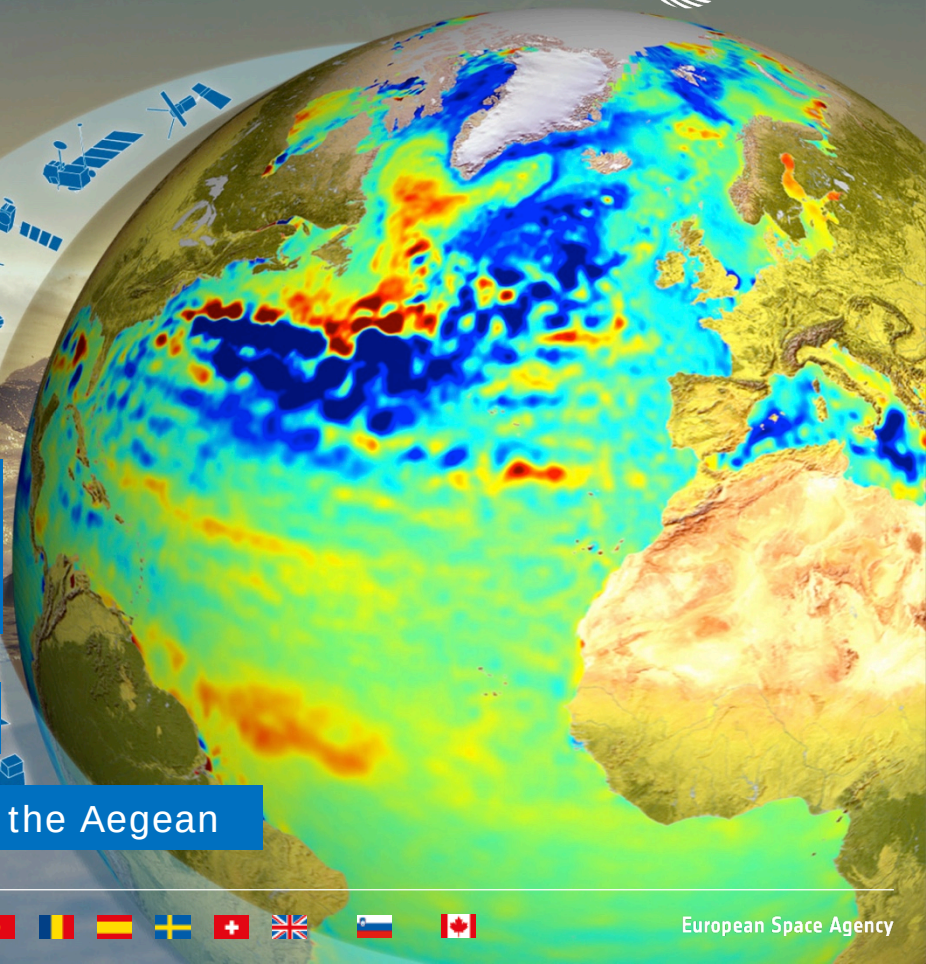
→ ATLANTIC FROM SPACE WORKSHOP

23–25 January 2019
National Oceanography Centre
Southampton, UK

Plastic litter detection from space: current knowledge and lessons learned from the Plastic Litter Project 2018

K. Topouzelis and A. Papakonstantinou

Department of Marine Sciences, University of the Aegean



Plastic Litter Project 2018

Innovative exploratory application of UAS and open-access satellite imagery in remote detection of floating plastics in natural seawater.

Scope:

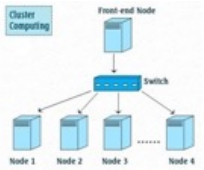
i) Explore the feasibility of detecting plastics in the aquatic environment using UAS and open access satellite missions, and

ii) to extract meaningful spectral measurements in near-real scenarios & compare the geospatial information ranging from moderate to very high resolution.

How plastic targets are seen Copernicus Sentinel-2 images?

Are we able to simulate the coarse satellite pixel using the fine UAS resolution?

Marine Remote Sensing Group (MRSG)



MARINE
REMOTE SENSING
GROUP
DEPARTMENT OF MARINE SCIENCES
UNIVERSITY OF THE AEGEAN
http://mrsg.aegean.gr

Sentinel-2

Sentinel-3

Agro Mapping

Plastic Litter Project 2018

Three artificial plastic targets 10 x 10 m:
1) 3600 x 1.5 L plastic bottles,
2) 135 plastic bags and
3) 200 sqm fishing net.

Plastic Litter Project 2018

Plastic Litter Project 2018

University of the Aegean

Sentinel-2 (acquisition 7 June 2018)

7 June 2018

Marine Litter Project 2018

6 & 7 June 2018 (Dedicated to the World Environment Day and to Word Ocean Day)

Satellite data:

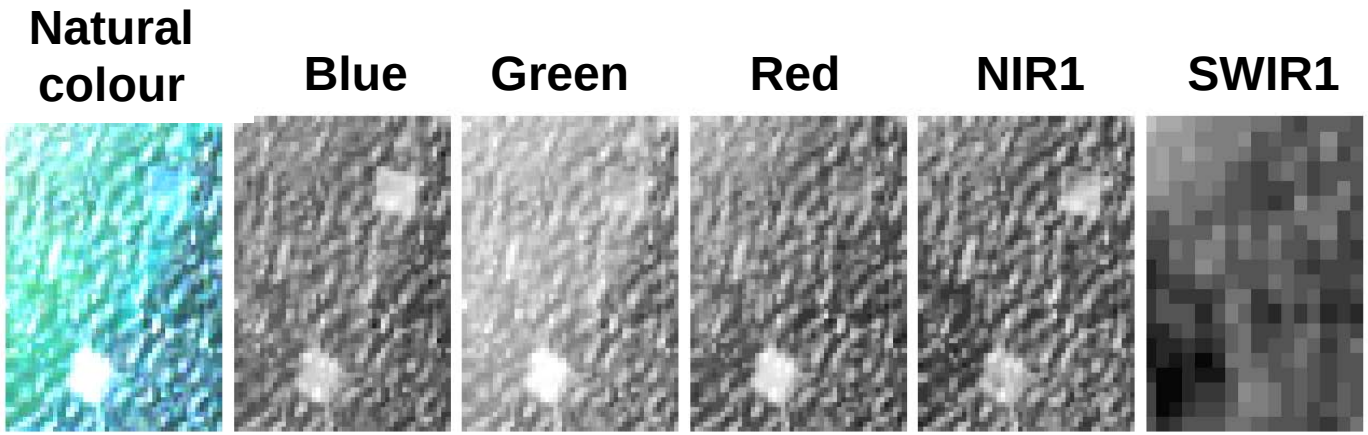
- Sentinel-2,
- Sentinel-1,
- Planet,
- WVIII,
- TerraSAR-X.

