ESA Discovery and Preparation – OSIP

Campaign on Remote Sensing of Plastic Marine Litter

Ocean Scan

Executive summary

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ocean scan

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1. Executive summary

During the past two decades, the amount of in-situ data and information about marine litter has dramatically increased, especially in the last five years. News about the different garbage patches and citizen awareness has also led to the publication of online surveying campaigns and mobile apps to collect data. An increasing number of projects and initiatives that address the issue of marine litter worldwide include local in-situ campaigns for litter collection and identification of litter signatures in aquatic environments through the pairing of remote sensing technologies and Artificial Intelligence (AI) techniques. Remote sensing has great potential to contribute in mapping marine litter and today, some of the best performing technologies for image analysis were built using open labelled databases. However, the advancement of research in this field is experiencing a slow down due to scarcity of relevant validation data.

One limiting factor for the full development and use of remote sensing for marine litter detection is the access to reliable, extensive, and consistent ground truth of debris ground observations. Although in-situ information exists, the datasets available come with several limitations that ultimately reduce their usefulness in remote sensing applications. First, information is distributed sparsely in different databases, often not updated, inaccessible or focusing only on a specific area. Second, in-situ data collections of plastics or other types of litter are usually tackled in a project-specific approach and often by organisations or teams not familiar with remote sensing technologies and, thus, its data requirements. Consequently, the methodologies used to collect the data are not standardised. Also, the sampling methodologies design rarely considers the requirements to obtain a reliable and robust ground truth that could allow proper AI and Earth Observation (EO) research. For example, existing in-situ databases of marine litter often lack accurate geolocation and temporal (date and time) stamps, essential metadata to perform remote sensing studies.

The increasing possibilities opened by remote sensing technologies in marine litter research can potentially address the identification of debris, the type of litter, pollution sources, distribution patterns, generating a growing demand for curated ground data to develop and validate the different approaches used. It is to address this urgent need that Ocean Scan was created.

Ocean Scan is the first inclusive labelled global marine plastic database, designed to benefit remote sensing researchers. Ocean Scan brings together global in-situ observations and their matching Earth Observation data in one place, and offers additional features specifically designed to benefit remote sensing researchers. Ocean Scan it is available via an online platform easily accessible through a simple log it and it also includes a mobile application specifically designed to collect and classify in-situ data using a standardised approach compatible with remote sensing needs.

With observations significantly more extensive and geographically more diverse than a research campaign, Ocean Scan enables the scientific community to work globally and tackle the problem collaboratively, unlocking and promoting the potential of Earth observation research in marine litter studies, implementing complete data collection methodologies and fostering collaboration between organizations and researchers across the world, and relying on a clear code of conduct.

Ocean Scan was created by the consortium composed by isardSAT, represented by the child company Lobelia Earth; Prototyp Stockholm; Helmholtz Centre Potsdam - the German Research Centre for Geosciences (GFZ) and Zero Plastic Working Group (ZPWG), represented by its coordinator Université de Versailles Saint Quentin (UVSQ).

Ocean Scan web platform is available at www.oceanscan.org.

