, and presented in a format that enables decision-makers to make informed decisions. In CitiObs, we use the term DRI to refer for example to air quality maps generated using a combination of sensor data and model or satellite data, as well as, data reports aggregating ARD sensor data, spatially or temporally.
Environmental Monitoring	Environmental monitoring refers to the systematic and ongoing process of measuring or collecting environmental data. Environmental monitoring involves systematic observation, measurement, and analysis of various environmental parameters such as air pollutants, water, soil, and biodiversity to assess the health and quality of ecosystems and their interactions with human activities.
Toolkit	A toolkit is a set of practical and reusable tools (methods, or resources) that are used for supporting the implementation of Citizen Science initiatives.
Wearable Devices (Wearables)	A wearable device refers to a body-worn system equipped with sensing elements (sensors) that can continuously track our physical activities and provides real-time monitoring of environmental parameters such as air pollutants, temperature, and noise.

1 INTRODUCTION

The **CitiObs Environmental Monitoring Toolkit** is a comprehensive resource designed to support citizen and community-led initiatives in environmental monitoring activities related to Citizen Science and **Citizen Observatories initiatives (CS/COs)**. This introduction outlines the fundamental motivations for the toolkit (**the why**), its core components (**the what**), and the methodological framework it provides (**the how**) to empower citizens in protecting their health and urban environments.

1.1 The Why: Addressing Data Gaps and Building Trust

Traditional environmental monitoring often relies on a limited number of official monitoring campaigns or reference stations that lack the **resolution** necessary to identify hyper-local issues, like air pollution hotspots, noise or biodiversity loss. This creates significant **data gaps**, leaving many communities "in the dark" about the specific state of their local surroundings. Without localized data, there is often a lack of visibility, accountability, and action for the communities most affected by environmental hazards, reason why many citizens and communities decide to monitor the environment themselves.

While thousands of citizens are already engaged in monitoring their environment, their data is frequently dismissed by policy makers due to concerns regarding reliability and quality, standardization, or the "black box" effect of proprietary technology. The Environmental Monitoring Toolkit exists to bridge this gap by lowering technological barriers and providing the protocols needed to transform community-gathered data into trustworthy evidence that can influence local policy and governance.

Although the information in the CitiObs Environmental Monitoring Toolkit can be applied to different types of environmental monitoring, its main focus is on air quality.

1.2 The What: A Multi-Dimensional Resource for Citizen Science

The toolkit is an open-source, evolving tool developed to provide practitioners with a step-by-step roadmap to navigate the complexities of environmental monitoring. To make the documentation intuitive and accessible for diverse audiences, the toolkit is structured around a series of guiding questions (e.g., "What variables can be measured?", "How do we increase traceability?", or "How can I analyse my data?") that lead users directly to relevant solutions and resources. These resources are organized around the following primary themes:

- **Foundations and Planning (Environmental Monitoring):** This section focuses on the "pre-technical" phase, emphasizing that successful involvement in monitoring activities starts with a clear purpose rather than with technological solutions (i.e. sensors) , and to understand key established players in the environmental monitoring landscape, both in Europe and worldwide.
- **Sensing Hardware & Methods (Sensing Devices):** This section provides a deep dive into the technology used to detect and measure air quality and related environmental parameters. It includes comprehensive technical and non-technical criteria for choosing devices, and detailed considerations for mobile and wearable applications.

- **Digital Infrastructure (Sensor Data Platforms):** This section explores the frameworks used to collect, process, and manage data from distributed networks. It includes guidance on ensuring different systems can exchange information seamlessly using open standards like the OGC SensorThings API (STA), and what factors to consider when choosing a data platform.
- **Data Stewardship & Action (Data Management & Integration):** This section provides protocols for transforming raw sensor readings into trustworthy evidence for policy change. It includes strategies for documenting the origin, history, and transformations of data to build public and scientific trust, as well as specific strategies for relating environmental data to WHO Air Quality Guidelines and health impacts to make the findings more relatable. It also includes descriptions of methods developed within CitiObs for quality control and corrections, and for generating indicators.
- **Inclusive Participation (Community):** This section addresses the social dimension of environmental monitoring, with strategies to help non-technical participants to overcome technical barriers, and methods for maintaining participation over time. This section links also to the other toolkits developed in CitiObs (such as the Leave No One Behind Toolkit), that are also available in the Knowledge Platform.
- **Citizen Observatory Stories:** This section aims to become a collection of narratives from CS/CO initiatives to inspire and provide real-world examples. It includes a template based on the CSISTA tool for gathering impact stories.

1.3 The How: The Environmental Monitoring Journey

The Environmental Monitoring Toolkit guides initiatives through a monitoring journey, emphasizing that successful monitoring activities begin by clearly stating the intended purpose rather than directly delving into technical choices. Importantly, the toolkit is designed to be navigated in different ways depending on the user's needs and level of experience. Users can follow a structured template that encourages reflection on the key stages of planning, implementing, and evaluating a monitoring campaign. The toolkit also includes an AI-powered assistant within the GitBook¹ platform, allowing users to ask questions in natural language and be directed to the most relevant guidance, methods, and resources. This makes it possible to either follow a step-by-step process or explore specific topics on demand.

Both the toolkit narrative and the companion guidance start by converting a community's environmental concerns or "worries" into testable hypotheses and manageable research questions. Practitioners are then guided through stakeholder mapping to align expectations and foster collaboration with local authorities, NGOs, community groups, and other relevant actors.

The toolkit provides both technical and non-technical criteria for selecting appropriate monitoring approaches, helping users choose among static, mobile, or wearable sensing devices according to the specific goals of their campaign. To support interoperability and data sharing, the toolkit

¹ Gitbook: GitBook is a documentation platform that allows users to create, manage, and publish documentation using a clean editor and Git-based workflows. It is commonly used for open-source projects and enterprise documentation.

promotes the use of standardized protocols such as the OGC SensorThings API (STA) and STAplus, enabling data integration across different monitoring networks and platforms.

