International Marine Debris Data Harmonization Workshop

Workshop report

August 29 - 31, 2023, Yokohama, Japan

Recommended citation:

Palacz A.P., Lusher A., Lecellier D., Tamiya-Hase N., Fujioka M., Hasson A., Miyazaki K., Tekman M. eds. (2025). A report of the International Marine Debris Data Harmonization Workshop, 29-31 August 2023, Yokohama, Japan; doi: 10.5281/zenodo.17806147

IMDOS
INTEGRATED MARINE DEBRIS OBSERVING SYSTEM

Table of Contents

Executive Summary

The International Workshop on Marine Debris Data Harmonization took place at the PACIFICO Yokohama on August 29th to 31st 2023. It gathered marine debris professionals with a wide range of expertise from data management and marine debris monitoring to harmonization of methods and modelling.

The workshop was hosted by the Ministry of the Environment Japan (MOEJ) with organizational support from the Integrated Marine Debris Observing System (IMDOS). It was co-sponsored by the MOEJ, the EU H2020 EuroSea project, the EU4OceanObs project implemented by Mercator Ocean International, and the H2020 EUROqCHARM project.

The goal of the workshop was **to enhance the readiness level of data, including associated metadata, to support global data harmonization for selected key marine debris indicators** that will underpin the successful mitigation of plastic pollution. The workshop presented the state of the art when it comes to harmonization of monitoring methods and data synthesis efforts, and included several discussion sessions in plenary and dedicated breakout groups.

Through a series of presentations and discussion sessions participants achieved the following outcomes:

- **Initiated a coordinated network (community of practice) of ocean surface microplastic** data providers with an agreement to adhere to agreed common sampling protocols, metadata and data requirements. The network is to be further organized under the auspices of GOOS and IMDOS.
- **Obtained a consensus on marine debris metadata and data requirements of ocean surface microplastics as a leading example,** between key regional and global marine data integrators including MOEJ, EMODnet and NOAA NCEI with an agreed intention to expand onto and any other potential large data integrators globally
- **Provided recommendations for standardized metadata and data requirements** for the UNEP GPML Digital Platform data matrix
- **Agreed on a common vision to develop a roadmap for a federated data management system** for ocean surface microplastics and selected global-scale marine debris indicators.

This report provides a brief account of the different workshop sessions and how they contributed to addressing the workshop objectives and expected outcomes.

List of abbreviations

AMAP	Arctic Monitoring and Assessment Programme
CoP	Community of Practice
EMODnet	European Marine Observation and Data Network
EOV	Essential Ocean Variable
EU	European Union
GEO	Group on Earth Observations
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
GOOS	Global Ocean Observing System
ICES	International Council for the Exploration of the Sea
IMDOS	Integrated Marine Debris Observing System
IODE	International Oceanographic Data and Information Exchange
KPI	Key Performance indicator
MSFD	Marine Strategy Framework Directive
MOEJ	Ministry of the Environment, Government of Japan
NOAA NCEI	National Oceanic and Atmospheric Administration National Centers for Environmental Information
ODIS	Ocean Data information System
PAME	Protection of the Arctic Marine Environment
RAPs	Reproducible Analytical Pipelines
SOP	Standard Operating Procedure/Protocol
TGML	Technical Group on Marine Litter
TRL	Technical Readiness Level
UNEP GPML	United Nation Environment Programme Global Partnership on Plastic Pollution and Marine Litter

Motivation and objectives

The value of marine debris data shared with stakeholders via global platforms and data infrastructures remains limited due to insufficient coordination among initiatives addressing data comparability, availability, and quality assurance.

Establishing a federated data management system that aligns with the data requirements of marine debris research and monitoring, alongside the adoption of standardized metadata structures, would enable harmonization of data across studies, data centers, and monitoring programs. Moreover, such an approach would strengthen the capacity to generate data synthesis products and foster global coordination of marine debris monitoring and observation efforts. This, in turn, would advance capabilities in model development, scientific assessments, and evidence-based decision making. Support from international coordination bodies, such as the International Ocean Data Exchange (IODE), the Global Ocean Observing System (GOOS), and the Group on Earth Observations (GEO) Blue Planet, is essential to ensure integration into existing global systems and to enable efficient coordination across the entire value chain, from data acquisition to application. This coordination is also critical in supporting ongoing negotiations and the future implementation of a global treaty on plastic pollution.

The United Nations Environment Programme (UNEP) Global Partnership on Plastic Pollution and Marine Litter (GPML) Community of Practice (CoP) on Data Harmonization, together with the Integrated Marine Debris Observing System (IMDOS), seeks to address the challenges outlined above by promoting harmonized approaches to data acquisition, processing, and management. This includes standardization of associated metadata and alignment with best practices in data governance. In collaboration with key partners—such as the Ministry of the Environment, Japan (MOEJ), the European Union Marine Strategy Framework Directive (MSFD) Technical Group on Marine Litter (TGML), EMODnet Chemistry, and NOAA's National Centers for Environmental Information (NCEI) and the International Ocean Colour Coordinating Group Task Force on Remote Sensing of Marine Litter and Debris—the initiative aims to establish interoperability across data centers and monitoring programs. These efforts support UNEP's federated data model as implemented through the UNEP GPML Digital Platform.

These infrastructures have the potential to integrate data from diverse sources, including scientific research, environmental authority monitoring, NGO initiatives, and citizen science field campaigns, and are equipped to archive, aggregate, and synthesize this information for both scientific and policy applications. To enhance the comparability of monitoring data, it is essential to align with established guidance and large-scale monitoring frameworks, such as those developed by GESAMP, the EU MSFD TGML, and Japan's Ministry of the Environment (MOEJ) under the G20 Implementation Framework for Actions on Marine Plastic Litter.

To this end, a coalition of partner organizations, led by the Ministry of the Environment, Japan (MOEJ) and the Integrated Marine Debris Observing System (IMDOS), convened an international technical workshop aimed at enhancing the readiness level of marine debris data. The workshop focused on improving metadata identification and supporting global data harmonization for selected key indicators. These efforts are intended to underpin effective mitigation strategies for plastic pollution through improved scientific assessments and coordinated policy action.

The workshop had the following objectives:

1. To **exchange views** on **what data are necessary** to inform the marine debris indicators, and **to what level that can be provided** by the current capacity to monitor and observe the ocean;
2. To **map the current capacity to monitor and observe** selected global-scale marine debris indicators based on available knowledge of existing surveys;
3. To **harmonize the existing definitions and mandatory requirements for metadata and data reporting** on selected global-scale marine debris indicators and sampling methods, with a focus on ocean surface microplastics but with consideration of floating macro debris, water column microplastics, beach macro debris and seafloor macro debris from visual and imaging surveys;
4. To **conceptualize a global, federated data management system** for ocean surface microplastics and selected global-scale marine debris indicators;
5. To **initiate a coordinated observing network** for ocean surface microplastics guided by the criteria of the GOOS Observations Coordination Group, and with MOEJ guidelines for harmonizing ocean surface microplastic monitoring methods.

At the same time, the workshop provided opportunities to exchange the latest knowledge for monitoring plastic debris not routinely included within the current observation frameworks (very small microplastics, deep sea plastics, microplastics in the water column and seafloor sediments, etc.) and for monitoring plastic debris using new technologies.

In the lead up to the workshop, the Organizing Committee identified the following expected outcomes:

- **A coordinated network (community of practice) of ocean surface microplastic** data providers initiated under the auspices of GOOS and IMDOS, with an agreement to adhere to agreed common sampling protocol and metadata and data requirements.
- **Consensus metadata and data requirements sheet of ocean surface microplastics as a leading example** agreed among MOEJ, EMODnet and NOAA NCEI and any other potential large data integrators.
- **Recommendations for standardized metadata and data requirements** for the UNEP GPML Digital Platform data matrix.
- **Agreed roadmap towards a federated data management system** for ocean surface microplastics and selected global-scale marine debris indicators.

The following sections of the report outline how through individual thematic sessions the participants addressed the set objectives and comment on progress towards meeting the expected outcomes.

Session #1: Translating scientific data into policy and decision-making

Chair: Kotaro Fujii Rapporteur: Mine Tekman

Objectives and proceedings

This session aimed to showcase examples of how scientific data can successfully be translated into policy and decision making, from around the world. Furthermore, it aimed to introduce the concept of a federated and interoperable data management system and incite a discussion on why it is necessary to support policy and decision making. The session had a largely introductory nature, intended to set the scene for the ensuing thematic sessions. Nonetheless, it contributed to the first workshop objective focused on exchanging views on marine debris data requirements and applications. The session included case study examples of policy and decision making being supported by data, and explanation on how a federated and interoperable data system could further enhance these activities.

A presentation of case studies

Nine attendees presented short "quick fire" presentations as case studies to demonstrate how scientific data was being transferred and used to support policy and decision making.

Georg Hanke (JRC, Italy) presented progress in the EU. The EU Marine Strategy Framework Directive (MSFD) was adopted in 2008. Policy priorities were decided, and more funding was made available for science. Outputs of increased research lead to increased public awareness and also formed the basis for the EU Plastics Strategy. Measures were taken at the EU level, as well as international and global commitments. Litter, including plastic pollution, is included under the MSFD. Assessments are being performed on the gathered data to assess whether a change can be detected.