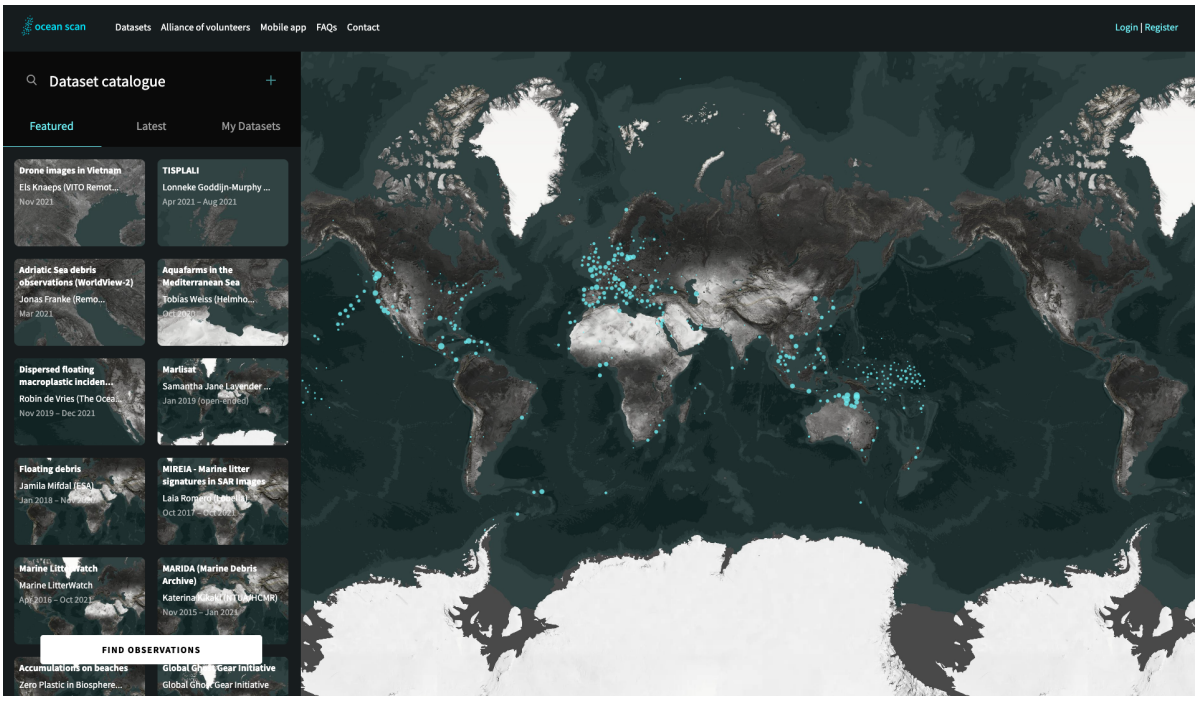

Figure 1: Ocean Scan web portal

The web portal enables marine litter data upload, download, edit, exploration, and visualisation and is accessible to anybody without need for registration. Login is however needed to access detailed information about observations. Observations are grouped in datasets, also called campaigns, which can have two levels of privacy:

- Public: registered users are able to access metadata on campaign and observation level;
- Not Public: registered and not registered users are able to see only campaign metadata while they are not able to access the observations metadata;

The database has been pre-populated with the support of the Alliance of Volunteers, composed by a curated selection of leading international experts, which voluntarily included their data in the platform as pioneer users. The list of volunteers is available in a dedicated section of the website (https://www.oceanscan.org/the-alliance).

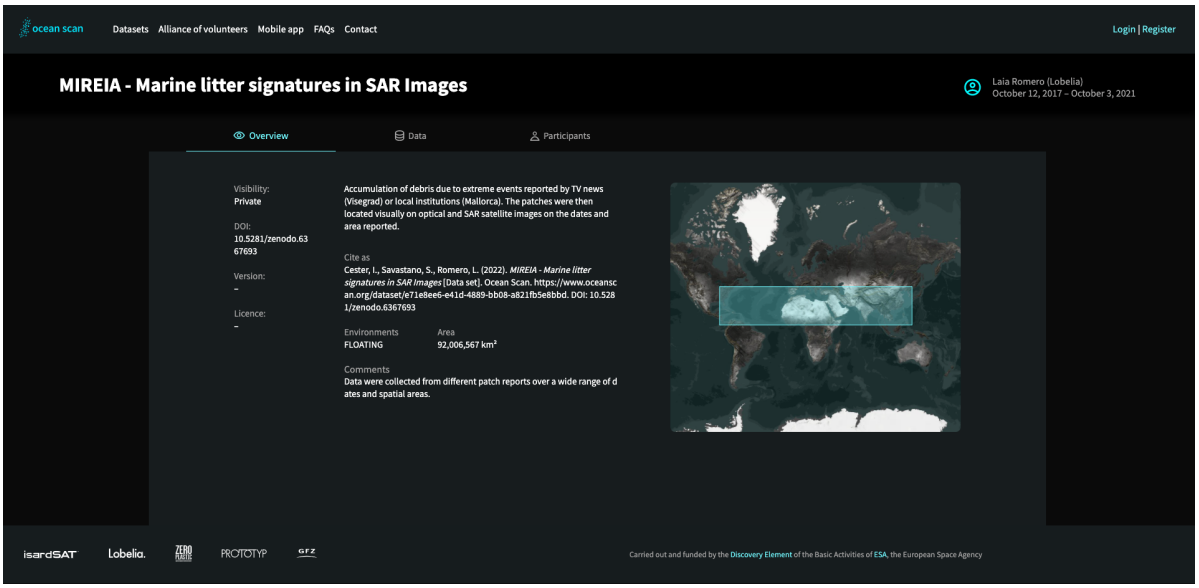

Figure 2: Example of a dataset page

Each observation includes the following metadata:

- Geolocation, date and time stamp;
- Visual inspection metadata, which provides a first visual characterization of the observation in terms of shape, surface area and depth;
- Source and validation type with which instrument the observation was identified and eventually validated or verified;
- It is possible to specify if the observation is a controlled target;
- It is possible to register the absence of litter, which can indicate either clean water or materials different from litter (e.g. accumulations of foam or algae);
- Each observation can be associated with one or more measurements which indicate the type of material and the quantity composing the observation. It is also possible to include if the measurement is approximate and if the observation has been collected;
- If available, a validation image can be included. Currently ingestion of the images is supported by the API and the Mobile app;
- Thumbnails EO images matching the observations (retrieved for -3 and +3 days centred in the observation point) are also shown and currently include Sentinel 1, Sentinel 2 and Sentinel 3 missions. Further development can also include very high resolution (VHR) missions.