A critical component of the toolkit is the guidance on how to transform raw sensor measurements into Analysis Ready Data (ARD) through quality assurance and validation processes using tools such as ValAir and the FILTER framework. The resulting data can then be combined with models, satellite observations, and other contextual information to produce Decision Ready Information (DRI), such as air quality maps and exposure assessments. With this, the Environmental Monitoring Toolkit supports the CitiObs project vision of enhancing Citizen Observatories data and transforming it into actionable information.

2 METHODOLOGY FOR THE DEVELOPMENT OF THE TOOLKIT

The Environmental Monitoring Toolkit was developed through an iterative, participatory process that combined desk research, stakeholder engagement, practitioner workshops, and technical validation activities. The objective was to ensure that the toolkit addressed real-world challenges faced by Citizen Observatories (COs), Citizen Science practitioners, communities, and technical experts involved in environmental monitoring.

2.1 Identification and Review of Existing Resources

The first step in the development of the Toolkit was the identification and review of existing tools, toolkits, methodologies, approaches, and resources related to environmental monitoring, Citizen Science, and Citizen Observatories. This review was conducted through an extensive online search and provided the foundation for the initial structure and content of the Toolkit.

2.2 First Co-design Workshop: Identifying Barriers and Needs

To complement the desk research, a workshop was organised during the CitiObs plenary meeting in Barcelona in June 2023. Nineteen CitiObs partners participated in the session, representing a balanced mix of natural and social science expertise. Participants were divided into seven groups and engaged in a hands-on discussion focused on their experiences with Citizen Science and Citizen Observatories.

The workshop aimed to identify barriers associated with the use of sensing devices and environmental monitoring systems, particularly regarding technical skills, sensor deployment, data quality, interoperability, data interpretation, and related challenges.

The activity was organised into two stages:

1. **Issue Identification** – Participants were given 20 minutes to document barriers and challenges encountered when using sensing devices and monitoring systems within Citizen Observatories.
2. **Issue Mapping** – Participants selected three to five key issues and discussed them in greater detail by answering four guiding questions:
 - a. At which stage of the monitoring process does the issue appear?
 - b. Who is affected by the issue?
 - c. What causes or contextual factors contribute to the issue?
 - d. How was the issue solved, or how could it be solved?

The discussions generated valuable insights into recurring challenges experienced across Citizen Observatories. The outputs were systematically captured and used to identify the initial entry points and thematic structure of the Toolkit.

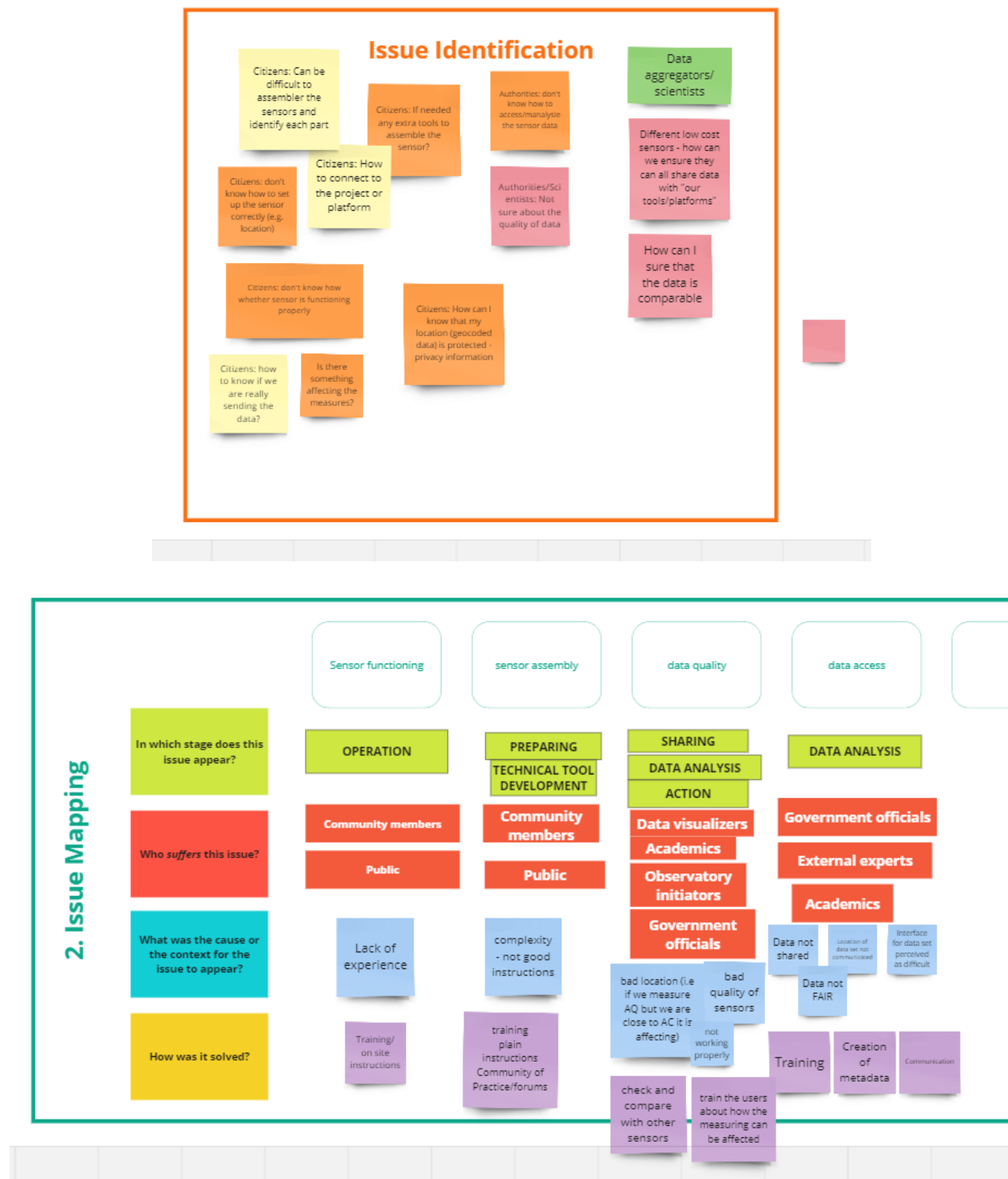


Figure 1. Example of the Miro board conducted during the CitiObs face-to-face meeting in Barcelona, June 2023. Top: Issue Identification, Bottom: Issue Mapping.