Plastic Litter Project 2018

Sentinel-2 satellite
7 June 2018

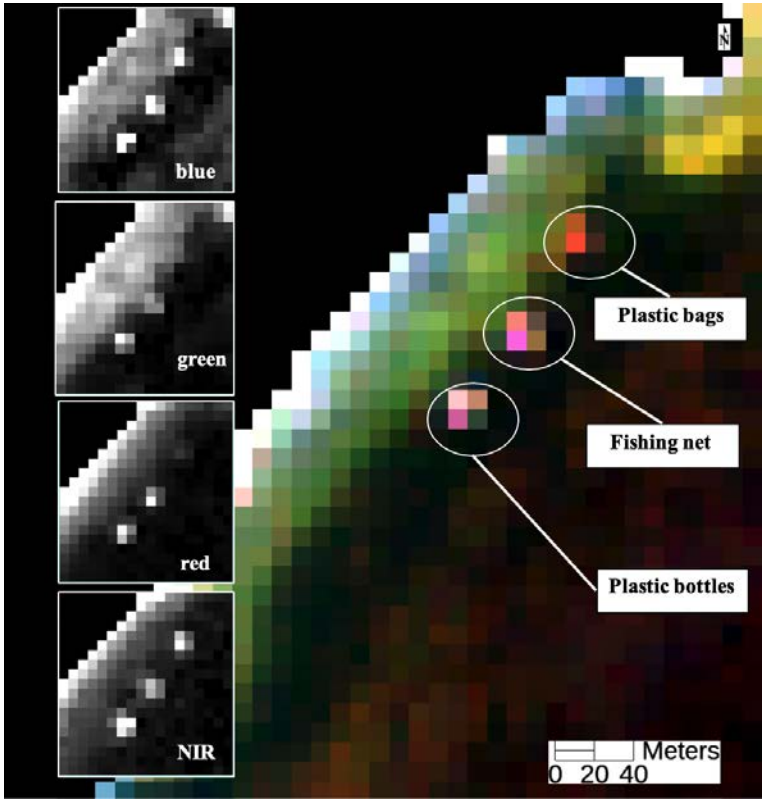
PlanetScope satellite
7 June 2018

Submerged targets visible in all VNIR but not SWIR



WVIII Satellite
(6 June 2018)

Plastic Litter Project 2018



Blue (490 nm): best differences between the targets

Green (560 nm): smaller difference among plastic bottles and fishing net.

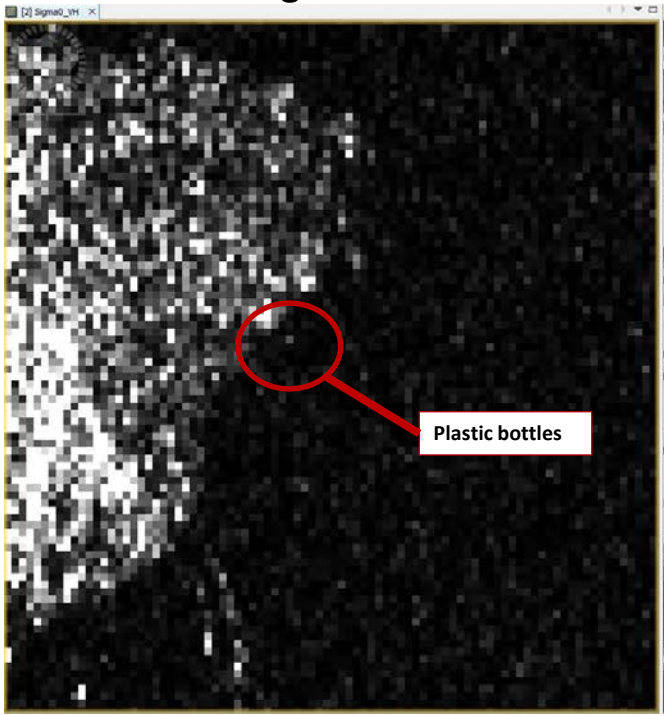
Red band (665 nm): plastic bags can separated from fishing net and plastic bottles

NIR band (842 nm) plastic bottles can be separated from the rest two targets

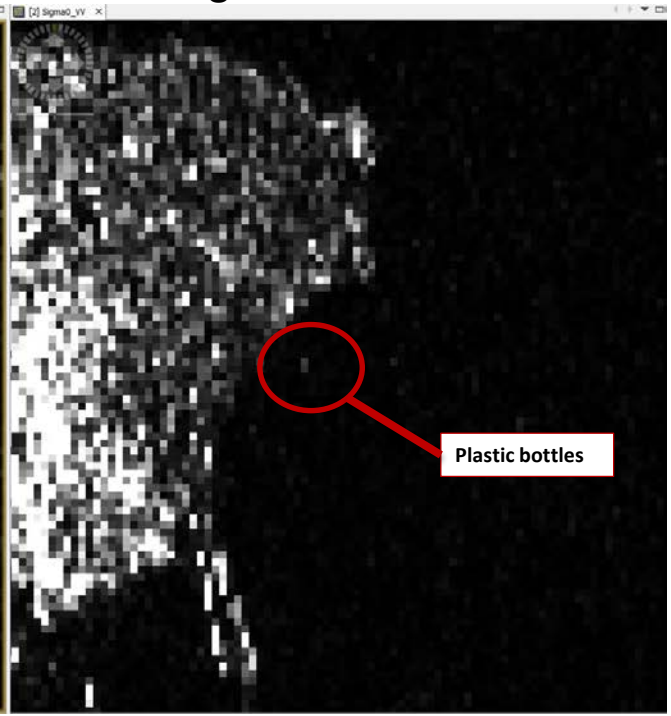
Plastic Litter Project 2018

Sentinel-1
IW SLC
7 June
2018

Sigma VH



Sigma VV



UAS DATA

Number of raw images and geo-spatial resolution acquired using a suite of sensors attached to a S900-UAS.