Francois Galgani (IFREMER, France) presented recommendations for monitoring strategies based on the GESAMP Expert Working Group report from 2019.
GESAMP (2019). Guidelines for the monitoring and assessment of plastic litter and microplastics in the ocean (Kershaw P.J., Turra A. and Galgani F. editors), IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP/UNDP/ISA Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Rep. Stud. GESAMP No. 99, 130p; http://www.gesamp.org/publications/guidelines-for-the-monitoring-and-assessment-of-plastic-litter-in-the-ocean

Jennifer Webster (NOAA, USA) shared 2 examples of policy measures in the US.

- Disposable bag tax: Businesses started to charge 5 cents for plastic bags, which generated 19 million dollars revenue. This revenue helped fund garbage collection and was used for education purposes. Thanks to this measure the usage of plastic bags decreased 46% in the Washington DC area.
- ALDFG: Fishing gear could not be legally removed by anyone but the owner, which hindered the efforts for disposal and recovery. Massachusetts, California, Oregon and Washington authorized the retrieval for a couple of days during the closed season.

Noriko Tamiya-Hase (MOEJ, Japan) presented the advances in Japan connected to litter pollution.

- 1st Law: The Act on promoting the Treatment of Marine debris. This was initiated in 2009 and amended in 2018 to include microplastics pollution. This was followed in 2019 with the National Action Plan on Marine Litter, Strategy on plastic circularity domestically, and also the Osaka Blue Ocean Vision at G20 and beyond.
- 2nd Law: Promotion of circularity of Plastic established in 2021 and enforced in 2022.

Both of these promoted science-based approaches to accumulate scientific knowledge on: Monitoring, Data Harmonization, Inventory of discharged amount, Ecological Impact Assessment. Monitoring activities are supported by MOEJ for its scientific foundation. It led to the creation of several monitoring guidelines including:

- Guidelines for harmonizing surface microplastics (https://www.env.go.jp/content/000170493.pdf)
- Guidelines for remote sensing activities *(under development at the time of this workshop)* (https://www.env.go.jp/content/000331405.pdf)

Amy Lusher (NIVA, Norway) presented the 6 working groups coordinating environmental issues in the Arctic, among which PAME and AMAP address litter and plastic pollution. PAME is focused on desktop study and AMAP focus is science & policy assessments.

- Priority 1) Immediate trend monitoring in water, sediments, beaches, sediments, seabirds
- Priority 2) Future trend monitoring
- Priority 3) Compartments to be further assessed

Suchana Chavanich (Chulalongkorn University, Thailand) presented Thailand's roadmap on plastic waste management 2018-2030.

- 1st target: reduce and stop using single-use plastic. 7 kinds of plastic have been identified and will be progressively banned between 2019-2025 including cap seals of water bottles and microbeads.
- 2nd target: 100% circular economy by 2030.

Thailand has been monitoring marine debris since 2009. It started monitoring microplastics in 2017 with beaches, the coastal area, and mussels. More than 30 stations are set to look for microplastics accumulation in sediments and biota.

Daoji Li (ECNU, China) presented China's case study for using scientific data in policy and decision making, started in 2013. The microplastic monitoring and ecological risk assessment project started in 2016 with an aim to inform policies. Recommendations were submitted to the government and a related policy was endorsed in 2020 to reduce plastic pollution.

Reza Cordova (BRIN, Indonesia) presented the impact of international pressure to address plastic pollution in Indonesia. Until 10 years ago and the Jambeck et al, plastic pollution was "unnoticed" in Indonesia. Since then, there has been an observed 35% decrease in plastic waste entering the ocean. The Indonesian government aims for a target of 70% reduction in plastic leakage to the environment by 2025, supported by the National Plastic Waste Reduction Strategic Actions for Indonesia.

Marilia Ragagnin (University of Sao Paulo, Brazil) presented a case study which began in Brazil in 2018, through a formalized cooperation with the University of Sao

Paulo. The aim was to develop the Sao Paulo State plan to combat marine litter. In order to collect data and establish the baseline, a Strategic Plan was developed with PEMALM. Its goals were to:

- To create a strategy
- To combine knowledge with 450 key stakeholders
- To establish communication between science and management

The project kicked off in 2019 and the implementation phase started 2022-23. Now more than 600 stakeholders have joined the Clean Ocean Network, with the following actions: Engagement, Monitoring, Integration with other policies. A collaborating platform was set for marine litter and to build capacity. The monitoring indicators are as follows: (i) generation of litter, (ii) exposure, (iii) effects. In addition, the MipMap project was launched for mapping potential risks of microplastics on biota.

Marina Santana (AIMS, Australia) presented the AIMS microplastic research program that was established following a report on marine contaminants in the Great Barrier Reef 10 years ago. It has carried out spatial and temporal assessments to develop long-term monitoring strategies and established standard operating procedures (SOPs) and QA/QC protocols that have been adopted by the Integrated Marine Observing System (IMOS) Microplastics Sub-Facility. This data is accessible via the Australian Ocean Data Network (AODN) portal for uptake by policy makers. The program is also involved in conservation and educational engagement activities.

Why is a federated and interoperable data management system necessary in supporting policy and decision making

Lucy Scott (IODE, Belgium) and **Pier Luigi Buttigieg (AWI, Germany)** conveyed through their presentation that a federated interoperable data management system which helps stabilize the digital assets under a common goal will enhance collaboration on translating data into policy and decision making. Policy changes quickly and science should align with it. Therefore long-term, multilateral, new informative products are needed. These digital assets & data products must inform each other in real-time, be modular, and add value to the federated system.

Presenting the example of the Ocean Infohub (https://oceaninfohub.org/), Lucy and Pier Luigi showed how, since 2018, it has allowed for local, national, regional data systems integration to share information in a federated way. There are three related initiatives:

- ODIS Catalog of Sources (ODISCat)
- the Ocean Data information system
- the Ocean Infohub project

ODIS and Ocean Infohub are sustainable, interoperable, inclusive, open and accessible. Three pilot regions have participated in designing the project and have taken a lead on pilot projects to test interoperability between existing information hubs: Latin America and the Caribbean, Africa and the Pacific Small Island Developing States.

Key take-aways

- Presenters gave insights into local/regional situations which highlighted the availability and value of different approaches to convert science to policy at country and regional levels.

- When asked which monitoring data should be produced by the international community, it was discussed that ocean surface microplastics are one of the most matured areas of monitoring. But the technical aspect as well as the needs aspect (what people think is important) should be considered.
- More interactive communication at the science-policy interface is required to identify and implement the right solutions for marine debris monitoring and mitigation.
- Equity should be considered for those who are not involved yet. This includes enhancing accessibility to encourage participation by citizens and businesses.
- Participants stressed the importance of developing and adhering to harmonized monitoring guidelines.
- Interoperability will be ensured by metadata harmonization.

Session #2: Addressing data gaps to inform marine debris indicators

Chair: Yutaka Michida Rapporteur: Laura Gomez Navarro

Objectives and proceedings

Following up from Session #1, the objective of this session was to exchange views on:

- What data is necessary to inform the marine debris indicators, and
- To what level that can be provided by the current capacity to monitor and observe the ocean.

This session featured the following presentations which set the scene for an ensuing discussion in plenary:

- **Francois Galgani** (IFREMER, France) and **Georg Hanke** (JRC, Italy): "How to prioritize monitoring efforts to better inform regulations for the Plastics Treaty?"
- **Mine Tekman** (GEO Blue Planet, France): "Why is it important to monitor different ecosystem compartments together in a region?"
- **Stefano Aliani** (CNR, Italy): "EUROqCHARM's Reproducible Analytical Pipelines and their contribution to the EOV development"
- **Shungu Garaba** (Uni Oldenburg, Germany): "What are the data requirements for remote sensing observations?"
- **Nikolai Maximenko** (University of Hawaii, USA): "How can numerical models support the design of a monitoring system and benefit from it?"

Key take-aways

- Marine debris monitoring data needs to be reliable and robust in order to meet the demands of various stakeholders, from science to policy and decision-making.

This in turn requires establishing quality control methods and procedures agreed by the international community.

- Harmonization and/or standardization of observing approaches is required to advance our capacity to report data with quality assurance. The need to agree on units of key monitoring variables is one example of where such harmonization work should focus on.
- Providing monitoring data in different ecosystem components will help to realize the need for a holistic approach to addressing marine pollution.
- Successful global monitoring of marine debris requires the appropriate selection and use of a variety of monitoring methods, from relatively simple and traditional methods such as visual scuba diving surveys to more complex approaches which require dedicated and high-tech infrastructure such as remote sensing.
- Availability and use of multiple observing and analysis approaches requires priority setting and clear categories for assessment of methods adequacy.
- There are existing frameworks which help determine requirements for coordinated multi-platform observations, including priority setting and observing design, as well as for selection of analytical methods, quality assurance and overall data management. These include the Essential Ocean Variable (EOV) framework of GOOS which is now being applied to marine plastics debris; but also the application of Reproducible Analytical Pipelines (RAPs) and Technology Readiness Level (TRL) assessment as recently demonstrated by the EUROqCHARM project.
- There needs to be more regular and more efficient communication between the marine debris modeling and the observation communities whose efforts are mutually supportive when it comes to enhancing and optimizing an integrated marine debris observing system.