2.3 Aligning the Toolkit with User Needs

A second workshop was conducted during the CitiObs plenary meeting in Oslo in January 2024. The purpose of this workshop was to strengthen the links between the CitiObs Toolkits developed in Work Packages 1 and 2 and the needs identified through the Mutual Learning and Needs Assessment workshops conducted with the five CitiObs Frontrunner Cases. The outcomes were used to refine the structure of the Toolkit and identify additional entry points reflecting user requirements.

2.4 Linking the Toolkit to the CitiObs Technical Architecture

A third workshop, involving partners from Work Package 2, was held during the CitiObs plenary meeting in Oslo in January 2024. The objective was to strengthen the alignment between the Environmental Monitoring Toolkit and the CitiObs Technical Architecture described in Deliverable D2.1 (Maso and Julia, 2023). During the workshop, participants reviewed the barriers and user needs identified in previous activities and discussed how the different components of the architecture could support Citizen Observatories throughout the environmental monitoring process.

The discussions led to the organisation of Toolkit content around a monitoring journey that mirrors the progression of data through the CitiObs architecture. Rather than presenting the architecture as a purely technical resource, the Toolkit was designed as a user-oriented entry point that helps practitioners understand the CitiObs technical results and navigate the different stages of environmental monitoring, from defining a research question and selecting sensing devices, to data management, quality assurance, analysis, visualisation, and decision-making.

This approach allowed the Toolkit to bridge technical and non-technical audiences. Users are gradually introduced to key architectural concepts such as data interoperability, metadata, provenance, SensorThings API (STA), Analysis Ready Data (ARD), and Decision Ready Information (DRI), while remaining focused on the practical challenges they encounter during monitoring campaigns. In this way, the Toolkit translates the technical architecture into actionable guidance and supports the adoption of CitiObs tools and services.

The Toolkit also serves as a gateway to the main components of the CitiObs architecture. It introduces users to ValAir and the FILTER framework for transforming raw sensor measurements into Analysis Ready Data, VirtualAir for federating and accessing interoperable environmental data services, and MapAir for generating Decision Ready Information such as environmental maps and visual products. By connecting methodological guidance with the underlying technical infrastructure, the Toolkit enables Citizen Observatories to understand not only how to conduct environmental monitoring, but also how their data can move through an interoperable workflow that supports broader scientific, policy, and community decision-making processes.

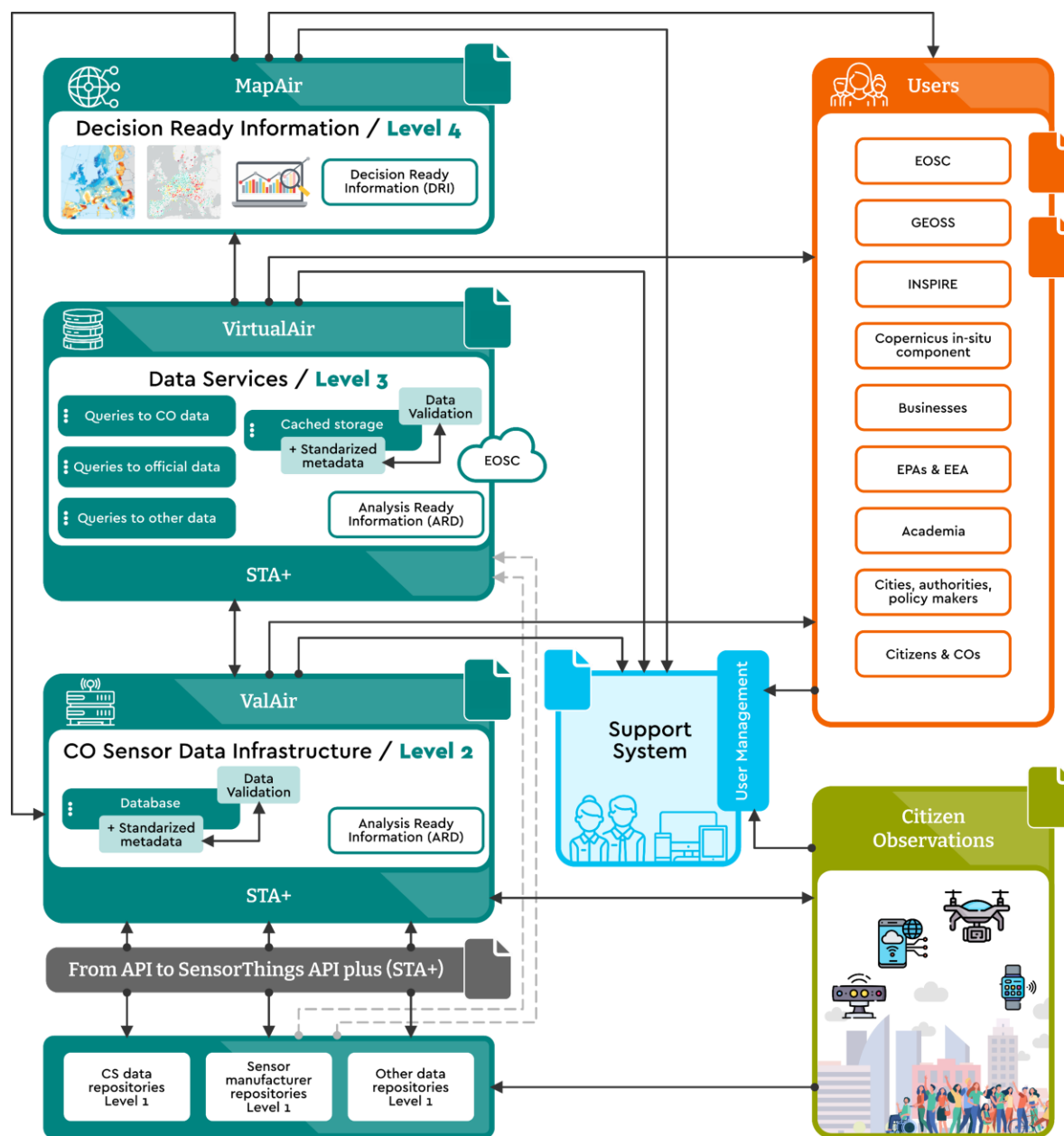


Figure 2. CitiObs Environmental Monitoring Architecture and data workflow. The architecture illustrates how citizen-generated observations move from data collection to decision support. Raw observations from sensors and other environmental data sources are harmonised using SensorThings API (STA+) standards, validated and transformed into Analysis Ready Data (ARD) through ValAir, federated through VirtualAir, and further processed into Decision Ready Information (DRI) products using MapAir. The Environmental Monitoring Toolkit acts as a user-oriented entry point to this architecture, guiding practitioners through the different stages of the workflow and the associated tools, methods, and services.