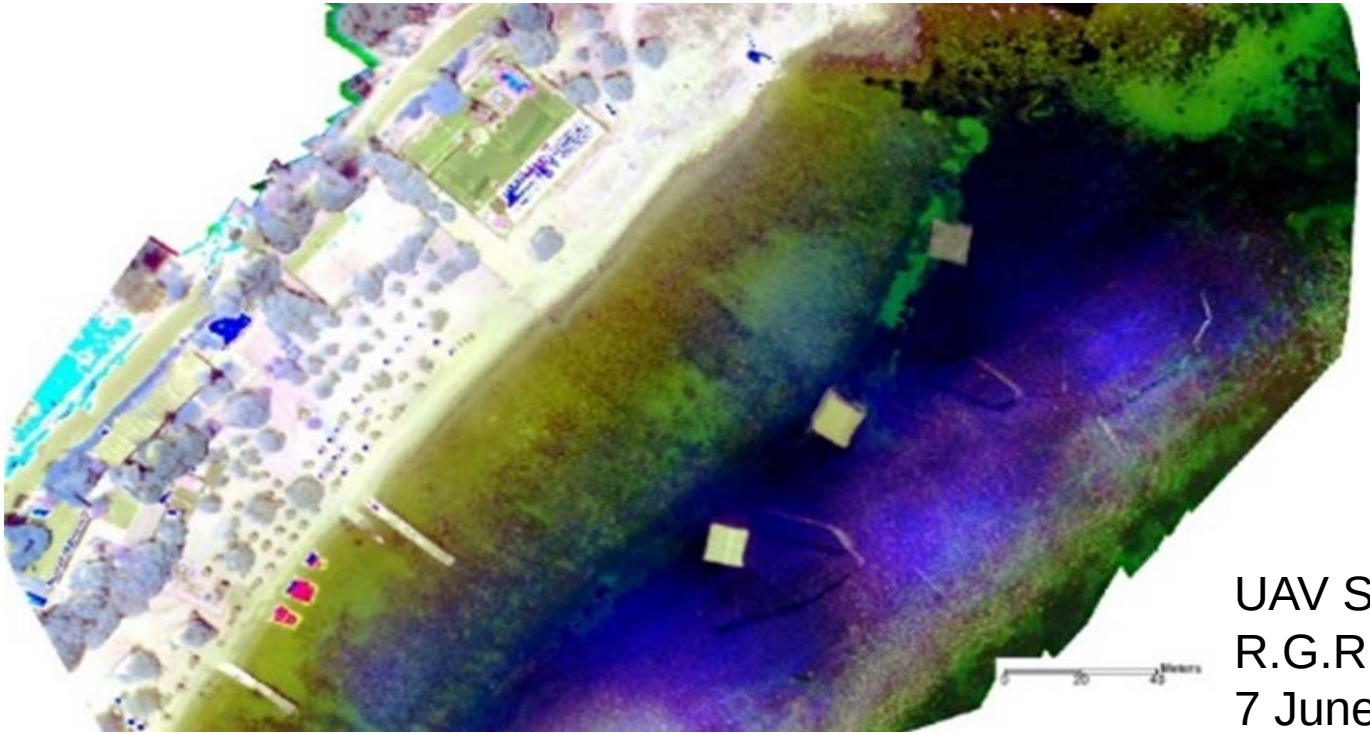
Name of Sensor	Number of Images	Resolution (cm / pixel)
Slantrange 3P	394	4.84
Parrot Sequoia multispectral	872	7.73
Parrot Sequoia RGB	187	2.72
Sony A5100	243	2.14
FliR DUO R Thermal	575	196.5
FliR DUO R Visible	575	10.53

