



Breakout Workshop #

# Challenges on Optical Satellite Remote Sensing for Marine Litter and **other** Floating Matter

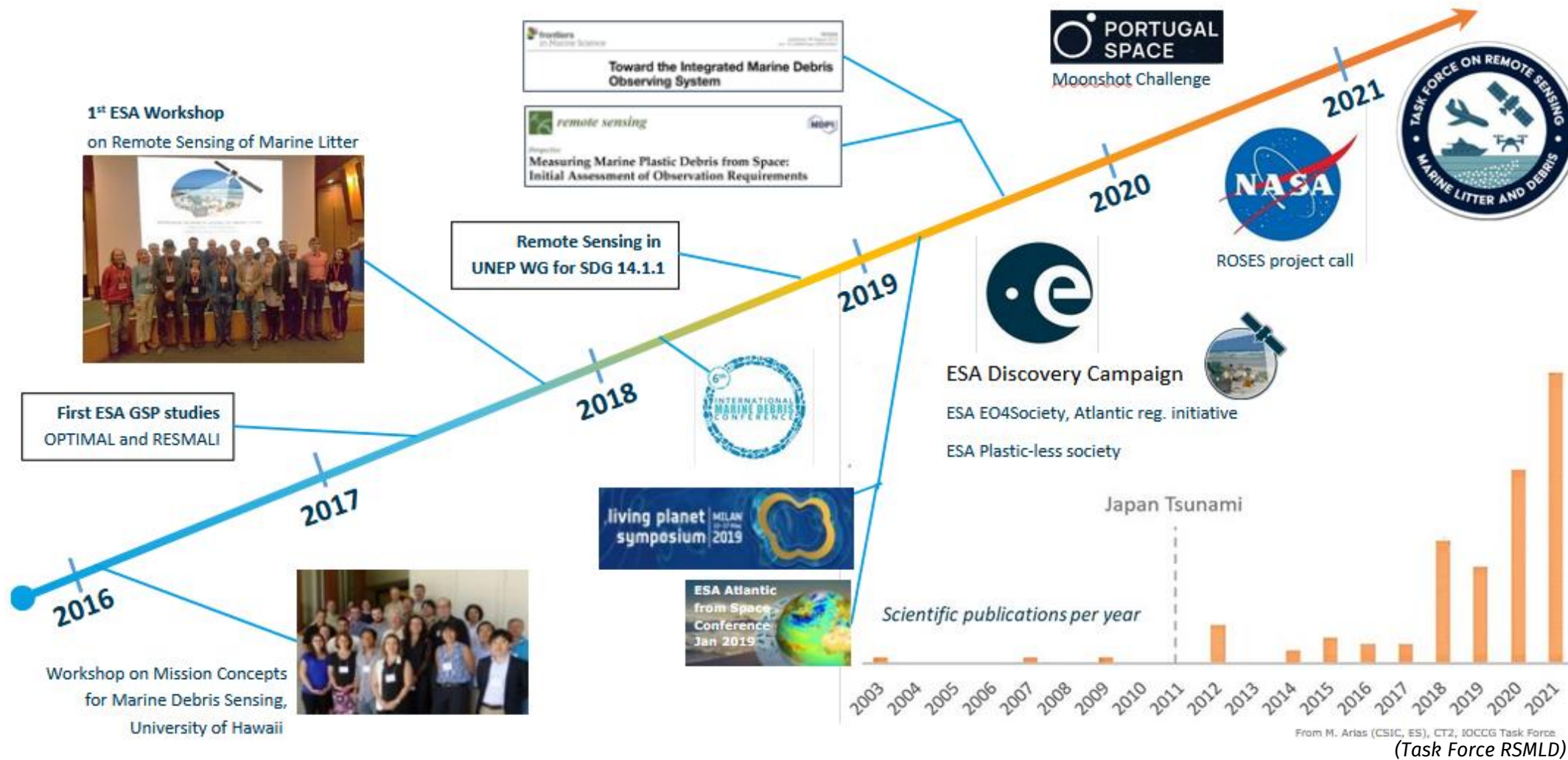
Chairs: Shungu Garaba and Victor Martinez Vicente



IOCS-2025 Darmstadt, Germany  
1 - 4 December 2025



# History



# Resources

Scan Me!