Session #3: Who is measuring what, where and when?

Chair: Marc Metian & Rapporteur: María Belén Alfonso

Objectives and proceedings

The objective of this session was to:

- Map the current capacity to monitor and observe selected global-scale marine debris indicators based on available knowledge of existing surveys.

To this end, the session included a brief discussion in plenary informed by two overview presentations which focused on monitoring schemes for water, sediment, beach, seafloor and core samples for plastic litter research worldwide:

- **Amy Lusher**: "*State-of-the-art monitoring methods and capacity for global scale marine debris indicators*"
- **Mikołaj Mazurkiewicz**: "*Overview of the existing projects/initiatives for monitoring marine debris*" (remote presentation)

In general terms, guidelines for plastic monitoring are more or less harmonized, but there is a lack of international integration and lack of coordination when it comes to global data access and distribution. While we need monitoring schemes to remain **stable over time in order to establish baselines,** the marine debris field is still **emerging** which means that the system needs to be **flexible and adaptive** to changing science and policy requirements as well as evolving technical capacity.

Our knowledge of actors carrying out monitoring or otherwise regular observations of marine debris is very patchy and incomplete. Most of the information about who is measuring what, where and when is being derived from information on what data has been made available through the various databases. Considering delays in data publication and lack of free and open access to many national and regional databases, our global overview of monitoring capacity is very likely underestimated. There is therefore an unknown but likely high percentage of marine debris observations globally which are not accessible and thus not used to advance our capacity to model and assess the state of marine pollution. There is an urgent need to maximize the value of every observation.

With regard to the state of harmonization of monitoring guidelines and harmonization of data streams, we need to distinguish between the different plastic sizes classes as well as the different environmental matrices. Much of this work was performed through the EUROqCHARM project, where the progress towards harmonization was addressed in relation to a global systematic review, divided across size class of plastics, as well as different matrices.

Size class of plastics:
From the peer-reviewed publications and international/regional guidelines, the following status could be concluded: For **Macroplastics,** the process of harmonization across protocols has begun, although many methods are mature with synergies across regions, however, the challenge of setting up monitoring programs related to the representativeness of sampling spatially unevenly distributed materials. With **Microplastics,** whilst there are challenges in setting up monitoring programmes, as per macroplastics, there are larger discrepancies surrounding sample preparation, processing, and data handling/reporting. Since there are different types of samples (including complex matrices), the diversity in methods applied across individual labs is considerable. Thus requiring a lot of work for harmonization. First harmonization attempts focus on providing data synthesis products which are made challenging due to the diversity of methods used across all steps of the analysis chain. Lastly, **mesoplastics** are often overlooked and gaps in existing guidelines have been identified. Importantly, they could be addressed through modification of existing approaches which have been successfully applied for macro- or microplastic observation.

Different environmental matrices:
When looking specifically at matrices, or target indicators, the available protocols or laboratory methods are at different levels of maturity. For example, **beach litter** is mature in terms of regional coverage, frequency and standardization. There is a lot of data from long-term monitoring, however mostly from the northern hemisphere. Whilst most **seafloor litter** data originates from European monitoring that relies on trawling. These protocols however do not have the potential for global application. There is a focus on quantitative data rather than qualitative. For the Pacific Ocean, there are leading efforts from Japan (JAMSTEC) to scale up the use of less destructive imaging

technologies based on deep-sea cameras surveys. With regards to microplastics, **sediment core sampling** has shown promise as a tool for reproduction of past conditions (using Chl-a as a proxy) and future conditions using models, and harmonised protocols are under development, at least in Europe. Lastly, **water-column microplastics** have been collected through many different protocols used by numerous initiatives, including citizen science projects (that tend to simplify methods). As a result, the available datasets are very heterogeneous and difficult if not impossible to compare. Conventional microplastics sampling does not work for quantitative purposes, therefore new methods are under development.

Key take-aways

- There is a need for systematic overview of different monitoring and observing initiatives, and an overview of the data management landscape to better understand and improve the flow of data from collection to dissemination on a regional and global level. Such a regularly updated overview could be maintained by IMDOS on the basis of the EuroSea project report (https://zenodo.org/records/7990578)
- The global (or even regional) data management landscape for marine debris is very complex. It is a challenge to select the most relevant source of data from among the many individual databases which remain most often disconnected from the others. Many of the databases could be re-designed in order to ease access to data by the end users.
- It is recommended that publicly available databases require concise and clear explanation of their mandate and an overview of type of data is made available and on what terms.
- An open question remains on how we should process and manage the dissemination of data originating from opportunistic sampling, to ensure their reliability and ultimately use in policy-making.

Session #4: Towards a global federated and interoperable marine debris data management system

Chair: Amy Lusher & Rapporteur: Maria Pogojeva

Objectives and proceedings

This sessions had the following two objectives:

- To harmonize the existing definitions and mandatory requirements for metadata and data reporting on selected global-scale marine debris indicators
- To conceptualize a global, federated data management system for ocean surface microplastics and selected global-scale marine debris indicators

To address these objectives, we divided the session into three parts, with the first two consisting of a mix of presentations and plenary discussions, and the third part structured around work in several breakout groups. Below is a summary of the session proceedings along with a list of key take-aways.

The vision for a federated and interoperable data management system

Three presentations set the scene for discussions on why and how to build a federated and interoperable data management system for marine debris.

Artur Palacz (IOPAN, Poland): *"IMDOS' Vision for a federated data management system (incl. GPML Community of Practice for Data Harmonization)"*

This presentation highlighted the critical value of building a federated and interoperable data management system for the successful implementation of the overall vision of IMDOS - a vision originally presented in Maximenko et al. (2019), and since then framed into the IMDOS Strategy document (https://tinyurl.com/imdos-strategy). The talk introduced a few basic principles to guide the development of a system which would integrate the needs of a community of data providers, data users and funders of observing initiatives. Specific references were made to the synergies with ongoing efforts of UNEP GPML Community of Practice (CoP) for Data Harmonization. This notion was further discussed with all workshop participants, with an agreement to better identify a common work plan between IMDOS and the CoP.

Atsuhiko Isobe (Kyushiu University, Japan): *"Global data synthesis products as a user need for federated data management system"*

This presentation highlighted the tremendous achievement of delivering the first global data synthesis products for surface floating microplastics in the ocean (Isobe et al., 2021) as an example of use case based on harmonized data originating from an international community of data collectors. The presentation explained key steps behind data product development, from its integration and standardization (fibres removed), to further data processing, analysis and mapping, and model projections of future microplastic distribution. The talk also included a call for sustained and expanded observations to enable product advancements and improvements.

The presentation was followed by a number of questions and issues to discuss regarding future evolution of this product, briefly summarized below:

- There is a need to collect more reliable data on vertical profile distribution of microplastics to test the assumption that some particles move out of the surface waters, whereas others sit on the very surface of the ocean. Similarly, greater availability of particle weight measurements would reduce the reliance of abundance only data. This was mentioned in the context of better resolving the contribution of fibers in microplastic samples.
- There is a need to expand the metadata specifications to include information on polymer composition and size in order to analyze any differences in microplastic composition.
- Pending specific requirements for uncertainty estimates from the data product users, there is the option of providing such information. While much needed, this exercise currently poses many challenges. The discussion focused on whether the community should focus on simpler and easier to obtain error flags, or strive towards proper uncertainty estimates from the get go. Experiences from similar data synthesis efforts

such as SOCAT and GLODAP in the ocean biogeochemistry community were given as examples of where we can draw on lessons learnt.
- It was pointed out that yearly updates would ideally be performed on the product (AOMI) to see how research changes in the future. However, this is a challenge which would be addressed better with a federated and interoperable system in place, replacing the need for regular calls for dedicated data submissions.

Pier Luigi Buttigieg (AWI, Germany) and **Lucy Scott** (IODE, Belgium): "*Establishing technical infrastructure for data sharing in a federated and interoperable data management system*"

This presentation guided the workshop participants on the capacity and planned activities towards establishing technical infrastructure for data sharing in a federated and interoperable data management system. The presentation was phrased in the context of lessons learnt from the ODIS process. Some key points from the presentation included: **(1)** Consensus of founding partners is needed on the technical approach, roadmap for the project and communication tools etc. (2) Establishing mechanisms upfront is important and the core structure should be stable and reusable, (3) Region specific needs and requests require **regional champions and thematic groups, (4)** Project management and interoperability are key, and (5) The technical team should have a high-level say in the upper levels of the project and make technical documentation available online.