Plastic Litter Project 2018

Plastic Litter Project 2018

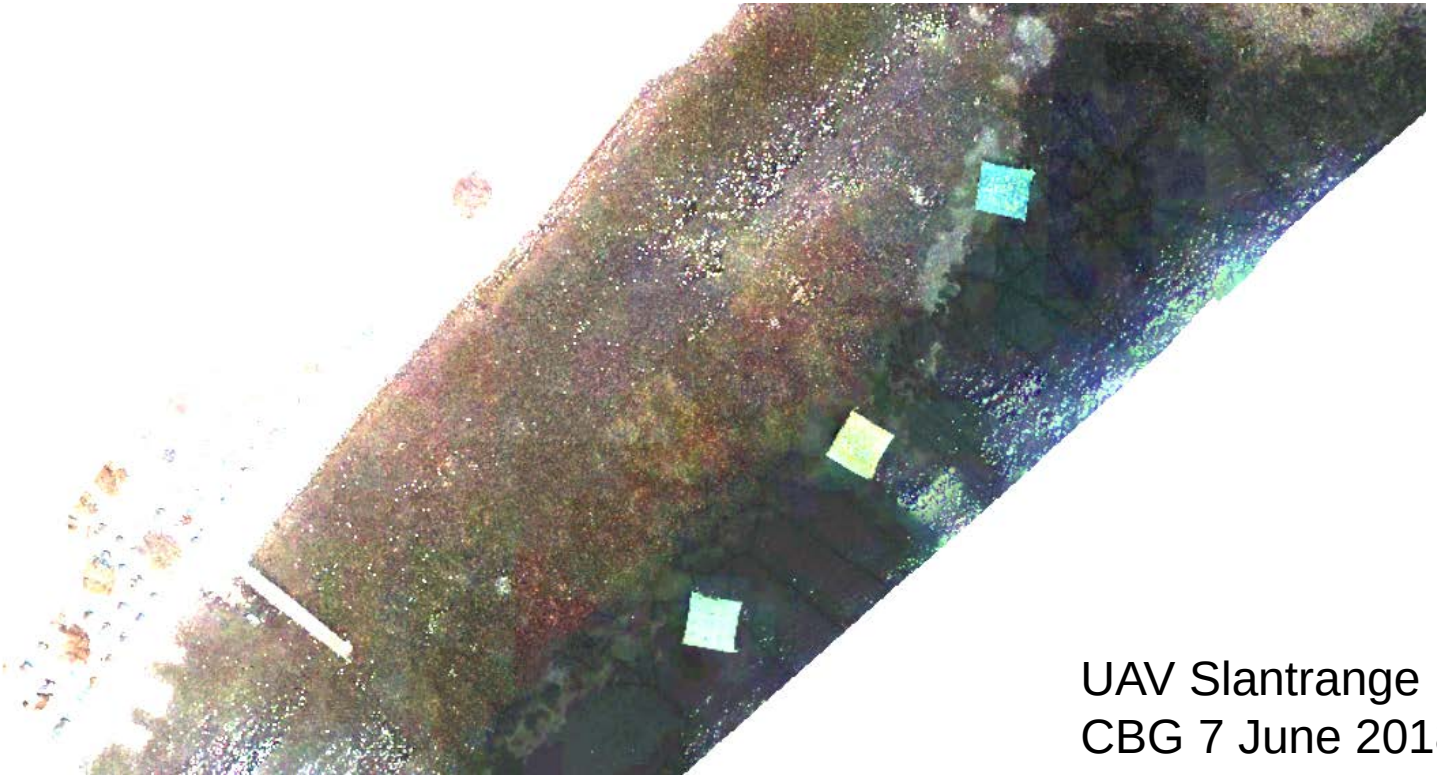
UAV SEQOUIA-RGB 7 June 2018

Plastic Litter Project 2018



UAV SEQOUIA-R.G.RE
7 June 2018

Plastic Litter Project 2018



UAV Slantrange
CBG 7 June 2018

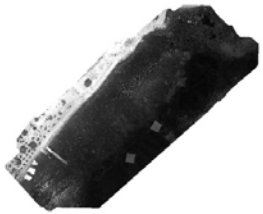
UAV Data acquisition

SLANTRANGE

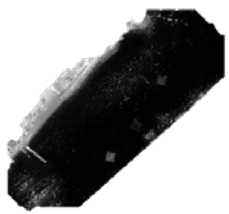
450 ±20

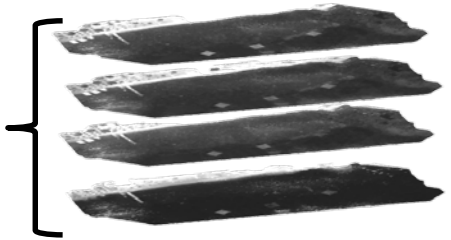
500 ±80

550 ±40



850 ±100

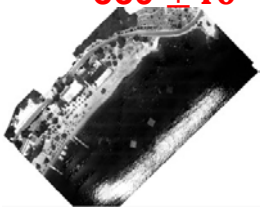




SEQUOIA

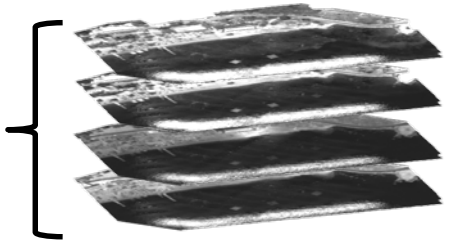
550 ±40

660 ±40



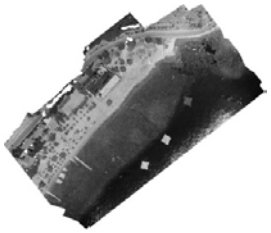
735 ±10

790 ±40

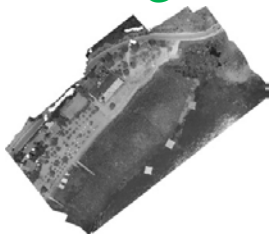


OPTICAL

R

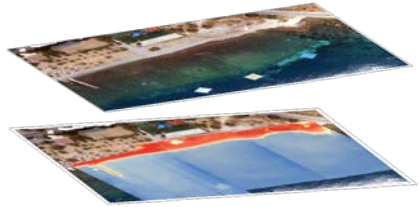


G

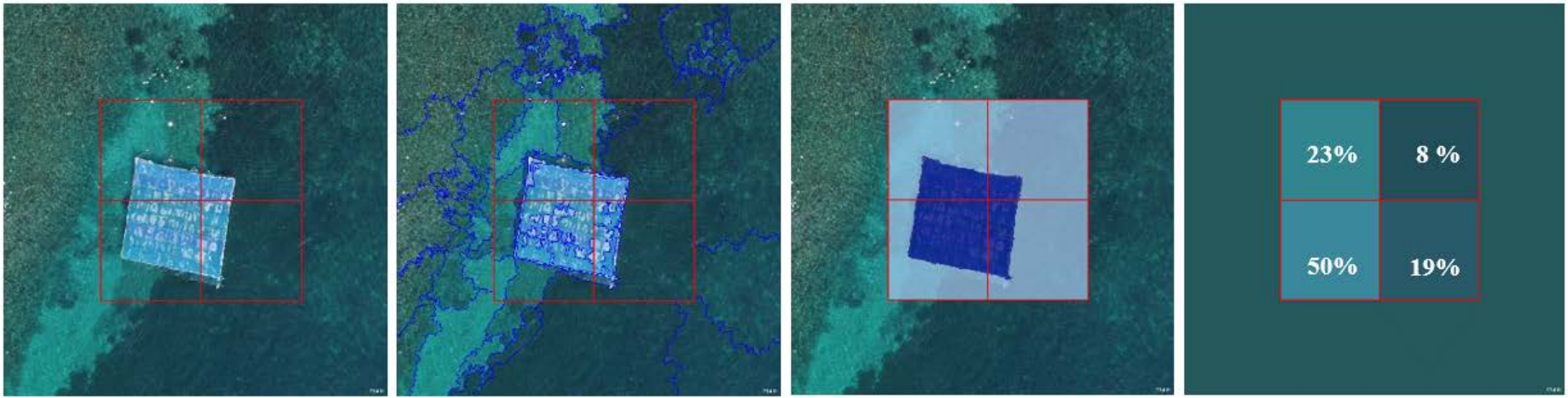


B

THERMAL



Combining Sentinel-2 and UAS data

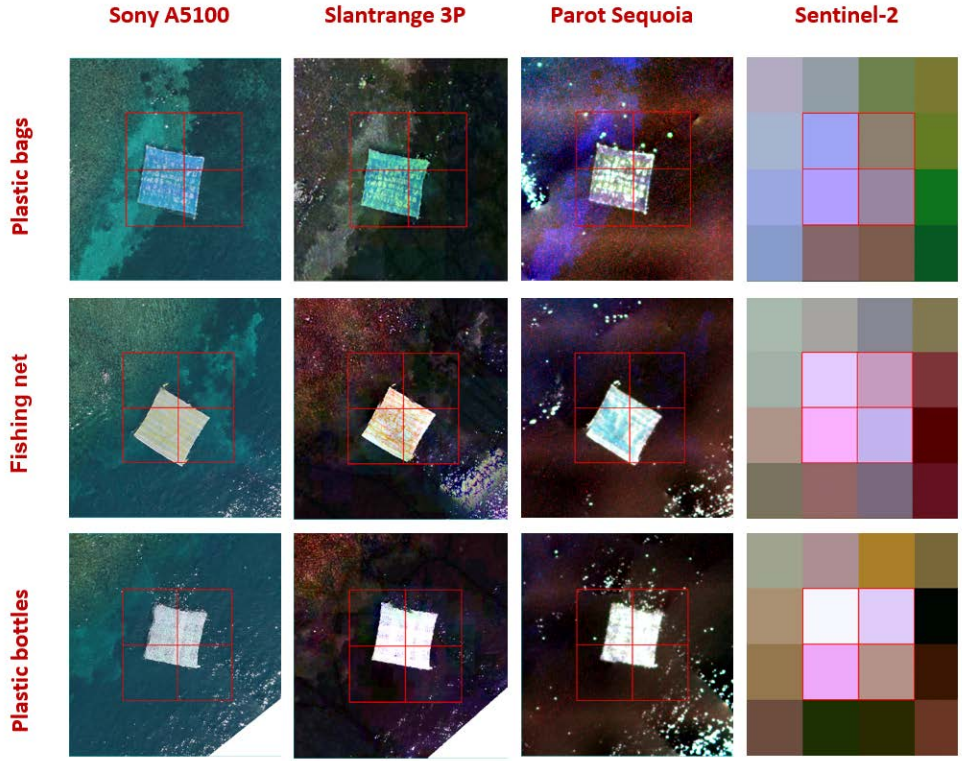


Percentage plastic coverage calculation for each Sentinel-2 pixel using the A5100 othophotomap

Plastic percentage coverage of Sentinel-2 pixels for the three plastic targets. Numbers represent the pixels values of the targets clockwise.

