D1.3 Urban ReLeaf data management plan

Funded by the European Union

UK Research and Innovation

Document Factsheet

Grant agreement	101086638
Call identifier	Horizon-CL6-2022-Goverance-01-08
Project title	Urban ReLeaf: Citizen-powered data ecosystems for inclusive and green urban transitions
Project start date	01/01/2023
Duration	48 months
Instrument	Horizon Europe
Type of action	Innovation action
Deliverable number	D1.3
Deliverable name	Urban ReLeaf data management plan
Work package	WP1: MANAGE: PROJECT MANAGEMENT AND COORDINATION
Task	T1.5: Data management and open science
Deliverable lead	IIASA
Deliverable type	DMP
Due date	30/06/2023
Review completed	29/06/2023
Submission date	30/06/2023
Document version	1.0

Disclaimer

Copyright notice

Acknowledgement

Funded by the European Union

UK Research and Innovation

Reference

Please cite this work as:

Moorthy, I., Hager, G., Boas, V. (2023). Urban ReLeaf data management plan. D1.3 for the Horizon Europe and Innovate UK co-funded project Urban ReLeaf under grant agreement ID: 101086638. 10061290 and 10041792. DOI: 10.5281/zenodo.8085352.

Deliverable name	Urban ReLeaf data management plan
Authors	Inian Moorthy, Gerid Hager, Vanessa Boas
Contributors	Katerina Karagiannopoulou (ICCS)

Short description	This deliverable represents the first iteration of the Urban ReLeaf Data Management Plan (DMP). It will be updated and shared with the EC prior to the periodic reviews.
Keywords	Data management, FAIR principles

Dissemination level		
PU	Public	X
SEN	Sensitive – limited under the conditions of the GA	
EU-R	Classified information - Restricted under EC Decision 2005/444	
EU-C	Classified information - Confidential under EC Decision 2005/444	

History

Version	Date	Released by	Comment
0.1	08.05.2023	Vanessa Boas (IIASA)	Draft structure
0.2	06.06.2023	Inian Moorthy (IIASA)	Content for Sections 1 & 2
0.3	23.06.2023	Inian Moorthy (IIASA)	Content for Sections 3 - 7
0.4	26.06.2023	Gerid Hager (IIASA)	Review and additions
0.5	28.06.2023	Vanessa Boas (IIASA), Inian Moorthy (IIASA)	Review and feedback integration
0.6	29.06.2023	Inian Moorthy (IIASA)	Feedback integration and formatting
0.7	20.06.2023	Vanessa Boas (IIASA), Inian Moorthy (IIASA)	List of acronyms added; formatting
1.0	29.06.2023	Inian Moorthy (IIASA)	Final version for submission

