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Volunteering for the future – Geospatial excellence for a better living

Mapping plastic based on multispectral UAV images

Gordana JAKOVLJEVIĆ, Bosnia and Herzegovina, Miro GOVEDARICA, Serbia,
Flor ALVAREZ TABOADA, Spain

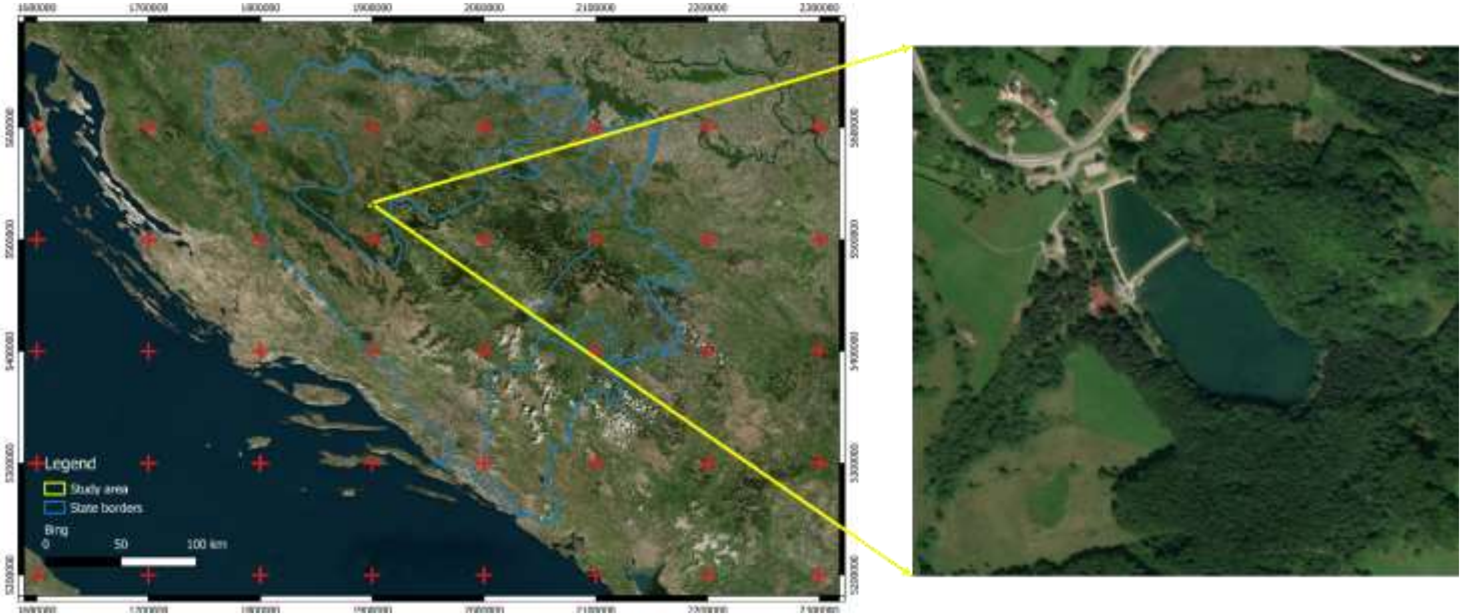
ORGANISED BY

PLATINUM SPONSORS

INTRODUCTION

- Global environmental problem
- Plastic litter can be classified into three categories based on size:
  - macroplastic (>5 mm),
  - microplastics (5 mm – 0.1 µm), and
  - nano plastics (0.1 – 0.001 µm)
- Monitoring tool for comprehensive analysis of spatial and temporal plastic
- Remote sensing technology

STUDY AREA



Balkana, Mrkonjic Grad

OPS

Nylon

PET

DATA

Spectral sunlight sensor

DJI PHANTOM 4 MS

- March 2022
- Spatial resolution 21 mm
- Trimble R10 GNNS receiver

Band	Wavelength
Blue (B)	450 nm ± 16 nm
Green (G)	560 nm ± 16 nm
Red (R)	650 nm ± 16 nm
Red Edge (RE)	730 nm ± 16 nm
Near-Infrared (NIR)	840 nm ± 26 nm

MATERIALS AND METHODS

Preprocessing
- Image unwrapping
- Image transformation
- Image combining
- Correction
- Training dataset creation

