

# Integrated Marine Debris Observing System (IMDOS): From vision to implementation



**Stefano Aliani**  
CNR ISMAR, Italy



**Artur Palacz**  
IOCCP/IOPAN, Poland

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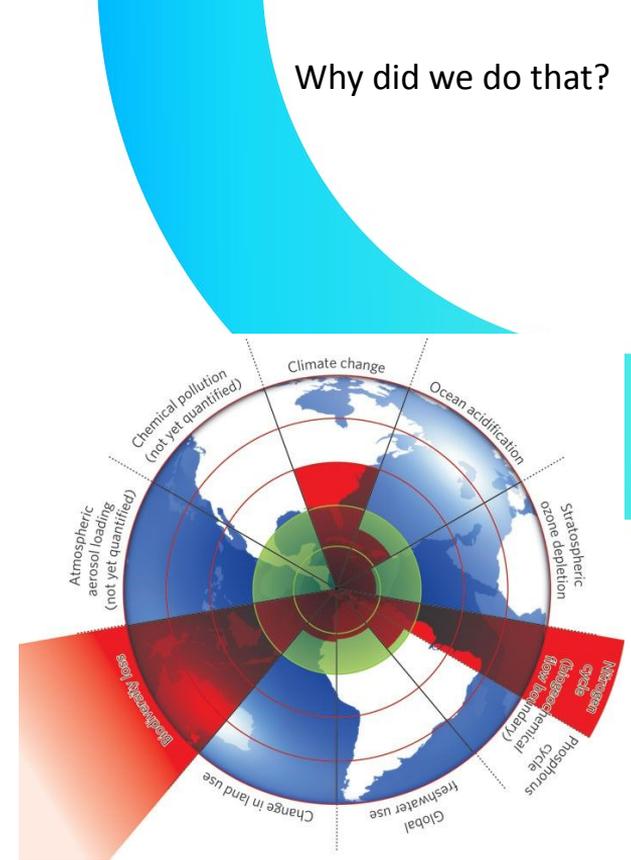


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CNR ISMAR, Italy

## WHY IMDOS?

Plastic pollution co-occurs with other natural and anthropogenic changes in the ocean, such as warming, sea level rise, acidification, and loss of biodiversity;

**and plastic pollution is one particular, and very visible, example of the lack of sustainability in our actions.**



Rockström et al., 2009

What we do now, makes our future better

## WHY IMDOS?

### Plastic pollution is a wicked problem

a **wicked problem** is a problem that is difficult or impossible to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognize.

It is the opposite of **hard but ordinary problems**, which people can solve in finite time period by applying standard techniques

New pollution > new method > new approach

Methods have no time to evolve > act soon

**What we do now, makes our future better**

Why did we do that?



Rittle and Webber 1973

## WHY IMDOS?

Plastic pollution is a wicked problem

A possible way to address wicked problems is integration,

i.e.  
to form, coordinate, or blend different units into a functioning unified whole

Why did we do that?



Integrated global observing system for plastic pollution does not exist

What we do now, makes our future better

## THE IMDOS IDEA WAS BORN



Working group SCOR – FLOTSAM  
(Floating Litter and its Oceanic  
Transport Analysis and Modelling).



What we do now, makes our future better

- In situ
- Modelling
- Remote Sensing



Working group SCOR – FLOTSAM  
Floating Litter and its Oceanic  
Transport Analysis and Modelling).



Observing System needed!