Project Partners

Table of Contents

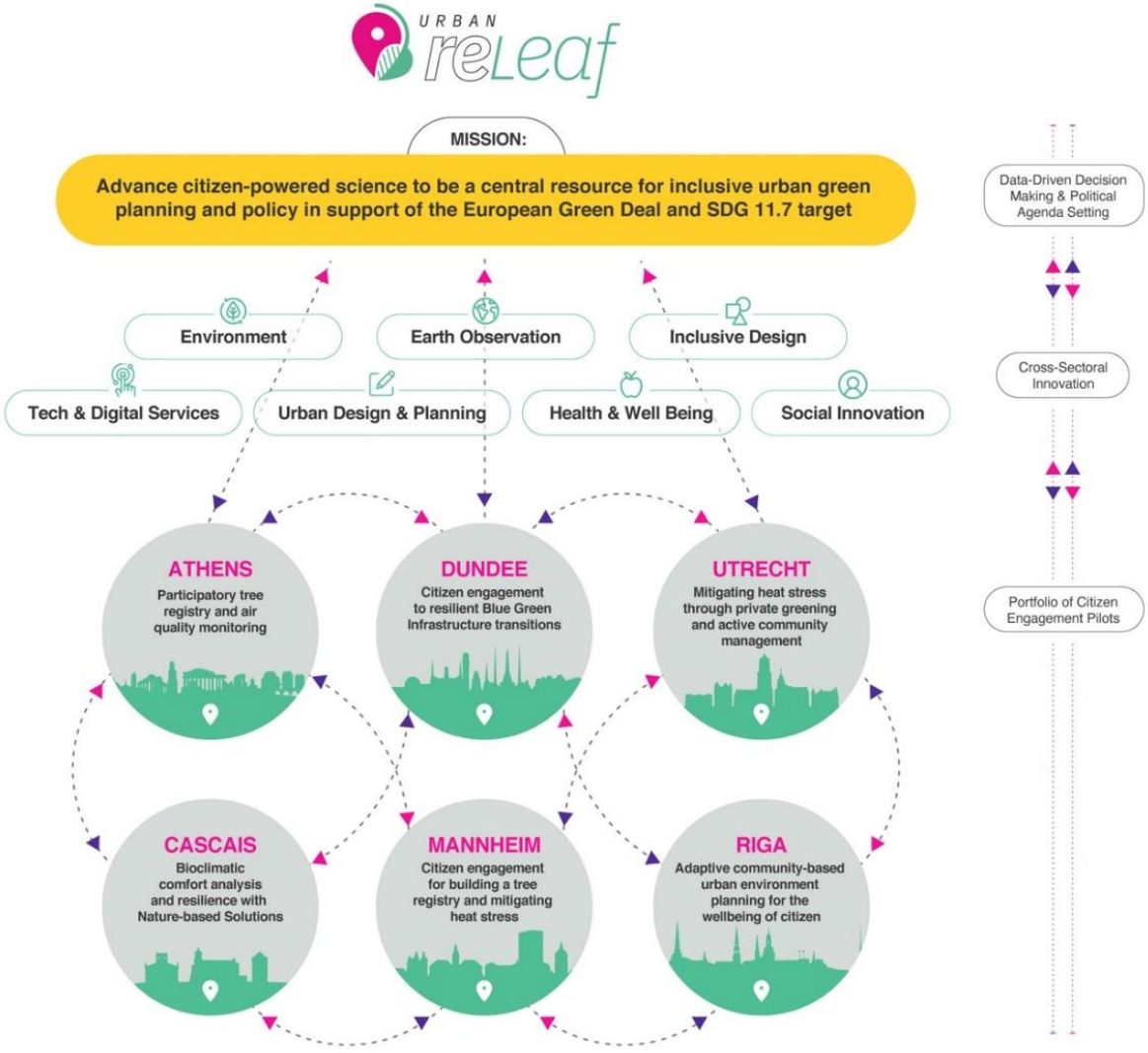
Acronyms

AP	Anonymised and Public
API	Application Programming Interface
AQ	Air Quality
BC	Black carbon
CIBOS	CIBOS Innovation Idiotiki Kefalaiouchiki Etaireia
CO	Confidential
CS	Citizen Science
CSO	Civil Society Organisation
DMP	Data Management Plan
DOI	Digital Object Identifier
EC	European Commission
EEA	European Environmental Agency
EMAC	EMAC Empresa Municipal De Ambientede Cascais Em Sa
EO	Earth Observation
EU	European Union
FAIR	Findability, Accessibility, Interoperability, and Reusability
GA	Grant Agreement
GDPR	General Data Protection Regulation
GEOMS	Generic Earth Observation Metadata Standard
GEOSS	Global Earth Observation System of Systems
GPS	Global Positioning System
IIASA	International Institute for Applied Systems Analysis
IICS	Institute of Communication and Computer Systems
ISO	International Organization for Standardization
LA	Licensed Access
LoRa	Long Range
NAP	Non-Anonymised and Public
NOA	Ethniko Asteroskopeio Athinon
ODbL	Open Data Commons Open Database License
ODI	Open Data Institute
OGC	Open Geospatial Consortium
PAR4P	Participatory Action Research for Policy
$PM_{2.5}$	Fine particulate matter
POPD	Protection of Personal Data
SDG	Sustainable Development Goal
TRH	Temperature and Relative Humidity
UFP	UltraFine Particles
UN	United Nations
WCS	Web Coverage Service
WFS	Web Feature Service
WMS	Web Map Service
WP	Work Package

List of Tables

Project Summary

Urban ReLeaf delivers citizen-powered data ecosystems to support cross-sectoral innovation and political agenda setting for climate change adaptation and green infrastructure planning in urban environments. At the heart of Urban ReLeaf's action- and mission-oriented approach to innovation are public authorities, established communities and citizen groups in six pioneering Urban ReLeaf cities: Athens, Dundee, Utrecht, Cascais, Mannheim and Riga. Public sector innovation will be underpinned by co-creation efforts and inclusive citizen participation, cutting-edge technologies to support citizen observations, as well as robust and quality-assured workflows for the integration and visualization of the data in authoritative data streams and platforms. The solutions will be piloted through civic engagement campaigns with established volunteer communities, focusing on the inclusion of minority and marginalized groups. Urban ReLeaf will showcase the democratization of urban greenspace monitoring and the wider policy-making process for cities in pursuit of urban climate resilience. Ultimately, the Urban ReLeaf data ecosystem and associated governance models will deliver new, inclusive pathways for data-driven decision making in support of the European Green Deal and the Sustainable Development Goals (SDGs) keeping cities resilient, livable, and accessible for all.



Executive Summary

This deliverable represents the first iteration of the Urban ReLeaf Data Management Plan (DMP). It outlines concrete rules and procedures regarding the acquisition, sharing, storage and publication of data. Additionally, the deliverable provides an overview of the type of data collected within the project as well as the plans to reuse the data in line with FAIR (Findable, Accessible, Interoperable, Reusable) principles. The DMP is not static and will be adapted regularly in line with changes and developments in the project. Updated versions of the data management plan will be available at each periodic review of the project.