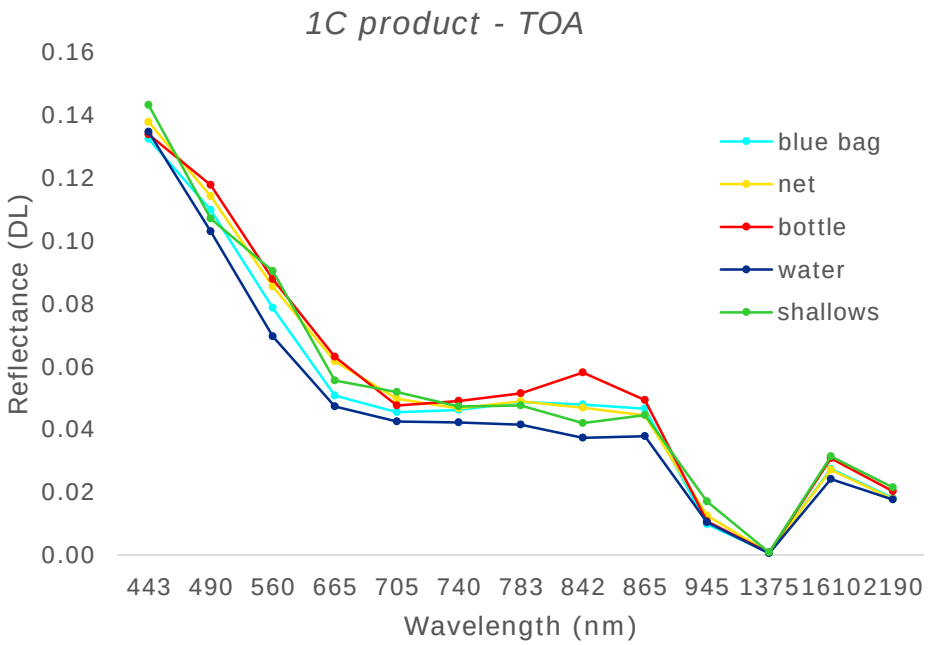
	Sentinel-2 pixel coverage			
	Pixel A	Pixel B	Pixel C	Pixel D
Plastic bottles	34%	29%	15%	18%
Plastic net	12%	3%	34%	55%
Plastic bags	23%	8%	19%	50%

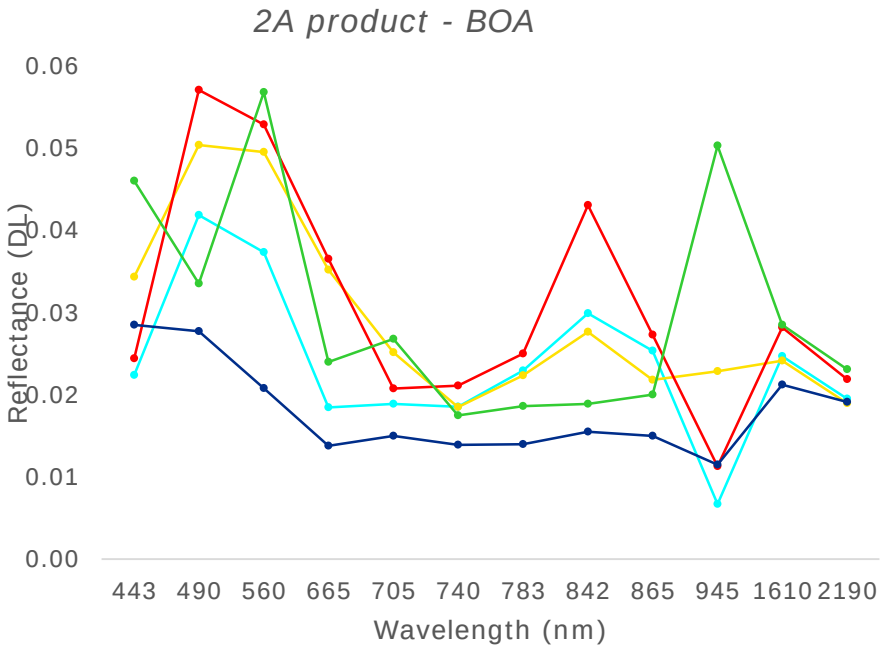
Plastic Litter Project 2018



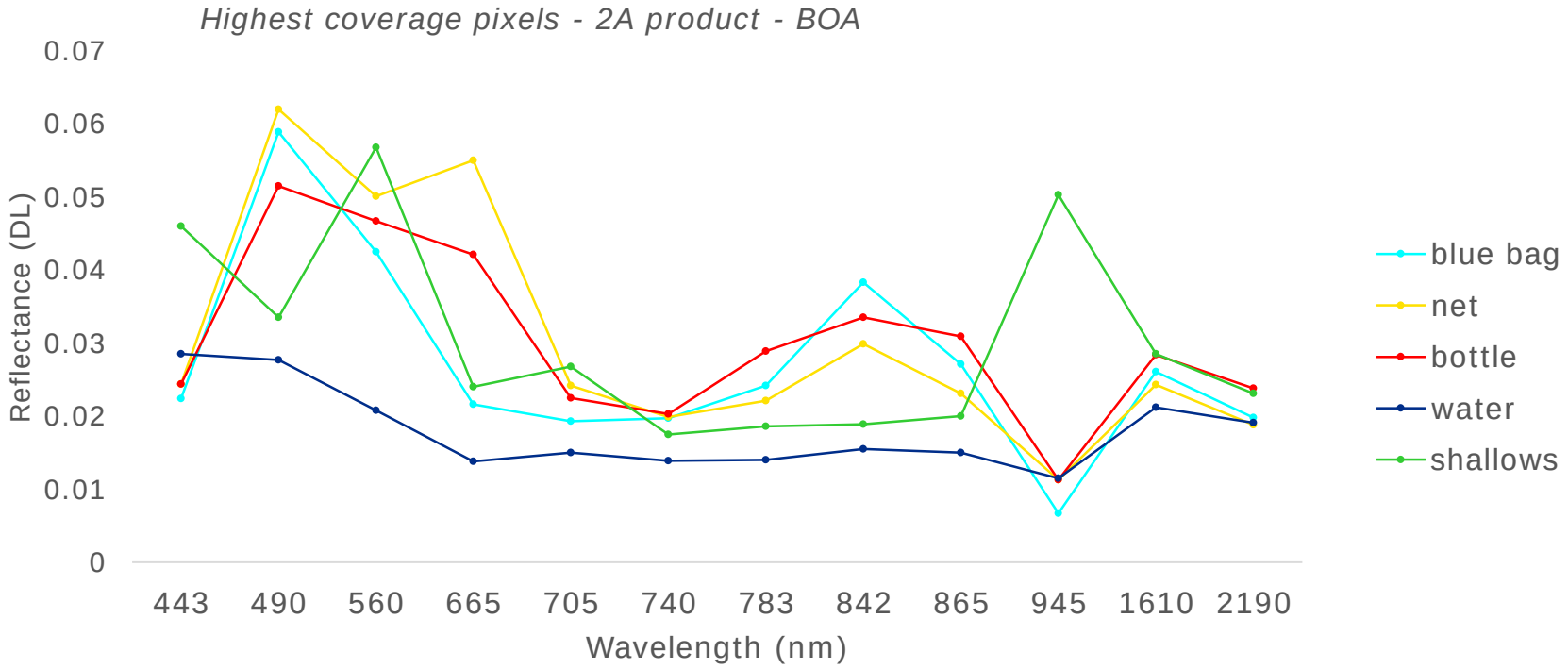
Plastic targets in the three orthophoto maps and in Sentinel-2 image. The annotated red grid illustrates the size and position of the four Sentinel-2 pixels on the orthophotomaps.