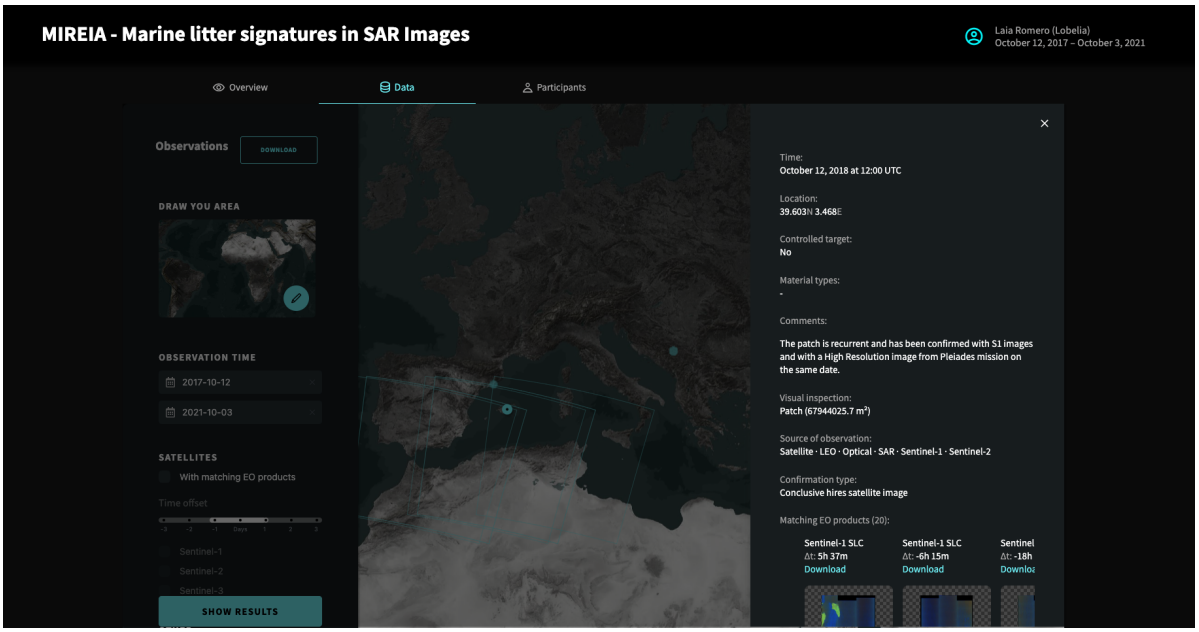

Figure 3: Example of observation metadata

Each campaign can include several participants. Each participant can add new observations to the campaign via a dedicated CSV available on the web portal, via Mobile app or via API.

Ocean Scan users retain full ownership of their data. For each new dataset ingested a Zenodo DOI (https://zenodo.org/) is created, if it is not provided by the author. This enables and supports credit recognition and ensures data provenance, also offering early accreditation for the work performed before the publication of the related paper.