The following questions and issues were raised during the plenary discussion:

- In response to the questions on whether there should be one database to house all components of different sizes (macro, micro, nano) and matrixes, it was suggested that the mission is to work with and bring together very different databases, and to provide support and clarity on their complementarity. There is a need to digitalise the data ecosystem in a way that enables people to explain and interoperate the datasets. This requires embracing the community, mapping the data, and examining current capacities and identifying gaps to be bridged.
- In order to address the issue of handling different datasets that are not comparable, development of a metadata graph was suggested.
- Ultimately, dedicated working groups and/or workshops are necessary to leverage the information originating from the marine debris digital ecosystem into policy applications.

Monitoring guidelines and requirements for data reporting

Four presentations followed to highlight the advances made around the world on databases and reporting. The speakers and their topics were as follows:

Matteo Vinci & Eugenia Molina Jack (OGS, Italy) spoke about ***EMODnet,*** which plays a major role in as a data base supporting the EU MSFD. They focused on how it put in place community best practices to avoid overlaps, with a data management strategy based on OSPAR for beach and seafloor and ICES for floating. The data is fragmented. There are two data pathways : metadata to the CDI system. As an example, beach litter guidelines are provided in the web portal and marine litter managers help to format data on beach litter so data can be validated.

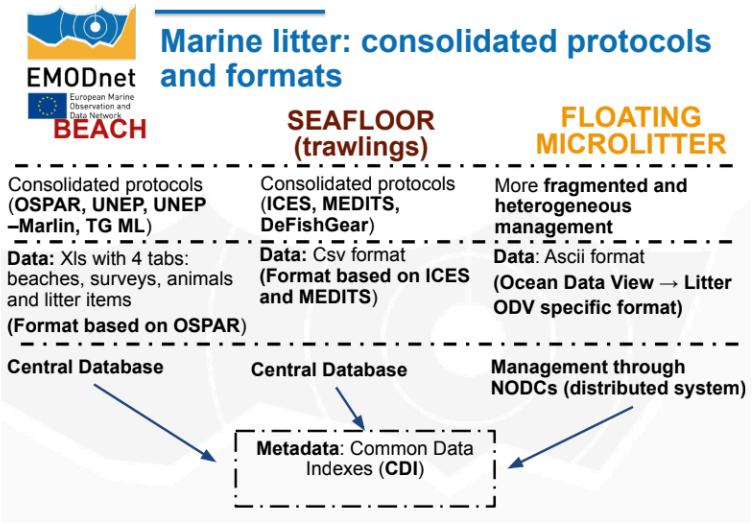

Figure 1: Overview of consolidated protocols and formats for EMODnet marine litter data management. Slide taken from the presentation by Vinci and Molina Jack.

Maria Santana (AIMS, Australia) spoke about the ***AIMS Microplastics monitoring program.*** She highlighted challenges in sampling including health and safety, logistics, limitations of the method, data failure, QA/QC and highlighted the importance of collaborations at the national level and across institutes.

Masayuki Fujioka (MOEJ, Japan): *Marine Litter Monitoring Data Sharing Project*. The purpose is to improve data comparability and to link datasets, providing an easy-to-understand map through this database system. As more people should be aware of the problem, the data should be easily accessible. Expected users gather researchers, policymakers and the general public. MOEJ is working on a database for ocean surface microplastics under this project.

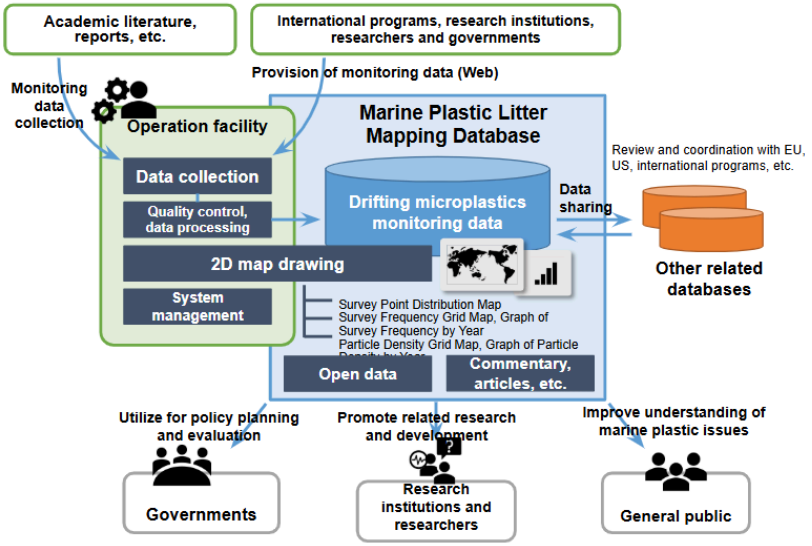

Figure 2: Conceptual diagram of the Marine Plastics Litter Mapping Database developed by MOEJ. Slide taken from the presentation by Fujioka.

Key take-aways

- Ensuring the accuracy and reliability of data is a high priority across all projects and initiatives.
- The data value chain should be practical which means that it is necessary to clarify the position of each stakeholder and to make the best use of their resources.
- Compatibility of the different observing system components is essential so that policymakers can properly compare data and make informed decisions based on them.
- Maximizing the value of every data point is essential. If possible, the data could or should be used repeatedly for multiple purposes.
- When speaking of marine debris monitoring and addressing marine pollution use terms that users can understand regardless of cultural or background knowledge.
- Processed data such as maps and videos should be accessible to a wide variety of stakeholders, including NGOs and policy makers.
- On a finer scale, issues like handling of "fiber" data were raised as topics that need to be addressed when updating monitoring and data harmonization guidelines.

Breakout Groups

Session 4 continued with division of all workshop participants into several breakout groups which focused on specific domains of marine debris. Following is a summary of key outcomes of the discussions.

Breakout Group #1: What data, data items and units should be mandatory requirements for metadata and data reporting?

The following items have been agreed as minimum metadata requirements for ocean surface microplastics as a leading example of concrete metadata setting.

- *Sampling time*: Using UTC/GMT time stamps should be standard. Start time and end time should be enlisted.
- *Sampling location*: Start location and end location should be enlisted.
- *Size:* 2 category, 300μm≦d<5mm and 5mm ≦d, is reasonable. However, the data less than 1mm include uncertainty. A third category to capture mesoplastics is recommended: 5mm-2.5cm.
- *Unit*: Particle per m^3 that is the particle number per filtered water volume measured with a flowmeter is reasonable.
- *Sampling equipmen*t: Name of equipment should be standardized and listed. Mesh opening is also required for the net. Text responses should also be acceptable.
- *Recommended meta data include*: Particle weight, size, polymer type and fiber percentage as supplementary data. Ship speed, net length, wind speed and significant wave high, oceanic conditions, presence of biota and marine life activity can all be reported into supplementary data.
- As an additional requirement, to take reference digital photographs/pictures and to archive/reserve a small sample is strongly recommended for future verifications.

Breakout Group #2: Potential elements for the roadmap of the Guidelines

The following discussion was mainly conducted on items additionally needed for metadata, mainly assuming ocean surface microplastics (supplement discussion of BG#1):

- *Uncertainty estimates*: Remove operator bias as much as possible. Standardized operation should be effective, e.g., size measurements, judgement of color and shape, wind speed and wave height measurements.
- *Correction factor:* Report all the metadata needed to compute the correction factors.
- *Polymer types/Colour/Shape/Form:* Information on shape, form and polymer types should be ideally provided. The exclusion of textile fibers from the database is recommended.
- *Convention:* Ideally always measure both and provide raw available data only. If weight is not available, do not attempt any conversion.

The following discussion was mainly conducted on items selected for the federated and interoperable system:

- *Guarantee period*: Ideally eternity/forever (maintenance cost might be an issue). The option of using other data repositories / external servers might be explored.

Breakout Group #3: Socio-Technical challenges for harmonizing surface microplastic data within a federated data management system

Discussions were held mainly on the following challenges:

- *Coordination and governance is not strong:* Identify collective goals and compose the articles of federation (under the umbrella of IMDOS). Try to avoid bilateral agreements.
- *Long term archives of data:* There are good examples from genome databases.
- *Independent professional & representative for standards:* Convene or build such a mechanism to have persistent discussions around these standards.
- *Collective digital culture:* Clearly define the cultural problem.
- *Innovation by the research community:* Solved by having defined innovation to the operation pathway.
- *Under-representation of the global South:* Identify and implement equity mechanisms.
- *Limited awareness of and coordination:* Greater outreach and coordination with other thematic groups.
- *Lack of transparency:* Convene meeting spaces (in-person or online) for joint development of, and consensus on, methodologies.
- *Different competing priorities leading to fragmented data systems*: Ensure that there are open discussions on priorities.
- *Technical capacity not sufficient*: Identify capacities and gaps.
- *Lack of a mechanism to accommodate:* Convening of adequate expert groups.
- *Global authority for guidelines is not clear:* Federation has a mechanism to call for low-level guidance, subject to revision.

Breakout Group #4: How to apply harmonization of existing ocean surface microplastic databases for other global level indicators

The breakout group discussions focused on how the existing ocean surface microplastics database could be applied for other global level indicators. The global indicators (SDGs) foresee floating litter and beach litter as significant indicators, and it is likely that monitoring will also be included in the UN plastic treaty. The role and responsibility for each involved organisation should be clarified.