Plastic Litter Project 2018

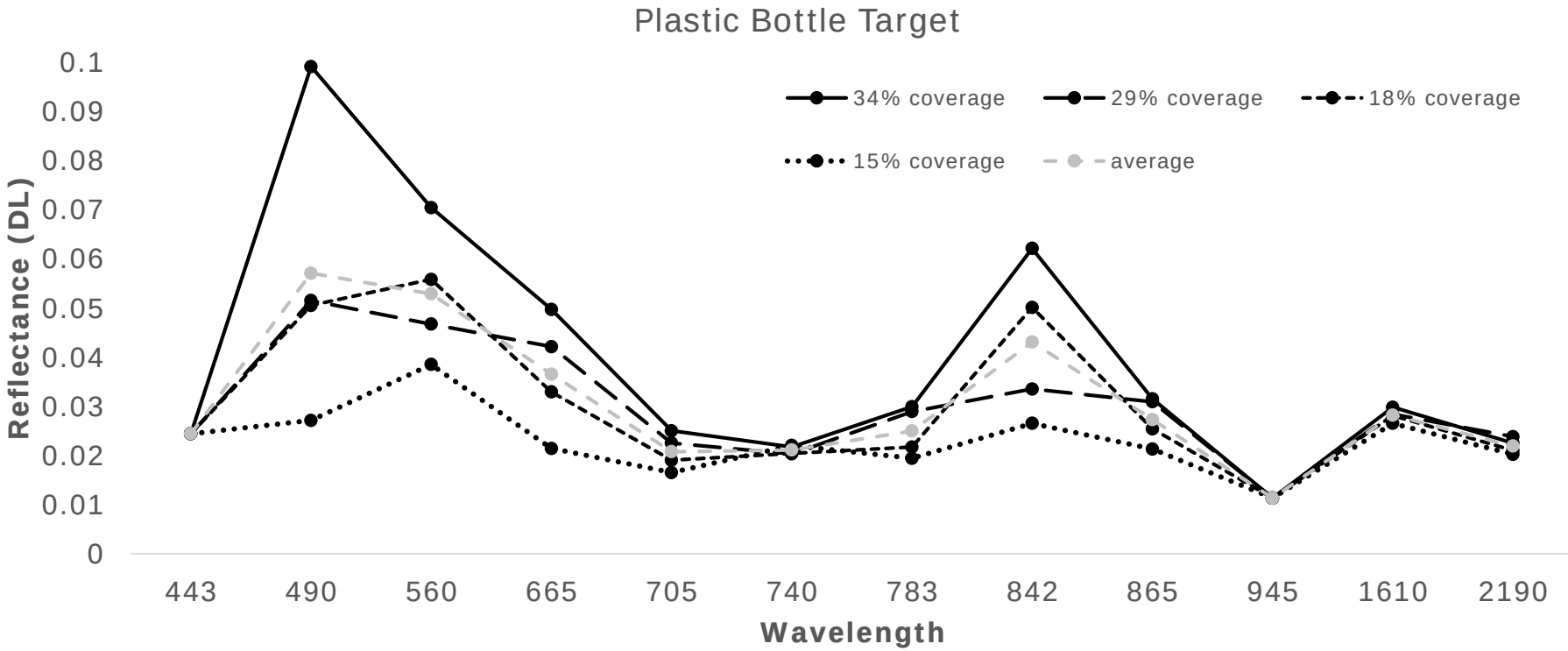




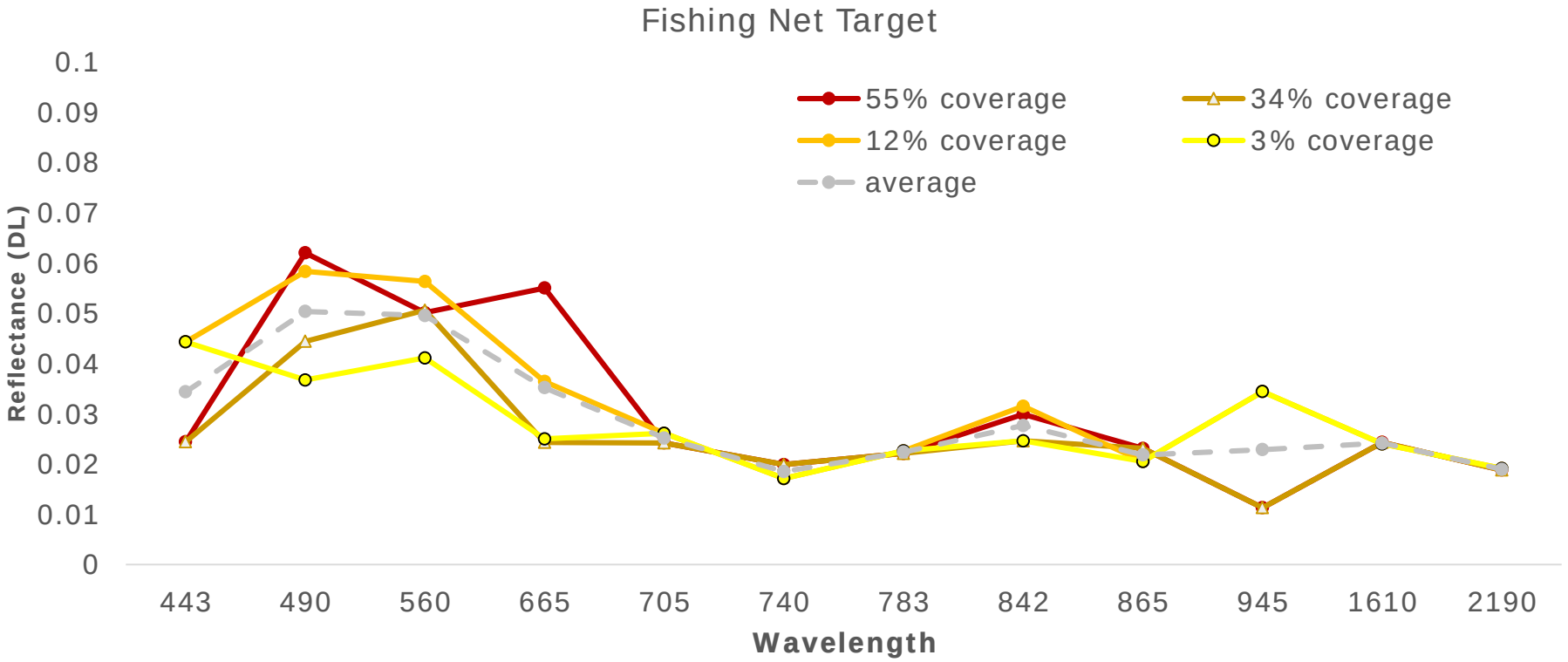
Plastic Litter Project 2018



Plastic Litter Project 2018



