Funded by
the European Union

Ref. Ares(2025)6249810 - 31/07/2025

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101088822.

D 5.1. Data Management Plan

Title: Plastic Pirates - Go Europe!
Data Management Plan
Date: 30.05.2025
Update: 31.07.2025
Confidentiality: Public

Executive summary

This document has been elaborated as a deliverable (D5.1) in the framework of the PlasticPiratesEU action describing the project's data management procedures for all data to be collected, processed and/or generated in line with the guidelines on FAIR data management and Open Science in Horizon Europe. The term FAIR describes a set of guiding principles to make data findable, accessible, interoperable, and reusable. The data management plan (DMP) is compiled in compliance with the template provided by the European Commission (version 1.1; 2022-04-01).

Funded by
the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101088822.

Document information

Deliverable title	Plastic Pirates – Go Europe! Data Management Plan
Authors	Philip Ackermann (DLR-PT), Charlotte A.L. Dhondt (VLIZ)
Citation	Ackermann, P.; Dhondt, C.A.L.; DLR Projektträger (DLR-PT): Germany; Flanders Marine Institute (VLIZ): Belgium; (2025): Plastic Pirates – Go Europe! Data Management Plan
Deliverable number	D5.1
Work package	WP5
Due date of deliverable Belated due date *(as agreed between coordinator and project officer)*	30. November 2022 31. May 2023
Submission date	31. May 2023
Update	31. July 2025
Dissemination level	Public
Version	V02

Funded by
the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101088822.

Executive summary 1

1. Data Summary 4

2. FAIR data 4

2.1. Making data findable, including provisions for metadata 4

2.2. Making data accessible 5

2.3. Making data interoperable 6

2.4. Increase data re-use 7

3. Other research outputs 7

4. Allocation of resources 8

5. Data security 9

6. Ethics 9

7. Other issues 10

Funded by
the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101088822.

1. Data Summary

Re-use of existing data:
The project re-uses data from the previous Plastic Pirates project (2019-2022), specifically the dataset available at zenodo (https://doi.org/10.5281/zenodo.4600790). The reason for re-using this data is to compare the findings with the PlasticPiratesEU project's new data, which will be collected through citizen science efforts, in order to increase the robustness of the results. Additionally, environmental, weather, demographic or physio-chemical data might be reused for data analysis.

Types and formats of data:
PlasticPiratesEU generates or re-uses data in the form of field observations, photographs, and measurements of micro-, meso- and macrolitter, specifically plastics, in rivers and other water bodies and on beaches in Europe. In addition, there is also laboratory analysis data for micro- and mesoplastics in the water (particle characteristics) and qualitative data about the possible litter sources and weather conditions during sampling. Data are collected using a standardized protocol (see section 2.4) that has been developed by the Plastic Pirates project. The data is stored in a spreadsheet format (.xlsx and .csv) and includes accompanying photographs in various formats.

Purpose of data generation or re-use:
The purpose of data generation or re-use is to investigate the presence and distribution of plastic litter in rivers and other bodies of water and on beaches in Europe. This is in line with the project's objectives of identifying the sources of plastic pollution, assessing the impact on the environment, and promoting solutions to reduce plastic waste.

Expected size of data:
The expected size of the data generated by the project is difficult to estimate, as it will depend on the number of citizen scientists involved and the number of sites sampled, and will grow as sampling continues. However, based on current citizen science efforts by the Plastic Pirates project, it is reasonable to expect more than a thousand observations and accompanying photographs. Actual data files will not exceed a few gigabytes. Pictures could exceed 100 gigabytes.

Origin/provenance of data:
The data generated by the project is be collected by citizen scientists, i.e. schoolchildren and teachers, youth groups and youth group leaders, with the support of local experts. The data is be collected at different times and locations, in synchronised sampling periods across Europe.

Data utility:
The data generated by the project, as well as the re-used data from the Plastic Pirates project, is useful to researchers studying plastic pollution in waterways, as well as to policymakers and advocacy groups interested in developing solutions to reduce plastic waste. The data is also useful to citizen science practitioners interested in learning about successful protocols for engaging the public in scientific research.

2. FAIR data

2.1. Making data findable, including provisions for metadata

To ensure the findability of the data, unique persistent identifiers (PIDs) is used. The dataset is assigned a DOI (Digital Object Identifier) that enables long-term access to the data and metadata.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101088822.

Rich metadata is provided to allow discovery of the data. The metadata includes information such as the title, contributors (persons, institutes) with PIDs, citation, date of publication, file format, DOI, usage licence, link to project, temporal and spatial coverage, keywords and methods used to generate the data. General standards such as the Dublin Core Metadata Element Set and the DataCite Metadata Schema is followed. If necessary, additional metadata is created to provide more detailed information about the data and to ensure its discoverability and reusability.