2.5 Validation with the Citizen Science Community

Further validation was conducted during the European Citizen Science Association (ECSA) Conference held between 3 and 6 April 2024. Two workshops were organised with Citizen

Science and Citizen Observatory practitioners from across Europe. More than 30 participants contributed to discussions aimed at:

- Identifying barriers and challenges in environmental monitoring with citizens;
- Assessing the prevalence and significance of these barriers across different contexts;
- Collecting practical use cases, lessons learned, common pitfalls, and inspirational success stories.

The outcomes provided additional evidence of practitioner needs and informed subsequent revisions of the Toolkit.

2.6 Pilot Workshops and Capacity Building Activities

The Toolkit was further refined through a series of practical workshops delivered within the CitiObs project.

In February 2025, the CitiObs T2.1 team organised the first Environmental Monitoring Workshop, *Setting Up a Successful Monitoring Campaign*, with representatives from the CitiObs Frontrunner Cases. A second workshop with the same theme followed in March 2025. These sessions enabled participants to test and provide feedback on the emerging methodology and resources contained in the Toolkit.

To support the workshops, the consortium developed a series of structured reflection templates that guided participants through the planning, implementation, and data interpretation stages of environmental monitoring campaigns. These templates were subsequently refined and incorporated as supporting resources within the Environmental Monitoring Toolkit.

In October 2025, CitiObs organised the *Environmental Monitoring Toolkit Workshop*, an online hands-on session, with representatives from the Frontrunner and Alliance Cases, focused on making sense of citizen-generated environmental data. Participants were introduced to a range of open tools and methods, including VirtualAir, ValAir and python data recipes, the [*Measure Together web platform from RIVM*](#), wearable sensing approaches, and creative data visualisation techniques. Feedback from participants contributed to further improvements of the Toolkit's guidance on data analysis and interpretation.

In June 2026, CitiObs organised an *Environmental Monitoring Toolkit Roadshow* involving representatives from the Frontrunner, Alliance, and Fellow Cases. The roadshow provided an opportunity to showcase the completed Toolkit, demonstrate its different navigation pathways and resources, and gather feedback from a broader community of Citizen Observatory practitioners. Participants explored how the Toolkit could support the planning, implementation, analysis, and communication stages of environmental monitoring campaigns.

A key component of the roadshow was the inclusion of presentations from two Alliance Cases that had applied the Toolkit in their own environmental monitoring activities. These presentations highlighted how the Toolkit had been used in real-world contexts, the benefits and challenges experienced by users, and lessons learned during implementation. The interactions with Toolkit users provided valuable validation of the Toolkit's practical applicability and generated additional insights for future improvements.

The discussions and feedback collected during the roadshow informed final refinements and helped assess the Toolkit's relevance, usability, and applicability across a diverse range of Citizen Observatory contexts.

2.7 Iterative Development and Continuous Improvement

The Environmental Monitoring Toolkit was therefore developed through an iterative co-design process involving researchers, technical experts, Citizen Science practitioners, and Citizen Observatory communities. Insights from workshops, practical testing activities, and stakeholder engagement informed the Toolkit's content, structure, and navigation pathways. This process ensured that the final Toolkit addresses both technical and non-technical challenges encountered throughout the environmental monitoring journey, from campaign design and sensor deployment to data analysis, interpretation, and decision-making.

The design and navigation of the Environmental Monitoring Toolkit were also shaped by feedback gathered throughout the co-design and validation process. Workshop participants consistently highlighted the need for both a structured pathway that could guide less experienced practitioners through the different stages of a monitoring campaign and a more flexible mechanism for finding information relevant to specific challenges. In response, the Toolkit was implemented in GitBook and designed to support multiple navigation approaches. Users can follow a step-by-step monitoring journey, use reflective templates to support campaign planning and implementation, or access content through the integrated AI assistant, which enables natural-language queries and directs users to relevant guidance and resources. In addition, feedback from the CitiObs Cases emphasised the value of learning from real-world experiences. This led to the inclusion of the Community Stories section, which showcases practical examples, lessons learned, challenges encountered, and successful approaches from Citizen Observatories and Citizen Science initiatives. These stories complement the technical guidance by providing contextualised examples that help users relate the Toolkit's recommendations to their own environmental monitoring activities.

Beyond the life of the project, the Toolkit being released as open source in GitHub², allows anyone to contribute and build upon the materials. Several feedback mechanisms, including direct feedback through the Gitbook interface, as well as mainstream git collaboration features such as issues and pull requests are provided.

² The Environmental Monitoring Toolkit is available at: <https://github.com/CitiObs/environmental-monitoring-toolkit>

3 THE ENVIRONMENTAL MONITORING TOOLKIT

The Environmental Monitoring Toolkit is one of several interlinked resources available through the [CitiObs Knowledge Platform](#), which provides a central gateway to the knowledge, tools, methods, and guidance developed throughout the CitiObs project.

The Environmental Monitoring Toolkit is an open-access resource to support Citizen Observatories, Citizen Science practitioners, community organisations, researchers, public authorities, and other stakeholders involved in environmental monitoring. The primary goal of the Toolkit is to equip users with practical guidance, tools, methods, and resources to overcome barriers that hinder the effective use of sensing devices and other monitoring systems in community-based environmental monitoring initiatives.

The Toolkit was developed in response to challenges identified by CitiObs in relation to the implementation of technologies within Citizen Observatories and Citizen Science practitioners, including difficulties related to selecting and deploying sensing technologies, ensuring data quality, managing and interpreting data, increasing interoperability across platforms, engaging communities, and translating environmental observations into meaningful information that can support decision-making. Rather than focusing solely on technological solutions, the Toolkit adopts a socio-technical perspective that recognises the importance of community engagement, governance, communication, and capacity building throughout the monitoring process.