Plastic Litter Project 2018



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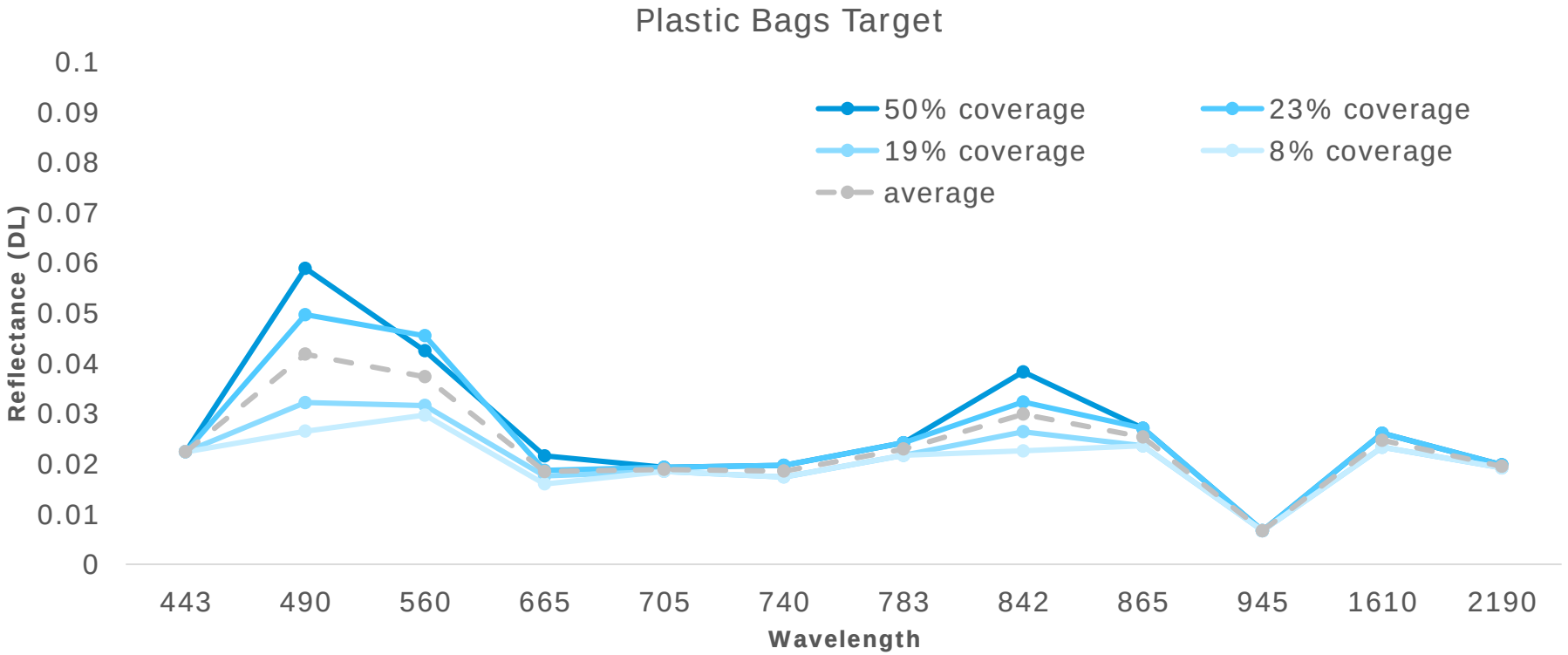
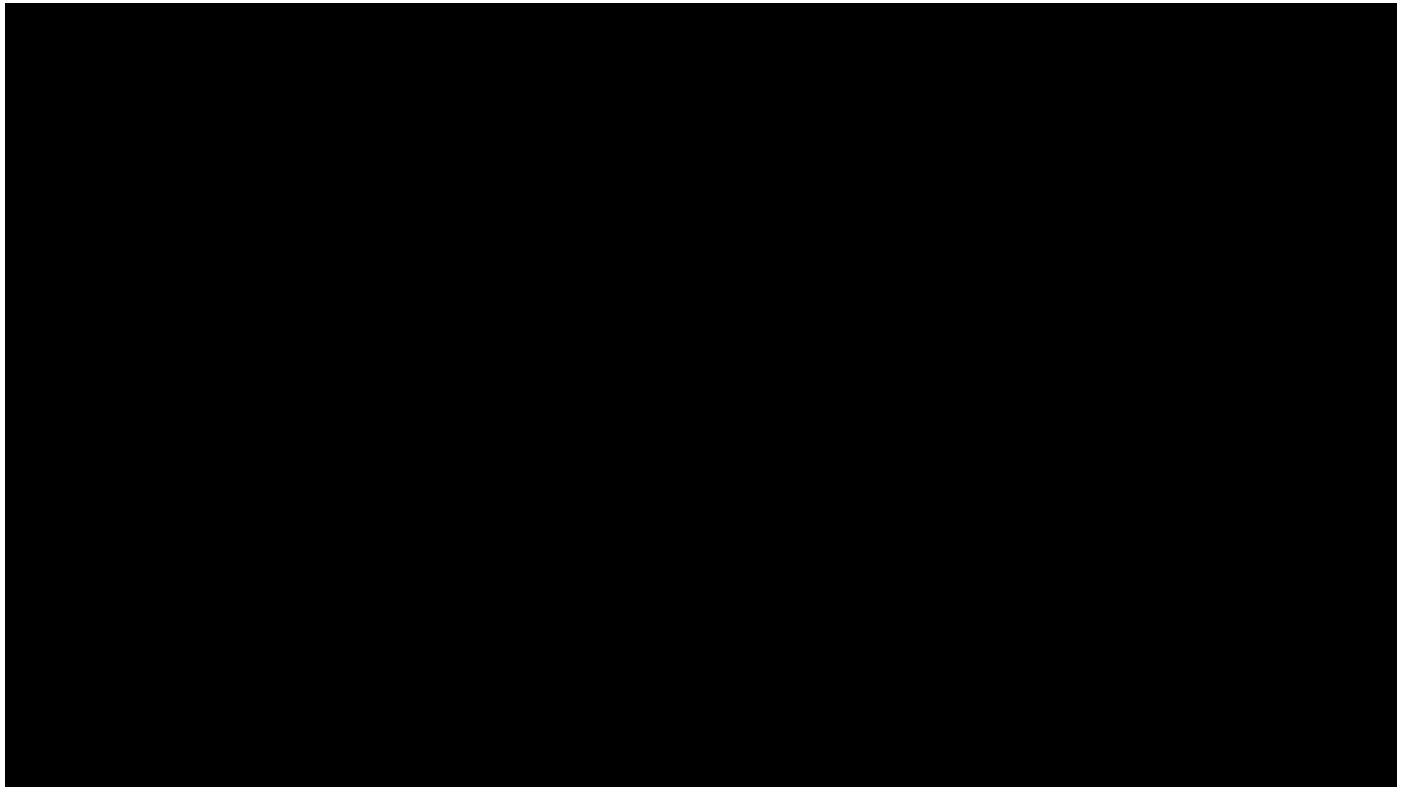