**What we do now, makes our future better**

The IMDOS first idea presented

2019

OCEAN  
OBS'19



AN OCEAN OF OPPORTUNITY  
September 16-20, 2019

The screenshot shows the front page of a research article on the Frontiers website. At the top left is the Frontiers logo and the journal title 'frontiers in Marine Science | Ocean Observation'. A navigation bar includes links for SECTION, ABOUT, ARTICLES, RESEARCH TOPICS, FOR AUTHORS, EDITORIAL BOARD, and ARTICLE ALERTS. The article title is 'Oceanobs'19: An Ocean of Opportunity'. It is a REVIEW article published in Front. Mar. Sci. on 28 August 2019. The article title is 'Toward the Integrated Marine Debris Observing System'. The authors listed are Nikolai Maximenko, Paolo Corradi, Kara Lavender Law, Erik Van Sebille, Shungudzemwoyo P. Garaba, Richard Stephen Lampitt, Francois Galgani, Victor Martinez-Vicente, Lonneke Goddijn-Murphy, Joana Mira Veiga, Richard C. Thompson, Christophe Maes, Delwyn Moller, and Carolin Regina Löscher. On the right side, there are buttons for 'Download Article' and 'Export citation', and a large view count of 56,276 TOTAL VIEWS. A 'View Article Impact' button is also present.

What we do now, makes our future better

## The IMDOS first idea presented

White paper as a source of ideas

2019

There are many reasons why understanding marine debris is difficult:

- variety of object sizes (from tens of meters to microns) and shapes (e.g., spherical pellets, packaging films, fibers, and composite objects),
- complexity of chemical composition (e.g., different polymers, metals, glass, and organic materials),
- unknown sources and sinks, as well as pathways and decay processes
- different laboratories and groups use different methodologies to study marine litter, local observations are often hard to generalize into a global picture.

**What we do now, makes our future better**

2019

## The IMDOS first idea presented

### Platforms

Many platforms are used for marine debris observations

- *Satellites, Aircraft, and Drones*
- *Ships*
- *Autonomous platforms. Floats, gliders and Autonomous Surface and Underwater Vehicles*
- *Fixed Point Observatories*
- *Benthic landers and crawlers*
- *Shoreline monitoring and Beachcombing*

REVIEW article

Front. Mar. Sci., 28 August 2019 | <https://doi.org/10.3389/fmars.2019.00447>



### Toward the Integrated Marine Debris Observing System

Nikolai Maximenko<sup>1\*</sup>, Paolo Corradi<sup>2</sup>, Kara Lavender Law<sup>3</sup>, Erik Van Sebille<sup>4</sup>, Shungudzemwoyo P. Garaba<sup>5</sup>,  
 Richard Stephen Lampitt<sup>6</sup>, Francois Galgani<sup>7</sup>, Victor Martinez-Vicente<sup>8</sup>, Lonneke Goddijn-Murphy<sup>9</sup>, Joana Mira Veiga<sup>10</sup>, Richard C. Thompson<sup>11</sup>, Christophe Maes<sup>12</sup>, Delwyn Moller<sup>13</sup>, Carolin Regina Löscher<sup>14</sup>, Anna

What we do now, makes our future better

## The IMDOS Stakeholders

IMDOS will help provide data to individuals, organizations, and governments dealing with the surveillance, impact management and mitigation of marine debris, including but not limited to the following groups:

- *Scientists*
- *Businesses*
- *Environmental activists and citizen scientists*
- *Educators*
- *Policy and decision makers*
- *Management of relevant marine environments*
- *First responders*

**What we do now, makes our future better**

# Proposed IMDOS Terms of Reference

- **promote the development of a global network of marine debris observations** according to Regional Seas Programme Action Plans and integrated within GOOS in cooperation with existing ocean observing infrastructures, networks and communities of practice;
- **define strategies and priorities** for coordinated and harmonised marine debris observations based on most relevant monitoring methods, standards and practices;
- **develop standard sampling protocols** and best practices in marine litter data collection **and support training activities** for their implementation;
- **promote integration of data management activities** to provide free and open access to marine debris data and information products for stakeholders (e.g., via the GPML Digital Platform);

# Proposed IMDOS Terms of Reference

- **support the development of remote sensing methods to detect marine debris** by enhancing availability of required ground-truthing data;
- **strengthen the interface between marine debris monitoring and modelling communities** to support the development of a Digital Twin of the Ocean for Marine Litter Pollution;
- **evaluate the readiness level and promote technological innovation** to advance global observing approaches;
- **create communication services** for the marine debris monitoring community