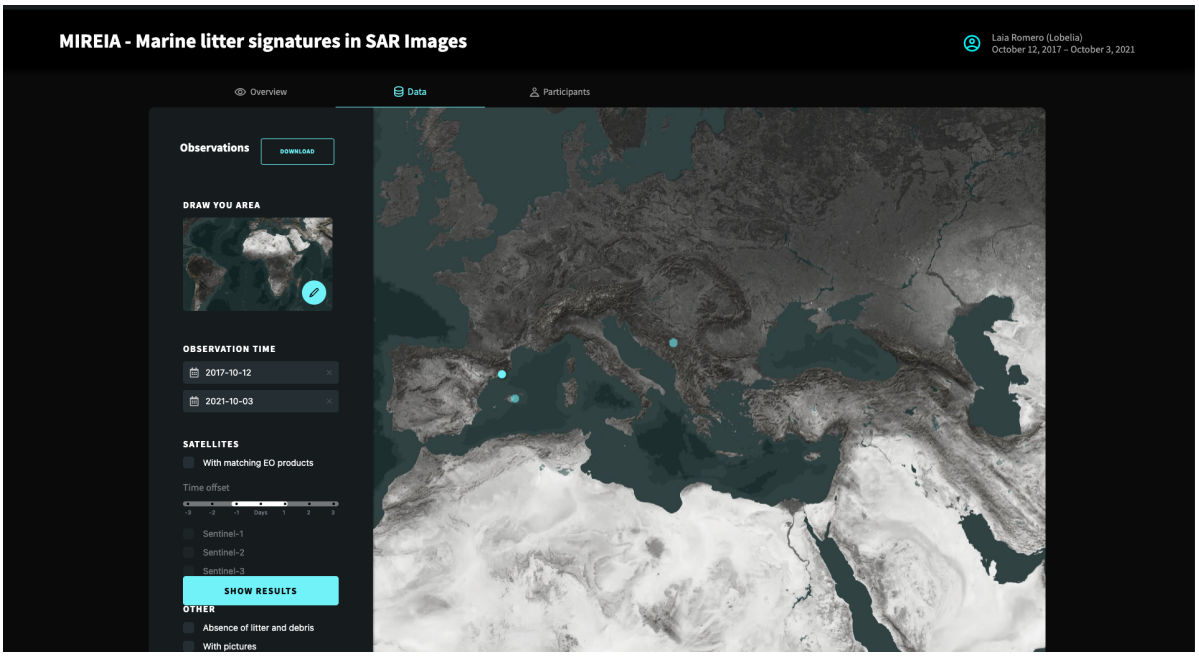

Figure 4: Example of filters on campaign level

Through the portal it is possible to navigate and filter observations at database and campaign level as well as download the data in CSV format. The catalogue is also accessible via API https://www.lobelia.earth/api-ocean-scan.

Ocean Scan offers a way to streamline data ingestion from other systems. This can be done via API, as well as via a dedicated straightforward and intuitive mobile application, which enable to directly ingest observational samples during field campaigns.

The app is available for both iOS (https://apps.apple.com/us/app/ocean-scan/id1550938728) and Android (https://play.google.com/store/apps/details?id=se.prototyp.oceanscanapp&hl=en&gl=US).

The field included in the app comprise all the relevant metadata listed before, and it also enables users to take or upload an image of the observations directly from the phone. The app also works in complete absence of network signal, and automatically pushes the data to the server when connection is available.

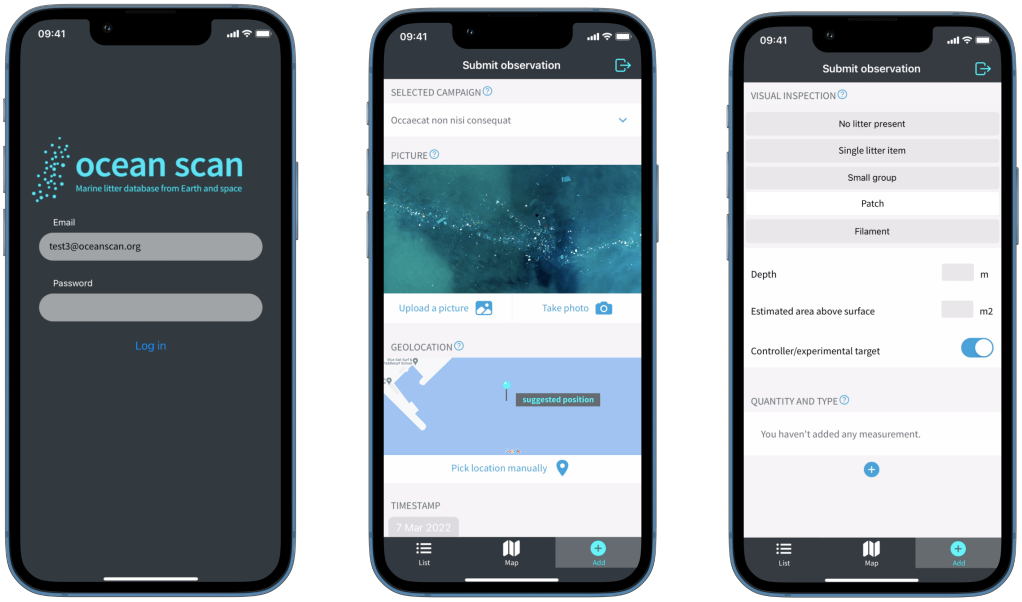

Figure 5: Ocean Scan Mobile app for iOS

Ocean Scan aims at facilitating and promoting global cooperation across marine litter research, offering a powerful tool not only for researchers but also for other types organisations working on marine litter and debris. From a downstream application point of view, Ocean Scan:

- Provides the grounds for extensive studies of remote sensing with AI for marine litter detection and tracking around sources, sinks and pathways;
- Provides a hands-on and very practical platform to boost EO studies for marine litter detection, greatly facilitating the collaboration between EO scientists with biologists and oceanographers that monitor and study plastic pollution occurrence in-situ;

- Offers a unified hub and harmonised data and metadata format, fulfilling the requirements to be used in AI modelling, in terms of standardisation, structure, and size, streamlining data collection and data standardisation processes;
- Offers tools to facilitate the contributions to a global database by migrating existing data from past campaigns and also by easing the data collection for future campaigns;
- Supports the launch of targeted data rescuing campaigns at sea;
- By promoting and boosting remote-sensing studies it accelerates the understanding of the problem, also supporting the design of tailored solutions on the ground and the design of future remote sensing missions.