[www.iocccg.org/group/marine-litter-debris/](http://www.iocccg.org/group/marine-litter-debris/)

Study from 2023:  
„Advances in Remote Sensing of  
Plastic Waste“



Implemented by

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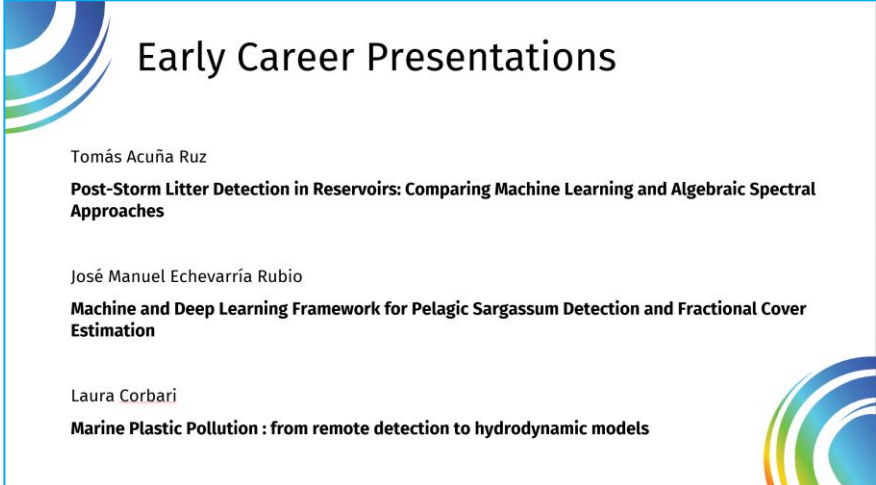
based on a decision of  
the German Bundestag

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# Agenda

- 5 ' Introduction to the session – Victor & Shungu
- 15 ' Minutes overall talk –Laura (+*Heidi, Chuanmin, Maddie*)
- 5' x 3 flash talks from the posters →
- Breakout in two groups discussions
- Coffee Break
- 5' x 2 recap from pre-break
- 45' discussion into breakout groups
- 30' summary of recommendations

A poster titled "Early Career Presentations" with a blue and green circular logo on the left. It lists three presentations by early career researchers.

Early Career Presentations

Tomás Acuña Ruz  
**Post-Storm Litter Detection in Reservoirs: Comparing Machine Learning and Algebraic Spectral Approaches**

José Manuel Echevarría Rubio  
**Machine and Deep Learning Framework for Pelagic Sargassum Detection and Fractional Cover Estimation**

Laura Corbari  
**Marine Plastic Pollution : from remote detection to hydrodynamic models**



# Team Work Input

Thank you all the in-person, online participants and Laura Lorenzoni for taking the minutes of the session.

## \* PIXEL RESOLUTION

BANDS? SPATIAL TT?

## \* ATM. CHARACTERIZATION

→ DO WE NEED NEW TECH? DON'T KNOW YET!

→ SWIR WIDTH vs. DETECTION

ARE THE CURRENT 1 ADEQUATE?

COVERAGE IN  
PIXEL

\* WHAT IS OUR  
ELEVATOR SPEECH?

\* RIVERS AS SOURCE - ↑  
SPATIAL RES. NEEDED + TIME

\* HARD TO ACCESS AREAS ↑

\* FIELD OBSERVATIONS

- SAMPLING STRATEGIES REQ?  
(WHAT DATA IS NEEDED?)

- RADIOMETRIC MEASUREMENTS OF ALC

- FUNCTIONAL COVERAGE OF FUSION

- PRESENCE/ ABSENCE

↑ FREQUENCY  
SNAPSHOT  
OF DEBRIS  
+ MODELS

## PHYSICAL CONDITIONS

- SS ROUGHNESS
- CIRCULATION

REQUIRES  
CLOSE  
COLLAB BW  
DISCIPLINES

↓  
WORKSHOP?