1 Introduction

Urban ReLeaf aims to co-create citizen-powered data ecosystems to support climate change adaptation, green infrastructure, and urban design planning. The project identifies critical information gaps and barriers to urban greening efforts and delivers a series of civic engagement and monitoring campaigns to overcome these gaps. In addition, it offers protocols for the uptake, validation, and long-term inclusion of citizen-powered data into official data streams. Urban ReLeaf tackles local issues of public interest across six pilot cities and contributes to European and global policies, while strengthening EU environmental monitoring mechanisms such as Copernicus and the Global Earth Observation System of Systems (GEOSS). The project progresses beyond awareness raising to mainstreaming citizen observations for data-driven decision making and political agenda setting. This evolution underpins our action-oriented mission and subsequent objectives:

Advance citizen-powered science to be a central resource for inclusive urban green planning and policy in support of the European Green Deal and SDG 11.7 target[1]

O1	Assess current urban greening policy processes within six European cities and co-create solutions that use citizen observations to complement existing data ecosystems and decision-making
O2	Support the validation and long-term inclusion of active and passive data from citizens for urban environmental monitoring within authoritative data streams, including GEOSS & Copernicus
O3	Mobilize and empower communities through widespread participation in issues of public interest surrounding urban green infrastructure
O4	Develop a community of practice around topics related to the use of citizen observations for urban planning to foster knowledge exchange and develop capacities across multiple sectors
O5	Produce flexible and innovative governance solutions to help scale-out inclusive urban green transitions in support of the European Green Deal and UN Sustainable Development Goals
O6	Promote recognition, adoption and trust of citizen observations and other novel data ecosystems for environmental monitoring to trigger innovation within public institutions

To address these objectives, Urban ReLeaf is organized into six work packages, within which various forms of existing and original data generated within the project will be integrated. This Data Management Plan (DMP) provides a detailed description of all the datasets that will be collected, processed, or generated during project implementation. In addition, details about data handling, sharing, curation and preservation during and post-project are outlined. The

[1] By 2023, provide universal access to safe, inclusive and accessible, green and public spaces, particularly for women and children, older persons and persons with disabilities

DMP is structured in a manner that addresses the key questions highlighted within the European Commission (EC) DMP template[2], with a focus on the topic of making data FAIR (Findable, Accessible, Interoperable and Reusable). It is important to highlight that the DMP is not a static document but rather evolves during the lifespan of the project. The consortium will update all relevant components of the plan at each periodic review (April 2024, December 2025) and ultimately finalize the plan at project completion (December 2026).

2 Data Summary

This section provides a summary of the data within Urban ReLeaf. The datasets within the project serve different purposes including, amongst others, supporting project communication, helping to build a far-reaching communication/partnership network, creating (in-situ) citizen science-based observations of the urban environment, generating resources (i.e., toolkits) to be exploited using FAIR principles. As a starting point, we provide a summary of the various datasets and their expected usage, which will be updated throughout the project (Table 1). While the project deals with different types of data, the DMP focuses on the data that will be collected actively by citizens and passively by low-cost sensors in the framework of the six pilots in Athens, Cascais, Dundee, Mannheim, Riga, and Utrecht as well as the analyses of existing datasets at municipal level.

Table 1: Urban ReLeaf data summary (*Usage Legend: CO – Confidential; AP - Anonymised and Public; NAP - Non-Anonymised and Public; Licensed Access – LA*)

Nature of dataset	Data type/description	Related WP	Expected usage/access
Original datasets to be produced as part of Urban ReLeaf	Project communication and dissemination assets, including internal and external communications	1, 6	CO, AP, NAP
	Internal meeting notes/minutes/action items	1	CO
	Partner contact details list	1	CO
	Confidential deliverables	1	CO
	Public deliverables	All	NAP
	Consent forms, filled in and signed from project participants	2,3,4,5	CO
	Interview data/insights	2	AP (NAP with specific consent)
	Stakeholder consultation data	2	AP (NAP with specific consent)
	Geospatial (in-situ) data from participatory tree registry app	3	AP
	Geospatial (in-situ) data from bioclimatic comfort /subjective perception app	3	AP
	Geospatial (in-situ) data from TRH sensors	3	AP
	Geospatial (in-situ) data from $PM_{2.5}$ monitors	3	AP
	Geospatial (in-situ) data from BC monitors	3	AP
	Geospatial (in-situ) data from UFP monitors		

[2] https://enspire.science/wp-content/uploads/2021/09/Horizon-Europe-Data-Management-Plan-Template.pdf

	Geotagged photos	3	AP
	Vector and raster maps from CS data	3	AP
	High-resolution Urban Atlas layers	3	AP
	Contact details of CoP members	5	CO (NAP with specific consent)
Existing datasets held within partners or from external providers	Municipal datasets from Urban ReLeaf pilot cities (see Appendix A)	3	LA
	Shared access to software repositories	3	CO
	Data from existing AQ sensors	3	AP
	Strava Metro mobility data	3	AP

2.1 Original data to be produced as part of the Urban ReLeaf project

Urban ReLeaf aims to co-create citizen-powered data ecosystems to support climate change adaptation, green infrastructure, and urban design planning across six partner countries in cooperation with established volunteer communities as well as minority and marginalized groups. More specifically, citizens will collect data relating to trees, temperature, humidity, and air quality in their cities, using customized tools/apps, based on the gaps identified through the mapping of existing data ecosystems. The purpose of such data generation is to complement official data streams and highlight the importance of citizen-powered observations in urban green planning. Several actors, including external organisations, can benefit from the data produced within Urban ReLeaf. Some examples include:

- Public sector – Local/Provincial/National/European authorities involved in environmental monitoring, climate change adaptation, SDG reporting, and civic engagement
- Private sector – Companies in the EO and environmental monitoring domains
- Academia
- NGOs working on urban greening and inclusive participation
- Civil Society Organisations (CSO)

To generate insightful citizen-powered data for these various actors, Urban ReLeaf adopts a demand-driven approach to technology development. Technological solutions, namely in the form of mobile applications and low-cost sensors, will be developed iteratively with key actors across the six pilot cities. Data quality and interoperability standards will be deployed via data interoperability gateways to ensure all data streams are compatible with selected standards. The generated Urban ReLeaf data streams will be accessible via open APIs to feed into respective city data portals and other relevant platforms for increased uptake and impact. The new data streams envisioned in the project fall under three categories: active sampling systems, passive sampling systems, and solutions involving Earth Observation.

Active sampling systems

Participatory Tree Registry

Urban ReLeaf will develop a comprehensive, modular data platform for documenting street-level trees, involving citizens in the creation of the inventory. The platform, to be developed by CIBOS, will include a campaign creation interface from which targeted campaigns can be run. A mobile app will allow (1) citizens to collect tree-related data and (2) city staff to register and monitor tree-related tasks to improve transparency and capacity building around urban green space maintenance. The exact requirements will be defined in late 2023. Potential geospatial data/characteristics to be generated include, amongst others:

- Tree location (latitude/longitude)
- Tree species (tree type/common name)
- Tree height
- Tree trunk diameter
- Tree age
- Tree health/condition
- Geotagged photograph
- Timestamp (date/time)

The exact data types and formats to be collected via the tree registry app will be included in the next version of the DMP.

Bioclimatic and subjective perception mapping

Studying the bioclimatic comfort of people around greenspaces and comparing this with built-up areas provides policy makers with crucial information for greenspace-related financial investments, especially under climate change scenarios and intensified heat waves. A mobile app will be iteratively developed by IIASA (WP3) to gather citizen feedback on perceived thermal comfort in urban areas, building on the City Oasis and FotoQuestGo apps from the LandSense project. The exact requirements, including sample design and survey questions, will be defined in late 2023. Potential geospatial data/characteristics to be generated include:

- Participant location (latitude/longitude)
- Survey responses related to thermal comfort variables
- Geotagged photos
- Timestamp (date/time)

The exact data types and formats to be collected via the bioclimatic comfort app will be included in the next version of the DMP.

Passive sampling systems – wearable and stationary

Temperature and Relative Humidity (TRH) measurements

Project partner ICCS will deliver custom-made, low-footprint portable (<50 g) devices to provide high resolution measurements enabling monitoring of urban heat islands and informing future urban greening. Air temperature (accuracy ±0.4 °C; 0 to 60 °C) and relative humidity (accuracy ± 3%; 20–80%) can be logged 1 to 6 times per hour or transmitted in bulk 2 to 4 times per day depending on pilot requirements. Two versions of the sensing device are

available: the first uses Bluetooth to connect to a mobile app for GPS location and data transmission, the latter uses the Long Range (LoRa) communication protocol. The advantages of using LoRa gateways in the pilot sites are as follows: it enables direct transmission to the city data platforms for storage and processing, while equally making it possible to target communities with reduced digital literacy or access to smartphones.

The exact data types and formats to be collected via the TRH sensors will be included in the next version of the DMP.

Air quality measurements

Within Urban ReLeaf, three air quality parameters will be measured.

1. Real-time monitoring of particulate matter ($PM_{2.5}$) using a low-cost sensor (PurpleAIR PA-II) - Initial testing for inter-device repeatability and accuracy of all air quality sensors will be carried out by NOA. Data quality sheets and protocols for micro- and macro- siting of devices will be prepared by NOA, building on its experience of setting up such networks in the frameworks of the RI-PANACEA, SMURBS and EMISSION projects.

2. **Black carbon (BC) -** This is known to have a detrimental impact on human health and thus there are growing calls for an intensification of monitoring. Project partner NOA will provide the portable equipment for BC monitoring (e.g., Aethlabs MA200 micro-aethalometers)

3. Ultrafine particles (UFP) - These are detrimental to human health and need to be monitored more closely. NOA will facilitate the utilisation of UFP monitors in pedestrian mapping campaigns, with routes contrasting traffic, residential and green areas to showcase the effect of urban greening on air quality indicators.

The exact data types and formats to be collected via the $PM_{2.5}$, BC and UFP monitors will be included in the next version of the DMP.

Earth Observation – Copernicus Urban Atlas

High-resolution green elements layers will be developed for integration in the Copernicus Urban Atlas for all six pilot cities for the 2024 and 2027 production cycles of the Urban Atlas. These layers will be at a higher resolution than the current minimum mapping unit used in the Urban Atlas (0.25 ha), allowing the inclusion of smaller public green spaces, e.g., for improved calculation of accessibility to greenspace. Experiments for the Urban ReLeaf cities will be conducted for the 2024 production cycle, and to operationalise a robust and scalable workflow for the 2027 product. Technical recommendations and specifications for the EEA will be provided on how to improve Copernicus-based urban greenspace monitoring for the EU Green Deal. The newly produced very high-resolution layers (< 1meter pixels) will cover key areas of interests for all six cities and close information gaps for planning, implementation, and scenario building.