There was some discussion that concluded that chemicals are outside of scope, currently. The discussion on specific indicators was continued on Day 3.

Session #5: Towards a network of sustained observing network for oceans surface microplastics and beyond

Chair: Giuseppe Suaria & Rapporteur: Amy Lusher

The objective of this session was to initiate a coordinated observing network for ocean surface microplastics guided by the criteria of the GOOS Observations Coordination Group, and with MOEJ guidelines for harmonizing ocean surface microplastic monitoring methods.

Artur Palacz and Nikolai Maximeko were invited to introduce the topic of this session and set the stage for discussions with a presentation on: "*Coordinated observing network for surface microplastics - a key component of IMDOS*." The presentation can be summarized through the following points:

- Several steps are needed to build an observing network; this network could be viewed as a network of coordinated networks, or the coordination of the different efforts. For example, a network of data analysis centers.
- GOOS was presented as an example. Coordination is focused around the observing requirements specified under the relevant EOV. GOOS Ship Observations Teams (SOT) have the potential to include marine debris observing components in its mission and scope.
- IMDOS was acknowledged as a development project of GOOS, and this opportunity could be capitalized on.
- Marine Plastics Debris has been conceptualized as a new type of EOV, providing a pilot demonstration of a new class of EOVs related to human impacts on the ocean. The first draft of the Marine Plastics Debris EOV Specification Sheet was based on the GESAMP Monitoring Guidelines, published in 2019. The draft EOV Specification Sheet was shared with workshop participants, and received extensive feedback.
- The next step could be realized through an **assessment of microplastics abundance.** This would allow optimization for long-term monitoring of trends. Given the advancement of the surface water guidelines (Michida et al.,

2019/2023), solid foundations already exist, and so the document could be condensed for operational use (focused SOPs).
- Whilst most focus has been on sampling with manta or neuston nets, now is also the time to look for areas with new opportunities, such as new instruments, etc. (underway pumping, FerryBox systems etc).

The presentation was followed by a discussion in plenary on "*Current monitoring capacity and challenges to be addressed through better coordination of observations and monitoring*." In particular, workshop participants were asked to answer the following question:

Which elements of the marine debris observations are mature enough to consider for coordination under IMDOS & GOOS?

The following points dominated the ensuing discussion:

- *Observations should consider the whole size spectrum of marine debris:* While we have well developed guidelines for microplastics thanks to MOEJ efforts, it is important to ensure macrodebris/litter is not overlooked. In many cases larger items have a greater impact on management and science. IMDOS can play an important role in this harmonization of methods, data and models.
- *It is likely that the global plastics treaty will focus on macro-scale indicators, such as shoreline debris:* Shoreline debris is a contender for global observations as methods are mature and converging. Work is still needed to harmonize data and assessments. We are in good timing to provide outputs from this workshop to the INC, and to ensure transfer of information from scientists to their home countries.
- *The case study on microplastics can be applied to other parameters:* this will require an authority to divide the work. A global federated system could support this.
- *IMDOS should be a system that brings parameters togethe*r: the macro to the micro, and the ecosystem compartments from seasurface, to shorelines and the seafloor. Data integration is key.
- *Harmonised protocols are the foundatio*n: training to implement protocols across global networks would be beneficial and IMDOS can play a role in explaining the requirements and what is feasible with current sampling protocols. This will also be strengthened through capacity building activities.
- *There is useful information in citizen science data:* however the extent to which it can be integrated with participatory science and research lead science should be further explored.
- *Coordination needs to be led by a community*, constructed as a system rather than individual efforts. IMDOS is a clear example of researchers from around the world coming together for a common cause, with its mandate strengthened by the endorsement of IOC-GOOS and GEO Blue Planet. Seeking endorsement from other international actors (e.g. SCOR, Regional Action Plan representatives) is further recommended.
- *IMDOS should engage with policy and governance bodies earl*y, across regional seas: IMDOS must acknowledge different needs and challenges. Regional Action Plans representatives play an important role in political decisions and action setting.
- IMDOS should have documentation on the process to increase the clarity and understanding of its expected outcomes.

- *Coordinate and collaborate with existing systems:* including UNEP GPML CoP and IOC. For setting up a global network, we need support from each country's government. Therefore IMDOS should be promoted at governmental level / the IOC.
- Metadata: Protocols and SOPs to align metadata will form the basis of IMDOS, it will support data sharing between countries. Focus should also be on regional security issues, and there may be a need to distinguish academic vs. governmental level data.
- Efficient coordination of IMDOS activities requires dedicated resources, in particular a technical manager/coordinator.

Key take aways*:*

- Delivery of reliable marine debris data critically depends on the ability to coordinate global observations. IMDOS has the potential to fill that niche in partnership with relevant projects and organizations.

Breakout tables: *How can we establish coordination between the different observing systems and different indicators?*

In the second part of this session workshop participants split up into five breakout groups focusing on marine debris indicators. The main discussion points and take home messages are presented.

Breakout group: Surface microplastics

Key discussion points:

- Existing guidelines are in place, but challenges remain in sampling, detection,analysis and data reporting.
- Current monitoring schemes offer limited sampling opportunities, though improvements are underway.
- IMDOS and IAEA can support targeted capacity building efforts.
- A collaborative network involving research institutes, private sector, NGOs, and local authorities could enhance action in the Global South.
- Technical harmonization should extend beyond sampling and processing to include data structure
- Data uncertainty is not yet quantified; support from CoP and a federated authority is needed.
- Measurement challenges include open-ocean weight estimation and conversion methodologies.
- IMDOS could develop mathematical tools for converting metadata (e.g., density, weight, mesh size, sea conditions). A mathematical toolbox for data conversion requires better parameterization and harmonization of heterogeneous datasets.

Future research should address:

- Data interpretation and model refinement
- Residence times and lifespans of surface microplastics

- Weight and mass conversion methods
- Climate change and carbon cycle interactions
- Fragmentation processes on seafloor and coasts
- Interactions with toxic chemicals and biological impacts
- Interdisciplinary collaboration with polymer scientists is recommended

Breakout group: Seafloor

Key discussion points:

- Seafloor protocols exist (e.g., by EU MSFD), however future global monitoring needs to avoid the use of monitoring methods which will cause environmentally negative impact (e.g. trawling).
- The basic approach for global monitoring would be an opportunistic one and taking advantage of the work done by divers or the work from NGOs.
- There is a need to discuss a suitable governance model for global seafloor monitoring.
- In the future, artificial intelligence will aid in seafloor monitoring.
- Data may be collected from different sources and methods. Once merged together, the reporting is relatively simple compared to microplastics, as there is a limited number of categories: user plastics, SUPs, fisheries etc.
- Some topics are still open for discussion, including units, a common database, focus on types of litter items, accumulation areas, integration of new approaches including acoustics and AI.

Breakout group: Beach litter

Key discussion points:

- There is a need to differentiate between types of beaches and coastal habitats, and based on that structure an observation program accordingly. Currently, mangroves and sensitive ecosystems /coastal habitats are understudied.
- Several protocols exist for macrolitter, they should be compared, harmonised, and optimized on a global level.
- Mesoplastics are overlooked in current protocols (or mentioned but not properly quantified) - data should be treated as important as microplastics and macrolitter
- Parameters and metadata are important for long term monitoring on beaches, not just clean ups.
- Additional parameters have to be considered. Should it be variable depending on the type of the beach and environmental parameters?
- Additional information on hydrodynamics, beach slope processes, type beach usage, accessibility, frequenting of cleanings by municipalities, and uncertainty factors should be included in metadata requirements.

Breakout group: Surface macroplastics

Key discussion points:

- There is a need for holistic protocol for various data collection methods.
- Basic meta information collected should be as follows: ship name, ocean conditions, observer, observed area (start/end GPS coordinates, time (UTC),

survey duration, strip width, drones, etc.), FML concentrations and litter types (e.g. JRC Masterlist).
- Image documentation needs to be addressed in the guidelines.
- Parallel observations can be conducted with AI-assisted methods, camera-based tools and observers (as exemplified by The Ocean Cleanup activities).

Breakout group: Biota

Key discussion points:

- Clear protocols are needed to monitor impacts related to ingestion and entanglement of plastics.
- Muscle tissue serves as a biomarker for pollutants, including persistent organic pollutants (POPs), and links to broader biota.
- Enhanced data sharing, lessons learned, and coordinated efforts are essential for continuous improvement.
- Integration of databases (e.g., biodiversity repositories) is critical for cross-referencing and holistic analysis.
- Chemical data from biota should act as a filtering layer to connect pollutants with biological effects.
- Molecular genetics offers insights into organismal responses to microplastic exposure.
- Macroplastic impacts include ingestion and entanglement; microplastics primarily involve ingestion.
- Protocols remain unharmonized across studies (e.g., Fulmar monitoring); long-standing programmes like Mussel Watch provide valuable baselines.
- Impact assessments must consider not only particle size but also interaction dynamics.
- Effects on biota should be linked to human health, fisheries, and existing ecological programmes with economic relevance.