# Integrated Marine Debris Observing System (IMDOS):

From vision to **implementation**



**Artur Palacz**

International Ocean Carbon  
Coordination Project, Institute of  
Oceanology PAN, Poland

# Initial coordination support for IMDOS provided by GEO Blue Planet & GOOS



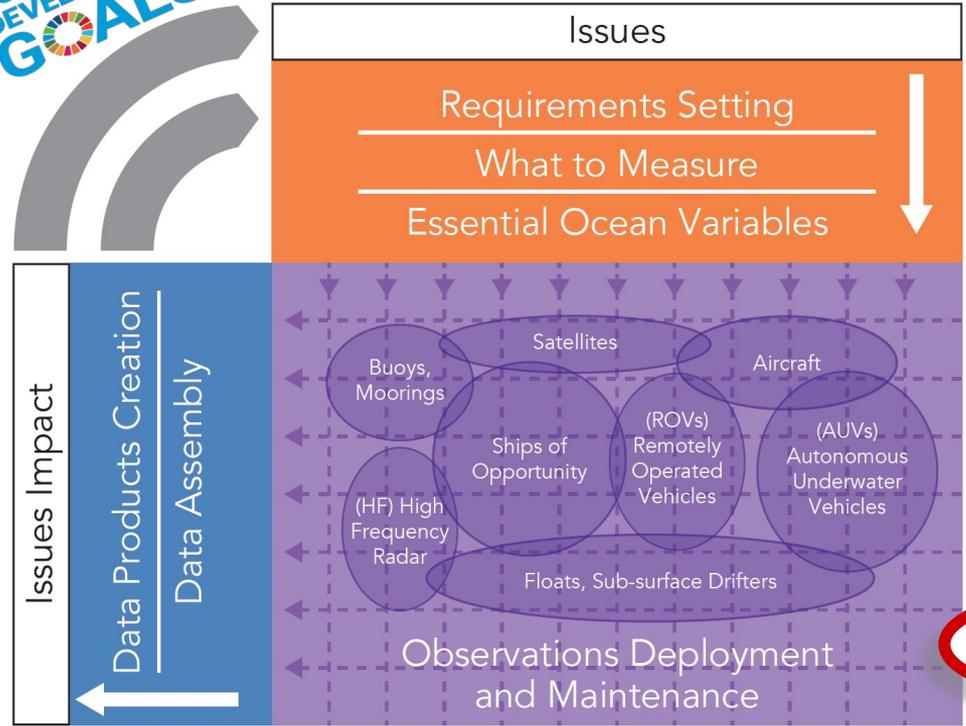
In collaboration with among others:



**Providing guidance and coordination** for a global sustained observing system to **strengthen the scientific knowledge** on marine debris/litter pollution.

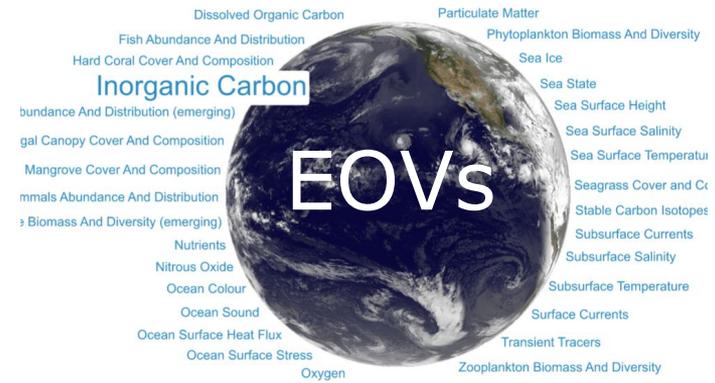
coordinates a large network of ocean observing platforms delivering data for climate, operational services and ocean health applications