The metadata is made available through online repositories and (meta)data catalogues (Zenodo and MarineInfo) to increase its visibility and accessibility. The metadata is offered in a machine-readable format such as XML or JSON, so that it can be easily harvested and indexed by search engines and other discovery tools. The data published on Zenodo is part of the Plastic Pirates community within the EU Open Research Repository.

Search keywords are provided in the metadata to optimize the possibility for discovery and potential re-use. These keywords are selected based on the research objectives and are used to help other researchers locate and retrieve the data.

2.2. Making data accessible

The PlasticPiratesEU consolidated data is deposited and published on Zenodo, a trusted repository for research data. Zenodo assigns a persistent identifier to each dataset and ensures that it can be freely accessed and shared by other researchers. PlasticPiratesEU uses Zenodo to ensure that the data is made openly available, and metadata is included to help users find and access the data.

The raw data (uploaded to the PlasticPiratesEU website by citizens) and the partly processed data (validated data provided by the local experts, not yet standardized and harmonized) is securely stored in another online data repository, the Marine Data Archive (MDA) of VLIZ, and is accessible for project partners and available upon request for third parties. This ensures that all versions of the data are accessible through a free and standardized access protocol. There is no need for a data access committee to evaluate/approve access requests to personal/sensitive data. In case third parties request access to the raw or partly processed data, the project coordinator and the local experts will evaluate and approve the request.

All data collected by PlasticPiratesEU is made openly available with a CC BY licence, with the exception of certain datasets that may need to be shared under restricted access conditions. The project clearly separates legal and contractual reasons from intentional restrictions, and specific beneficiaries may keep their data closed if opening their data goes against their legitimate interests or other constraints as per the Grant Agreement. If an embargo is applied to give time to publish or seek protection of intellectual property, the Plastic Pirates project specifies why and how long this will apply, bearing in mind that research data is to be made available as soon as possible. The data remains available for an indefinite period of time.

Regarding metadata, the Plastic Pirates project makes metadata openly available and license it under a public domain dedication CC0, as per the Grant Agreement. Metadata remains available in both Zenodo and MarineInfo, even if the data would no longer be available. Metadata contains information to enable users to access the data, and documentation or reference about any open software needed to access or read the data is included, if applicable.

Pictures are safely stored on the servers of DLR and remain under restricted access, since these may contain personal data. They are only accessible for partner institutes for data validation. Some pictures can be made available upon request for valid purposes (e.g., research on identification of litter items).

In conclusion, the Plastic Pirates project takes several measures to ensure that its data is deposited in a trusted

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101088822.

repository, made openly available, and accessible through a standardized access protocol. The project's efforts to make its data available to the wider scientific community and the public contribute to better understanding and addressing plastic pollution in rivers and waterways across Europe.

2.3. Making data interoperable

To make the Plastic Pirates data interoperable, it is important to follow established data and metadata vocabularies, standards, and formats that enable data exchange and re-use across different disciplines. The use of community-endorsed interoperability best practices are followed by PlasticPiratesEU to ensure compatibility with other datasets and to maximize the impact and usefulness of the data.

Following international (meta)data standards are used as much as possible:

- Date format: ISO 8601 (YYYY-MM-DD)
- Coordinates format: decimal degrees (WGS84 reference system – EPSG:4326)
- Material type microplastic particles (mostly polymers): http://vocab.nerc.ac.uk/collection/H05/current/
- Microlitter particle colour classes: http://vocab.nerc.ac.uk/collection/H04/current/
- EMODnet Chemistry – Guidelines and forms for gathering marine litter data: beach and seafloor trawlings. Version 7.1
- EMODnet Chemistry – Guidelines and formats for gathering and management of micro-litter data sets on a European scale (floating and sediment micro-litter). Version 0.2
- A Joint List of Litter Categories for Marine Macrolitter Monitoring (MSFD Technical Subgroup on Marine Litter, 2021)
- One of the most widely used metadata standards for environmental data is the Dublin Core Metadata Initiative (DCMI). This standard provides a set of common terms and definitions that can be used to describe a variety of resources, including datasets. By adopting the DCMI standard, the PlasticPiratesEU will ensure that its metadata is compatible with other datasets and can be easily accessed and reused by other researchers.

Before standardization of the data, individual datasets of the different countries are merged together into one large dataset and (meta)data formats are transformed to pursue consistency across countries. This harmonization process is important for data interoperability and makes future data analysis, comparison and integration easier.

In addition, PlasticPirates EU follows and implement efforts to set international standards to plastic waste data collection set-out by the Joint Research Centre, European Environmental Agency and Horizon Projects like EUROqCHARM.

