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Remote Sensing of Marine Litter

OPTIMAL - Optical methods for Marine Litter detection

Executive Summary (D8)

Issue 1.0

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CONTRACT REPORT

The work described in this report was done under ESA contract.

Responsibility for the contents resides in the author or organisation that prepared it.

Revision History

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1.0	04/08/2019	VMV	Creation

1 Executive Summary

The main aim of OPTIMAL was to perform a feasibility study on a potential mission or system to detect marine plasatic litter from satellite remote sensing. To do so, the project activities involved the following aspects:

- **User requirement consultation and engagement**: Through a literature review, an online questionnaire and a user consultation workshop co-organised with ESA initial requirements for marine litter mission have been collected. An initial iteration of a Compliance Matrix has been produced.
- **Experimental phase**: The user requirements have been refined through experiments in the laboratory, a field campaign and a satellite based study. It was found that only areas in the ocean with high concentrations of microplastics and low concentrations of chlorophyll could be amenable to observation using radiometry in the visible. In addtion, Sentinel-2 images provided preliminary evidence of aggregation of large material over fronts. Importantly, it has been shown through OPTIMAL that there is potential for plastic detection by focusing detection around the 1732 nm.
- **Conceptual Design and Development Plan**: Having demonstrated the potential for detection, the Conceptual Design and Developement Plan is mostly proposed in terms of a Scientific Roadmap, to progress the fundamental science through more realistic situations to refine sensor reguirements. At the same time, it has been proposed that current Earth Observation assets are used to create "risk maps" from oceanographic discontinuities that are likely to accumulate marine debris, like fronts or windrows.

Results from the project have been presented in several forums:

- **Scientific Publications published, submitted and in preparation**:
  - Maximenko et al including Martinez-Vicente (*Accepted to Frontiers in Marine Science*. Towards the Integrated Marine Debris Observing System.
  - Martinez-Vicente et al *submitted to Remote Sensing*. Measuring marine plastic debris from space: initial observation requirements.
- **International Conferences and Workshops**
  - Martinez-Vicente et al. Optical Methods for Marine Litter Detection (OPTIMAL): From User Requirements To Recommendations For A Mission Roadmap. Oral. ESA Atlantic from Space workshop. Southampton , February 2019.
  - Lauren Biermann, Victor Martinez Vicente, Sevrine Sailley, Aser Mata, and Christopher Steele, Towards a method for detecting macroplastics by satellite: examining Sentinel-2 earth observation data for

floating debris in the coastal zone. Oral. EGU General Assembly, Viena, April 2019.

  - Martinez-Vicente et al. Optical Methods for Marine Litter Detection (OPTIMAL): From User Requirements To Recommendations For A Mission Roadmap. Oral. ESA Living Planet Symposium. Milan , May 2019.
  - Mata et al. Optical Remote Sensing Detection Of Plastic Targets On The Shore: Field Campaign And Modelling Results. Poster. ESA Living Planet Symposium. Milan , May 2019.

- **News**:
  - BBC interview to L. Biermann: Can you spot ocean plastic from space? `https://www.bbc.co.uk/news/science-environment-47910600`

References

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