## MODELS

- SCALES (REGIONAL)
- MIXING (3D)
- PARAMETERIZATION

## EPISODIC EVENTS

- EASY TARGETS
- ROLE IN DEBRIS CONTR. UNKNOWN
- LIFETIME? (OF DEBRIS)

## SOURCES

- LAND/COASTAL HOTSPOTS

STANDARDIZED PROTOCOLS x  
METHODS  
VALIDATION

↑ IMPORTANT x CITIZEN SCIENCE

TECHNOLOGY USED MUST  
BE INTERDISCIPLINARY

## TECHNOLOGY

KNOWN LOCATION - DRONE

UNKNOWN LOCATION - RS

SPECTRAL MIXING MODELS

WHY? DETECTION OF CHANGE -

LONG-TERM TRACKING

- PREVENTION (OF DEBRIS IN OCEAN)
- SENSITIVITY/UNCERTAINTY
- BAND REQUIREMENT MODEL
- COVERAGE (TEMPORAL) < CONSTELLATION

WHAT TECH CAN WE LEVERAGE BEYOND

VIS/NIR? RADAR? LIDAR? POLYMETRIC

## AIRBORNE MEASUREMENTS

- OPPORTUNISTIC?
- TARGETED REQUIRE  
KNOWLEDGE A PRIORI
- WHAT VALIDATION  
IS NEEDED IN SITU?

3D ↑ FLNR  
ATM CORR.  
NEEDS WORK  
RESOLUTION?  
SHIP/DRONE/  
AIRBORNE  
IS PROMISING


REQUIRES WORK  
(MODELING)