The exact specifications of the high-resolution data layers will be included in one of the next versions of the DMP.

2.2 Existing datasets held within partners or from external providers

Municipal datasets from Urban ReLeaf pilot cities

A core tenet of the project is to explore pathways for integrating citizen-science data streams into official data sources for operational use and decision making. Under the leadership of ICCS, we created a comprehensive catalogue of the relevant existing datasets in each pilot city (See Appendix A). This assessment is critical to understand specifically where and how the anticipated Urban ReLeaf citizen-based observations can complement official data streams. A total of 188 datasets were identified (Athens: 19, Cascais: 17, Dundee: 22, Mannheim: 14, Riga: 35, Utrecht: 22). Various characteristics of the datasets including format and openness were evaluated to create detailed data ecosystems maps. An in-depth report describing the data ecosystems are published in D3.1 Urban ReLeaf data ecosystem map (DOI: https://doi.org/10.5281/zenodo.8085391).

Strava Metro data

The city pilots will also be supported by data provided by Strava Metro. Strava is a leading app for runners and cyclists and its dataset is the world's largest collection of human-powered mobility information. Through its social impact arm (Strava Metro), the Urban ReLeaf consortium has gained access to this data for all pilot cities. This comprehensive dataset provides a unique opportunity to uncover correlations/insights between pedestrian mobility and green/grey infrastructure. Exact usage of this dataset will be explored on a case-by-case basis with the city partners and relevant stakeholders.

3 Fair Data

The Urban ReLeaf project follows the EU Open Science policy and FAIR principles for scientific data management and stewardship. Data produced by Urban Releaf will be made **F**indable, **A**ccessible, **I**nteroperable and **R**eusable to maximize uptake and bring value to a plurality of actors.

3.1 Making data findable, including provisions for metadata

Urban ReLeaf strives to make the data, namely the citizen-based observations, the sensor data and open APIs from the pilot activities findable by using existing local, regional and national open data portals, which are harvested by the official European data portal. Metadata will accompany all data using ISO19115 metadata standard, following good data practices to increase findability. Additionally, the Generic Earth Observation Metadata Standard (GEOMS) will be applied. It outlines the metadata and data structure requirements developed to facilitate the use of geophysical datasets by improving their portability and accessibility, and by making their contents self-describing.

3.2 Making data openly accessible

Urban ReLeaf will support a culture of open science and open sharing using open data and open-source platforms, providing data in openly accessible and interoperable formats and documents in multiple languages. Urban ReLeaf tools will be designed so that data collected will align with FAIR principles. Urban ReLeaf will use the ODI Data Ethics Canvas (ODI 2019) to ensure open science and open data principles are thoroughly considered. To manage risk

in publishing open data, potentially sensitive data will be subject to a Data ethics and risk review. Urban ReLeaf will also release open-source code of applications and publish toolkits and other materials under a creative commons license, with specific attention on ensuring appropriate recognition of all parties involved, including the citizens. Furthermore, Urban ReLeaf will adhere to strict data protection and data privacy policies, in line with national and international legislation (such as GDPR).

The Urban ReLeaf project has already established a repository within Zenodo to share all relevant resources, including public deliverables and datasets. Developed under the OpenAIRE program and operated by CERN, Zenodo supports the open sharing of research papers, datasets, software and other related digital artefacts. Each submission has supporting metadata including a persistent Digital Object Identifier (DOI), to make items easily citeable and trackable. Since uploads on Zenodo appear online immediately and the DOI is registered in seconds, the data is not subject to restrictions and can be considered fully open. All data will be made available online in an open mode and Urban Releaf will release open-source code of applications. All datasets will be shared apart from personal data.

To facilitate early access to our research all Urban ReLeaf public deliverables to date have been uploaded to the Zenodo repository. These submissions will be updated and revised as needed after the EC's approval after each periodic review.

Table 2: Urban ReLeaf deliverables in the Zenodo repository

Del No.	Deliverable Title	DOI
D1.1	Kick-off summary and detailed work plan	https://doi.org/10.5281/zenodo.7684175
D6.1	Urban ReLeaf engagement, communication, and dissemination plan	https://doi.org/10.5281/zenodo.7936468
D1.3	Urban ReLeaf data management plan	https://doi.org/10.5281/zenodo.8085352
D2.1	Landscape report on policy processes and opportunities for inclusive participation	https://doi.org/10.5281/zenodo.8085367
D3.1	Urban ReLeaf data ecosystem map	https://doi.org/10.5281/zenodo.8085391
D6.2	Urban ReLeaf project website and social media accounts	*pending*

The Urban ReLeaf consortium will conform to the Horizon Europe Open Access mandates including Gold Open Access and Green Open Access (or self-archiving) for all scientific publications produced. All publications will be available via Green Open Access, e.g., through Zenodo, ResearchGate and repositories supported by individual institutions. Although some funds have been set aside for Gold Open Access, Urban ReLeaf consortium partners are encouraged to publish via this route, using in-kind contributions from their institutions to fund this where possible.