To ensure that project-specific ontologies or vocabularies do not hinder interoperability, PlasticPiratesEU provides mappings to commonly used ontologies. This enables other researchers to understand the meaning of the terms used in the Plastic Pirates dataset and to link it with other datasets that use different vocabularies.

Finally, including qualified references to other data is crucial for enhancing the usefulness of the Plastic Pirates dataset. By linking to other datasets, the project can provide context for its findings and enable other researchers to explore related data that may be relevant to their own research. Relevant references are added to the metadata.

In summary, to make the Plastic Pirates data interoperable, PlasticPiratesEU follows established metadata standards, use standard data formats for data exchange, provide mappings to commonly used ontologies, and

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101088822.

include qualified references to other datasets as much as possible. By adopting these best practices, the project maximizes the impact and reusability of its data, and contribute to a more open and collaborative scientific community.

2.4. Increase data re-use

PlasticPiratesEU provides comprehensive documentation to facilitate data re-use and validate data analysis. This includes detailed readme files that contain information on the file structure, file content, methodology of data collection and validation, codebooks, data cleaning, analyses, variable definitions, units of measurement, and any other relevant information that can aid in the interpretation and analysis of the data. The R script that is used for data standardization and harmonization is made available on GitHub as read-only.

PlasticPiratesEU recognizes the importance of making data as widely accessible as possible, and therefore, makes the data freely available under a CC BY licence, which is a standard usage licence that is in line with the obligations set in the Grant Agreement and with the EU Open Science policy. Data and metadata is shared as .csv and .txt files, which are open file formats.

The data produced in the project is usable by third parties after the end of the project. PlasticPiratesEU understands that the data generated can be valuable for other research projects, industry, citizens and policy, and therefore, ensure that the data remains accessible and useable by third parties in the long term. This is ensured either by repositories like Zenodo and MDA, or European data systems like EMODNet.

After data publication, (meta)data is disseminated to international data systems such as EMODnet, EU DTO and the European Atlas of the Seas to increase its visibility, reusability and longevity.

PlasticPiratesEU thoroughly documents the provenance of the data. The action booklets of the Plastic Pirates project document in detail the sampling protocol (what, why and how data are collected). During sampling, it is documented when, where and by whom the data have been collected. In addition, the Common Standards of the Plastic Pirates – Go Europe! (D.3.1) gives a detailed overview on how the data has been collected as well as the data quality assurance processes. The latter are comprehensive and rigorous to ensure the accuracy, reliability, and consistency of the data. Quality control measures at every stage of the data lifecycle, including data collection, processing, analysis, and dissemination are in place as well as high standards for data validation and verification (see also D.3.1 and Kiessling et al. 2019). Both the riverine and coastal booklet as well as D3.1 are published with a DOI.

3. Other research outputs

PlasticPiratesEU recognizes the importance of applying robust data management standards to all research outputs. This includes outputs like:

- D3.3 Plastic Pirates – Go Europe! Report Best Practices (2023)
- Plastic Pirates – Go Europe! Lessons-learned from upscaling a citizen science initiative across Europe (2024)
- Peer-reviewed data paper (data descriptor) to enhance the visibility and reusability of the data.
- An R Markdown script to generate summary statistic graphs of the data is also available on GitHub at https://github.com/vlizBE/Plastic-Pirates-Data-Consolidation/tree/main/Graphs%20results. The

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101088822.

script reads in the final CSV files for riverbank and floating data, summarizing the following information available in the datasets:

- Number of samplings per country per year
- Mean plastic weight collected per sampling per country
- Total plastic waste (kg) collected per country
- Percentage of plastic waste vs all other waste (kg) per country
- Distribution of litter types (by piece) throughout all countries (plastic, metals, glass, etc.)
- Distribution of SUPs and other plastics (by piece) per country
- Percentage of SUPs vs other plastics (by piece) per country
- Distribution of verified floating plastics (macrolitter and microlitter) per country
- Distribution of suspected riverine waste sources throughout all countries
- Number of participating institutions per country
- Number of unique rivers sampled per country
- Number of participating students per country

The script outputs all graphs in PNG format to a folder labeled with the date of generation for easy reference. This allows any dataset user to view the Plastic Pirates summary statistics in visual format.

Deliverables are openly available via CORDIS (https://cordis.europa.eu/project/id/101088822/results). Relevant deliverables and reports will be published once they have been finalized. By employing persistent identifiers, rich metadata, standardized access protocols, and interoperability practices, if needed, the project aims to enhance the discoverability, accessibility, and reusability of these outputs. This ensures that the valuable knowledge generated through citizen science efforts can be effectively shared and utilized by the wider scientific community.

