Plastic detection using a multi-model approach: The case of Southern California-Baja California

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Abstract. Floating plastic particles have been documented in all water bodies. In particular, increasing attention has been drawn to the impacts of microplastics on aquatic ecosystems. Their small size makes them more suitable for passive ingestion by a wide variety of organisms with serious effects on their survival rates (Cózar et al., 2014). Although an increasing body of literature addresses the impacts of marine litter and microplastic pollution, monitoring and reporting on their distribution, magnitude, and location remain an open issue. A standardized and sound framework to detect marine litter and MPs enables traceability of the water pollution cycles to confirm existing ocean models and estimates of the absolute volumes and flows of plastics into the marine environment. Furthermore, it can be used to determine environmentally realistic and standardized effects associated with the risk of exposure to plastic pollution and leachates for marine ecosystems. To this end, the framework can be employed to produce scenarios and time series to project marine litter and MPs accumulations under specific conditions. Finally, it will advance understanding of the dislocated effects of human activities on the marine environment, localizing potential sources of plastic and MPs leachate into water bodies.

This study aims to produce a consistent global harmonized system for detecting plastic and MPs in coastal waters, analyzing the southern California-Baja California shore area (United States-Mexico border) as a main case study. In doing so, it attempts to overcome the limits posed by existing detection systems on one hand, and addresses marine plastic pollution as a transboundary issue, which requires trans-national and harmonized accounting on the other. In particular, the following question is addressed: What are the magnitude, abundance, distribution, and location of the sources and pathways into the marine environment of marine plastic debris? Figure 1 shows a plastic model detection methodology using a multi-modal approach for the southern California-Baja California region.

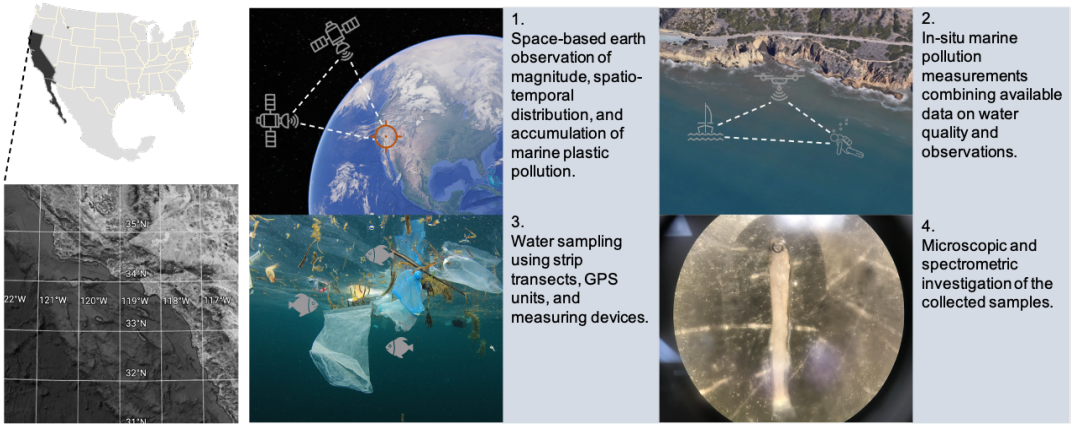

Figure 1. Plastic detection using a multi-model approach for the southern California-Baja California region: (1) *Space-based earth observation* is used to map plastic accumulations along the coastline of southern California and Baja California and create a consistent ocean particle tracking model. Satellite imagery is then combined with high resolution spectrometric images to detect the extent of plastic accumulations that are not readily visible through satellite images (e.g., smaller plastic particles, ocean plastic flows below the water surface). (2) *Marine pollution measurement and modeling*, integrating available data on water quality (national statistics and accounting, environmental reports) and in-situ observations using detection sensors. (3) Measurements are conducted on selected areas through *water and fish sampling*. Sampling materials include strip transpect, portable GPS units, measuring devices, and digital cameras. (4) Finally, the collected samples are analyzed using a microscope. Specific analyses include *incidence and amount of plastic accumulations* in the water samples, and interconnections between MPs encounter and ingestion rates in marine organisms. In particular, this paper will address (1).

This study is an ongoing project developed through a collaboration between Politecnico di Milano, Milan (Italy) and San Diego State University, San Diego (California). Its ultimate goal is to produce a model protocol for plastic and MPs detection in water bodies and sustainable best practices and implications for coastal and environmental managers, the maritime and tourism industry, and coastal populations that rely on marine resources for their livelihood. Expected outcomes of the study encompass the development of a replicable and scalable model to harness the power of satellite imagery by combining earth observations from ESA OptiMAL project and open source participative geodata of marine plastic debris by the support of OpenStreetmap and especially JOSM and MapOSmatic. The goal is to assess regional coastal models, while identifying hotspot meshes (patches, and particles in the upper layer of the ocean) acquired by citizen mapping.

References

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