Task Force on Remote Sensing of Marine Litter and Debris

ESA Living Planet Symposium Report

25 - 26 May 2022

1 Overview

The International Ocean-Colour Coordinating Group (IOCCG) Task Force on Remote Sensing of Marine Litter and Debris (RSMLD) has, as an overarching goal, **to coordinate the advancement of current and future remote sensing technologies and techniques that have potential to provide observations of plastic litter over all aquatic environments, including their interfaces with land (e.g. coasts, shores, rivers, lake bank) and land areas in proximity with potential leakage path to water bodies**. Considering all remote sensing technologies, with a key interest on radiometric approaches, the Task Force aims to promote a unified interdisciplinary international team of remote sensing experts with the goal to coordinate the development of traceable and transparent approaches for **detecting**, **identifying**, **quantifying** and **tracking requirements** of **aggregated plastic litter patches** composed of all size classes.

To this end, we had two key activities coordinated by the Task Force (i) scientific session and (ii) networking event. These activities were aimed to provide a status update to the stakeholders, provide a community two-way feedback and identify ways forward.

2 Activities

2.1 Scientific sessions

Two scientific sessions were provided;

- A8.08.1 Advances and EO Applications in Remote Sensing of Marine Litter and Debris – 1 chaired by Laura Lorenzoni and Paolo Corradi

In this session 5 oral presentations were provided (**Annex 1a**). The presented topics covered different approaches for detection of large filament-like accumulations of floating matter/marine litter at sea, UAV detection of macrolitter in the North Pacific ocean gyre, modelling of polarization signatures of nano- and micro-plastics in the water column.

- A8.08.2 Advances and EO Applications in Remote Sensing of Marine Litter and Debris – 2 chaired by Manuel Arias and Victor Martinez-Vicente

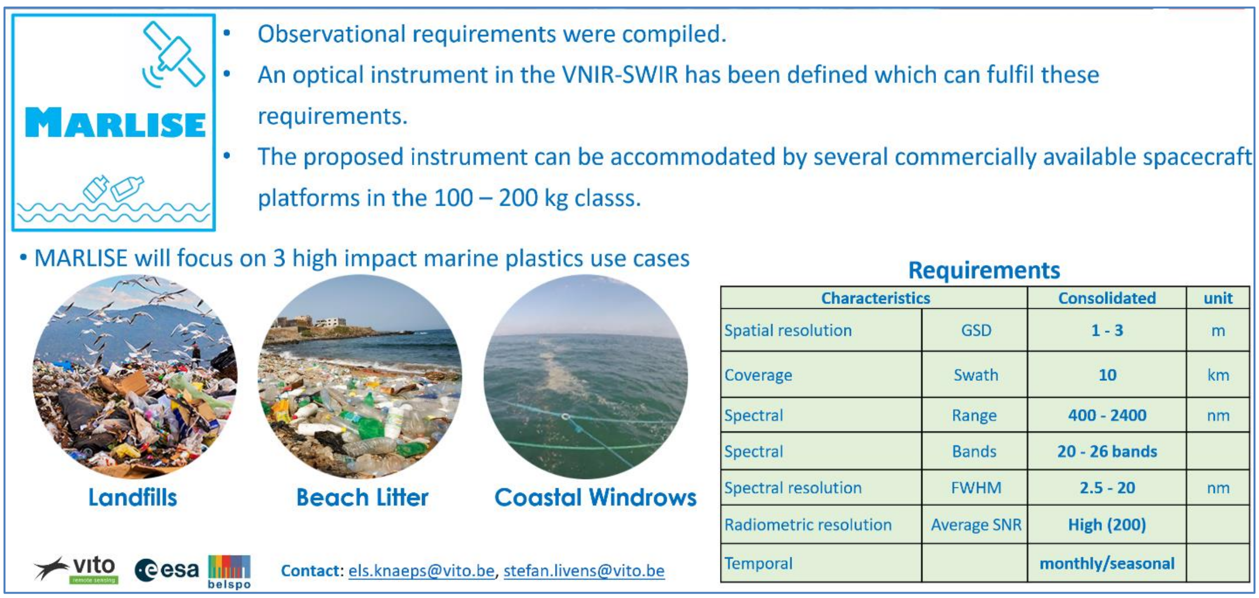
In this session 5 oral presentations were provided (**Annex 1b**). The topics were covering the use of artificial targets for satellite observations, use of machine learning algorithms to conduct analyse on remote sensing imagery, technologies and numerical simulations.

The two oral sessions A8.08.1 and A8.08.2 attracted a significant number of people in the room (up to 160-180) and received positive remarks. Presentations will be soon available on the symposium website https://lps22.esa.int/.

2.2 Networking event

The event was centered at providing an introduction of Task Force on Remote Sensing of Marine Litter and Debris to the ESA LPS attendees. The networking session attracted around 40 people (it was not advertised as well as the sessions), with a good involvement of the participants Short presentations were given to summarized key advances from the proposed Simulator ML-OPSI, dedicated database Ocean Scan, WASP, MARLISE and RESMALI.

A recently defined Marine Litter mission concept was discussed and it is summarized below



Characteristics		Consolidated	unit
Spatial resolution	GSD	1 - 3	m
Coverage	Swath	10	km
Spectral	Range	400 - 2400	nm
Spectral	Bands	20 - 26 bands	
Spectral resolution	FWHM	2.5 - 20	nm
Radiometric resolution	Average SNR	High (200)	
Temporal		monthly/seasonal	

Figure 1. MARLISE overview and target zones.