Framework for Ocean Observing Process Diagram



**NEW**

**Essential Ocean Variable: Marine Plastics Debris**





**BRIDGING THE GAP BETWEEN OCEAN  
AND COASTAL OBSERVATIONAL DATA  
AND SOCIETAL NEEDS TO DELIVER  
ACTIONABLE INFORMATION**

**Supporting a Marine Litter Working Group**

**Committed to implementing the vision of IMDOS**

**Marine Litter**



# Guidance from an international interim Steering Committee

**Stefano Aliani** (CNR ISMAR, Italy)

**Paolo Corradi** (ESA, Netherlands)

**Francois Galgani** (Ifremer, France)

**Georg Hanke** (JRC, Italy)

**Kara Lavender Law** (SEA, USA)

**Nikolai Maximenko** (Uni Hawaii, USA)

**Toste Tanhua** (GEOMAR, Germany)

**Alexander Turra** (Uni São Paulo, Brazil)



## Coordination:

**Audrey Hasson** (Mercator/GEO BP, France)

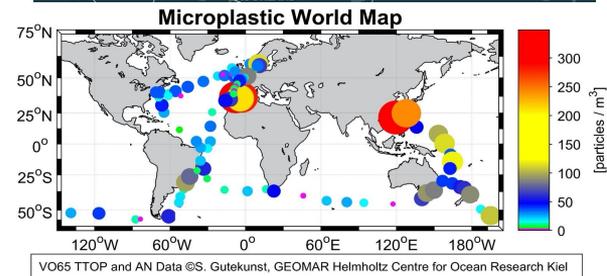
**Artur Palacz** (IOCCP/IOPAN, Poland)

**Promote the development of a global  
network of marine debris  
observations**

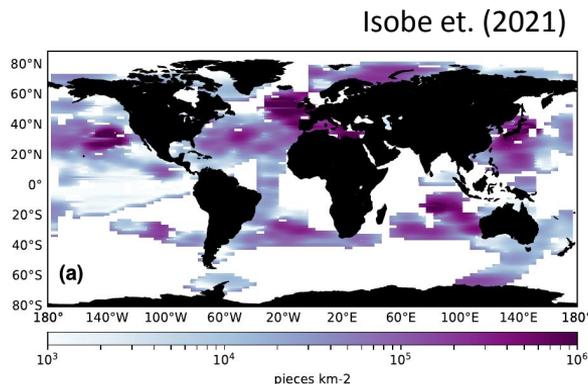
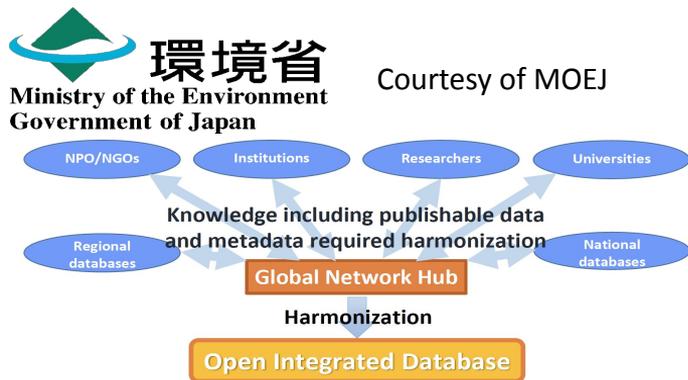
**Who & How?**

# Coordinated network for surface floating plastics

- Harmonization of microplastic sampling methods and interoperable data management solutions (building on Japan/G20 efforts)
- Expanding citizen science monitoring beyond beach litter through sailing community engagement
- Integration within the Ship Of Opportunity Programme



Tanhua et. al (2020)



6:10 PM · Jan 30, 2021 · Hootsuite Inc.