Ursus  
Staufen

Ursus  
Staufen



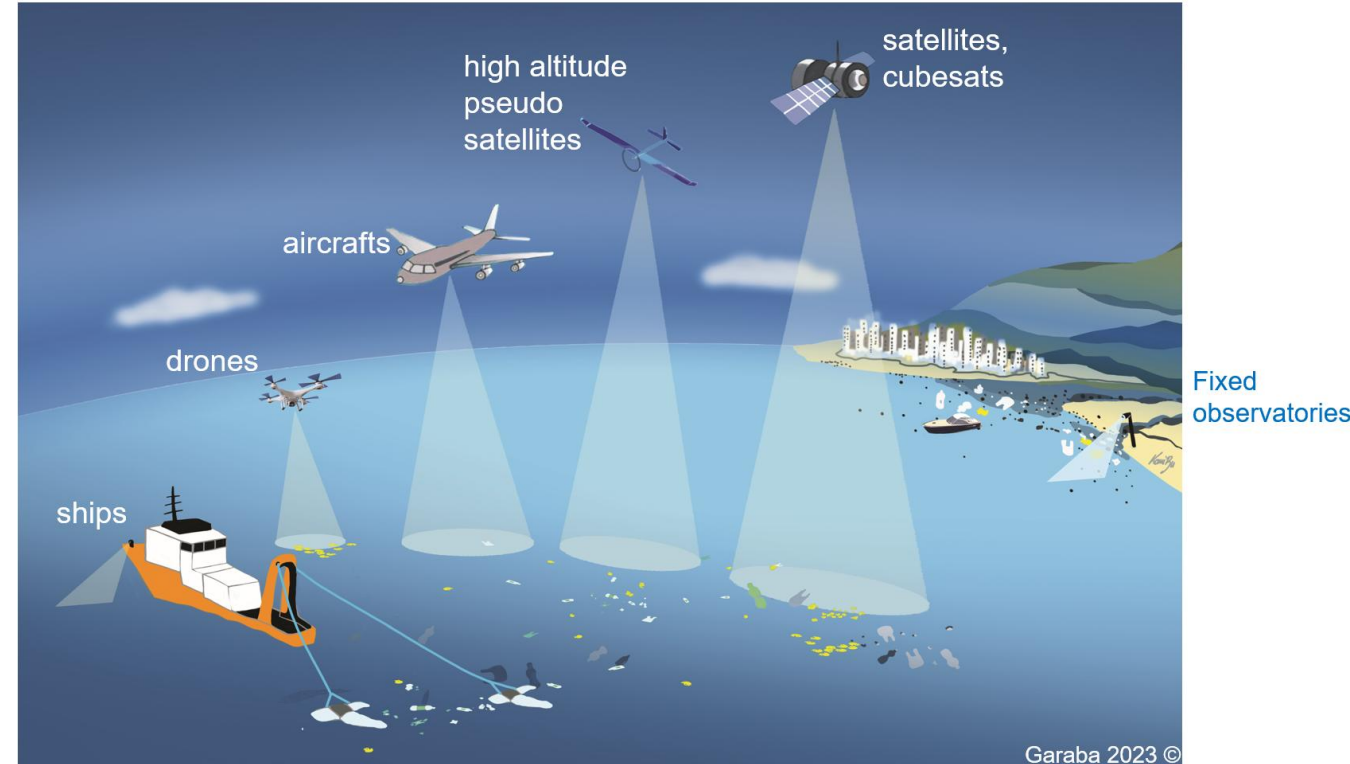
# Opportunity

- So far, floating matter detection has proof-of-concept activities using current missions (e.g., Sentinel-2, MODIS, PRISMA, EnMAP, EMIT)
  - Upcoming ESA CHIME hyperspectral mission with relevant bands (VIS-SWIR) has potential to further advance the field... but!
  - Is the spatial resolution good enough?
  - Are we prepared to deal with these big datasets?
- Need more in situ observations to address these questions
- 