The Toolkit is organised around the environmental monitoring journey, guiding users from the early stages of defining environmental concerns and formulating research questions through to data collection, quality assurance, analysis, visualisation, interpretation, and communication of results. It promotes the principle that successful environmental monitoring begins with a clearly defined purpose and community need, rather than with the selection of a particular technology.

The Toolkit currently contains content organised into five main thematic areas:

- **Environmental Monitoring**

This section introduces the foundations of environmental monitoring and supports users in planning monitoring campaigns. Topics include defining research questions, stakeholder mapping, setting monitoring objectives, selecting environmental variables, and understanding different monitoring approaches and methodologies.

- **Sensing Devices**

This section focuses on sensing technologies and monitoring equipment. It provides guidance on different types of sensing devices, technical and non-technical criteria for selecting sensors, installation procedures, mobile and wearable monitoring approaches, and practical considerations for deploying monitoring equipment in community settings.

- **Sensor Data Platforms**

This section introduces the infrastructure required to collect, store, manage, and share environmental data. It covers topics such as sensor data platforms, interoperability, FAIR data principles, SensorThings API (STA), STApplus, and the technical considerations involved in developing and selecting data infrastructures.

- **Data Management**

This section supports users in transforming observations into meaningful information. It includes guidance on data quality, traceability, metadata, contextualisation, transparency, accessibility, data analysis, visualisation, Analysis Ready Data (ARD), Decision Ready Information (DRI), and interoperability across monitoring systems.

- **Community**

Recognising that environmental monitoring is fundamentally a social process, this section focuses on participation, inclusion, communication, and community engagement. Topics include addressing barriers to technology adoption, increasing confidence in sensor use, promoting participation, communicating results effectively, integrating health perspectives into environmental monitoring, and learning from the experiences of other Citizen Observatories.

- **Additional Resources**

In addition to these thematic areas, the Toolkit includes a glossary of key concepts, links to external resources, examples of tools and services developed within CitiObs, and a growing collection of Community Stories that document experiences, lessons learned, challenges, and successful practices from Citizen Observatories and Citizen Science initiatives. Together, these elements provide users with both practical guidance and real-world examples that can support the design, implementation, and sustainability of environmental monitoring activities.

The Environmental Monitoring Toolkit is available online at monitoring.toolkit.citiobs.eu and accessible through the [CitiObs Knowledge Platform](#), which serves as the central access point to the knowledge resources developed within the project. The Knowledge Platform brings together the different CitiObs Toolkits and supporting materials, enabling users to navigate across technical, social, governance, and participatory aspects of Citizen Observatories. This integrated approach encourages users to explore complementary resources beyond environmental monitoring and supports a holistic understanding of how Citizen Observatories can be designed, implemented, and sustained. Through the Knowledge Platform, users can access the Toolkit, search for relevant resources, discover related guidance from other CitiObs work packages, and benefit from the interconnected structure of the CitiObs knowledge ecosystem.

3.1 Supporting Resources

3.1.1 A Short Guide to the Environmental Monitoring Toolkit

To increase accessibility and support users who may find the full Toolkit overwhelming, the CitiObs consortium also developed a companion resource entitled *Your Environmental Monitoring Journey: A Short Guide for Communities*. The guide distils the main concepts, recommendations, and resources from the Toolkit into a concise and accessible format aimed at community groups, Citizen Observatories, Citizen Science practitioners, and other non-expert users. The short guide will be available in the CitiObs Knowledge Platform.

The short guide presents environmental monitoring as a step-by-step journey, guiding users through the key phases of a monitoring campaign: defining objectives, engaging stakeholders, selecting sensing technologies, managing data, ensuring data quality, communicating results, and evaluating outcomes. It translates technical concepts into accessible language and provides

practical recommendations that can be applied without requiring advanced technical expertise. The guide also includes a glossary of key concepts and a set of ten milestones that help users plan and implement successful monitoring initiatives.

The development of the short guide responds directly to one of the barriers repeatedly identified throughout the CitiObs workshops: the perception that environmental monitoring technologies and data processes are too complex for non-experts. By providing an entry-level resource that complements the full Toolkit, the guide lowers the barrier to participation and supports the broader CitiObs objective of making environmental monitoring more inclusive and accessible.

Before its final publication, the short guide will be reviewed with the CitiObs Frontrunner, Alliance, and Fellow Cases to ensure that the content is relevant, understandable, and applicable across different environmental monitoring contexts. Feedback from this review process will be used to further refine the guide and improve its accessibility for diverse audiences.

Following this review, the guide will be published alongside the Environmental Monitoring Toolkit and translated into multiple languages to increase accessibility across Europe. Initial translations are planned in English, Spanish, and French, with additional language versions to be developed in accordance with the dissemination and accessibility objectives of the CitiObs project. Through these translations, the consortium aims to broaden the reach of the Toolkit and support environmental monitoring initiatives across different linguistic and cultural contexts.

3.1.2 Practical Reflection and Planning Templates

In addition to the Environmental Monitoring Toolkit and the accompanying short guide, the CitiObs consortium developed a set of practical templates designed to support practitioners in applying the Toolkit guidance to their own monitoring initiatives. The templates function as facilitated reflection and planning exercises that guide users through the different stages of an environmental monitoring campaign.

The templates were originally developed and used during the Environmental Monitoring Workshops organised with the CitiObs Frontrunner Cases. Their purpose was to support participants in translating the guidance contained in the Toolkit into concrete plans and actions relevant to their own monitoring campaigns. The workshops also provided an opportunity to test and refine the templates based on participant discussions and practical experiences.

The first template focuses on the design and preparation of a monitoring campaign. It supports users in defining their research question, identifying stakeholders, establishing project objectives and success indicators, selecting monitoring parameters, and identifying suitable sensing devices and data platforms. The template encourages users to reflect on both technical and non-technical aspects of monitoring while providing direct references to relevant sections of the Toolkit.