Processing
- U-Net fine tunning

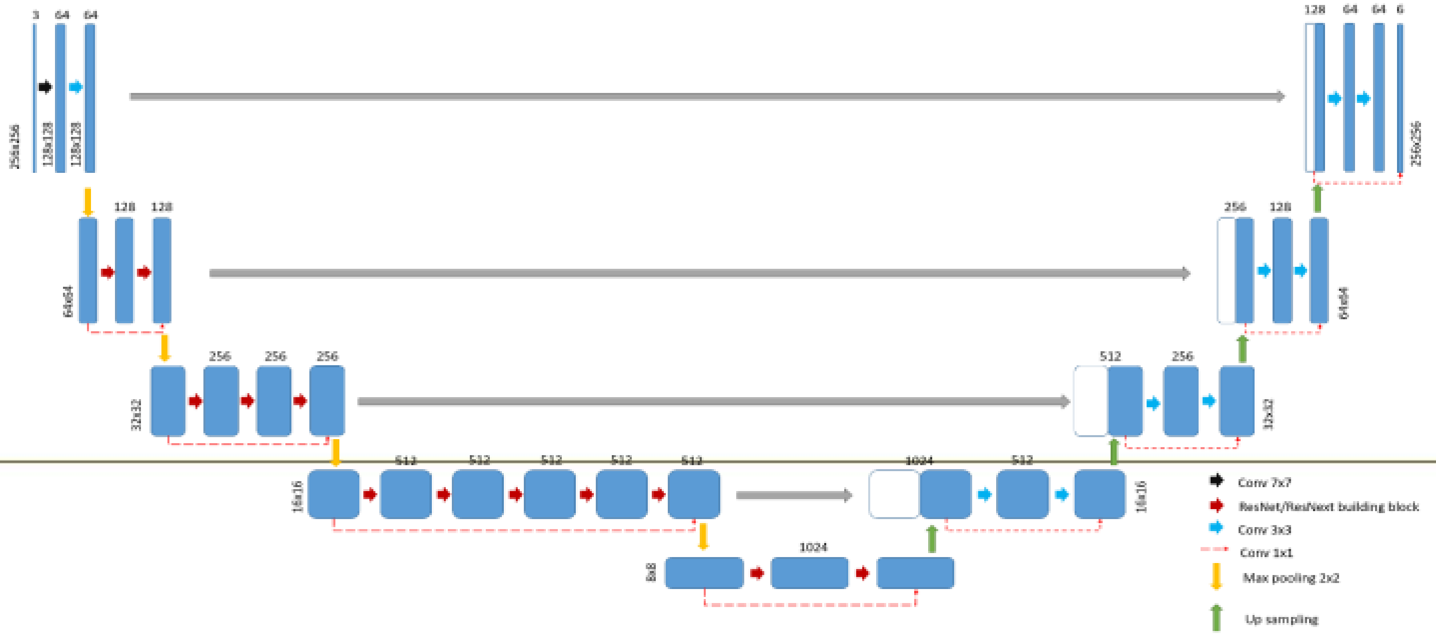
Accuracy assessment
- Precision
- Recall
- F1-score
- Visual inspection

Preprocessing

- Open-source library developed in Python
- Spectral sunlight sensor's data was used to remove the influence of solar radiation intensity
- Image alignment – the creation of multispectral image
  1. Image unwrapping
  2. Transformation to align bands,
  3. Image combining and cropping
- Training data creation

