Plastic Litter Project 2018: Exploring the Detection of Floating Plastic Litter using Drones and Satellite İmages

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Abstract

Plastic litter has been shown to pose a significant problem in the marine environment and the food chain at all trophic levels. Within the scope of Plastic Project 2018, we investigated the prospective use of imaging technology on airborne and spaceborne platforms in detecting floating plastic litter. Three artificial targets of plastic litter were prepared using PET-1water bottles, LDPE plastic bags and nylon fishing ghost nets. Each target measured 10 m x 10 m fixed by a PVC frame to prevent spillage as well as to make an aggregated target. We evaluated the derived spectral reflectances of these plastic litter targets gathered from the airborne (drone) and spaceborne (Sentinel-2) images. Improved geo-referencing of the high geo-spatial resolution (resampled 10 m) Sentinel-2 images was achieved by utilizing excellent geospatial resolution (<0.03 m) drone images. Further analysis involved determining accurate pixel coverage of each target with future application in quantification efforts. Of the three plastic litter targets, it was noted that the plastic bottles had the highest spectral reflectances that were measured by the Sentinel-2 mission image. The experiment showed that Sentinel-2 satellites could be used to detect marine plastics when they cover a large area. The Sentinel-2 NIR band can significantly contribute to marine litter detection and the water content partly influence the behaviour of spectral values.

Keywords: floating plastic litter, remote sensing, spectral reflectance of plastics, drones, UAV, UAS, pollution

1. Introduction

Drones and satellites are proving to be an essential source of information in understanding the distribution of floating plastic litter that complements classic invaluable net trawl datasets (Garaba et al., 2018; Maximenko et al., 2016; Topouzelis et al, 2019). Remote sensing platforms have the potential to generate the supplementary information offering geo-spatial and temporal coverages important for detecting and tracking floating plastics. Exploratory studies have shown the benefits of using remote sensing platforms in detecting, identifying and quantifying floating plastics and land based plastics (Aoyama, 2016; Garaba et al., 2018; Garaba and Dierssen, 2018; Hörig et al., 2001; Veenstra and Churnside, 2012, Topouzelis et al, 2019).

2. Data and Methodology

The PLP2018 was conducted on 06 and 07 June 2018 to Tsamakia beach of Mytilene on Lesvos Island, Greece. During the first day, 06 June 2018, the robustness of the proposed pipeline for target setup and UAS data acquisition was examined. Tsamakia beach is about 400 m in length. The top layer of the beach is sandy mixed with some pebbles and the deeper waters are covered by *Posidonia Oceanica* seagrass meadows. Weather conditions during the experiment were ideal; clear skies, very calm sea conditions (1 - 2 cm of waves, no visible white caps) and with low wind speed (2m/s). Some clouds appeared in the northern part of the area without affecting the study area.

The targets used in PLP18 were plastic bottles, plastic bags and plastic fishing net (Figure 1). Each target held together by a 10 x 10 m frame, matching the Sentinel-2 spatial resolution. We used PVC pipes with a 20 inch o construct the frame and we attached plastic net with 1.5 cm mesh size to create the base of the frame. The frame was essential for preventing plastics loss by a possible sinking of samples. The three targets positioned 30 m away between them and away from the coastline to avoid mixed pixel detection from spaceborne data. The full deployment was materialized by 30 students, divers and inflatable boats at 10:00 local time (GR) and removed at 20:30 just after Sentinel-1 satellite overpass. The targets were position very successful in relevant good depth (around 8 meters). The weather was sunny with low wind speed.

3. Results

Each target is captured in four pixels in Sentinel-2 image due to image geometry and resampling procedure. All targets are visible in the image since the pixel radiance values are significantly changed from the neighboring pixels. The plastic bottle target is clearly seen in true color composite and in all bands individually to (Topouzelis et al., 2019). The northeast pixel seems to contain the most part of the target

because it differs significantly in the spectral value from the rest three pixels. The fishing net target is also visible in the bands and the RGB combination. The two east pixels of the target have the same spectral response and seem to contain most part of the target. A full overview of the experiment is given to (Topouzelis et al., 2019) and to Marine Remote Sensing Group web page (https://mrsg.aegean.gr/).

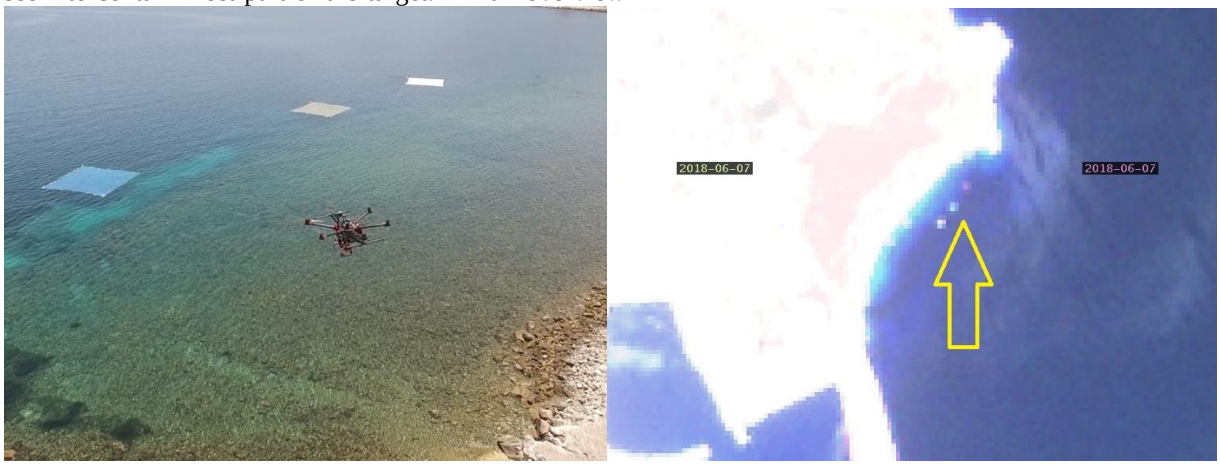

Figure 1. A drone image of the blue plastic bags, yellow fishing net and clear water bottles as floating targets (left) as captured on 07 June 2018 Sentinel-2 image (right)

4. Discussion And Conclusions

The main target of the present paper was to understand if commercial Sentinel-2 satellites can be used for marine plastic detection, and if yes in which extent. The three 10m artificial targets built during the experiment represented areas with high litter surface concentration i.e. cumulative open sea areas. Each, plastic target was identified by the Sentinel-2 satellite image in four pixels, due to image geo-registration issues, in optical bands and in NIR bands. Therefore, the main conclusion which can be derived from the experiment is the ability of Sentinel-2 to detect plastics, when they cover large area. This area could be a large portion of the 100 m2 coverage of Sentinel-2 pixel. The percentage plastic coverage of the satellite pixels justified how the plastic targets represented in the satellite image. The spectral behavior on the plastic coverage is crucial for future plastic detection and volume calculation algorithms from space.

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