The second template focuses on data management, analysis, interpretation, and communication. It helps practitioners consider contextual information and metadata, assess data quality, identify suitable analysis tools, reflect on data visualisation and storytelling approaches, and prepare for communicating results to different audiences. The template also encourages reflection on data transparency, privacy, licensing, interoperability, and accessibility.

Stage #1 Define your why

 In this stage, I am going to help you define the main reasons why you want to collect data. Let's start by defining your research question.

 Fill in the following sentence:

 We want to monitor...

because...

Figure 3. Excerpt of Environmental monitoring toolkit practical Reflection and planning Templates.

Both templates are structured as guided exercises supported by a conversational "CitiObs Bot" persona, making them accessible to users with limited technical expertise. Rather than providing prescriptive instructions, they encourage participants to reflect on their own objectives, resources, constraints, and community context. The templates can be used independently, during workshops, or as part of training and capacity-building activities. Together with the Toolkit and the Short Guide for Communities, they provide a complementary set of resources that support environmental monitoring initiatives from initial planning through to data interpretation, communication, and action.

3.1.3 Recorded Workshops and Training Materials

To further support capacity building and knowledge transfer, the CitiObs consortium made a series of Environmental Monitoring Workshops publicly available through the CitiObs website. The recordings provide users with access to presentations, demonstrations, practical examples, and discussions related to the planning and implementation of environmental monitoring campaigns.

The workshop recordings complement the Toolkit by offering an alternative learning format that allows practitioners to engage with the material through real-world examples and expert explanations. Topics covered include the design of monitoring campaigns, stakeholder engagement, sensor selection, data quality, data analysis, visualisation, and interpretation of environmental data. The recordings also showcase the experiences of CitiObs cases and

practitioners, providing valuable insights into the practical application of the methods and tools described in the Toolkit.

The publicly available recordings currently include:

- [Environmental Monitoring Workshop: Setting Up a Successful Monitoring Campaign \(Part 1\)](#), which introduces the key considerations for planning and designing an environmental monitoring campaign.
- [Environmental Monitoring Workshop: Setting Up a Successful Monitoring Campaign \(Part 2\)](#), which focuses on preparing for data management, data quality assessment, analysis, visualisation, and communication of results.
- [Environmental Monitoring Toolkit Workshop: Making Sense of Citizen-Generated Environmental Data](#), which introduces participants to open tools and methodologies for data analysis, quality assurance, visualisation, and interpretation of environmental monitoring data.

Together, these workshops provide practical examples of how the concepts, methods, and tools presented in the Environmental Monitoring Toolkit can be applied in real-world Citizen Observatory initiatives. The CitiObs consortium is also expanding the collection of supporting learning resources through the development of short instructional videos that complement the written guidance provided in the Toolkit. These videos are designed to explain specific concepts, tools, and workflows in a concise and accessible format, making it easier for practitioners to understand and apply the Toolkit's recommendations.

An example of this approach is the video ["SmartCitizen Kit"](#), which introduces key concepts related to sensing technologies and environmental monitoring in an accessible format.

Building on the experience gained through the workshop recordings, future video resources will provide practical guidance on topics such as environmental monitoring campaign design, sensing technologies, data quality, analysis workflows, and the use of CitiObs tools and services. These materials are intended to support different learning styles, increase accessibility, and facilitate the uptake of the Toolkit by new audiences, particularly community groups and practitioners with limited technical expertise.

The recordings are available through the CitiObs website and form part of the broader collection of learning resources associated with the CitiObs Knowledge Platform.

4 STRUCTURE AND IMPLEMENTATION OF THE TOOLKIT

The Environmental Monitoring Toolkit follows the same overall structure as the other CitiObs Toolkits. This was a deliberate design choice, as the CitiObs Toolkits were conceived as a holistic knowledge ecosystem rather than as a collection of separate resources. Maintaining a common structure across the Toolkits supports a socio-technical approach to Citizen Observatories, recognising that many barriers to environmental monitoring emerge not only from technological challenges but also from their interaction with social, organisational, governance, and community-related factors.

The Toolkit is organised around a set of entry points that address practical questions commonly encountered by Citizen Observatory practitioners. Following an approach inspired by the WeObserve Knowledge Hub (WeObserve, 2021), content is structured around user-driven questions, such as “How do we...?”. This format aims to make the Toolkit intuitive to navigate and directly applicable to real-world monitoring activities.

Each entry typically follows a common structure:

- **Why is this relevant?** – A brief narrative describing the challenge, barrier, or problem being addressed and explaining its relevance within environmental monitoring.
- **How can this be done?** – Practical guidance, methods, approaches, tools, and examples that can help users address the identified challenge.
- **Useful resources** – Links to additional materials, including guidance documents, videos, webinars, academic publications, software tools, project deliverables, and external resources.
- **You might also be interested in...** – Cross-references to related pages within the Environmental Monitoring Toolkit and other CitiObs Toolkits, encouraging users to explore complementary topics and fostering a holistic understanding of Citizen Observatories.

The structure of the Toolkit was further informed by the CitiObs Technical Architecture. Entry points were grouped according to the different stages of the environmental monitoring journey, allowing users to progressively move from defining monitoring objectives and selecting sensing technologies, through data management and quality assurance, to analysis, visualisation, and decision support. In this way, the Toolkit serves as a practical gateway to the CitiObs architecture while remaining accessible to non-technical audiences.

4.1 Platform Selection and Collaborative Development

A key objective of the Toolkit was to remain a living resource that could continue evolving beyond the duration of the CitiObs project. For this reason, GitHub was selected as the primary platform for storing the Toolkit content. GitHub provides a transparent and collaborative environment that enables contributions, version control, issue tracking, and peer review of content updates. This approach allows not only CitiObs partners, but also Frontrunner Cases, Alliance Cases, Fellow Cases, and external practitioners to contribute new resources, examples, stories, and improvements over time.

The collaborative approach has already resulted in contributions from project participants. For example, the Barcelona Frontrunner Case contributed content on incorporating a health perspective into environmental monitoring³, helping to broaden the Toolkit beyond purely technical aspects and reinforcing the socio-technical approach underpinning CitiObs.