Processing

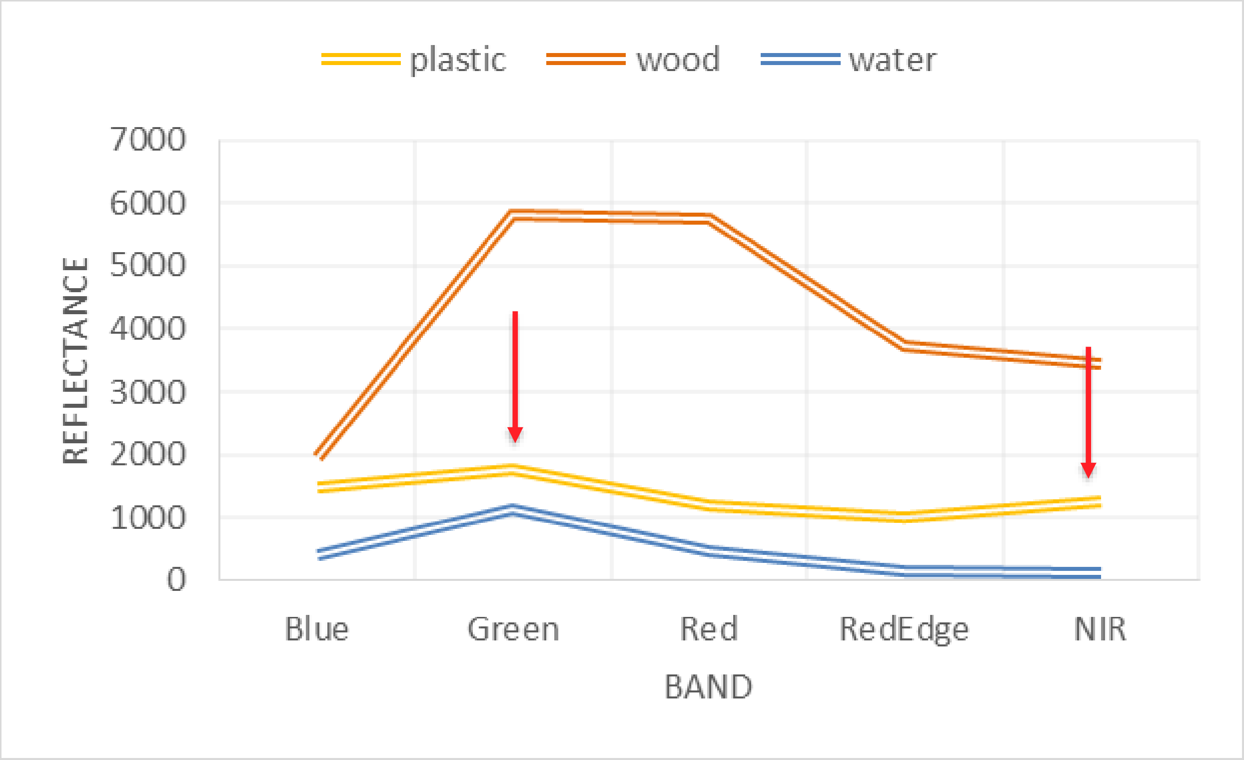
- U-Net architecture with ResNet 34 encoder
- Encoder side consists of convolution filter (3x3), rectified linear unit (ReLU) and max-pooling operation (2x2)
- ResNet consists of multiple bottleneck residual blocks