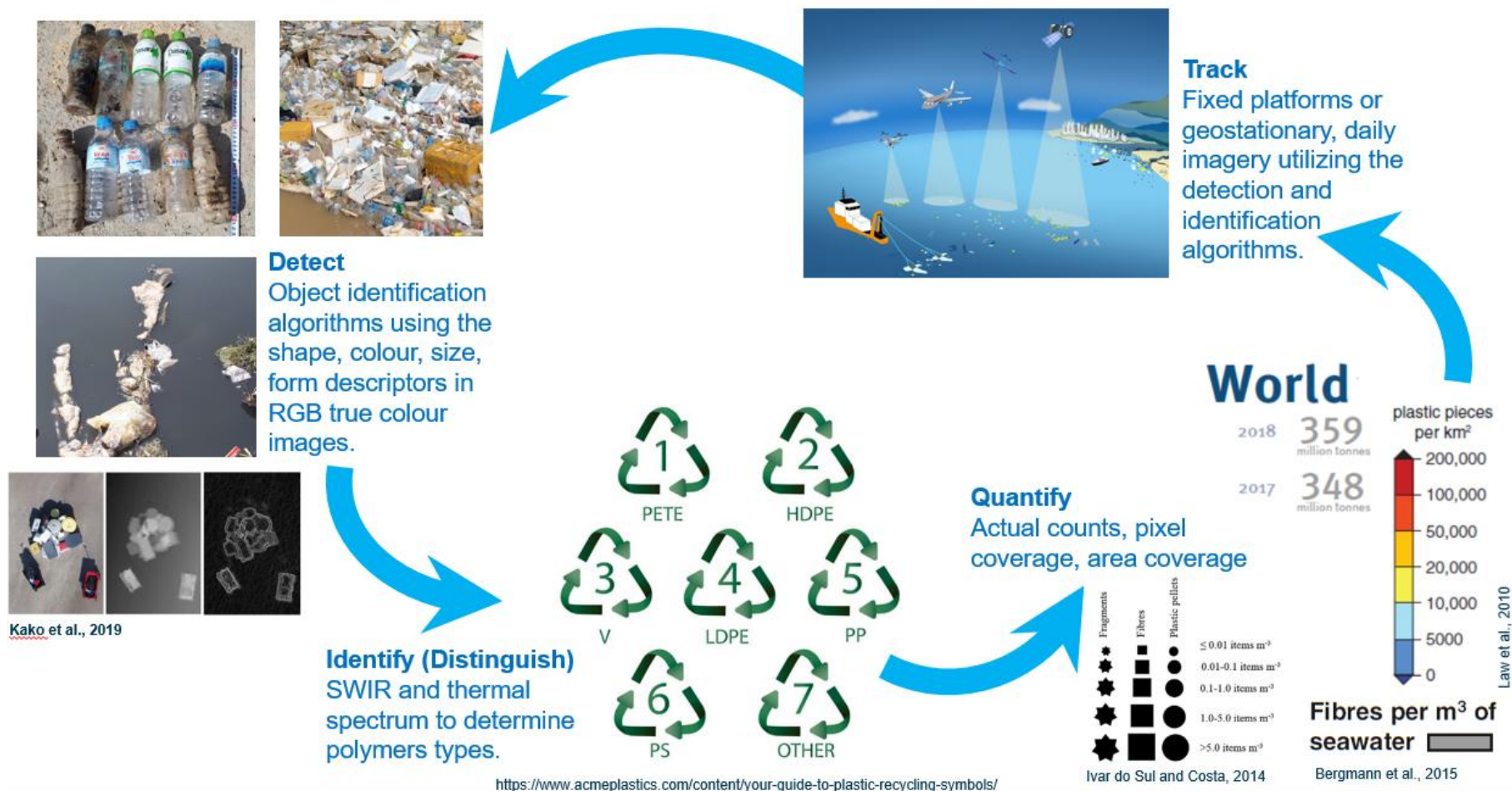
# Challenge 1

- **What datasets are needed to take us to next TRL:**
- **Do we need dedicated field surveys (e.g., hotspots, extreme events)?**
  - Completeness of the data (including optical measurements)
  - Which metrics to litter (item number concentration?, % coverage)
- **Do we need citizen science approaches**
- **Do we need both? Or other?**