3 Key Outcomes

- The level of participation demonstrated there is a significant interest at different levels and a growing community around the challenge of remote sensing of marine litter, which is opening new research scenarios in the marine environment.
- Drone-based technologies for marine litter detection demonstrate already a relevant degree of maturity, and they could be already suitable for effective local services.
- Current satellite data is proving to be useful for the detection and monitoring of proxies of floating marine litter pollution and even as proxy of potential aerial microplastics.
- Induced fluorescence, microwave and polarimetric technologies have been showing promising potential in the detection of plastic litter in laboratory based experiments.
- The need for a robust simulator was emphasized as a step forward from the ML-OPSI breadboard concept developed.
- A mission concept has been pushed forward by the community with promising capabilities. The work requires further progress and extensive studies but it nurtures from advances done in the topic during the last few years.
- Consequently, experts from ESA member states were urged to contact their national delegates to support and engage to advance in the discussion of a potential mission.
- The concern by the community of publications overselling the capabilities of remote sensing in meeting the primary goals of detection, identification, quantification and tracking of litter was raised.
- Interdisciplinary efforts to engage stakeholders were recommended, in an effort to strengthen a two-way street communication between end-users, space agencies and experts generating end-products.
- Efforts are to be made to encourage, incorporate and train the next generation of scientists to advance the topic on remote sensing of marine litter and debris.

4 Acknowledgments

The IOCCG Task Force would like to thank all the speakers, presenters, contributing members and participants.

Annex 1a: Oral Presentations

Time	Title
08:30	FRONTAL: Satellite FRONTs for detection of Anthropogenic plastic Litter V. Martinez-Vicente et al.
08:45	Observation of Marine Litter Windrows with Sentinel-2/MSI as a Strategic Target for Plastic Pollution M. Arias et al.
09:00	Satellite remote sensing of marine litter floating in open ocean and coastal waters Y.-J. Park et al.
09:15	Self-supervised learning for robust floating debris detection J. Mifdal et al.
09:30	Unraveling the spatial heterogeneity of floating macroplastics at the sea surface using Unmanned Aerial Vehicles (UAVs) R. de Vries et al.
09:45	Polarization signatures of nano- and micro-plastics suspended in the water column simulated at the water surface and top-of-atmosphere levels T. Harmel et al.

Annex 1b: Oral Presentations

Time	Title
10:40	Plastic Litter Project (PLP) 2021 – calibration and validation data for Sentinel-2 floating marine litter remote detection D. Papageorgiou et al.
10:55	Exploring spectral signature unmixing techniques and machine learning algorithms on fused multi- and hyper-spectral data for plastic marine litter detection – the REACT project A. Aiello et al.
11:10	Spectral responses meet AI to detect Marine Litter M. Moshtaghi et al.
11:25	Presenter was not available Marine litter detected by UAV over Patagonian Pristine beaches C. Mattar
11:40	Experimental tests for the detection and characterisation of Plastic Marine Litter by means of fluorescence LIDAR technique V. Raimondi et al.
11:55	Advancing Remote Sensing of Floating Marine Microplastics H. Dierssen et al.

Annex 2: Poster Presentations

Code	Title
62710	Eyes on Plastic – flying high, diving deep to fight aquatic plastic litter E. Haas et al.
62740	The Use of Spaceborne Radars to Image Ocean Microplastic Dynamics C. Ruf et al.
63621	Detecting and recognising surface accumulations in Sentinel-2 imagery T. Kutser et al.
63646	Monitoring of Large Plastic Accumulation Near Dams Using Sentinel-1 Polarimetric SAR Data M. Simpson et al.
63653	Ocean Global Watcher: Detection of marine anomalies using radar or optical satellite images A. Lagrange et al.
64067	Identifying macro plastics assisted by close-range hyperspectral remote sensing and deep learning N. Gnann et al.
64415	Coastal Marine Litter Observatory: drone imagery and AI for marine litter detection K. Topouzelis et al.
64611	Detection of Marine Plastic Source Locations using Machine Learning applied to Sentinel-1 & Sentinel-2 Data S. Lavender et al.
64613	River plastics from space: Combining Sentinel-1 and UAV imagery to monitor mixed debris patches L. Schreyers et al.
65419	Tackling the plastic debris challenge at its source – Linking EO data with multi-source in-situ data for modelling debris pathways from source to sink A. Brand et al.
65445	Using hyperspectral radiometry towards subpixel detection of plastic debris on rivers and shorelines. A. Mata et al.
65637	Feasibility of a satellite mission for monitoring marine macroplastics S. Livens et al.
66571	Assessment of Machine Learning for floating marine litter detection L. Fronkova et al.
66724	River plastic monitoring from space: Fact of fiction? T. van Emmerik et al.
66777	A review of the application of satellite mapping techniques for marine litter monitoring M. King et al.
66853	PLASTIC MONITOR: Detecting riverine plastic conglomerations, fluxes and pathways in Indonesia M. Eleveld et al.
66965	Using a drone-based thermal infrared camera to monitor floating plastic litter L. Goddijn-Murphy et al.
67309	Finding Floating Plastics in Plant Patches using Worldview-3 Satellite Imagery L. Biermann et al.
67385	Ocean Scan, a marine debris database from Earth and space L. Romero et al.
67469	Airborne backscatter LIDAR data over the Great Pacific Garbage Patch and their processing for the Detection of Marine Litter: pros and cons analysis L. Palombi et al.