3.3 Making data interoperable

Data quality and interoperability standards will be deployed via data interoperability gateways to ensure all data streams are compatible with selected standards. As part of T3.3 NOA will implement data protocols and interoperability standards for passive sampling systems. In this

context, appropriate calibration approaches will be proposed (centralized vs. localized vs. hybrid) and calibration models/guidelines will be provided to local partners/stakeholders. Where existing or proprietary observations need to be integrated, data interoperability gateways will be deployed to ensure other data streams are compatible with selected standards.

The project will work on using standards to ensure the interoperability of data based on best practices. For example, the project will explore the use of the Open Geospatial Consortium's (OGC) SensorThingsAPI to provide open, geo-spatial enabled interconnections with the TRH Sensors and AQ monitors. Data will be provided using well established standard web service interfaces fit for our purpose, e.g., OGC's Web Services (WFS, WMS, WCS, etc.), which allow the use of multiple data formats. The project will capitalize on tools and best practices being developed in ongoing projects such as NEXTGEOSS and EIFFEL. Concretely, it will utilize a factsheet of best practices regarding optimized formats for EO metadata so that Urban ReLeaf datasets uploaded in GEOSS and other infrastructures achieve maximum reusability.

3.4 Increase data re-use

The anonymised and public data will be made re-usable by providing technical documentation and applying a Creative Commons open data licences (i.e., CC0, CC BY and CC-BY-NC). Additionally, to support reuse, the project consortium will focus on assessing and improving the quality of citizen-sourced and sensor data streams using a range of methods: 1. Community-level indicators to augment and verify citizen sensed data with collective, impartial or partial knowledge, 2. Clear citizen science data collection protocols and guidelines, 3. Practical and scalable methods for sensor data validation and calibration, 4. Quality assurance strategies that use observations or verification flows from other citizen observers to provide confidence levels to the observations, 5. Exchange of good practices among citizen observers, and 6. Augmenting the metadata with data quality indicators such as the OGC Data Quality Working Group and/or INSPIRE.

4 Other Research Outputs

Other research outputs will be published according to EU Open Science policy and FAIR principles for scientific data management and stewardship. As the project evolves, the DMP will be updated to consider the management of the other research outputs.

5 Allocation of resources

The costs for data management are fully integrated into the project budget. They are shared amongst the partners responsible for the data capture and processing. Urban Releaf has a small budget to finance open access to research publications in scientific journals. Sound data management is the responsibility of every project partner. Nevertheless, through T1.4 IIASA supports relevant partners and is responsible for the overall data management and open science practices within Urban ReLeaf. The costs associated with the long-term maintenance of data archives will be covered by IIASA as project-in-kind contributions, including the maintenance of the server space where all the data produced by the project will reside after the project ends.

6 Data security

Data collected within the framework of Urban ReLeaf will be stored in accordance with partners' institutional requirements that strictly adhere to EU legislation (the GDPR (EU) Regulation 2016/679) for data protection and storage. Data are stored in in- house and cloud servers, with backups as appropriate. The environment is set up such that we restrict access to the database strictly to our trusted network and through APIs that let us choose exactly which data are accessible to which users.

7 Ethical aspects

Ethical aspects related to data gathering, storage and use are outlined in detail in the deliverable D7.2 Protection of Personal Data (POPD) - Ethics Requirement No. 2, which is not a public deliverable. Therefore, we include relevant sections here in this public deliverable.

7.1 Processing and protection of personal data

This section outlines some concepts and key considerations with regards to the type and purpose of data to be collected and processed. Based on Article 15 (Data Protection) in the Urban ReLeaf Grant Agreement, the beneficiaries must process personal data under the Agreement in compliance with the applicable EU, international and national law on data protection (in particular, Regulation 2016/679). The beneficiaries ensure that that personal data are:

- processed lawfully, fairly and in a transparent manner in relation to the data subjects
- collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes
- adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed (i.e., data minimisation)
- accurate and, where necessary, kept up to date
- kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the data are processed and
- processed in a manner that ensures appropriate security of the data.

Where appropriate, national regulations on personal data will be implemented to guarantee the highest standards in personal data management.

Urban ReLeaf will employ a "data protection by design and by default" approach (Art 25, GDPR) to help mitigate ethical risks. Since data protection by design is one of the best ways to address the ethics concerns that arise from research activities, the consortium will give utmost attention to privacy issues at the co-design stage (2023). For instance, this refers to the adherence to principles of purpose limitation, data minimisation, psedonymisation or anonymisation and establishing protocols for data subjects to exercise their fundamental rights. A Data Protection Checklist will be completed and updated as necessary during project implementation. This checklist details the processing steps, procedures of data acquisition, security measures and data transfer.