4. Allocation of resources

Making data and research outputs FAIR involves various costs, including direct and indirect expenses related to storage, archiving, re-use, security, and other data management activities. These costs can include infrastructure costs for data storage and hosting, expenses for implementing data management systems and software, costs for data cleaning and quality assurance processes, and resources needed for ensuring long-term preservation and accessibility of the data.

To cover these costs, the project leverages the Horizon Europe grant, as costs related to research data/output management are eligible expenses within the framework of the Grant Agreement. PlasticPiratesEU allocates the necessary resources from the grant to support FAIR data practices, ensuring compliance with the funding requirements.

This is achieved by:

- Subcontracting parts of these task to the local Plastic Pirates partners (i.e. data cleaning and quality assurance processes, data verification, data storage and data consolidation)
- Subcontracting preparation of the data for long-term preservation, management, accessibility, re-usability and upload to Open Data repositories like Zenodo to skilled and experienced experts that are part of the Plastic Pirates community
- Choosing free to use (Open Source) repositories like Zenodo or EMODnet

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101088822.

The overall coordination of data management is done by the PlasticPiratesEU coordinator (DLR) with the help of subcontracted experts as part of the Plastic Pirates community. Decisions on the long-term availability and preservation of the data are taken by the General Assembly of the Plastic Pirates initiative. Both data uploaded to the website by the citizens (raw data and pictures) as well as partly processed data (validated data) and consolidated data (standardized and harmonized data) provided by the experts are archived for the longer term. This is useful to trace back the data processing steps that were used and for possible future research that could be done on the raw data.

5. Data security

Ensuring data security is a crucial aspect of our project's data management strategy. PlasticPiratesEU implements provisions to safeguard data throughout its lifecycle, including data recovery, secure storage/archiving, and transfer of sensitive data.

For data recovery (raw data and pictures), it establishes regular backup procedures to minimize the risk of data loss. This involves creating redundant copies of the data and storing them in secure locations. These backup processes are performed according to industry best practices and are regularly tested to ensure data integrity and availability.

To ensure secure storage and archiving of all data, the project utilizes the Marine Data Archive (VLIZ - https://mda.vliz.be/) and Zenodo, which are trusted repositories that adhere to recognized standards and best practices for data preservation and curation. These repositories employ robust security measures to protect the data from unauthorized access, breaches, or loss. Access controls, encryption, firewalls, and other security mechanisms are implemented to safeguard the data during storage and archiving. Raw data and partly processed data (validated data) are only be accessible by experts of the project partners and by third parties on request with approval of the project coordinator and the experts.

When transferring sensitive data, PlasticPiratesEU employs secure protocols and encryption methods like DLR's SharePoint to protect the data during transit. This helps prevent unauthorized access or interception of the data during transfer.

6. Ethics

There are ethics and legal issues related to data sharing in the Plastic Pirates project. The terms of participation provided on the plastic-pirates.eu website outline the conditions and rights associated with data sharing. These terms address copyright, personal rights, and the right of use granted to the organizer. Participants are required to explicitly consent to the exclusive, spatially and temporally unlimited use of the data and photos they submit.

Hence, informed consent for data sharing and long-term preservation are included in the questionnaires used to collect personal data. According to the terms of participation, participants are required to agree to the conditions that grant the organizer exclusive rights to use the uploaded data and photos. This agreement includes the publication of data (including group and/or school name) and photos on the project's website. The terms also state that participants must ensure they have the right to represent the uploaded photos and have obtained consent from third parties involved in data collection.

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101088822.

PlasticPiratesEU is committed to complying with data protection regulations and maintaining the privacy of participants. Personal data collected, such as group names, contact person information, organization/school details, and email addresses, are be used solely for the evaluation of participation forms and to facilitate communication regarding the campaign and its results. The project organizers are not disclosing personal data to third parties except where necessary to carry out the event. The terms of participation explicitly state that the collection of personal data is subject to privacy policies outlined in Chapter 4 of the privacy policy. This ensures that personal data is handled in accordance with data protection regulations.

In the consolidated published dataset, only the school and group names are included, any other personal information of the citizens is excluded. School and group names are also visible on the Plastic Pirates website and including these with the data was considered a way of recognizing the valuable contributions of the citizens as data creators.

7. Other issues

The strategic advisory board strategically integrates the expertise from a broad variety of scientific and policy stakeholders into the implementation of the Plastic Pirates project. It, thus, on the one hand advises and informs the General Assembly on latest scientific developments, connections to local citizen science projects in the marine and freshwater domain, the ongoing work on monitoring plastic litter as well as point out ways how to best connect the Plastic Pirates' data to monitoring of EU policy objectives. It, on the other hand, supports the action's efforts to harmonize and standardise data collection, analysis, preservation and sharing.