Plenary discussion: Augmenting surface microplastic data collection and harmonisation guidelines for other indicators (water column microplastics, seafloor microplastics).

In the third part of this session, Giuseppe Suaria moderated a plenary discussion on how to augment surface microplastic data collection and harmonisation guidelines for other indicators such as water column microplastics and/or seafloor microplastics. The discussion was by guided by the following questions:

- Can we group the different guidelines into one document? Is it worth doing so?
- How can we take advantage of the workshop discussions to proceed with such an effort?

Water Column Monitoring

- The water column offers valuable opportunities for microplastic (MP) sampling, but presents technical and logistical challenges (e.g. low sample volumes, contamination risks, and sampling depth variability).

- Many different technologies are available and these should be compared.
- Defining sampling depths and understanding whether MPs are suspended or moving is critical for relevance and comparability.
- Europe prioritizes shoreline and surface monitoring due to cost-effectiveness and perceived relevance, raising concerns about investing in water column studies.
- Modelling efforts require better data on MP transport and sinking dynamics; current observations are too limited for robust validation.

Seafloor & Sediment Considerations

- Sediments are the final sink for marine litter and microplastics; mapping and monitoring are essential and should not be deprioritized.
- The term "seafloor" needs clarification (deep vs. coastal), and methodological readiness is lower compared to surface sampling.
- Hotspot identification remains uncertain—more empirical data is needed to distinguish real patterns from assumptions.

Data Collection & Methodology

- Volume and sampling methods are key constraints; many EOVs are measured with CTDs, but MPs pose unique challenges.
- There is a need to harmonize methodologies, especially for sediments and larger MPs, which are currently less developed than surface protocols.
- Polymer profiles and vertical distribution of MPs vary with depth, affecting pollutant transport and interpretation.
- Recording sample weight is recommended.

Data Management & Infrastructure

- A global, open-access database should be adapted to include water column and sediment data, with standardized metadata and formats.
- Spreadsheet formats must be streamlined; overly complex or inconsistent structures hinder data usability and professional integration.
- All data should be retained, even if not immediately useful, to support future research and modelling.

Strategic Direction

- Focus should be on collecting the data we need, not just what is easiest to obtain.
- Advancing seafloor and water column research will drive necessary methodological and technological development.

Session #6: Summary of workshop outcomes and next steps

Chair: Noriko Tamiya-Hase Rapporteur: Mine Tekman

Objectives and proceedings

The objective of this session was to review the workshop outcomes and identify next steps for implementation of decisions and recommendations.

To this end, the session included several summary presentations. Artur Palacz presented a roadmap towards report and publications on the outcomes of the workshop, as well as the agreed roadmap towards a federated and interoperable data management system for ocean surface microplastics and other marine debris observations.

Noriko Tamiya-Hase presented the results on consensus metadata and data requirements sheet for reporting on key marine litter indicators, focusing on the ones for ocean surface microplastics, followed by the overall summary of meeting outcomes, identified decisions and actions, task teams and leads.

The workshop summary included key take-aways from each session which are elaborated on in the corresponding sections of this report. In addition, below we provide some overall concluding remarks and take-home messages as reflections from the entire workshop, with an outlook for the future. This is complemented with a selected list of follow up activities which took place between the workshop and the time of publication of this report, and a selection of key recommended actions yet to be implemented.

Overall concluding remarks

- **Science-to-policy translation is achievable and essential**: Case studies from around the world demonstrated that scientific data can effectively inform and shape national and regional policies on marine debris.
- **Federated and interoperable data systems are critical**: A global, harmonized data infrastructure is needed to support consistent monitoring, enable data sharing, and facilitate policy development.
- **Monitoring must be holistic and standardized**: Observations across multiple ecosystem compartments (surface, water column, sediments, biota) and plastic size classes (macro, meso, micro) require harmonized protocols and metadata standards.
- **Global coordination is lacking but urgently needed**: Fragmented databases, inconsistent methodologies, and limited access to data hinder progress. A federated system can bridge these gaps.
- **Capacity building and inclusivity are vital**: Equity in participation, especially for underrepresented regions and stakeholders, must be prioritized to ensure global relevance and effectiveness.

Take home messages:

- **Microplastic monitoring is maturing**, but harmonization across size classes and environmental matrices remains a challenge.
- **Metadata standards must include particle size, shape, polymer type, sampling conditions, and uncertainty estimates** to ensure data quality and usability.
- **Open-access databases should be streamlined and clearly documented** to maximize their value for researchers, policymakers, and the public.
- **Citizen science and opportunistic sampling** can contribute meaningfully if integrated with robust QA/QC frameworks.
- **Global collaboration is key**: Regional champions, thematic working groups, and shared goals will drive progress toward a unified marine debris data ecosystem.

Follow up activities carried out since the workshop

A number of activities which stemmed from the workshop discussions have taken place over the 2023-2025 time period. Below are a few examples with particular importance for ensuring the legacy of the workshop outcomes.

Technical Workshop on Seafloor Litter

A dedicated **technical workshop on seafloor litter** monitoring methods was convened by Georg Hanke and Francois Galgani with a group of international experts in September 2023. The workshop has focused on harmonization of data obtained from seafloor footage. Workshop **outcomes were recently published as a perspectives article** in Marine Pollution Bulletin, accessible from: https://doi.org/10.1016/j.marpolbul.2025.118500). This paper presents a global strategy for monitoring seafloor macrolitter - large debris like plastics - using harmonized, non-destructive imaging techniques. It highlights the seafloor as a major sink for marine litter, with significant ecological impacts. The authors propose standardized survey methods using tools like ROVs and AUVs, focusing on hotspots and vulnerable habitats. They emphasize the importance of image quality, metadata, and geolocation, and advocate for open-source AI tools to automate litter detection and classification. A federated global database based on FAIR principles is recommended to unify data from diverse sources. The paper also stresses linking monitoring efforts to policy and mitigation, supporting international treaties and the UN Sustainable Development Goals.

The **Yokohama workshop report and the paper on seafloor macrolitter monitoring are highly synergistic**, reinforcing calls for global coordination, standardization, and science-to-policy integration in marine debris management. Together, they form **a cohesive roadmap for building a unified, inclusive, and policy-relevant global marine debris monitoring system.**

Publication of the Atlas of Ocean Microplastics (AOMI)

The Atlas of Ocean Microplastics (AOMI; https://aomi.env.go.jp/) is a global database of ocean surface microplastics launched in May 2024 by MOEJ. It serves as a centralized platform for monitoring and observation data on microplastics collected from researchers, research institutions, and governments worldwide.

The database is **designed to improve data comparability** by organizing all data according to the "Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods," published by MOEJ in 2019. AOMI provides users with free access to quality-controlled data, including field survey details (e.g., sampling date, location, equipment type, weather), laboratory analysis methods (e.g., digestion, chemical treatment, particle identification), and results such as particle density and weight.

Critically, **AOMI also facilitates data sharing with other global databases, such as NOAA's Marine Microplastics Product and EMODnet's marine litter database**, further promoting international cooperation and data interoperability in line with the recommendations from the Yokohama workshop. The formation and public release of AOMI represents a key milestone towards building a global federated and interoperable data management system for marine debris.

MOEJ has conducted a workshop on data harmonization in 2024 and 2025, aiming at collecting more data to AOMI, and continuing the relevant discussion for other environmental metrics, too.

Publication of The Guidelines for Harmonizing Marine Litter Monitoring Methods Using Remote Sensing Technologies (ver.1.0 in 2024, and ver. 2025 in 2025)

The guidelines aim to further improve the comprehensiveness and efficiency of marine litter monitoring with remote sensing technologies (platforms, sensors, and image analysis). The Guidelines consist of 3 parts: the "main body" provides a general overview of the monitoring/research methods of marine litter using various remote sensing technologies. The "Annex" is about details of monitoring methodology for each technology (individual platform and the corresponding image analysis), and the "Appendix" presents the results of a demonstration project conducted to ensure the practicality of the methodology in the Annex. The Appendix and Annex of the latest ver.2.0 are dedicated for UAV and fixed camera as a platform and the image analysis.

Expansion of the IMDOS mandate and strengthened international coordination of marine debris observations

Following up on the workshop recommendations to **expand the mandate of IMDOS to represent the global marine debris observing community**, in July 2024 IMDOS launched a call for participation to form an expanded network of members. This call attracted over 100 experts from diverse backgrounds, including oceanography, data science, citizen science, and policy development. The goal was to **assemble a multidisciplinary team that could guide and support IMDOS in developing a robust and sustainable marine debris monitoring framework.** The inaugural IMDOS Steering Committee (SC), consisting of the Advisory and Sponsors Committee and the Work Programme Committee was formed from among the members of the network (https://imdos.org/news/announcing-steering-committee). The new IMDOS SC held its first meeting in January 2025 in Paris, France. By leveraging the expertise of the Steering Committee, IMDOS has since then continued to foster partnerships with governments, research institutions, NGOs, and industry players to enhance global engagement and resource-sharing.