15 Retweets 110 Likes

# Coupling coastal biodiversity and seafloor litter monitoring efforts in Europe and beyond

ONLINE WORKSHOP

## Towards a Coordinated European Observing System for Marine Macroalgae

### TOPICS

Observation strategies and data sharing practices  
Integration and sustainability  
Best practices and standard operating procedures

23rd-25th  
November 2021  
10-12am, 2-4pm CET

### WORKSHOP CO-CHAIRS:

Isabel Sousa-Pinto  
(CIIMAR, University of Porto)  
Lisandro Benedetti-Cecchi  
(Department of Biology,  
University of Pisa)



Addressed gaps and follows recommendations from:

- **Harmonized standard operating protocols and shared survey design** for visual monitoring methods (e.g. SCUBA diving)
- Successful demonstration in Estonia
- Potential for pilot co-design with MarCLIM project (UK and France macroalgae monitoring)



JRC SCIENTIFIC AND POLICY REPORTS

Guidance on Monitoring of  
Marine Litter in European Seas

*“Considering opportunities to couple monitoring efforts may be the best approach to monitor litter on the sea-floor. (...) [e.g.] with programmes on biodiversity.” (p.64)*

*A guidance document within  
the Common Implementation  
Strategy for the Marine  
Strategy Framework Directive*

**Define strategies and priorities for coordinated and harmonised marine debris observations**

**Who & How?**

# Essential Ocean Variable Specification Sheet

## Marine Plastics Debris



### Name of EOV

### Marine Plastics Debris

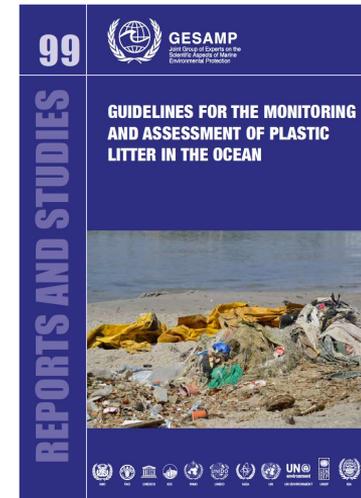
### EOV sub-variables

- beach litter: abundance per type & size category
- floating microplastics: abundance, weight
- floating macroplastics: abundance
- seafloor litter: abundance per type & size class (macro, micro)

*Additional sub-variables under consideration:*

- Macroplastics in biota (ingestion by seabirds, fish, sea turtles)
- Microplastics in biota (ingestion by seabirds, bivalves)

- Based on GESAMP WG40 recommendations for global scale monitoring
- Reconciling EOVs & SDG indicator frameworks
- Broad public consultation to be launched later in 2022



HELLO from the

## EU Marine Strategy Framework Directive - Technical Group on Marine Litter

to the UN Ocean Conference and the IMDOS side event!

45 experts representing 15 EU Member States, 3 Regional Sea Conventions, EC, EEA, NGOs, discussing issues of marine litter monitoring and management in EU and Regional Seas



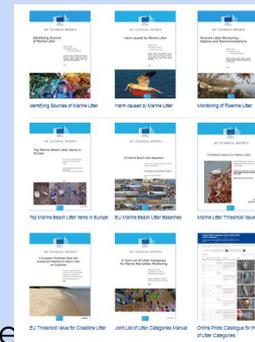
### Some Main Topics:

Updated Guidance for Marine Litter Monitoring

- Beach/Coastline Litter
- Floating Litter
- Seafloor Litter
- Microlitter
- Ingestion and Entanglement

Trends of Beach Litter in EU  
Baselines and Thresholds

Measures against Marine Litter



**Support the development of remote sensing methods to detect marine debris by enhancing availability of required ground-truthing data**