Results

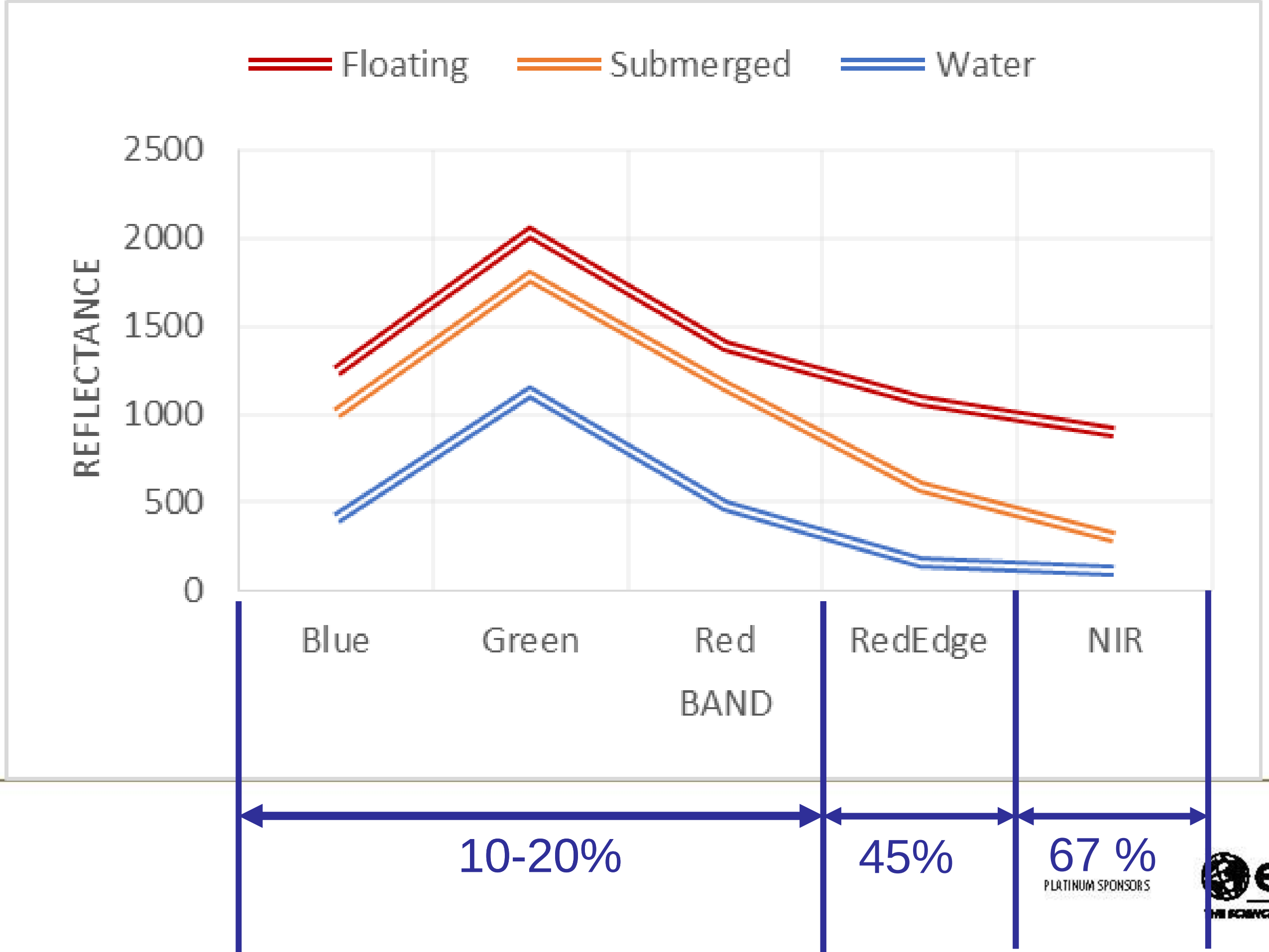
Spectral signatures

1. Plastic type
2. Color
3. Size
4. Orientation
5. Surface features (sun glint, biochemical characteristics of water)



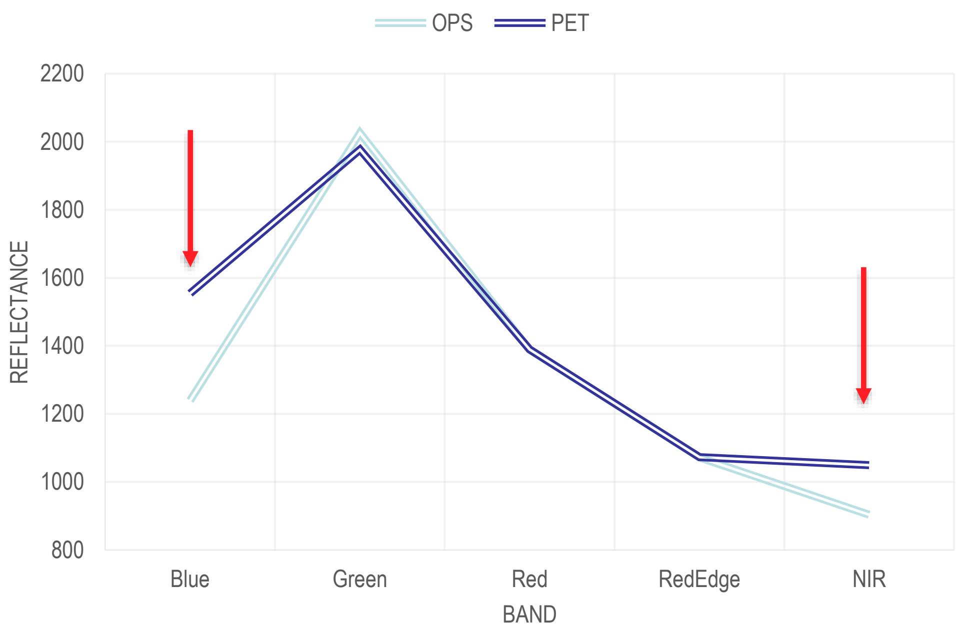
Results

- Spectral signatures – floating and submerged plastic



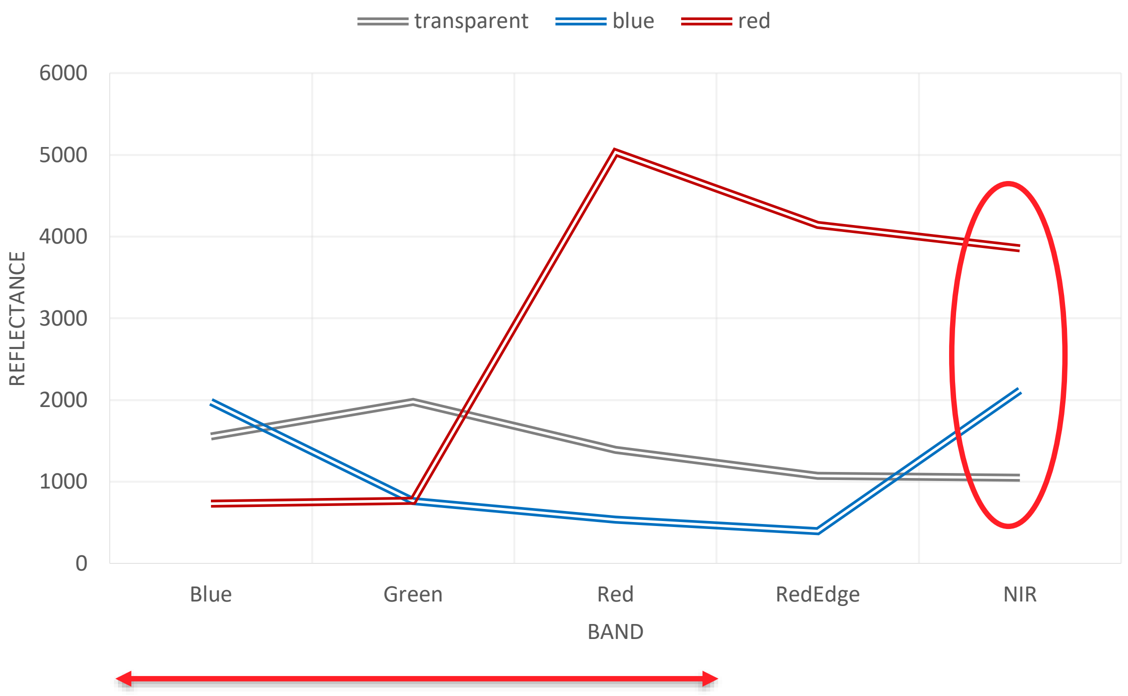
Results

- Spectral signatures – different plastic types



Results

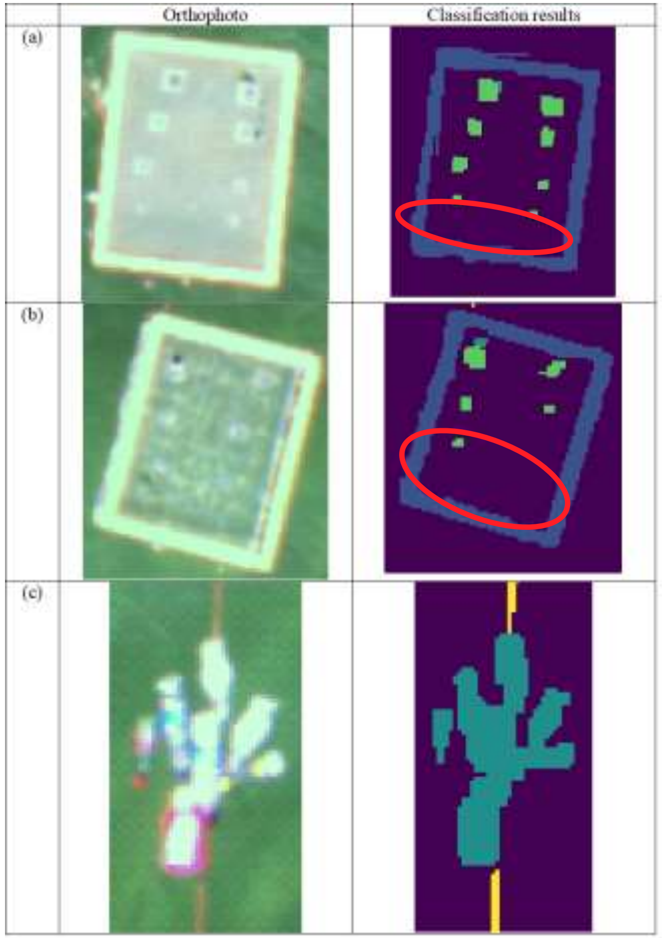
- Spectral signatures – different plastic color



Results

- Plastic detection

	Precision	Recall	F1
OPS	0.75	0.68	0.71
Nylon	0.91	0.52	0.66
PET	0.80	0.85	0.82



Omitted 1 and 2 cm sq

Omitted 1 to 5 cm sq

Conclusion

- NIR part of spectrum is most suitable for the detection of floating plastics
- Visible part of spectrum is preferable for submerged plastic
- U-Net accurately detect different kinds of floating plastics
- Algorithm is was not detected all plastic pixel but it is highly trustable when it does