In June 2025, the UN Ocean Conference in Nice, France, provided an opportunity for members of the new IMDOS Advisory and Sponsors Committee to officially express their support for the mission and vision of IMDOS and sign the **Declaration of Common Purpose**. The signed Declaration represents a collective commitment to harmonize marine debris monitoring efforts, close knowledge gaps, and deliver reliable, accessible data to all stakeholders—from scientists and policymakers to coastal communities and the private sector. This event was followed by an official side event "Driving Change with Data: The Integrated Marine Debris Observing System" which highlighted the global initiative's mission, showcased successful international collaborations, and explored how harmonized data and monitoring systems support marine litter policies worldwide.

Launch of the UNEP GPML Global Plastics Hub

The Global Plastics Hub is a digital platform which serves as a one-stop hub for sharing knowledge and data, guiding countries in evidence-based policymaking, and fostering collaboration among stakeholders. It was officially launched on May 29, 2025 by the GPML. The platform integrates data from multiple sources to support informed and collective action across the entire plastic lifecycle.

The platform features a Knowledge Hub with a curated repository of research, tools, policies, and best practices; a Data Hub with interactive visualizations of global datasets on plastics trade, waste management, and plastics in the environment; a Country Dashboard for visualizing plastics flows at the national level; and a Country-Dedicated Workflow to support the development of evidence-based national action strategies in 19 pilot countries.

GPML-IAEA Community of Practice (CoP) Workshop on Harmonization of Monitoring and Assessment of Plastic Pollution

Significant advancements in the area of harmonization of marine debris observations were made through the GPML-IAEA Community of Practice (CoP) Workshop on Harmonization of Monitoring and Assessment of Plastic Pollution, organized by UNEP GPML in partnership with the International Atomic Energy Agency (IAEA). Held in hybrid mode on 11-13 March 2025 at IAEA Environment Laboratories Monaco, the event gathered experts of plastic pollution across the plastic lifecycle, including members of CoPs, experts and researchers leading plastic monitoring and assessment efforts, and data partners/providers of the GPML Global Plastics Hub (formerly known as the *Digital Platform*).

This GPML CoP Workshop aimed to: (i) identify Key Performance Indicators (KPIs) across the plastic lifecycle for comprehensive progress measurement towards addressing plastic pollution from source to sea; (ii) identify key terminologies and definitions to inform a glossary for greater comparability of data of identified KPIs; (iii) explore options for data integration and expansion of the Digital Platform Data Hub for global and national monitoring and assessment and progress tracking; (iv) further align efforts and strengthen coordination with international partners through the GPML.

During the workshop participants were divided into 3 break-out groups aligned with 3 domains of the plastic lifecycle: (i) Plastics in the Economy (production, trade, and leakage from consumption); (ii) Waste Management (waste handling and emissions); (iii) Plastics in the Environment (macro- and microplastics on land and in water).

Workshop outcomes from the Plastics in the Environment group included the suggestion of coastal macro-litter monitoring as a KPI (although more discussion between experts would be needed as areas of concern remain). It was agreed that units, size range, characterization, frequency of the survey and localisation were still needed to be discussed. Recommended next steps included organizing workshops with various regional groups of experts, and beach cleanup organizations to ensure the feasibility of the proposed guidelines on the ground.

Advancements in remote sensing observations of marine debris

Advances in remote sensing of plastic waste were summarized in a report under that title published in 2023 by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. The report is available for download from:
www.giz.de/en/downloads/giz-2023-en-advances-in-remote-sensing-of-plastic-waste.pdf

A number of international community workshops, benefitting from coordination by the IOCCG Task Force on Remote Sensing of Marine Litter and Debris, also took place between 2023 and 2025. These include but are not limited to:

- Surface Plastic Remote Sensing (SPARSE) Workshop: a way forward for the detection of marine litter and floating matter; 28-30 May 2025, Santa Chiara Lab, University of Siena, Italy; https://sites.google.com/unisi.it/sparse2025
- Remote Sensing of Marine Litter Workshop 2023; 16-17 October 2023, ESA-ESTEC, Noordwijk, Netherlands; https://atpi.eventsair.com/remote-sensing-of-marine-litter

Outstanding activities as recommended

There are several actions recommended by the workshop participants which have not yet been initiated. The recently funded EU project BioGeoSea (09.2025-02.2029) is dedicated to support IMDOS and its international partners to help advance coordination of marine debris monitoring and data harmonization. Among other things, the project will follow up on the actions recommended below.

Guidelines and other publications:

- Finalize the draft of the Marine Plastics Debris EOV Specification Sheet with the input of the workshop participants, and present to the GOOS Steering Committee for approval. Timeline: September 2026
- Develop an up-to-date summary of the current global capacity to monitor marine debris based on the EuroSea project report on marine plastic contaminant monitoring (https://zenodo.org/records/7990578), and input from workshop participants among other sources. Timeline: 2026-2027
- Submit an application for GOOS Endorsement of the MOEJ guidelines for surface microplastics (https://www.env.go.jp/content/000331405.pdf) and remote sensing activities (https://www.env.go.jp/content/000331405.pdf). Timeline: April 2026

Roadmap for a federated data management system:

- Obtain consensus among marine debris data providers and key data integration centres globally on a pathway towards interoperability.

- Establish commonly agreed data and metadata formats following the workshop recommendations.
- Develop a pilot demonstration of a federated and interoperable data management system for ocean surface microplastics.

Workshop Agenda

TUESDAY | 29 AUGUST 2023

Session #1: Rationale and objectives of the workshop

Chair: Kotaro Fujii Rapporteur: Mine Tekman

Time	Title	Presenter(s)
08:30-09:00	Registration on site	
09:00-09:10	Welcome	Hiroshi Ono
09:10-0915	Logistics	IDEA Consultants, Inc.
09:15-09:45	Objectives of the Workshop	Organising committee Noriko Tamiya-Hase
9:45-10:00	What kind of marine litter data and information is needed for developing risk-based assessments? A policy perspective.	*Heidi Savelli (UNEP GPML)*
10:00-10:30	Photo session & Coffee Break	
10:30-11:30	Translating scientific data into policy and decision-making: A presentation of case studies. *Q&A*	Georg Hanke (EU), Jennifer Webster (USA), Noriko Tamiya-Hase (Japan), Amy Lusher (Arctic), Suchana Chavanich (Thailand), Daoji Li (China), M. Reza Cordova (Indonesia), Marilia Ragagnin (Brazil), *Marina Santana (Australia)*
11:30-12:00	Why is a federated and interoperable data management system necessary in supporting policy and decision making?	Lucy Scott & Pier Luigi Buttigieg
12:00-13:30	Lunch Break	

Session #2: Addressing data gaps to inform marine debris indicators

Objective: To exchange views on what data is necessary to inform the marine debris indicators, and to what level that can be provided by the current capacity to monitor and observe the ocean.

Chair: Yutaka Michida Rapporteur: Laura Gomez Navarro

Unless otherwise noted, each agenda item consists of a 10-min presentation followed by discussion.

13:30-14:00	How to prioritize monitoring efforts to better inform regulations for the Plastics Treaty?	Francois Galgani, Georg Hanke
14:00-14:30	Why is it important to monitor different ecosystem compartments together in a region?	Mine Tekman
14:30-14:50	EUROqCHARM's Reproducible Analytical Pipelines and their contribution to the EOV development	Stefano Aliani

14:50-15:10	What are the data requirements for remote sensing observations	Shungu Garaba
15:10-15:30	How can numerical models support the design of a monitoring system and benefit from it ?	Nikolai Maximenko
15:30-16:00	Coffee Break	

Session #3: Who is measuring what, where and when?

Objective: To map the current capacity to monitor and observe selected global-scale marine debris indicators based on available knowledge of existing surveys

Chair: Marc Metian Rapporteur: María Belén Alfonso

Unless otherwise noted, each agenda item consists of a 10-min presentation followed by discussion.

Time	Title	Presenter(s)
16:00-16:30	State-of-the-art monitoring methods and capacity for global scale marine debris indicators	Amy Lusher
16:30-17:00	Overview of the existing projects/initiatives for monitoring marine debris	*Mikołaj Mazurkiewicz*
17:00-17:40	Community contribution: participants are encouraged to take the floor to complete this overview	all, moderated by Marc Metian
17:40-17:45	Discussion Wrap up	Marc Metian
18:00	Wrap up of the day	Organising committee Amy Lusher & Kazuki Miyazaki
18:00-20:00	Evening reception	

WEDNESDAY | 30 AUGUST 2023

Session #4: Towards a global federated and interoperable marine debris data management

Objectives: (1) To harmonize the existing definitions and mandatory requirements for metadata and data reporting on selected global-scale marine debris indicators
(2) To conceptualize a global, federated data management system for ocean surface microplastics and selected global-scale marine debris indicators

Chair: Amy Lusher Rapporteur: Maria Pogojeva

Unless otherwise noted, each agenda item consists of a 10-min presentation followed by discussion.