To provide a more user-friendly experience, the content managed through GitHub was published through GitBook. GitBook was selected because it offers several features that support accessibility, discoverability, and continuous improvement of the Toolkit. These include structured navigation, search functionality, integrated feedback mechanisms that allow users to comment on and suggest improvements to content, and an AI-powered assistant that helps users locate relevant information through natural-language queries. Together, GitHub and GitBook provide a workflow that combines open and collaborative content development with an accessible and intuitive user experience for practitioners and communities.

³ Contribution by Barcelona Frontrunner Case: <https://monitoring.toolkit.citiobs.eu/community/how-to-bring-a-health-lens-to-environmental-monitoring>

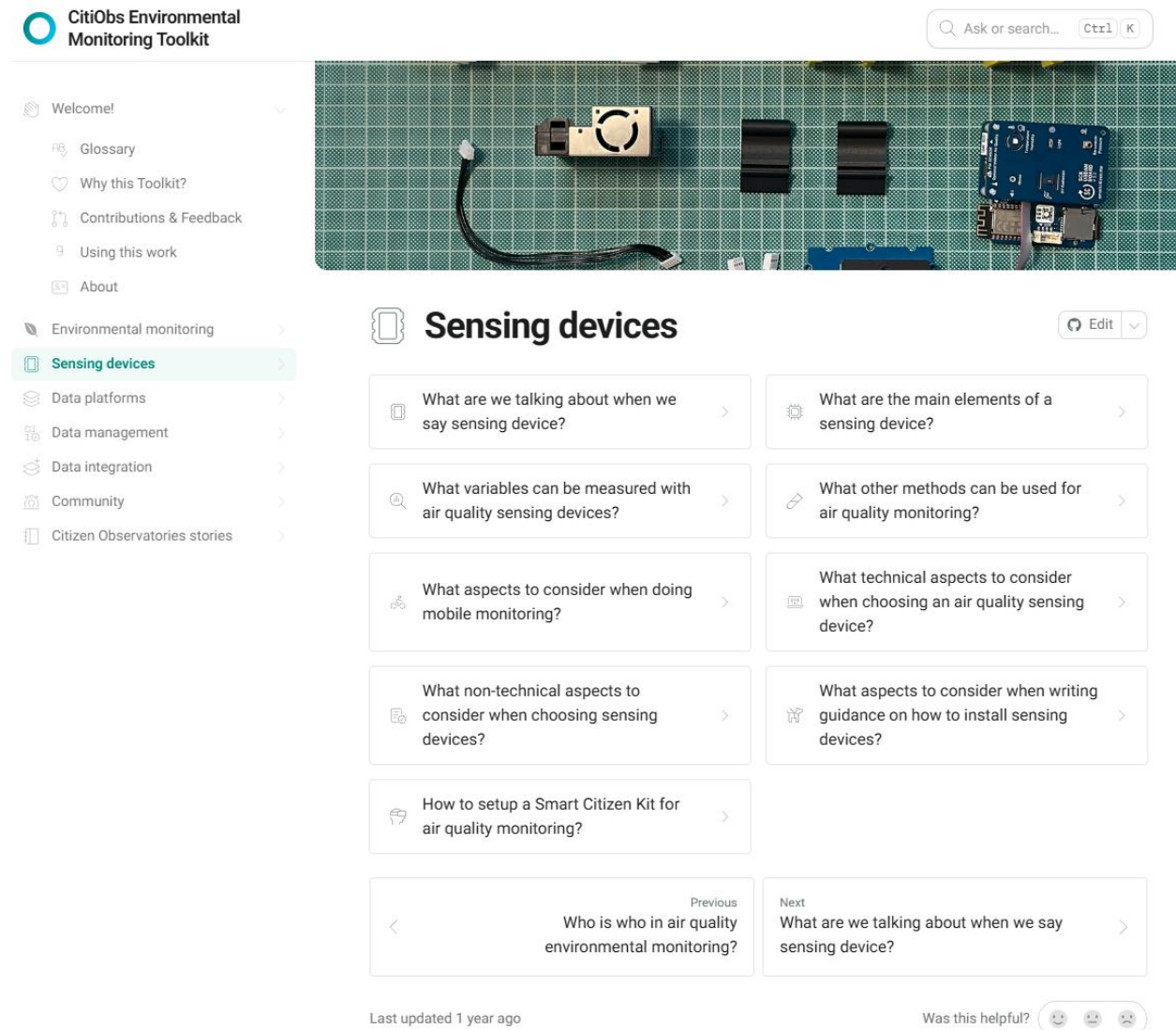


Figure 4. The CitiObs Environmental Monitoring Toolkit implemented in GitBook. The platform combines structured navigation, integrated feedback mechanisms, AI-assisted search, and collaborative content development through GitHub to support continuous improvement and long-term sustainability of the Toolkit.

4.2 Validation Through Co-design, Testing and User Engagement

As mentioned above, the Environmental Monitoring Toolkit was developed and refined through an iterative process involving continuous engagement with CitiObs partners, Citizen Observatories, and environmental monitoring practitioners. While no formal evaluation survey was conducted, validation of the Toolkit took place through a series of workshops, pilot activities, demonstrations, and practical applications that informed successive revisions of its content, structure, and functionality. The implementation of the Toolkit in GitBook enables continuous feedback through built-in commenting and feedback features, while the GitHub repository supports ongoing contributions and content improvement via issues and pull requests. These mechanisms ensure that validation and refinement can continue beyond the duration of the CitiObs project, supporting the Toolkit's long-term sustainability and relevance.

5 SUSTAINABILITY AND FUTURE DEVELOPMENT

The Environmental Monitoring Toolkit was conceived as a living resource that can continue evolving beyond the lifetime of the CitiObs project. As mentioned in previous sections, the Toolkit has been designed to support continuous updates, community contributions, and the incorporation of emerging knowledge, technologies, and practices in environmental monitoring and Citizen Observatories.

The toolkit infrastructure enables not only CitiObs partners, but also Citizen Observatory practitioners, researchers, public authorities, and community organisations to contribute new resources, examples, methodologies, and lessons learned. The inclusion of the Community Stories section further supports the continued growth of the Toolkit by creating a space where practitioners can share experiences from real-world monitoring initiatives.