# Challenge 2

- **Speaking** the same language has been difficult

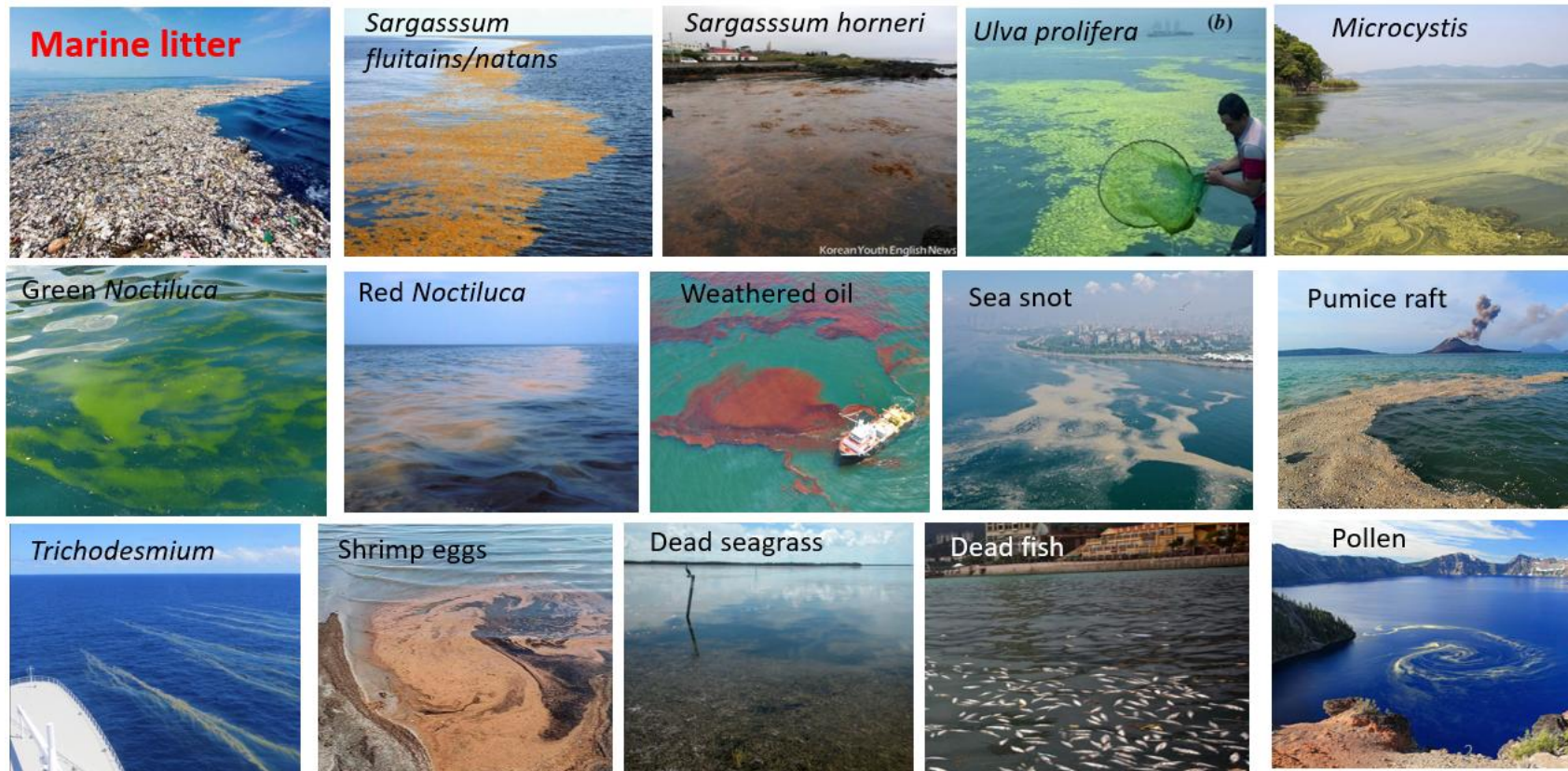




# Challenge 2(b)

- **Speaking** the same language, have common well-defined methodologies, data curation and **open science because of**

The many types of floating matters



(Hu, 2025)

**Table 1.** Terminology adopted in this review.


| Term   | Description   |
|--|---|
| Flotsam  | Floating material of natural or anthropogenic origin.   |
| Marine litter or marine debris                 | Any persistent, manufactured, or processed solid material that is directly or indirectly discarded, disposed of, or abandoned into the open ocean, coastal, or inland aquatic environment (UNEP [1]).               |
| Marine plastic litter or marine plastic debris | A subset of marine litter formed by a wide range of synthetic polymers and associated additives, covering a wide range of composition and properties, as defined by community standards (GESAMP [7]).               |
| Detection                                      | Discrimination of marine plastic litter from the environmental background, including other marine litter, based on the measurement of a physical quality that can be directly ascribed to the presence of plastics. |
| Characterisation                               | Classification of the composition (e.g., polymer type) and sizes of marine plastic litter.  |
| Quantification                                 | Estimation of the concentration, abundance, and/or area coverage of marine plastic litter.  |
| Monitoring                                     | Repeated measuring of marine plastic litter to detect a trend in space or time.   |
| Tracking                                       | Assessment of the spatial, temporal and concentration dynamics of marine plastic litter.  |
| Anomaly  | A signal that is different from the background (or expected value) that can be an indicator of the presence of marine plastic litter.   |
| Proxy  | One or a combination of indirect variables that correlate with the presence of marine plastic litter.   |
| Floating                                       | Operationally defined as marine plastic litter collected within 1 m of the sea surface.   |
| Emergent                                       | Any part of the marine plastic litter that is above the sea surface.  |

(Goddjin-Murphy et al., 2024)



# Recommendations

Short term: ~1-2 y  
Medium term: ~5 y  
Long term: ~>10 y


- **Rec 1:** The agencies need a long-term strategy to sustainably support development, including:
    - **Workshop** – short term- to mid-term :
      - harmonise concepts, define limitations: e.g. focus on techniques that separate floating plastics from the rest of floating matter
      - refine policy needs and requirements
      - science requirements for in situ dataset collection to advance to the next TRL level (citizen science and/or dedicated campaign)- what are the needed datasets
      - produce a roadmap
    - Attention! Only a workshop is not enough – need also time to develop the roadmap
- 





# Recommendations


Short term: ~1-2 y  
Medium term: ~5 y  
Long term: ~>10 y

- **Rec 2:** The Marine litter Remote Sensing community (e.g., through the IOCCG Task Force on RSML ) needs to connect with communities in the short-medium term to refine requirements :
    - Within ocean colour experts to explore application of proxies
    - Outside ocean colour remote sensing (e.g., modelling transport of floating litter, in situ marine litter scientists, citizen science scientists, biology, oceanography).
- 



# Recommendations

Short term: ~1-2 y  
Medium term: ~5 y  
Long term: ~>10 y

- **Rec 3:** The Agencies need to support evaluation of multimodal approaches (e.g., SAR, LIDAR -for vertical structure, *polarimeter*) and multiscale platforms (e.g., **drone**, *aircrafts*, cubesats, satellite) in the mid to long term to improve the distinction of unique floating matters.
  - **Rec 4:** For the ocean colour community to engage actively with the Task Force – Need more active members in the short term.
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# History in the making !