**Who & How?**

# IOCCG Task Force: Remote Sensing of Marine Litter and Debris

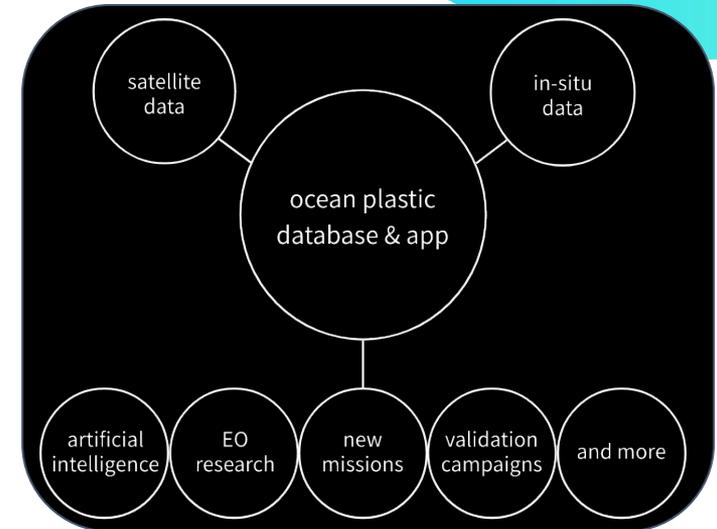


ocean scan

**Linking marine litter ground truth and remote sensing data**

## Role in IMDOS:

- provision of remote sensing requirements for ground-truthing data
- guidance on integration with other elements of the observing system



# **Promote integration of data management activities**

(including data harmonization)

## **Who & How?**

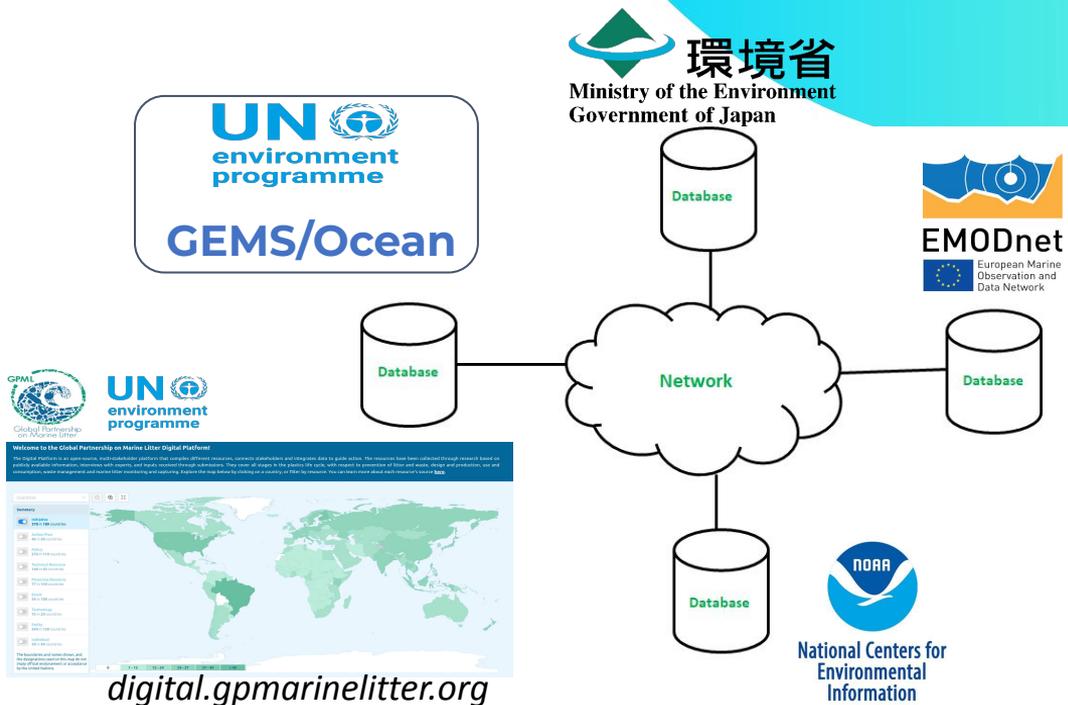
# A federated data management system

Data submitted **only once** in a **standard format**  
but accessible to **various users from multiple sources**

UNEP GPML Ontology  
& Data Harmonization  
Communities of  
Practice



IMDOS network of  
data management  
experts



# Help us build IMDOS together to generate a collective impact



Source: UCLA

## JOIN US !!!