Future development of the Toolkit may include the addition of new thematic areas, monitoring technologies, case studies, community stories, and examples of best practices emerging from Citizen Observatories and Citizen Science initiatives. As environmental monitoring technologies, standards, and data infrastructures continue to evolve, the Toolkit can be updated to reflect new developments, including advances in sensing technologies, interoperability standards, data quality methodologies, artificial intelligence, and decision-support tools.

Additional development activities will include the continued production of multimedia learning resources, including short instructional videos, case-study presentations, demonstrations of CitiObs tools and methodologies, and explanatory content linked directly to specific Toolkit entries. These resources will complement the written Toolkit and contribute to the long-term capacity-building legacy of the project.

The CitiObs consortium also recognises the importance of maintaining the relevance of the Toolkit through continued engagement with practitioners and communities. Workshops, training activities, demonstrations, and contributions from Citizen Observatories provide opportunities to identify emerging needs and ensure that the Toolkit remains responsive to real-world challenges.

Following the completion of the CitiObs project, the Environmental Monitoring Toolkit will continue to be maintained as part of the CitiObs Knowledge Platform. Through its connection to international Communities of Practice and the global network of CitiObs Fellow Cases, the Toolkit has the potential to support Citizen Observatories and Citizen Science initiatives not only in Europe but worldwide.

The Knowledge Platform provides a long-term home for the Toolkit and its associated resources, ensuring continued accessibility and enabling future updates and contributions. The Toolkit is expected to serve as a resource for existing Communities of Practice. In particular, the consortium envisions continued use and enrichment of the Toolkit through networks such as the European Citizen Science Association (ECSA) Working Group on Air Quality and the Citizen Science Global Partnership (CSGP) Citizen Science and Air Quality Community of Practice (CSAQ). These communities bring together practitioners, researchers, policymakers, and community organisations from different regions and provide an opportunity to share experiences, identify emerging needs, contribute new content, and ensure that the Toolkit remains relevant and up to date. Through these established networks, the Toolkit can continue to evolve as a shared community resource and support environmental monitoring initiatives well beyond the duration of the CitiObs project.

The recorded workshop materials hosted through the [CitiObs YouTube](#) channel further contribute to the long-term accessibility of the knowledge generated by the project, allowing future practitioners and Communities of Practice to benefit from the training activities conducted during CitiObs.

6 CONCLUSIONS

The Environmental Monitoring Toolkit represents a key outcome of the CitiObs project, bringing together practical guidance, technical resources, community experiences, and capacity-building materials to support Citizen Observatories and Citizen Science initiatives engaged in environmental monitoring. Developed through an iterative co-design process involving project partners, practitioners, Frontrunner Cases, Alliance Cases, Fellow Cases, and wider Citizen Science communities, the Toolkit addresses many of the barriers that can hinder the effective use of sensing technologies and environmental data.

The Toolkit adopts a socio-technical perspective, recognising that successful environmental monitoring depends not only on technological solutions, but also on community engagement, stakeholder collaboration, data governance, communication, and the ability to translate environmental observations into meaningful action. By structuring content around practical questions and the environmental monitoring journey, the Toolkit provides accessible guidance that supports users from the earliest stages of defining a monitoring objective through to data analysis, visualisation, communication, and decision-making.

A distinctive feature of the Toolkit is its close integration with the CitiObs Technical Architecture. Through concepts such as Analysis Ready Data (ARD), Decision Ready Information (DRI), interoperability standards (STA), and supporting services including TAPIS, ValAir, VirtualAir, and MapAir, the Toolkit serves as a practical entry point to the technical infrastructure developed within the project. In doing so, it bridges the gap between technical systems and the needs of Citizen Observatory practitioners.

Beyond the Toolkit itself, CitiObs has developed a broader ecosystem of supporting resources that increase accessibility and facilitate learning. These include the *Environmental Monitoring Journey: A Short Guide for Communities*, practical reflection and planning templates tested with the Frontrunner Cases, publicly available workshop recordings, instructional videos, and the Community Stories section. Together, these resources provide multiple entry points for users with different levels of experience, technical expertise, and learning preferences.

Despite its breadth and iterative development process, the Environmental Monitoring Toolkit has several limitations. Environmental monitoring technologies, data infrastructures, standards, and practices continue to evolve rapidly, meaning that some tools, platforms, and recommendations may require periodic updates to remain current. Furthermore, while the Toolkit has been informed by a diverse range of Citizen Observatory experiences, workshops, and case studies, its development has been primarily grounded in European contexts, including the regulatory frameworks, technical infrastructures, governance arrangements, and environmental monitoring practices commonly found across Europe. As a result, some recommendations may not be directly transferable to other regions of the world. In particular, Citizen Observatories and Citizen Science initiatives operating in low- and middle-income countries may face additional challenges related to access to technology, internet connectivity, technical capacity, funding, institutional support, or environmental monitoring infrastructure, requiring adaptations to the approaches presented in the Toolkit. More broadly, the Toolkit cannot fully capture the wide variety of environmental, social, cultural, regulatory, and technical contexts in which monitoring initiatives operate worldwide. Users should therefore consider the Toolkit as a source of guidance rather than a prescriptive methodology and adapt its recommendations to their specific circumstances and local needs. In addition, although the Toolkit aims to lower barriers to participation and

technical understanding, successful implementation of some monitoring approaches may still require access to specialised expertise, equipment, funding, or institutional support. For these reasons, the Toolkit should be considered a living resource that will benefit from continued contributions, feedback, and updates from practitioners, communities, researchers, and other stakeholders beyond the duration of the CitiObs project.

The Environmental Monitoring Toolkit has been designed as a living resource that can continue evolving beyond the lifetime of the CitiObs project. Through its integration within the CitiObs Knowledge Platform, collaborative development through GitHub, publication through GitBook, and engagement with Communities of Practice such as the European Citizen Science Association (ECSA) Working Group on Air Quality and the Citizen Science Global Partnership Citizen Science and Air Quality Community of Practice (CSGP-CSAQ), the Toolkit is well positioned for continued use, maintenance, and growth.

Ultimately, the Toolkit contributes to the broader CitiObs vision of empowering citizens and communities to participate meaningfully in environmental monitoring, generating trustworthy environmental information, and supporting evidence-based action towards healthier, more sustainable, resilient, and inclusive cities.