The following definitions of personal data and data processing are acknowledged by the Urban ReLeaf consortium:

Personal data *are defined extremely broadly and include 'any information relating to an identified or identifiable natural person'. An 'identifiable natural person', or 'data subject', is 'one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person' (Article 4(1) GDPR).*

Data Processing *includes 'any operation or set of operations which is performed on personal data or on sets of personal data, whether or not by automated means, such as collection, recording, organisation, structuring, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, restriction, erasure or destruction' (Article 4(2) GDPR).*

Urban ReLeaf will potentially collect personal data from human participants in various activities that are strictly necessary to achieve the objectives of the research as outlined in Table 3. The full details of the type of personal (i.e., sensitive, secondary) data across these planned activities will be updated periodically throughout project implementation.

Table 3: List of activities involving potential personal data collection

Task	Activity involving potential personal data collection	Categories of personal data (Personal, Sensitive, Secondary)			Collection Status
		P	Sen	Sec	
T2.1	Interviews with stakeholders from local authorities	X			Ongoing
T2.2	Participatory Action Research for the development of Policies (PAR4P) stakeholder workshops	X			May - June, 2023
T2.3	Pop-up community and culture labs	X	X		2024 - 2025
T2.4	Reflections and insights workshops	X			2026
T4.2 - 4.7	Implementation of Urban ReLeaf city pilots (i.e., citizen science engagement campaigns)	X	X	?	2025-2026
T5.1	Urban ReLeaf Community of Practice	X			2024-2026
T6.4	Exploitation plan and business model pathways (i.e., Design for Business sprints)	X			2024 - 2026

Interviews with stakeholders from local authorities within the Urban ReLeaf city pilots (WP2) involve the collection of personal data including:

- Name, Affiliation, E-mail address, and Phone Number.

An informed consent procedure clearly outlines the need for and purpose of the data collection, what will be done with the data and all the processing steps involved. Only personal data that are essential to achieve the research task will be collected. The consortium will ensure that data collected in the project is protected by adequate organisational and technical arrangements. These arrangements will ensure an appropriate security level in relation to the

risks of collecting and storing the data. The personal data will be anonymised before being shared outside of the immediate project team.

Research data (i.e., interview responses) will be pseudonymised and identified through an encoding key. The name and/or other personal data that could allow the identification of the participant will never be indicated publicly. This unique identifier will link all basic data required for the study. The master key file linking the centre's study numbers with personal identifiers will be maintained in a password protected file with limited access. All files containing personal data will be stored in encrypted and password-locked files. Access to these files will be limited to authorised project personnel. Only researchers linked to the project will have access to personal data for project purposes. According to the GDPR, each participant will be informed of their rights to 1) access personal data 2) change personal data in the database 3) request that their personal data be erased from the database and 4) restrict processing of personal data to certain purposes.

Reported study results will pertain to analyses of aggregate data. No individual's name will be associated with any published or unpublished report of any study, unless deliberate consent is given, e.g., for testimonials or personalised storytelling. All data will be anonymised if made openly available and shared under an Open Data Commons Open Database License (ODbL).

7.2 Processing of special categories of personal data

A key ambition within Urban ReLeaf is to engage vulnerable groups in environmental observation and co-creation efforts through inclusive strategies. Urban ReLeaf will demonstrate the inclusion of such groups in city-wide campaigns, environmental monitoring, and co-creation of greening solutions. The inclusion will be assured through an adapted 3-step recruitment process (open call, selection, targeting) based on socio-demographic and socio-economic recruitment criteria, also building local partnerships with trusted intermediates to reach out to women and other vulnerable groups. As a result, it is anticipated that some sensitive personal information on e.g., gender, ethnicity and income will be relevant for evaluating the effectiveness of the project's strategy towards inclusiveness. The project will pay particular attention to the collection of such special categories of personal data which is defined as:

> **Special categories of personal data** (formerly known as 'sensitive data') are subject to more stringent data-protection safeguards. They include 'personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a natural person's sex life or sexual orientation' (Article 9(1) GDPR).

Detailed justification of the collection and processing of special categories (sensitive) data will be updated in the Data Management Plan before the start of the relevant activities, which are anticipated for 2024.

References

Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC ('GDPR') (OJ L 119, 4.5.2016, p. 1).