Plastic Litter Project 2018



Plastic Litter Project 2019

EO tracking of marine debris in the Mediterranean Sea from public satellites (EO Science for Society permanently open call for proposals)

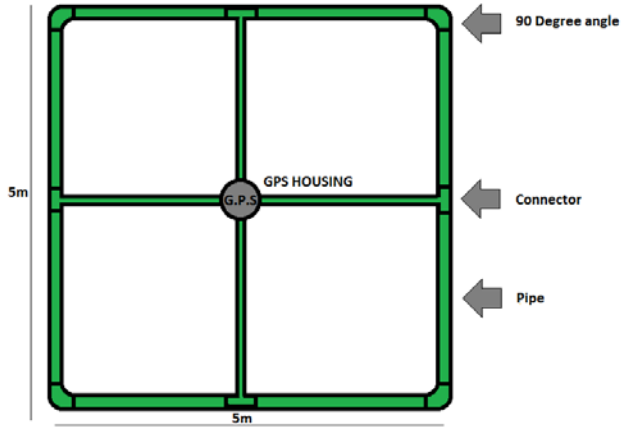
Argans

University of the Aegean

CNR-ISMAR

Universidad de Cádiz

4 new targets



Lesvos Island

Summary – Conclusions (1)

Sentinel-2 images can be used for plastics detection, when they cover relatively large area (large portion of the 100 m^2).

Plastic bottles detected with 30% pixel coverage, but other two targets (plastic bags and fishing net) require a 50% coverage.

S2 observations should aim in areas where the plastic coverage is at least half of the pixel spatial resolution.

S2 NIR band (842 nm) significantly contribute and the water content partly influence the behavior of spectral values.

Summary – Conclusions (1)

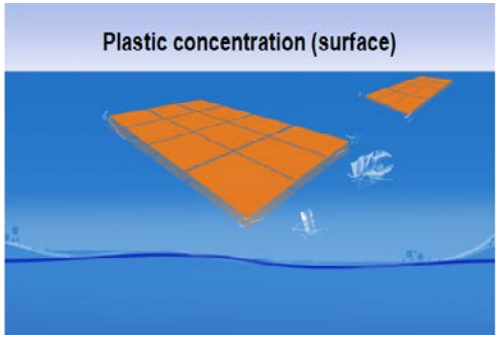
Marine macro-plastics can be seen from space even when they are some centimeters below the water surface.

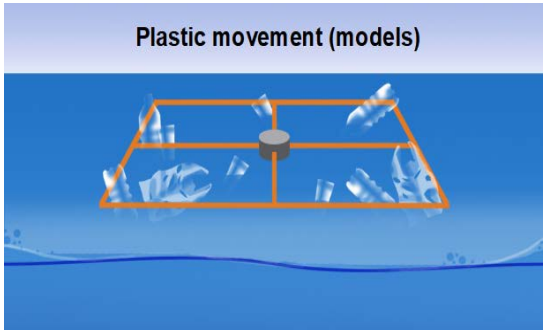
Two atmospheric correction models examined. Differences larger than the actual pixel value. None of them were notably matching with the UAV measurement.

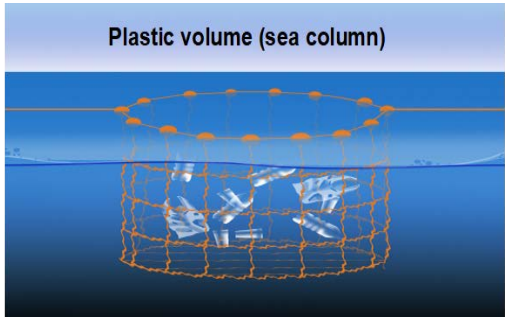
Need of reliable atmospheric correction model. The international community should determine through validation campaigns the optimum algorithm for atmospheric correction above coastal areas.

Recommendations

- Better understanding of the spectral behavior of plastics in real environment
- Exploratory studies - Capacity building - cal/val campaigns
- Hyperspectral observations - permanent cal/val infrastructures.
- Test the variability of plastic types, sizes, plastic concentration (surface), plastic volume (sea column) and plastic movement (drifts).







Acknowledgments

Targets construction was completed by more than 30 undergraduate students in the Department of Marine Studies at University of the Aegean.

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Plastic Litter Project 2018

MARINE
REMOTE SENSING
GROUP
DEPARTMENT OF MARINE SCIENCES
UNIVERSITY OF THE AEGEAN
http://mrsg.aegean.gr

Dr. Konstantinos Topouzelis

topouzelis@marine.aegean.gr