Time	Title	Presenter(s)
09:00-09:30	IMDOS' Vision for a federated data management system (incl. GPML Community of Practice for Data Harmonization)	Artur Palacz
09:30-10:00	Global data synthesis products as a user need for federated data management system	Atsuhiko Isobe
10:00-10:30	Establishing technical infrastructure for data sharing in a federated and interoperable data management system	Pier Luigi Buttigieg & Lucy Scott
10:30-11:00	Coffee Break	
11:00-12:00	Monitoring guidelines and requirements for data reporting • MOEJ (Masayuki Fujioka, Japan) • NOAA NCEI (Jennifer Webster, USA) • EMODnet Chemistry (Matteo Vinci & Eugenia Molina Jack, EU) • AIMS/IMOS (Marina Santana, Australia)	10' each + 5 mins questions
12:00-13:30	Lunch Break	

Session #4 continued

Chair: Mine Tekman Rapporteur: Katsiaryna Pabortsava

Unless otherwise noted, each agenda item consists of a 10-min presentation followed by discussion.

Time	Title	Presenter(s)
13:30-14:00	Guidelines for Harmonizing Ocean Surface Microplastic Monitoring Methods	Yutaka Michida
14:00-15:00	Harmonization of existing database structures for surface microplastics (EMODNet, NOAA NCEI, AOMI)	Kohei Yoshiie
15:30 - 16:00	Potential elements to be considered in the roadmap of the Guidelines (e.g. uncertainty estimates, correction factors, smaller particles, polymer types (fibers), spectra databases)	Giuseppe Suaria
15:30-16:00	Coffee Break	
16:00-16:30	Introduction of the break-out tables exercise	*Noriko Tamiya-Hase*
16:30-17:30	Break-out tables 1. What data, data items and units should be mandatory requirements for metadata and data reporting? 2. Potential elements for the roadmap of the Guidelines	Moderated by: 1. A. Isobe 2. G. Suaria

	3. Socio-Technical challenges for harmonizing surface microplastic data within a federated data management system 4. How to apply harmonization of existing ocean surface microplastic databases for other global level indicators.	3. P.L Buttigieg & L. Scott 4. A. Lusher
17:30-18:00	Break-out tables rapporteurs feedback	moderated by Mine Tekman

THURSDAY | 31 AUGUST 2023

Session #5: Towards a network of sustained observations of surface microplastics and beyond

Objective: To initiate a coordinated observing network for ocean surface microplastics guided by the criteria of the GOOS Observations Coordination Group, and with MOEJ guidelines for harmonizing ocean surface microplastic monitoring methods.

Chair: Giuseppe Suaria Rapporteur: Amy Lusher

Unless otherwise noted, each agenda item consists of a 10-min presentation followed by discussion.

Time	Title	Presenter (s)
09:00-09:20	Coordinated observing network for surface microplastics - a key component of IMDOS	Artur Palacz & Nikolai Maximenko
09:20-10:30	**Plenary Discussion:** Current monitoring capacity and challenges to be addressed through better coordination of observations and monitoring *Which elements of the marine debris observations are mature enough to consider for coordination under IMDOS & GOOS?*	Artur Palacz & Nikolai Maximenko
10:30-11:00	Coffee Break	
11:00-11:15	Introduction to breakout tables: - How to establish coordination and organise effective interactions between various components of an integrated observing system?	Artur Palacz
11:15-12:15	Breakout tables: 1. Surface microplastics; 2. Seafloor; 3. Beach litter; 4. Surface macroplastics; 5. Biota	Moderated by:
12:15-12:45	Presentations by breakout groups	
12:45-13:45	Lunch Break	
13:45-15:00	**Plenary discussion:** Augmenting surface microplastic data collection and harmonisation guidelines for other indicators (water column microplastics, seafloor microplastics).	Moderated by Giuseppe Suaria
15:00-15:30	Coffee Break	

Session #6: Summary of workshop outcomes and next steps

Objective: To review the workshop outcomes and identify next steps for implementation of decisions and recommendations

Chair: Noriko Tamiya-Hase Rapporteur: Mine Tekman

15:30-16:00	A roadmap towards report and publications on the outcomes of the workshop	Artur Palacz
16:00-16:30	Presentation of the agreed roadmap towards a federated and interoperable data management system for ocean surface microplastics and other marine debris observations.	Artur Palacz
16:30-17:00	Consensus metadata and data requirements sheet for reporting on key marine litter indicators	Noriko Tamiya-Hase
17:00-18:00	Summary of meeting outcomes, identified decisions and actions, task teams and leads.	Noriko Tamiya-Hase

List of Workshop Participants

[Online-only participants marked in italics]

Last Name	First Name	Affiliation	Country
Hosts			
Ono	Hiroshi	Senior Advisor to the Minister, Ministry of the Environment, Japan (MOEJ)	Japan
Fujii	Kotaro	Director, Office of Policies against Marine Plastic Pollution, Marine Environment Division, Environmental Management Bureau, Ministry of the Environment, Japan (MOEJ)	Japan
Organizing Committee			
Fujioka	Masayuki	Ministry of the Environment, Japan (MOEJ)	Japan
Hasson	*Audrey*	*GEO Blue Planet / Mercator Ocean International*	*France*
Lusher	Amy	Norwegian Institute for Water Research (NIVA)	Norway
Miyazaki	Kazuki	Ministry of the Environment, Japan (MOEJ)	Japan
Palacz	Artur	International Ocean Carbon Coordination Project (IOCCP)/ Institute of Oceanology Polish Academy of Sciences (IO PAN)	Poland
Tamiya-Hase	Noriko	Ministry of the Environment, Japan (MOEJ)	Japan
Tekman	Mine	GEO Blue Planet / Mercator Ocean International Consultant, Ozyegin University	Turkey
Experts			
Alfonso	María Belén	Center for Ocean Plastic Studies (COPS), Kyushu University	Japan
Aliani	Stefano	National Research Council - Institute of Marine Sciences (ISMAR-CNR)	Italy
Arakawa	Hisayuki	Tokyo University of Marine Science and Technology	Japan
Buttigieg	Pier Luigi	GEOMAR	Germany
Chavanich	Suchana	Chulalongkorn University	Thailand
Cordova	Muhammad Reza	Research Center for Oceanography, The Indonesian National Research and Innovation Agency (BRIN)	Indonesia
Galgani	Francois	IFREMER	France
Garaba	Shungu	University of Oldenburg	Germany
Gomez Navarro	Laura	University of Utrecht and Institut Mediterrani D'Estudis Avançats (IMEDEA)	Netherlands
Hagmann	Pascal	OceanEye	Switzerland
Hanke	Georg	European Commission Joint Research Centre, JRC	Italy
Hinata	Hirofumi	Ehime University	Japan
Isobe	Atsuhiko	Kyushu University	Japan
Jandang	Suppakarn	Center for Ocean Plastic Studies (COPS), Kyushu University	Japan
Kataoka	Tomoya	Ehime University	Japan
Li	Daoji	East China Normal University	China
Maximenko	Nikolai	International Pacific Research Center, University of Hawaii, USA	USA

Mazurkiewicz	*Mikołaj*	*Institute of Oceanology Polish Academy of Sciences (IO PAN)*	*Poland*
Metian	Marc	International Atomic Energy Agency (IAEA)	Monaco
Michida	Yutaka	Atmosphere and Ocean Research Institute, The University of Tokyo	Japan
Molina Jack	*Maria Eugenia*	*National Institute of Oceanography and Applied Geophysics (OGS)*	*Italy*
Santana	*Marina*	*Australian Institute of Marine Science (AIMS)*	*Australia*
Nakano	Haruka	Center for Ocean Plastic Studies (COPS), Kyushu University	Japan
Nihei	Yasuo	Tokyo University of Science	Japan
Pabortsava	Katsiaryna	National Oceanography Centre, Southampton	UK
Pogojeva	Maria	University of Haifa	Israel
Ragagnin	Marilia	University of Sao Paolo	Brazil
Raimund	Stefan	The Ocean Race	France
Saegusa	Jun	Japan Coast Guard	Japan
Seki	Noritaka	Mizuho Research & Technologies, Ltd	Japan
Scott	Lucy	IOC Project Office for IODE, IOC-UNESCO	Belgium
Suaria	Giuseppe	National Research Council - Institute of Marine Sciences (ISMAR-CNR)	Italy
Suzuki	Go	National Institute for Environmental Studies	Japan
Takahashi	Yukihiro	Hokkaido University	Japan
Tanaka	Shuhei	Kyoto University	Japan
Tokai	Tadashi	Tokyo University of Marine Science and Technology	Japan
Uchida	Keiichi	Tokyo University of Marine Science and Technology	Japan
Vinci	*Matteo*	*National Institute of Oceanography and Applied Geophysics (OGS)*	*Italy*
Watanabe	Eriko	Mizuho Research & Technologies, Ltd	Japan
Webster	Jennifer	National Oceanic and Atmospheric Administration	USA
Yamashita	Rei	Atmosphere and Ocean Research Institute, The University of Tokyo	Japan
Yoshiie	Kohei	Mizuho Research & Technologies, Ltd	Japan
Yousefian	Ali	Center for Ocean Plastic Studies (COPS), Kyushu University	Japan
JAPAN NUS CO., LTD.			Japan

Secretariat
IDEA Consultants, Inc. Japan.