Appendix A: Summary of existing data assets in Urban ReLeaf pilot cities

City	No. of Datasets	Domain	Dataset Description	Data Owners
Athens	**15**	Urban Greening	Tree registry, Trees records National Garden of Athens and maps, Tree records reported as pavement objects (Athens district and historical center), Records with plant boxes and parterre;	**PUB** • Greening departments of 7 districts • Municipality of Athens • YPEN **RES/ACA** • PANACEA consortium
	0	TRH	/	
	7	AQ	National Air Pollution Monitoring Network (e.g. PM10, CO, NO, NO2, O3, SO2) PANACEA PM2.5 Sensor Infrastructure (Athens Network)	
	0	Thermal Comfort	/	
	2	Ancillary	Noise volume (Lden index), Pavements	
Cascais	**14**	Urban Greening	Green urban areas, Orthophotos, Land Use, Tree registry (protected, interventions) Potential Natural Vegetation, Assessment of ecosystem services [carbon removal, pluvial runoff avoided, pollutant removal]	**PUB** • Cascais Town Hall (Green Infrastructure Management Division) • Cascais Town Hall (Forest Technical Unit) • EMAC • Directorate-General for Territory **RES/ACA** • Institute for Nature Conservation and Forests **PRIV** • QART • Individual scientists
	5	TRH	16 stations [Humidity, Temperature]	
	8	AQ	11 AQ stations [NO2, O3, PM2.5, PM10, SO2, CO], AQ for Outdoor Activities	
	3	Thermal Comfort	Climate Change Adaptation Plan, Fire hazard map, Fire risk map	
	4	Ancillary	11 AQ stations [noise, pressure, wind speed and direction, precipitation], 5 stations [Barometer, Evapotranspiration, Precipitation, Wind Speed, Direction, Max, WindSamps, Solar Radiation, UV]	
Dundee	**8**	Urban Greening	TPO Boundaries, National Forest (Woodland) Inventory, Tree locations, Native Woodlands and Plantations on Ancient Woodland Sites, Ancient Woodland Inventory, Habitat and Land Cover Map, Local Nature Reserves	**PUB** • Dundee City Council (Forestry Department)
	2	TRH	Ambient and Modelled Temperature	

	7	AQ	AQ (single records, maps or projections) - NO_2, PM1, PM2.5, PM10, SO_2	• Scottish Government (Scottish Natural Heritage, Scottish Forestry) **RES/ACA** • SEPA • DEFRA • James Hutton Institute • Forest Research **PRIV** Scottish Water
	0	Thermal Comfort	/	
	10	Ancillary	Wind speed & direction, Noise maps, Open spaces, Soil Inventory, Topsoil Organic Carbon Content (TOC), SPA, SSSI, NVC, RAMSAR, SIMD	
Mannheim	**3**	Urban Greening	Aerial 3D laser scanning survey, Public green spaces, Newly planted trees	**PUB** • City of Mannheim • Smart City Mannheim **RES/ACA** • State Institute for the Environment of Baden Württemberg
	4	TRH	Surface infrared temperature; Isothermal map; temperature, humidity (2 sources)	
	2	AQ	AQ [NOx, CO2]	
	0	Thermal Comfort	/	
	9	Ancillary	Wind speed and direction, Cold air corridors, Heat areas, Buildings, Noise, Soil moisture and temperature, Heavy rain hazard maps, Precipitation, Cool places maps, Air pressure, Global radiation	
Riga	**9**	Urban Greening	Protected areas, Protected species/trees, Contaminated sites, Invasive tree species, EO-spectral indices, Green spaces, Land use and protection zones, Orthophotos, Forests, Tree records, Cities meadows.	**PUB** • Riga City Council development department (Building Control department) • Central Statistical office • Riga municipality (City Development department, Riga City Architect's Office) • Latvian Geospatial Information Agency • Nature protection administration **RES/ACA**
	2	TRH	Air temperature forecasts, Meteorological operational data (updated and archived)	
	12	AQ	AQI, AQ PM (dust), VOC (Benzene, NO2, and SO2), SensorCommunity PM 2.5, AQ 3 stations, Monthly AQ reports	
	0	Thermal Comfort	/	
	27	Ancillary	Wind direction & speed, Noise pollution, UHI maps, CC scenarios, Total precipitation, UV radiation, Pollen Concentration, Contaminated sites, Surface water quality, Water level, Water temperature, depth, Population density	

				• Latvian Environment, Geology and Meteorology Center **PRIV** • Freeport of Riga • VSIA "Latvian State Roads"
Utrecht	**5**	Urban Greening	Treemap (species, year, tree number), Old trees 80 years and older, Forest plants with trees, Green structure vision map, Land use	**PUB** • Municipality of Utrecht • Province of Utrecht • Scottish Government • Province of Utrecht (HIG Traffic Systems BV) • Statistics Netherlands • Atlas Natural Capital **RES/ACA** • RIVM • CIMLK • KNMI • Witteveen+Bos • Wageningen • KWR Water Research Institute **PRIV** • SODAQ • Civity • Climate Impact Atlas
	4	TRH	Temperature (3 sources), Humidity (1 source)	
	15	AQ	Annual means and single records, - PM2.5 (5 sources), PM10 (2 sources), PM1 (1 source), - AQ pollutants [NO2, CO2, NO, NO2, O3, NO2, NH3]	
	5	Thermal Comfort	Climate change maps (Number of tropical days, summery days, warm days), Warm nights, Heat maps (2050 Best and Worse-case CC scenario), Risk drought stress, Drought susceptibility nature, UHI	
	6	Ancillary	Green Bicycle roots (air pressure); Traffic light intensity; Traffic data (bike, car, truck, pedestrian); Noise, Water Quality	

*Data owners are categorised as: **RES/ACA**: Research Institute & Academic body; **ASSOC/NGO**: Association & Non-Governmental Organisation; **PUB**: Public Authorities/Administration, **PRIV**: Private Industry & Small and medium-sized enterprise. See D3.1 for more details (DOI: https://doi.org/10.5281/zenodo.8085391)*